



## Quality of life among Korean gastrointestinal cancer survivors



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### ABSTRACT

**Purpose:** The number of gastrointestinal (GI) cancer survivors has been steadily increasing owing to early diagnosis and improved cancer treatment outcomes. The quality of life (QoL) of cancer survivors can provide distinct prognostic information and represent their functioning. This study aimed to investigate the levels of symptoms, psychological distress, and QoL of GI cancer survivors, and identify factors associated with QoL.

**Method:** A cross-sectional survey was conducted among 145 survivors of gastric or colorectal cancer in a university-affiliated hospital, Seoul, South Korea. The questionnaire consisted of the M. D. Anderson Symptom Inventory Gastrointestinal Cancer Module, Distress Thermometer, and brief version of the World Health Organization Quality of Life Assessment Instrument. Quantile regression was used to assess the associated factors of QoL. The 10th, 25th, 50th, 75th, and 90th conditional quantiles were considered. **Results:** The most common symptoms were fatigue (24.9%), numbness or tingling (17.2%), feeling bloated (17.2%), dry mouth (15.9%), and difficulty remembering (11.8%). Thirty-two percent (47/145) of the participants reported severe distress. A level of symptoms was significantly associated in the 10th and 25th quantiles, representing poor QoL. Economic burden was a significant influencing factor in all quantiles. **Conclusion:** Our results indicate that high burden from symptoms might be associated with lower QoL in GI cancer survivors, and higher economic burden from cancer treatment was associated with lower QoL. These results suggest that symptom management and support for economic difficulties should be included in the strategies to enhance the QoL of GI cancer survivors.

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### 1. Introduction

The number of cancer survivors has been steadily increasing due to advances in early detection and improved cancer treatment outcomes. In Korea, gastrointestinal (GI) cancer survivors account for 34% of all cancer survivors. The prevalence rates of gastric and colorectal cancers are relatively high (13.4% and 12.3% of all, respectively), but the survival rate has risen to more than 70% (Oh et al., 2016). As more people survive from cancer, the quality of life (QoL) of cancer survivors has become the center of cancer survivorship.

The QoL of cancer survivors represents their treatment experience, and physical and psychosocial functions; can be used to

identify subgroups of patients who require further monitoring; and guides approaches for patient-centered interventions after cancer treatment completion (Trask et al., 2009). Recent studies have suggested that QoL can provide distinct prognostic information as a predictor of survival duration in various cancers (Kim et al., 2016; Movsas et al., 2009). Movsas et al. (2009) reported that non-small-cell lung cancer patients with lower QoL scores had an approximately 70% higher mortality rate than those who with higher scores.

Although most cancer survivors can maintain their levels of physical, psychological, and social functions at a similar status as that before cancer treatment, certain subgroups of survivors are likely to be at risk of decreased QoL, even after more than 5 years since cancer diagnosis and at a disease-free state (Lee et al., 2014). Moreover, it was reported that the subjective overall health status was poor in 41.3% and 31.5% of cancer survivors in Korea and the

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United States, respectively (Kim and Kim, 2017; Underwood et al., 2012). A study reported that colorectal cancer survivors had worse health status and limited activity compared with their non-cancer controls, and breast and prostate cancer survivors (LeMasters et al., 2013), while other studies showed no significant difference in global QoL between Korean GI cancer survivors and the general population (Bae et al., 2006).

Studies on factors associated with impaired QoL in GI cancer survivors found that age, comorbidity, cancer recurrence, type of surgery, and physical activity impacted QoL (Huang et al., 2007; Rodriguez et al., 2015). Cancer-related symptoms and psychological distress have also been associated with the QoL of cancer survivors (Russell et al., 2015; Yu et al., 2016). Patients who have completed GI cancer treatments could experience symptoms caused by surgery, including swallowing difficulty or feeling bloated, and symptoms caused by chemo- or radiotherapy, including diarrhea, urination or bowel dysfunction, sexual dysfunction, or numbness or tingling (Kim et al., 2012; Phipps et al., 2008; Russell et al., 2015). Among cancer survivors, 10–40% experience significant and lasting psychological distress caused by fear of recurrence, worries about health, physical change, social isolation, or economic burden (Hoffman et al., 2009; Zabora et al., 2001). These late effects may have a profound impact on the QoL of GI cancer survivors.

Understanding factors associated with the QoL of GI cancer survivors could be the first step toward developing health promotion interventions and helping to identify patients who would be at risk of decreased functioning and then to prioritize delivery of a customized care. Despite that the prevalence of GI cancer and survival rates of patients with GI cancer have grown steadily, little is known about the actual condition of the QoL among these patients.

Considering that the QoL of GI cancer survivors could be influenced by various factors, specific determinants that have strong impacts on a certain QoL status should be identified in order to provide more-effective and customized interventions, especially identifying cancer survivors with high risks of impaired QoL. Most studies have attempted to determine factors associated with QoL by estimating effects on the mean with conventional least squares regression methods. This analysis has a risk of sample selection bias, which is generated from lack of representativeness, as results are subject to the influence of outliers. For this reason, a more detailed feature of covariate effects should be provided by estimating conditional status to identify factors associated with the QoL level by using a quantile regression method (Koenker and Hallock, 2001).

In this study, we investigated levels of symptoms, psychological distress, and QoL among GI cancer survivors and examined factors that contribute to their QoL by using quantile regression.

## 2. Methods

### 2.1. Study design

This study used a descriptive and cross-sectional design, aimed at investigating the relationships between symptoms, distress, and QoL in GI cancer survivors and examining factors that impact QoL depending on its level. This study was conducted with approval of the institutional review board (IRB No. 4-2015-0723) of a university-affiliated hospital in Seoul, South Korea.

### 2.2. Study population

We approached to the patients who visited colorectal cancer clinics for their follow-ups after completing cancer treatments and asked several questions for initial screening and intention to

participate in survey between October 2, 2015–November 26, 2015. The inclusion criteria were as follows: (1) survivors of gastric or colorectal cancer who were off any cancer treatment such as surgery, chemotherapy, or radiotherapy; (2) no evidence of cancer recurrence or metastasis at the time of survey; (3) at least 20 years old. Informed consent was obtained from all the participants. A total of 151 patients participated in the survey and 6 of them were excluded from analysis due to current undergoing cancer treatment after medical record reviewing or incomplete responds. We included 145 survivors of GI cancer in an analysis.

### 2.3. Measures

Information on demographic characteristics, disease-related characteristics, symptoms, distress, and QoL was collected by using standardized questionnaires and a medical chart review.

#### 2.3.1. Symptoms

The Korean version of the M. D. Anderson Symptom Inventory Gastrointestinal Cancer Module was used to measure symptom levels (Wang et al., 2010). This 24-item questionnaire contains 13 items on general symptoms, 5 items on GI symptoms, and 6 items on interference. All item scores range from 0 to 10, with higher scores indicating greater severity of symptoms and disturbance. Scores of  $\geq 5$  indicate moderate to severe symptom severity in this study. Cronbach's  $\alpha$  was 0.80 in a previous study (Wang et al., 2010) and 0.89 in this study.

#### 2.3.2. Distress

To measure distress, the Korean version of the Distress Thermometer developed by the National Comprehensive Cancer Network was used (Network NCC, 2007). This measurement is a single item rated from 0 to 10. Scores of  $\geq 4$  points indicate severe distress.

#### 2.3.3. Quality of life

QoL was measured by using the Korean version of the brief World Health Organization Assessment Instrument (WHOQOL-BREF) (The WHOQOL Group, 1998). This instrument is composed of 26 items with the following five subcategories: physical health, psychological, social relationship, environmental, and overall domains. It uses a 5-point Likert scale ranging from 1 (never) to 5 (always) to rate each item, with higher scores indicating more positive response, except for three reversed items. The total score ranges from 26 to 130 points. Cronbach's  $\alpha$  was 0.82 in this study.

### 2.4. Statistical analyses

The demographic and disease-related characteristics of the participants were analyzed by using frequency, percentages, means, and standard deviations. Symptoms, distress, and QoL were estimated as means and standard deviations. Differences in symptoms, distress, and QoL depending on the participants' characteristics were analyzed by using the *t*-test and analysis of variance by conducting a Scheffé test for the post hoc analysis. A quantile regression analysis was performed to identify influencing factors according to QoL level. General multiple linear regression is usually performed, focusing on the relationship between the outcome and covariates of the fixed mean value, not allowing identification of predictors depending on the variation of an outcome variable if it shows a skewed distribution or has outliers. This method has the limitation of searching determinants while considering various characteristics of individuals in social science research because it is difficult to identify factors that influence a certain status of outcome that is far from the mean (Austin and

Schull, 2003; Koenker and Hallock, 2001). Quantile regression is less sensitive to outliers in data, having coefficient estimates that are more robust than those from conventional linear regression, which are characterized by overly low standard errors. When the outcome does not follow normal distribution, quantile regression provides more efficient estimators (Petracci and Cavrini, 2013). Therefore, a quantile regression method might make it possible to investigate factors associated with specifically low or high values of the phenomena being studied by the interest of the researcher. This approach can be applied in the analysis of the impact of each independent variable depending on quantiles in heterogeneous conditional distribution by estimating regression coefficients (Koenker and Hallock, 2001). The 10th, 25th, 50th, 75th, and 90th conditional quantiles were considered in this study. The quantile regression coefficient estimates were obtained by performing simultaneous quantile regressions. A *p*-value of <0.05 was considered significant for covariate selection. All analyses were performed by using STATA version 13.0.

### 3. Results

The general characteristics of the study participants are shown in Table 1. The mean age of the participants was  $62.07 \pm 10.79$  years (range, 32–84 years), and 67.6% of the participants were male. Ninety-eight participants (67.6%) reported that they had a spouse (married or co-habitant). Seventeen participants (11.7%) reported that they perceived a high economic burden from treatment, whereas 50 participants (34.5%) reported having little financial difficulty for treatment.

As for the disease-related characteristics of the participants, 50 (34.5%) were diagnosed with gastric cancer; 53 (36.6%), with colon cancer; and 42 (29.0%), with rectal cancer. Most participants were in stage III (50.3%) at diagnosis, and 97 (66.9%) received concurrent chemotherapy after surgery. The mean period since treatment completion was  $39.23 \pm 40.01$  months (median, 26; range, 0–243). Of the participants, 46.2% were within 2 years after finishing any

**Table 1**  
Characteristics of participants (*N* = 145).

Variables	Categories	n(%)
Age(yr)	<65	87(60.0)
	≥65	58(40.0)
Gender	Male	98(67.6)
	Female	47(32.4)
Spouse	Yes	131(90.3)
	No	14(9.7)
Education	≤middle school	46(31.7)
	High school	47(32.4)
	≥college	42(29.0)
Occupation	Employed	67(46.2)
	Unemployed	76(52.4)
Economic burden of treatment	High	17(11.7)
	Moderate	69(47.6)
	Low	50(34.5)
Diagnosis	Gastric cancer	50(34.5)
	Colon cancer	53(36.6)
	Rectal cancer	42(29.0)
Stage	I	18(12.4)
	II	46(31.7)
	III	73(50.3)
	IV	8(5.5)
Type of treatment	Op only	19(13.1)
	Op+CTx.	97(66.9)
	Op+CTx.+RT	29(20.0)
	Time since treatment completion	67(46.2)
<2 years	2–5 years	40(27.6)
	≥5 years	38(26.2)

Abbreviation: CTx, chemotherapy; Op, operation; RT, radiotherapy.

type of treatment.

The participants' status of symptoms, distress, and QoL is shown in Table 2. The mean symptom score was  $18.99 \pm 21.45$  (range, 0–180), and the number of symptoms that the participants reported they experienced was  $4.83 \pm 4.09$  (range, 0–18). The most common moderate to severe symptoms were fatigue (24.9%), numbness or tingling (17.2%), feeling bloated (17.2%), dry mouth (15.9%), and difficulty remembering (11.8%). The mean distress score was  $2.72 \pm 2.49$  (range, 0–10), with 47 (32.4%) of the participants reporting severe distress. The mean QoL score was  $96.03 \pm 11.65$  (range, 26–130). The QoL was composed of five subcategories, namely physical health (mean  $\pm$  SD [range]:  $27.34 \pm 4.13$  [7–35]), psychological ( $22.07 \pm 3.41$  [6–30]), social relationship ( $10.23 \pm 1.91$  [3–15]), environmental ( $29.57 \pm 3.73$  [8–40]), and overall QoL domains ( $6.83 \pm 1.29$  [2–10]).

The differences in status of symptoms, distress, and QoL according to the participants' characteristics are shown in Table 3. The score of symptoms statistically significantly differed according to cancer type. In the post hoc analysis, the gastric cancer group had a higher symptom level than the colon cancer group. The distress score was significantly lower in the groups of females, high-school graduates, those with colon cancer, those with stage I disease, and those at 5 years and more since treatment completion than in the other groups. In terms of QoL, those who perceived high economic burden from treatment and those without a spouse showed significantly low scores.

The results of the quantile regression analysis of the possible influencing factors of QoL are reported in Table 4. Higher cancer stage at diagnosis was associated with decreased QoL, especially in

**Table 2**  
Level of symptoms, distress, and quality of life (*N* = 145).

Variables	M±SD	moderate to severe n(%)	
Symptoms	Number of Symptoms	4.83 ± 4.09	
	Symptom score	18.99 ± 21.45	
	Fatigue	2.35 ± 2.53	46(24.9)
	Numbness or tingling	1.88 ± 2.73	25(17.2)
	Feeling bloated	1.55 ± 2.42	25(17.2)
	Difficulty remembering	1.95 ± 2.32	17(11.8)
	Dry mouth	1.76 ± 2.60	23(15.9)
	Drowsy	1.28 ± 1.87	13(9.0)
	Diarrhea	1.04 ± 2.21	14(9.6)
	Disturbed sleep	0.96 ± 2.03	13(9.0)
	Constipation	0.87 ± 1.95	13(9.0)
	Sadness	0.86 ± 1.99	11(7.5)
	Pain	0.80 ± 2.10	12(8.2)
	Distressed	0.77 ± 2.10	11(7.5)
	Lack of appetite	0.63 ± 1.88	11(7.5)
	Change in taste	0.62 ± 1.81	9(6.2)
	Shortness of breath	0.57 ± 1.55	8(5.5)
	Nausea	0.46 ± 1.50	5(3.5)
	Difficulty swallowing	0.37 ± 1.49	6(4.2)
	Vomiting	0.27 ± 1.16	2(1.4)
Interference score	Mood	7.53 ± 12.14	
	Mood	1.41 ± 2.55	24(16.6)
	General activity	1.36 ± 2.40	22(15.2)
	Enjoyment of life	1.29 ± 2.57	14(9.7)
	Relations with people	1.20 ± 2.49	20(13.8)
	Walking	0.84 ± 2.02	15(9.4)
	Work	0.79 ± 1.97	20(13.8)
Distress		2.72 ± 2.49	47(32.4)
	Quality of life	96.03 ± 11.65	
Overall	Overall	6.83 ± 1.29	
	Physical health	27.34 ± 4.13	
	Psychological	22.07 ± 3.41	
	Social relationships	10.23 ± 1.91	
	Environmental	29.57 ± 3.73	

Note. Symptom, moderate to severe (≥5); distress, severe (≥4).

**Table 3**  
Symptoms, distress, and quality of life (QoL) by characteristics of participants (N = 145).

Variables	Categories	Symptoms		Distress		QoL	
		M±SD	t or F (p)	M±SD	t or F (p)	M±SD	t or F (p)
Age(years)	<65	21.04 ± 25.02	1.71	2.86 ± 2.58	0.72	96.56 ± 11.84	0.66
	≥65	15.44 ± 14.26	(0.090)	2.56 ± 2.34	(0.475)	95.27 ± 11.41	(0.512)
Gender	Male	17.64 ± 22.28	−0.89	3.06 ± 2.67	2.53	95.57 ± 10.19	−0.62
	Female	21.02 ± 19.62	(0.373)	2.08 ± 1.91	(0.013*)	96.98 ± 14.21	(0.541)
Spouse	Yes	18.28 ± 21.86	0.82	2.77 ± 2.56	−0.69	96.69 ± 10.97	−2.11
	No	23.21 ± 16.86	(0.415)	2.43 ± 1.65	(0.497)	89.86 ± 15.88	(0.036*)
Education	≤middle school <sup>a</sup>	19.45 ± 20.11	0.15	2.79 ± 2.41	3.92	94.28 ± 11.28	0.68
	High school <sup>b</sup>	17.35 ± 16.97	(0.863)	2.17 ± 2.04	(0.022*)	95.67 ± 12.82	(0.510)
	≥college <sup>c</sup>	19.33 ± 24.88		3.60 ± 2.68	b<c <sup>†</sup>	97.14 ± 10.51	
Occupation	Employed	18.72 ± 24.60	0.08	2.64 ± 2.42	−0.33	97.58 ± 9.66	1.62
	Unemployed	18.42 ± 17.72	(0.935)	2.78 ± 2.50	(0.745)	94.49 ± 12.80	(0.109)
Economic burden of treatment	High <sup>a</sup>	20.29 ± 16.91	0.08	2.71 ± 2.49	0.25	83.06 ± 12.19	16.86
	Moderate <sup>b</sup>	18.33 ± 20.09	(0.926)	3.01 ± 2.53	(0.782)	95.30 ± 10.26	(<0.001**)
	Low <sup>c</sup>	19.44 ± 23.65		2.72 ± 2.39		99.74 ± 9.48	a<b,c <sup>†</sup>
Diagnosis	Gastric cancer <sup>a</sup>	25.00 ± 27.93	3.76	3.16 ± 2.78	3.18	94.28 ± 11.54	1.29
	Colon cancer <sup>b</sup>	13.80 ± 14.87	(0.026*)	2.07 ± 2.21	(0.045*)	97.91 ± 11.23	(0.279)
	Rectal cancer <sup>c</sup>	17.68 ± 17.91	a > b <sup>†</sup>	3.10 ± 2.30	b < a,c <sup>†</sup>	95.71 ± 12.22	
Stage	I <sup>a</sup>	11.44 ± 21.60	0.92	1.56 ± 2.04	3.95	99.83 ± 15.21	1.01
	II <sup>b</sup>	21.35 ± 23.25	(0.431)	3.63 ± 2.89	(0.010*)	94.59 ± 10.98	(0.390)
	III <sup>c</sup>	18.90 ± 20.74		2.44 ± 2.19	a<b <sup>†</sup>	95.74 ± 10.97	
	IV <sup>d</sup>	19.00 ± 15.21		3.00 ± 2.00		98.50 ± 12.56	
Type of treatment	Op only	13.00 ± 22.59	0.79	1.58 ± 2.10	2.55	99.95 ± 11.29	2.15
	Op+CTx.	19.60 ± 21.63	(0.457)	2.86 ± 2.59	(0.082)	96.20 ± 11.11	(0.121)
	Op+CTx.+RT	19.72 ± 20.06		3.10 ± 2.21		92.93 ± 13.10	
Time since treatment completion(years)	<2 <sup>a</sup>	21.51 ± 23.90	2.03	3.16 ± 2.36	6.61	94.24 ± 10.16	1.77
	2–5 <sup>b</sup>	19.70 ± 19.59	(0.135)	3.18 ± 2.50	(0.002**)	96.63 ± 12.99	(0.173)
	≥5 <sup>c</sup>	12.92 ± 17.71		1.53 ± 2.33	a,b > c <sup>†</sup>	98.58 ± 12.37	

<sup>†</sup>Post-hoc: Scheffé test, \*p < 0.05; \*\*p < 0.01.

the highest quantile. The symptom score was associated with impaired QoL, and the association was significant for the 10th and 25th percentiles of QoL, with coefficients equal to −0.18 and −0.17, respectively. The magnitude of this association tended to increase in the lower QoL quantiles. A high economic burden from cancer treatment was certainly an important aspect to consider. It was found to be significantly associated with impaired QoL across the overall quantiles considered, having a greater effect on the higher outcome distribution.

#### 4. Discussion

This study demonstrated that symptom burden was significantly associated with lower QoL levels and that economic burden was associated with all QoL levels in GI cancer survivors by using a quantile regression method.

By comparing the QoL levels of our participants with those of Korean non-cancer populations in previous studies (Jang et al., 2013; Choi et al., 2012), we found that the GI cancer survivors had higher QoL than the general population. Even though results have remained inconsistent, this finding might reflect that patients who survive from cancer usually report a more positive assessment of their QoL by recognizing a changed concept of well-being and meaning of posttraumatic growth (Yun et al., 2014). Continuous health management such as lifestyle changes followed by limitations of physical and role functions is required after cancer

treatment, like in other chronic diseases. However, it may cause relatively high satisfaction for life because survival from cancer could lead to the possibility of complete recovery. Thus, helping cancer survivors perceiving their disease experience as an inward growth according to a positive concept by recovering function and improving QoL would be important.

Gastric or colorectal cancer itself and treatments are likely to cause various late effects such as bowel, urinary or sexual dysfunction, diet restriction, or body image disturbance, which require alterations in diet, work, and social relationships even after 5–10 years since cancer diagnosis and have considerable negative impacts on social and occupational functioning (Bailey et al., 2015; Kim et al., 2012). These results indicate that screening for individuals at risk of impaired QoL is still needed during a considerable period since cancer treatment completion.

We found that a level of symptoms was significantly associated with impaired QoL for the 10th and 25th quantiles in this study. That is, QoL was significantly lower in the group with a higher symptom level than in the group with a lower symptom level. We could not find any study that applied quantile regression and reported symptom status as a specific influencing factor of certain quantiles of QoL. However, recent studies suggest that symptoms cancer survivors are experiencing provided considerably relevant information on their QoL (Kim et al., 2012; Phipps et al., 2008).

Fatigue, the most common symptom in the present study, is highly prevalent among cancer survivors, regardless of cancer

**Table 4**  
Quantile regression analysis on the influencing factors of quality of life (QoL).

Covariates	QoL				
	10%	25%	50%	75%	90%
	Coefficient (95% CI)				
Age	−0.16 (−0.54 to 0.22)	−0.17 (−0.25 to −0.09)	−0.19 (−0.47 to 0.08)	−0.25* (−0.44 to −0.05)	−0.17 (−0.42 to 0.08)
Gender					
Female	2.79 (−3.35 to 8.93)	2.48 (−2.81 to 7.76)	1.56 (−1.69 to 4.81)	3.67 (−0.53 to 7.88)	4.52 (−3.48 to 12.52)
Marital status					
Yes	14.48 (−1.00 to 29.95)	5.81 (−5.60 to 17.22)	7.25 (−1.25 to 15.75)	4.47 (−8.23 to 17.16)	2.57 (−8.15 to 13.30)
Economic burden of Treatment					
Moderate	−2.10 (−11.43 to 7.24)	−5.54 (−12.84 to 1.76)	−5.75** (−9.61 to −1.89)	−6.18** (−10.50 to −1.86)	−9.09** (−14.77 to −3.41)
High	−16.37* (−33.68 to 0.93)	−16.75** (−25.65 to −7.86)	−17.99** (−27.04 to −8.94)	−15.06** (−25.94 to −4.18)	−18.75** (−28.82 to −8.68)
Cancer type					
Colon cancer	−5.17 (−13.32 to 2.97)	0.43 (−7.05 to 7.91)	3.19 (−4.21 to 10.59)	4.81 (−0.20 to 9.81)	4.01 (−4.38 to 12.39)
Rectal cancer	1.31 (−10.73 to 13.36)	8.51 (−4.30 to 21.33)	3.08 (−5.34 to 11.50)	1.51 (−5.50 to 8.52)	2.10 (−9.19 to 13.40)
Stage					
II	8.83 (−7.86 to 25.52)	−0.53 (−14.83 to 13.77)	−5.17 (−13.85 to 3.50)	−8.73 (−13.78 to 4.31)	−24.26* (−34.77 to −9.75)
III	5.47 (−8.27 to 19.21)	−1.06 (−15.30 to 13.18)	−5.04 (−14.47 to 4.38)	−7.97 (−21.59 to 5.65)	−23.82* (−35.90 to −11.74)
IV	12.29 (−4.95 to 29.54)	−6.97 (−25.03 to 11.10)	−9.39 (−24.12 to 5.34)	−7.19 (−21.81 to 7.42)	−27.55* (−39.69 to −15.41)
Type of treatment					
Op+CTx.	−0.47 (−14.82 to 13.88)	2.22 (−10.94 to 15.39)	4.16 (−3.13 to 11.44)	6.19 (−6.13 to 18.51)	11.50 (−13.74 to 36.74)
Op+CTx +RT	−2.20 (−18.82 to 14.41)	−7.09 (−24.07 to 9.89)	−3.19 (−12.07 to 5.68)	6.94 (−7.57 to 21.45)	12.02 (−12.78 to 36.82)
Time since treatment completion					
2–5 years	2.17 (−4.81 to 9.15)	0.02 (−7.39 to 7.44)	1.09 (−3.27 to 5.45)	2.76 (−1.74 to 7.25)	4.07 (−1.77 to 9.91)
≥5 years	5.39 (−6.34 to 17.13)	2.05 (−7.78 to 11.10)	2.07 (−2.69 to 6.84)	1.21 (−3.71 to 6.13)	1.15 (−6.49 to 8.80)
Symptoms	−0.18** (−0.29 to −0.06)	−0.17** (−0.25 to −0.09)	−0.12 (−0.23 to 0.00)	−0.06 (−0.17 to 0.04)	0.09 (−0.17 to 0.34)
Distress	−1.13 (−2.60 to 0.34)	−0.94 (−1.93 to 0.05)	−0.53 (−1.42 to 0.36)	−0.69 (−1.59 to 0.22)	−1.05 (−2.70 to 0.60)
Constant	81.98 (56.09 to 107.86)	96.08 (70.66 to 121.49)	109.89 (90.93 to 128.85)	117.87 (96.63 to 139.11)	129.05 (103.62 to 154.49)

Note. Reference variables: Male(for gender); No(for marital status); Low(for economic burden for treatment); Gastric cancer(for cancer type); I(for stage); Op only(for type of treatment); <2 years(for time since treatment completion), \*p < 0.05; \*\*p < 0.01.

types. Investigations to find ways to support cancer survivors who experience fatigue have been conducted because of the severe impact of fatigue on the daily life, social functioning, and QoL of these patients. Exercise on fitness or cognitive behavioral therapy has been suggested as an effective intervention (Kampshoff et al., 2015; Willems et al., 2017). Among the symptoms that the participants complained of, numbness or tingling, feeling bloated and difficulty remembering are more disease- or treatment-specific than fatigue. In particular, peripheral neuropathy is induced by platinum compounds known as standard agents for chemotherapy for gastric and colorectal cancers, such as oxaliplatin and cisplatin. According to Mols et al. (2013), chemotherapy-induced peripheral neuropathy (CIPN) was reported even 2–11 years after diagnosis of colorectal cancer, and the symptoms had a negative effect on the daily functioning and, subsequently, the QoL of cancer survivors (Mols et al., 2013). Although treatment and prevention of CIPN remain difficult, pharmacological interventions such as duloxetine and non-pharmacological approaches with physical activities or Scrambler therapy (noninvasive cutaneous electrostimulation) have been used to help patients improve their physical

performances (Pachman et al., 2015; Smith et al., 2013; Wickham, 2007). As cancer survivors experience different symptoms according to their cancer type and treatment, intervention strategies should be tailored with cancer- or treatment-specific approaches.

In addition, education about the high risk of developing late symptoms should be provided to patients prior to cancer treatment, which can help survivors predict and manage their symptoms. The need for information about managing side effects or complications of treatment ranked high among cancer survivors (Russell et al., 2015). Providing information in the supportive care continuum impacts the reduction of symptom experience and increase in knowledge, which would improve QoL. For example, education about breast cancer-related lymphedema helped survivors have fewer symptoms and remained as a predictor of better symptom outcomes (Fu et al., 2010). Symptom experience might be recognized as an inevitable consequence of cancer treatment, but education on symptom management is important because various late effects could hinder the recovery to the state before the cancer diagnosis.

Cancer survivors who continue to experience cancer-related

symptoms are more likely to have concerns about the disease and their overall health status, as well as anxiety or depression, which could cause secondary health problems. These problems have been reported to affect expenditure in accordance with the use of medical resources and impact the economic burden throughout the cancer survivorship trajectory (Han et al., 2014). Therefore, the issue of symptoms is likely to be connected to financial difficulty, considering problems on rehabilitation in society and recovery of economic functioning.

We also found that economic burden from cancer treatment was associated with a decreased QoL across all the quantiles. That is, a higher perceived economic burden was negatively associated with impaired QoL regardless of the level. This result is consistent with that of previous research that showed that the lower the socio-economic level, the lower the awareness of QoL or subjective health status (Zafar et al., 2015). Cancer survivors continue to experience difficulties due to the economic impact of reduced socioeconomic activity or problem of returning to work in addition to the burden of medical expenses in cancer treatment (Han et al., 2014). The comorbid condition and poor health status could contribute to the unemployment of cancer survivors, losing their jobs related to treatment, and discrimination in the workplace. Furthermore, cancer survivors who experienced economic burden from treatment were less likely to adhere to medical care than those without economic burden (Kent et al., 2013). It may cause a vicious circle on survivorship by expanding medical cost and secondary health problems. Multidisciplinary rehabilitation of cancer survivors to prevent and improve impairment has been suggested as an intervention that may positively impact patients' ability to return to work, in turn reducing the economic burden of cancer on individuals, their families and society in general (Silver et al., 2013).

To overcome the poor long-term survival in the advanced stage, the development of targeted therapy and immunotherapy has been rapidly progressing in the area of GI cancer treatment. The advancement of the new approaches has been accompanied with absolutely high treatment cost. This may cause a greater increase in economic burden than conventional therapies. Considering the political aspects of cancer survivor management, both a systematic and efficient intervention model and financial support are required. Even though economic burden is not identified well in the clinical setting, the implication of economic burden on survivorship care needs to be understood by using a validated measurement for patient report, engaging patients actively in the decision making process for care, and providing information on the cost of care (Zafar et al., 2015).

It is interesting that our results suggest that cancer stage at diagnosis was associated with QoL in the 90% quantile group. A previous study reported that regional, distant, or unstaged/unknown stage was progressively associated with a very low physical component of QoL in the 10% percentile of QoL among colorectal cancer survivors (Adams et al., 2016). Cancer survivors with higher-stage disease are vulnerable to more-severe symptoms owing to massive treatments and the advanced disease itself, which are important factors of QoL status. As the underlying reasons for an association between cancer experience and QoL among cancer survivors may be specific not only to the physical component but also to the social or psychological component, more research would be necessary to understand the different aspects of QoL between early and advanced stage cancer.

Cancer survivors are also more likely to be vulnerable to psychological distress such as anxiety and depression, which affect daily activities, than the non-cancer population (So et al., 2009). Fear of recurrence and poor self-perception of health status have been identified as important risk factors of psychological distress (Choi and Park, 2016; Custers et al., 2016). Persistent psychological

distress is likely to have long-term harmful consequences on cancer survivors' health management and survival (Choi and Park, 2016). Unlike other studies, however, this study did not identify distress as a predictor of QoL at any quantile. The reason could be the inadequate number of sample for detection of the impact of distress level on QoL, or the nature of voluntary survey participation might have prevented patients with severe distress to be included in this study. In addition, awareness that gastric and colorectal cancers are known in public as successfully curable diseases with high survival rates in Korea might reduce the influence of distress on a certain QoL level. Future studies need to examine cancer survivor groups that are vulnerable to psychological distress with impaired QoL.

This study has several limitations. First, the result should be carefully interpreted because this study assessed gastric and colorectal cancer survivors at a university-affiliated hospital in Korea. Second, it is likely that we missed the disease-specific facet of QoL because we used the WHOQOL-BREF, which focused on the general population, considering that the subjects were not cancer patients but survivors. Third, in terms of the measured variables, social support, which has been found as a main factor that affected QoL in previous studies, was not included in the questionnaire. Further investigations with larger populations and a longitudinal study design in GI cancer survivors from multiple sites are needed to confirm the diverse contribution of factors of QoL according to the cancer survivorship trajectory. Nevertheless, the study is significant, as it is the first trial that used a quantile regression method to provide information for identifying specific factors that affect the QoL level of GI cancer survivors. These findings are also applicable to the development of intervention programs to enhance the QoL of cancer survivors, considering the circumstance of individual patients.

## 5. Conclusion

Our results indicate that a level of symptoms is a significant factor of impaired QoL in the lower QoL group. In addition, patients with higher economic burden may be more vulnerable to poorer QoL, regardless of the QoL level. This finding suggests a need for symptom management to enhance the QoL of GI cancer survivors. In particular, reducing the symptom experience in the clinical setting is needed for cancer survivors with lower QoL, which can lead to improvement in QoL. Furthermore, perceived economic burden was also an important determining factor of QoL. Thus, financial support and plans for an enhanced work environment, as well as medical support, should be considered in cancer survivorship plans so that cancer survivors can return and readopt easily to society. Further research for the development and effectiveness evaluation of various interventions to improve the QoL of GI cancer survivors is also needed.

## Conflict of interest

None.

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