# RESEARCH



# Interdependence of health between patients with colorectal cancer and family caregivers: a cross-sectional study

Young Man Kim<sup>1,2</sup>, No Eul Kang<sup>3</sup>, Min Ro Lee<sup>4</sup>, Gi Won Ha<sup>4</sup> and Hye Chong Hong<sup>5\*</sup>

# Abstract

**Background** Despite numerous shared health challenges during treatment and recovery, the interdependence of health between patients with colorectal cancer and their family caregivers remains underexplored. This study applied the actor-partner interdependence model (APIM) to examine this dyadic relationship.

**Methods** This descriptive correlational survey involved patients with colorectal cancer who visited the outpatient department for postoperative follow-up, along with their family caregivers. From 343 consenting participants, responses from 100 matched patient-caregiver pairs were analyzed. Data collection occurred at J Hospital from August 2023 to May 2024. Key variables included the psychological health and quality of life (QoL) of both patients and caregivers, patient self-care, and caregiver contribution to self-care. Statistical analysis was performed using Stata 16.1, with structural equation modeling.

**Results** The mean age of patients was 65.57 years; 51% were male, 66% had colon cancer, and 34% rectal cancer. The caregivers' mean age was 56.11 years; 55% were female, and 66% were spouses. The analysis of actor effects showed that the psychological health and QoL of both patients and caregivers independently influenced their respective outcomes. The analysis of partner effects revealed mutual influences between the psychological health of patients and caregivers impacted patients' self-care. While there was a correlation between the QoL of patients and caregivers, it was not statistically significant in the structural equation modeling.

**Conclusions** This study underscores the profound interdependence of health between patients with colorectal cancer and their caregivers, revealing significant mutual impacts on psychological health and, to a lesser extent, self-care. These insights suggest the need for targeted interventions to improve both patient recovery and caregiver support, even where some correlations lack statistical significance.

**Trial registration** Prospectively registered with the Clinical Research Information Service (CRIS) under the Clinical Trial Number KCT0008743 (Registration Date: 2023.08.25).

Keywords Colorectal cancer, Family caregivers, Psychological health, Actor-partner interdependence model

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### Background

Colorectal cancer (CRC) is one of the most common cancers and the leading cause for cancer mortality worldwide [1]. In the United States, the 5-year relative survival rate for localized colon and rectal cancer is 91% and 90%, respectively, while that for distant colon cancer is 13% [2]. In Korea, CRC is the fourth most prevalent cancer, with the 5-year survival rate for localized CRC being 93.9% [3]. The recent advanced treatment protocols have led to increased CRC survival rates but also place substantial physical and psychological burden on both patients and family [4]. Patients undergoing active cancer treatment and recovery often rely heavily on family members for support, creating a complex dynamic of interdependence between both parties regarding their health and well-being [5]. Understanding this dynamic is crucial for developing interventions that address the needs of both patients and caregivers, ultimately improving outcomes for both.

Research has increasingly highlighted the physical and psychological burden on both patients with CRC and their family caregivers. Many patients with CRC must live with enterostomy and a stoma during their survival, which may impact body image and physical functions [6]. Patients with CRC often experience significant psychological distress including depression, stigma, and disgust, which can adversely affect their self-care practices and overall quality of life (QoL) [7, 8]. Self-care involves skills that patients need to learn and practice to manage chronic health illnesses such as CRC to achieve positivity and satisfaction in life [9]; moreover, it directly influences health outcomes and patients' ability to maintain high QoL [10, 11]. Given the limited resources and support provided by professional health care, family caregivers play a vital role in supporting patients with CRC and often contribute significantly to the patient's self-care efforts [12]. This contribution, referred to as caregiver contribution to self-care, is essential because the effectiveness of patient self-care is often dependent on the support they receive from their caregivers [13]. However, caregivers may experience high levels of stress, anxiety, and depression during their engagement in long-term contribution to self-care, which can impair their ability to provide this crucial support, thereby indirectly affecting the patient's recovery and well-being [14–16]. Despite the critical role of caregivers, the bidirectional effects between patient and caregiver health, particularly in the context of self-care and caregiver contribution to self-care, have not been thoroughly explored in prior research. Although family structures in Korea are similar to those in Western countries, Korean culture remains influenced by Confucian values, including family relationships, filial piety, and benevolence. These cultural factors may affect caregiver contribution to self-care and patient self-care behaviors, differing from those observed in Western contexts [17]. Thus, the generalizability of our study findings to other cultures should be interpreted with caution.

The Actor-Partner Interdependence Model (APIM) offers a robust framework for examining the mutual influence of patients and caregivers on each other's health outcomes. This model allows for the analysis of both actor effects-how an individual's characteristics affect their own outcomes-and partner effects-how one's characteristics affect the other's outcomes [18]. Applying this model to the study of patients with CRC and their caregivers provides valuable insights into the interdependence of their psychological health, self-care behaviors, and QoL. Building on this framework, Kim and Lee [19] conducted a systematic review and metaanalysis exploring these relationships within the context of colorectal cancer. They synthesized findings of existing studies and confirmed that while the psychological distress of patients and caregivers significantly affects their respective QoL, few studies have simultaneously examined the QoL of both parties within the same study [19]. Notably, there is a gap in the literature with respect to the concurrent evaluation of QoL of caregivers and patients, despite the intertwined nature of their health outcomes.

In this study, we aimed to investigate the actor-partner effects within dyads of patients with CRC and their family caregivers. We examined how psychological health impacts self-care and QoL, considering both actor and partner effects. The research questions of this study are as follows: (1) Does the psychological health of patients with CRC impact their self-care and QoL? (2) Does caregivers' psychological health impact caregiver contribution to self-care and caregivers' QoL? (3) Are there reciprocal (partner) effects between the psychological health and QoL of patients with CRC and caregivers? (4) Do patients' self-care and caregiver contribution to self-care mediate both the actor and partner effects of psychological health on QoL? By including self-care and caregiver contribution to self-care in our analysis, we aimed to capture the full spectrum of interactions occurring within these dyads. Recognizing that effective self-care in patients is closely linked to the support they receive from caregivers, we sought to address a notable gap in the literature regarding the concurrent effects of QoL of patients and caregivers. This study aims to fill this gap by identifying these relationships and informing targeted interventions that can simultaneously address the needs of both patients and caregivers, thereby enhancing their overall well-being. Given the growing recognition of the intertwined health outcomes of patients and caregivers, this study is critical for guiding comprehensive care strategies in oncology settings. Understanding the complex interactions between patient and caregiver health is essential for developing holistic approaches that support the entire caregiving unit, ultimately leading to better health outcomes for both patients and their caregivers.

# Methods

The study was prospectively registered with the Clinical Research Information Service (CRIS) under the code KCT0008743.

# Study design and setting

This study is a descriptive correlational survey using a cross-sectional design. It was conducted at the Digestive Surgery Outpatient Clinic of Jeonbuk National University Hospital, a tertiary care facility and the Jeonbuk Regional Cancer Center in Jeonju, South Korea. The hospital follows global standardized treatment protocols for patients with CRC, ensuring consistency in medical management. Additionally, all patients included in the study had completed surgical treatment, thus reducing variability in disease management and providing a relatively homogeneous clinical baseline.

### Participants

The study involved patients with CRC and their family caregivers. The inclusion criteria for patients were as follows: (1) adults aged 18 years or older, (2) individuals who had undergone surgical treatment for CRC and were attending follow-up care at the hospital, and (3) those with a primary caregiver, such as a spouse or family member, who provided care. For caregivers, only primary family caregivers aged 18 years or older were eligible to participate. All participants provided voluntary informed consent. Exclusion criteria included individuals with cognitive impairments or psychiatric disorders, such as dementia, and those with severe health conditions that hindered communication.

Initially, the goal was to recruit at least 216 pairs of patients and caregivers to ensure adequate power for structural equation modeling (SEM), considering a 7% non-response rate [20, 21]. However, despite efforts to recruit participants over the course of one year, a total of 243 CRC patient-caregiver dyads were screened. Among them, 35 patients (14.4%) and 107 caregivers (44.0%) declined participation, resulting in 207 patients and 135 caregivers who responded. The overall non-response rate was 29.2%. The reasons for declining participation varied: most caregivers considered their participation unnecessary, viewing the study as patient-focused, while many patients cited time constraints due to outpatient visits and medical schedules. After data collection, 107 patients and 35 caregivers could not be matched with a corresponding dyad partner, leading to 100 matched pairs. The final number of matched pairs was lower than originally planned; however, it met the rule of thumb for SEM, which requires a sample size of at least 10 times the number of key variables. This study included six key variables; hence, a minimum of 60 pairs was sufficient [22].

# Measurements

# QoL

Patients' QoL was assessed using the brief version of the World Health Organization Quality of Life scale (WHOQOL-BREF), a widely validated instrument that evaluates the overall QoL across four domains: physical health, psychological health, social relationships, and environment [23]. The WHOQOL-BREF scale consists of 26 items, with higher scores indicating better QoL. Notably, this tool was also used to measure the QoL of family caregivers, ensuring consistency in the evaluation across both groups. In the original validation study, the tool demonstrated Cronbach's alpha values of 0.82 for physical health, 0.81 for psychological health, 0.68 for social relationships, and 0.80 for Environment [23]. In the current study, the WHOQOL-BREF showed good internal consistency, with Cronbach's alpha values for patients ranging from 0.71 to 0.83 and for caregivers from 0.66 to 0.89 across the four domains. The total WHOOOL-BREF score ranges from 26 to 130, with higher scores indicating better overall QoL.

# Self-care

To measure the self-care behaviors of patients, the Self-Care of Chronic Illness Inventory (SC-CII) was employed. This inventory includes 19 items and is divided into three subscales: self-care maintenance, self-care monitoring, and self-care management; higher scores indicated better self-care behaviors [24]. The original validation of the SC-CII reported Cronbach's alpha values of 0.81, 0.86, and 0.71 for self-care maintenance, self-care monitoring, and self-care management, respectively [24], while in this study, the reliability coefficients were 0.69, 0.88, and 0.75, respectively. Although the SC-CII is divided into these three subscales, all 19 items were used as a single construct of self-care in the correlation and SEM analyses to assess the interdependence between patients and caregivers. The total SC-CII score ranges from 19 to 95, and scores were standardized to a 100-point scale for analysis.

### Caregiver contribution to self-care

To assess how caregivers contribute to the self-care of patients, the Caregiver Contribution to Self-Care of Chronic Illness Inventory (CC-SC-CII) was used. This 19-item scale specifically measures the caregivers' involvement in the maintenance, monitoring, and management of the patient's illness. Higher scores on this scale reflect a greater contribution by caregivers to the self-care of the patient [25]. The original validation of the CC-SC-CII reported Cronbach's alpha values of 0.83, 0.93, and 0.74 for caregiver contribution to self-care maintenance, caregiver contribution to self-care monitoring, and caregiver contribution to self-care management, respectively [25], while in this study, the reliability coefficients were 0.78, 0.90, and 0.82, respectively. Similar to the SC-CII, the total CC-SC-CII score ranges from 19 to 95 and was standardized to a 100-point scale for analysis.

# Psychological health

Psychological health was measured using the 21-item Depression Anxiety and Stress Scale (DASS-21) [26], which can be used to evaluate the psychological state of patients, focusing on three key areas: depression, anxiety, and stress. Each subscale's score is doubled to obtain the final score. Notably, DASS-21 was also used to assess the psychological health of family caregivers, providing a consistent measure across both groups. In the original study, the Cronbach's alphas for the subscales of depression, anxiety, and stress ranged from 0.73 to 0.81 [26]. In this study, the reliability coefficients for patients were 0.86 for depression, 0.80 for anxiety, and 0.87 for stress, while for caregivers, they were 0.93, 0.91, and 0.91, respectively. The total DASS-21 score ranges from 0 to 126, with higher scores indicating greater psychological distress.

### General and disease-related characteristics

Both patients and caregivers' general and disease-related characteristics were collected to provide essential context for the study. For patients, demographic data included age, sex, education level, marital status, religion, employment status, and economic status. Disease-related variables encompassed tumor location, cancer stage, type of treatment (surgery, chemotherapy, radiation), time since diagnosis, comorbid conditions, and presence of ostomy. For caregivers, similar demographic data were gathered, including their age, sex, education level, relationship to the patient, religion, and employment status. Additionally, the presence of any comorbid conditions in caregivers were recorded.

# **Data collection**

Data were collected from August 2023 to May 2024 at the outpatient clinic of Jeonbuk National University Hospital. The data collection process involved face-to-face interviews and structured questionnaires administered by a trained research assistant. The assistant followed a standardized protocol to ensure consistency and reliability in data collection. The structured questionnaires were validated for use with the study population, capturing comprehensive information from both patients and caregivers. All collected data were securely stored and regularly reviewed to ensure accuracy and completeness, maintaining high data quality standards throughout the study period.

### **Ethical considerations**

This study was conducted following approval from the Institutional Review Board (IRB) of Jeonbuk National University Hospital (Approval No. CUH 2023-07-001-003). All participants were informed about the study's objectives, procedures, potential risks, and benefits before their participation. Written informed consent was obtained from all participants, ensuring their voluntary involvement in the study. Participants were also assured that their data would be treated confidentially and anonymously, with all personal identifiers removed before data analysis. The study adhered to ethical principles, including respect for autonomy, beneficence, and confidentiality, ensuring the protection of participants' rights and well-being throughout the research process.

# Statistical analysis

The collected data were analyzed using STATA 16.1 software. Descriptive statistics, including mean, standard deviation, frequency, and percentage, were calculated for general and clinical characteristics. Independent t-tests and analysis of variance (ANOVA) were used to examine differences in dependent variables based on specific characteristics, while paired t-tests were conducted to compare key variables between patients and caregivers. Pearson correlation coefficients were employed to explore relationships between major variables.

Given the dyadic nature of the data, the Actor-Partner Interdependence Model extended for Mediation (APIMeM) was selected as the final analytical approach. Alternative methods, such as multilevel modeling (MLM) and actor-only models, were considered but deemed less suitable. MLM does not fully capture the reciprocal influences within dyads, while actor-only models overlook partner effects. APIMeM, implemented via SEM, enables a comprehensive examination of actor and partner effects, as well as mediation processes, making it the most appropriate choice for analyzing interdependent health outcomes in patient-caregiver dyads [27].

Prior to conducting the analysis, the necessary assumptions for SEM were carefully evaluated. These included checking for multicollinearity, normality, and linearity of the data. The data were found to meet these assumptions, allowing for reliable SEM analysis. SEM with bootstrapping (1,000 replicates) was then performed to examine the interdependence of health outcomes between patients and caregivers. Additionally, based on the results of univariate analysis, which revealed significant differences in QoL associated with specific variables, the SEM analysis was adjusted for patients' economic status and comorbidity, as well as caregivers' education level and comorbidity, to control for their potential confounding effects.

Given the relatively high non-response rate and the potential for selection bias, we conducted a sensitivity analysis to evaluate its impact on the study findings. Univariate analyses compared matched and non-matched patients in terms of general characteristics, diseaserelated factors, and key study variables. A multiple regression model was then applied to determine whether matched status significantly affected QoL, adjusting for covariates that differed significantly between the two groups. This approach allowed us to assess the influence of selection bias on study outcomes.

# Results

Associations between participants' characteristics and QoL Participants' characteristics and their univariate associations with QoL were analyzed. Among patients, significant associations were found between QoL and both economic status and comorbidity. Patients with a high economic status reported significantly higher QoL scores compared to those with moderate or low economic status (F = 14.03, p < 0.001). Similarly, patients without comorbidities had higher QoL scores than those with comorbidities (t = 2.23, p = 0.028). For caregivers, educational level and comorbidity were significantly associated with QoL. Caregivers with higher educational levels had better QoL (t = -3.17, p = 0.002), and those without comorbidities reported higher QoL compared to those with comorbidities (t = 2.74, p = 0.007) (Table 1).

# Psychological health, patient self-care, caregiver contribution to self-care, and QoL

The analysis compared psychological health, patient self-care, caregiver contribution to self-care, and QoL between patients and caregivers using paired t-tests. The paired t-test results showed no significant differences in overall psychological health between patients and caregivers (t = -0.49, p = 0.628). Similarly, there were no significant differences between patients' self-care scores and caregivers' contribution to self-care scores across all subscales (maintenance (t = 0.45, p = 0.657), monitoring (t = -1.79, p = 0.076), and management (t = -1.10, p = 0.275)) and for the total self-care score (t = -0.93, p = 0.353). However, caregivers also had a higher overall QoL than patients (t = -1.99, p = 0.049). Significant differences were observed in specific domains of QoL, with caregivers scoring higher in physical health (t = -2.23, p = 0.028) and social relationships (t = -2.58, p = 0.012) (Table 2).

### Correlations between patient and caregiver variables

Correlation analyses revealed a significant positive relationship between patients' and caregivers' psychological health (r=0.21, p=0.034). Patients' QoL was negatively correlated with their psychological health (r = -0.49, p < 0.001) and caregivers' psychological health (r = -0.30, p = 0.002). Additionally, caregivers' QoL was positively correlated with their contribution to self-care (r = 0.33, p = 0.001) and patients' QoL (r = 0.23, p = 0.020). (Table 3).

### Actor-partner effect testing

The final structural equation model was developed to examine the interdependence between psychological health, patient self-care, caregiver contribution to selfcare, and QoL among patients with CRC and their family caregivers. The model included adjustments for patients' economic status and comorbidity, as well as caregivers' education level and comorbidity, which were significant in the univariate analysis.

Significant actor effects were identified in the model. Specifically, patients' psychological health had a negative impact on their QoL (B = -0.36, p<0.001), and patients' self-care was positively associated with their QoL (B = 0.24, p = 0.013). For caregivers, psychological health negatively influenced their QoL (B = -0.23, p = 0.001), while their contribution to the patient's self-care positively impacted their own QoL (B=0.41, p<0.001) (Fig. 1).

The model also revealed significant partner effects. Caregivers' psychological health had a negative impact on patients' self-care (B = -0.12, p=0.044). Additionally, there was a significant reciprocal relationship between the psychological health of patients and caregivers (B=117.02, p=0.030), indicating a mutual influence on each other's psychological well-being. Other paths in the model were not statistically significant, and the mediation analysis did not yield significant results (Fig. 1).

# Sensitivity analysis

To evaluate the impact of selection bias, a sensitivity analysis was conducted (Supplementary Table 1). Univariate comparisons between matched and non-matched patients revealed significant differences in age (p = 0.008), marital status (p = 0.002), educational level (p < 0.001), time since diagnosis (p = 0.007), and psychological health (p = 0.013). Among caregivers, significant differences were observed in age (p = 0.023) and relationship to the patient (p < 0.001). However, QoL did not differ significantly (p = 0.067 for patients, p = 0.273 for caregivers).

To determine whether these differences influenced the main study outcomes, a multiple regression analysis was conducted, adjusting for significant covariates. After controlling for potential confounders, matched status did not significantly predict QoL in either patients or caregivers (p > 0.05). These findings suggest that selection bias had little impact on the results.

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Table 1	Participants'	characteristics	and univariate	association v	with QoL ( $N = 200$ )
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Variables	Patients (n = 100) Patients' QoL			Caregivers (n = 100)	Caregivers' QoL			
	M±SD or <i>n</i> (%)	M±SD	t/F	р	M±SD or <i>n</i> (%)	M±SD	t/F	р
Age (years)	65.57±10.64				56.11±12.37			
<65	47 (47%)	87.91±16.08	1.57	0.119	71 (71%)	$89.62 \pm 14.93$	0.41	0.684
≥65	53 (53%)	$82.79 \pm 16.40$			29 (29%)	88.17±18.74		
Sex								
Male	51 (51%)	83.90±16.68	-0.81	0.421	45 (45%)	89.33±16.83	0.07	0.941
Female	49 (49%)	86.55±16.11			55 (55%)	89.09±15.52		
Marital status								
Single/divorced/widowed	12 (12%)	$83.50 \pm 19.97$	-0.38	0.704				
Married	88 (88%)	$85.43 \pm 15.94$						
Relationship								
Spouse					66 (66%)	88.94±16.31	0.03	0.973
Adult child					28 (28%)	89.79±15.77		
Others					6 (6%^)	89.33±17.00		
ducational level								
High school or less	81 (81%)	8401+1683	-151	0.135	55 (55%)	8480+1643	-3.17	0.002
College or higher	19 (19%)	$90.26 \pm 13.51$	1.51	0.155	45 (45%)	94 58 + 13 93	5.17	0.002
	15 (1570)	90.20 ± 19.91			13 (1370)	51.50 ± 15.55		
No	26 (26%)	82 50 + 20 03	1 2 2	0300	14 (1406)	70.03 + 20.64	283	0.064
Vos	20 (20%)	$82.30 \pm 20.03$	1.22	0.500	62 (62%)	$79.93 \pm 20.04$	2.05	0.004
Housowife	41 (4170) 22 (2204)	00.22 ± 15.40			02 (0270)	$90.33 \pm 14.37$		
	SS (SS%)	05.30±10.30			24 (24%)	90.05 ± 15.05		
Ne	42 (420/)	02.20 + 16.52	1.50	0.121	47 (470/)	0074 1721	0.27	0.701
NO	42 (42%)	82.29±16.52	-1.52	0.131	47 (47%)	88./4±1/.21	-0.27	0.791
Yes +	58 (58%)	87.31±16.08			53 (53%)	89.60±15.08		
conomic status'	5 (50)	449.49.959						
High "	5 (5%)	113.40±8.53	14.03	< 0.001				
Moderate	/9 (/9%)	85.66±13.99		c <b<a< td=""><td></td><td></td><td></td><td></td></b<a<>				
Low	16 (16%)	/4.13±18.30						
_omorbidity								
No	46 (46%)	89.09±16.83	2.23	0.028	70 (70%)	91.99±14.65	2.74	0.007
Yes	54 (54%)	81.89±15.36			30 (30%)	82.70±17.47		
Type of cancer								
Colon cancer	66 (66%)	84.97±16.26	-0.20	0.846				
Rectal cancer	34 (34%)	$85.65 \pm 16.82$						
Stage								
1	31 (31%)	$88.65 \pm 14.94$	1.01	0.391				
2	28 (28%)	$81.21 \pm 16.56$						
3	35 (35%)	$85.26 \pm 17.04$						
4	6 (6%)	$85.67 \pm 18.73$						
Chemotherapy								
Completion	36 (36%)	$85.75 \pm 18.31$	1.56	0.216				
Under treatment	15 (15%)	$78.47 \pm 13.04$						
None	49 (49%)	$86.86 \pm 15.55$						
Radiotherapy								
Completion	8 (8%)	$95.13 \pm 16.37$	3.07	0.051				
Under treatment	2 (2%)	$65.50 \pm 19.09$						
None	90 (90%)	84.76±15.98						
lime since diagnosis								
<1year	29 (29%)	84.38±19.24	0.28	0.755				
≥ 1year, <3years	52 (52%)	84.73±15.04						
≥ 3years	19 (19%)	$87.74 \pm 15.78$						
Ostomy	- \/							

# Table 1 (continued)

Variables	Patients (n = 100)	Patients' QoL		Caregivers (n = 100)	Caregivers' QoL				
	M±SD or <i>n</i> (%)	M±SD	t/F	р	M±SD or <i>n</i> (%)	M±SD	t/F	р	
No	93 (93%)	85.15±16.45	-0.11	0.913					
Yes (temporary)	7 (7%)	85.86±16.58							

Notes. QoL=Quality of life; M=Mean; SD=Standard deviation. <sup>†</sup>Post-hoc test was conducted using Bonferroni correction

Table 2 Psychological health	n, self-care	contribution to self-	-care, and gu	uality of life (	(N = 200)
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Variables	Categories	Patients (n = 100)	Caregivers (n = 100)	t	р
		M±SD or <i>n</i> (%)	M±SD or <i>n</i> (%)		
Psychological health	Total score	24.16±21.43	25.62±26.03	-0.49	0.628
	Depression	8.28±8.08	8.14±9.33	0.12	0.901
	Normal	43 (43%)	50 (50%)		
	Mild	12 (12%)	3 (3%)		
	Moderate	16 (16%)	18 (18%)		
	Severe	4 (4%)	6 (6%)		
	Extremely severe	25 (25%)	23 (23%)		
	Anxiety	6.78±6.78	6.68±8.41	0.10	0.918
	Normal	37 (37%)	41 (41%)		
	Mild	14 (14%)	16 (16%)		
	Moderate	11 (11%)	11 (11%)		
	Severe	9 (9%)	9 (9%)		
	Extremely severe	29 (29%)	23 (23%)		
	Stress	9.10±8.11	10.80±9.32	-1.52	0.132
	Normal	47 (47%)	39 (39%)		
	Mild	10 (10%)	7 (7%)		
	Moderate	14 (14%)	19 (19%)		
	Severe	14 (14%)	16 (16%)		
	Extremely severe	15 (15%)	19 (19%)		
Self-care <sup>†</sup> &	Total score	73.36±14.20	75.23±14.31	-0.93	0.353
Contribution to self-care <sup>†</sup>	Maintenance	74.20±15.89	73.17±17.19	0.45	0.657
	Monitoring	77.28±20.28	82.20±18.29	-1.79	0.076
	Management	70.23±16.86	73.24±15.53	-1.10	0.275
Quality of life	Total score	85.20±16.37	89.20±16.04	-1.99	0.049
	Physical health	$3.09 \pm 0.59$	3.26±0.60	-2.23	0.028
	Psychological health	3.18±0.77	$3.29 \pm 0.84$	-1.04	0.300
	Social relationships	$2.95 \pm 0.88$	$3.20 \pm 0.70$	-2.58	0.012
	Environment	3.27±0.67	3.37±0.61	-1.11	0.269
	Overall quality of life	3.36±0.93	3.45±0.81	-0.82	0.416
	General health	2.99±0.99	3.15±0.94	-1.21	0.230

Notes. M = Mean; SD = Standard deviation. <sup>†</sup>Patients' self-care and caregivers' contribution to self-care were analyzed using paired t-tests. The total and subscale scores were standardized to a 0-100 scale

# Discussion

This study investigated the relationships between psychological health, patient self-care, caregiver contribution to self-care, and QoL in patients with CRC and their family caregivers, utilizing the APIM framework. We found that the psychological health and QoL of both patients and caregivers independently influenced their respective outcomes. Additionally, partner effects analysis revealed mutual influences between patients' and caregivers' psychological health, with caregivers' psychological wellbeing also affecting patients' self-care. The discussion explores these actor and partner effects to enhance understanding of their interdependent dynamics.

Psychological health is a significant concern for patients with cancer as the diagnosis and treatment of cancer can lead to anxiety, depression, emotional distress, and fear of prognosis and possible side effects, which in turn may lead to decline in psychological health and QoL [28, 29]. Consistent with previous research, our study revealed that psychological health was related to QoL in patients with CRC [28, 30, 31]. More than half of the patients with CRC in our study reported experiencing depression, anxiety, and stress; this indicates the importance of screening

Variables	Psychological health		Self-care	Contribution to self-care	QoL	
	Patients	Caregivers	Patients	Caregivers	Patients	Caregivers
	r(p)	r(p)	r(p)	r(p)	r(p)	r(p)
Patients' psychological health	1.000					
Caregivers' psychological health	0.21 (0.034)	1.000				
Patients' self-care	-0.04 (0.686)	-0.23 (0.024)	1.000			
Caregivers' contribution to self-care	0.04 (0.688)	0.09 (0.386)	0.01 (0.929)	1.000		
Patients' QoL	-0.49 (<0.001)	-0.30 (0.002)	0.24 (0.019)	0.04 (0.708)	1.000	
Caregivers' QoL	-0.14 (0.165)	-0.40 (<0.001)	0.04 (0.725)	0.33 (0.001)	0.23 (0.020)	1.000

**Table 3** Correlation relationships between variables of patients and caregivers (N = 200)

Notes. QoL = Quality of life



**Fig. 1** Actor-partner interdependence mediation model in patients with colorectal cancer and their family caregivers. *Notes*. Estimates are unstandardized regression coefficients; patients' economic status, comorbidity, caregivers' education level, and comorbidity were adjusted in the final structural equation model. Significant path coefficients are in solid line; \*p < 0.05, \*\*p < 0.01, \*\*\*p < 0.001

programs for psychological health, especially for those with low economic status and comorbidities. Although we did not examine social support and its relationship to QoL, previous studies have reported that patients with CRC with greater social support tend to have better psychological health [32, 33]. Future studies should consider social support, including friends, communities, and hospitals, and its relationship to psychological health and QoL.

Psychological health is another important factor influencing the QoL of caregivers of patients with CRC in this study. Previous study reported a high prevalence of psychological distress, including anxiety, depression, and fear, among caregivers of patients with CRC because these patients are highly dependent on caring services [34, 35]. Psychological distress can affect caregivers in many ways, for example, by adversely affecting family relationships and social interactions, which in turn can deteriorate the QoL of caregivers of patients with CRC [36, 37]. Previous studies have reported that psychological interventions to reduce anxiety or depression enhance QoL in caregivers of patients with cancer [38]. Caregivers in Korea have reported lower QoL compared to Western countries and other Asian countries [39]. There is a need for developing tailored intervention addressing psychological support and providing appropriate training to handle their caregiving tasks more effectively, thereby enhancing QoL of caregivers [38].

Consistent with previous research, we found that psychological health among patients with CRC is a significant factor influencing their caregiver's psychological health [19, 21, 30]. Further, we found a positive association between caregivers' psychological health and patients' self-care, which is consistent with the result found in a previous study with ostomy patients and their caregivers [40]. These results may indicate that patients are sensitive to the health of their caregivers, which in turn has a negative impact on their own health and health behaviors [40]. Thus, when healthcare providers assess psychological symptoms in patients with CRC, caregivers should also be assessed. These results further emphasize the need for dyadic intervention development targeting both patients with CRC and their caregivers to improve psychological health, health behaviors, and QoL.

Although we did not find the mediating roles of patient's self-care and caregiver contribution to self-care in the analysis, both of these factors were significantly associated with QoL. Self-care is crucial in chronic health conditions including cancer to have an active and emotionally satisfying life. Consistent with previous research, we found that self-care was positively related to QoL [10, 11, 41]. However, patients experience different symptoms and have different needs throughout their journey during cancer survivorship, which underscores the need for tailored interventions. Patients with CRC must be provided with appropriate training and support to increase selfcare skills from the stage of diagnosis to survivorship; this could help boost their recovery and QoL [11]. We did not find a direct relationship between caregiver contribution to self-care and patient's QoL. In other chronic diseases such as heart failure, caregiver contribution to self-care had indirect influence on patients' QoL through the mediation of patient self-care [42]. However, a caregiver's contribution to self-care was found to be directly related to their own QoL, which highlights the importance of including caregivers in self-care training programs. A possible reason why self-care and caregiver contribution to self-care were not significant mediators is that only 7% of patients had an ostomy, which requires extensive selfcare to prevent complications such as infections or skin irritation [43]. The findings may differ in studies with a higher proportion of ostomy patients. Future studies should recruit more patients with ostomies to examine the roles of patients' self-care and caregiver contribution to self-care in health outcomes. Further, the study design was cross-sectional and may not have fully captured the mediating effects of self-care and caregiver contribution to self-care. As the needs and importance of self-care and caregiver contribution to self-care vary across different phases of recovery and survivorship, their impacts on psychological health and QoL may also differ. Moreover, although the sample size met the rule of thumb for SEM and sophisticated statistical methods were used, 100 pairs may have been insufficient to detect the mediation effects. If more patients in similar recovery phases had been included, some mediating effects might have been observed. Future studies should employ a longitudinal design with larger samples to better capture these dynamics. Nevertheless, this study is significant as the first to examine the mediating roles of (patient) self-care and caregiver contribution to self-care in patients with CRC. It contributes to existing research by providing insights into the dyadic interactions within CRC caregiving relationships.

Although this is one of the few studies examining the interdependence of health between patients with CRC and family caregivers, a few limitations should be noted. This study adopted a cross-sectional design; hence, it does not explain the causal relationships between variables. Moreover, a selection bias may affect the validity of our study as we recruited 100 caregiver-patient pairs from a single outpatient clinic in Korea, potentially limiting the generalizability of findings to other populations and cultures. However, our sensitivity analysis showed no significant differences between participants and nonparticipants. We recommend follow-up studies with more generalizable populations, using random selection of institutions, quota sampling, and longitudinal designs across diverse cultures. Although this study included only primary caregivers, certain confounders-such as living arrangements, family closeness, and relationship satisfaction-may have influenced family dynamics and their impact on self-care and QoL. Future studies should comprehensively assess these potential confounders to better understand their effects on study findings. Moreover, patients with cancer tend to experience different levels of QoL throughout their survivorship; therefore, a longitudinal study design would be beneficial to monitor and examine psychological health and QoL and its associated factors in patients with CRC and their family caregivers.

### Conclusions

To our knowledge, this study is one of the few that explore the direct and indirect relationships between psychological health and QoL in patients with CRC and their family caregivers, especially in Korea. Our study confirmed the interdependence of psychological health in dyads of patients with CRC and their caregivers. It also highlighted the significant roles of patients' self-care and caregivers' contribution to self-care in their respective QoL based on APIM. Based on this evidence, it is important to develop dyadic interventions to improve psychological health for enhancing QoL of patients with CRC and their caregivers. Future longitudinal studies are recommended to confirm the causal relationships between variables examined in our study with patients with CRC and their family caregivers.

Abbreviations

ERC	Colorectal cancer
APIM	Actor-partner interdependence model
QoL	Quality of life
SEM	Structural equation modeling
NHOQOL-BREF	World health organization quality of life brief version
SC-CII	Self-care of chronic illness inventory
CC-SC-CII	Caregiver contribution to self-care of chronic illness
	inventory

DASS-21 HEART 21-item Depression anxiety stress scale Heart failure care for enhancing self-management at home by reinforcing discharge education with teach-back method

# **Supplementary Information**

The online version contains supplementary material available at https://doi.or g/10.1186/s12912-025-03062-4.

Supplementary Material 1

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### Author contributions

Conceptualization; YK, NK, KH, ML, Data curation; YK, NK, Formal analysis; YK, Funding acquisition; YK, Investigation; NK, KH, ML, Methodology; YK, KH, KH, ML, Project administration; YK, NK, Supervision; YK, KH, HH, Validation; YK, HH, Visualization; YK, Writing - review & editing; YK, HH, Writing - original draft; YK, HH, NK, KH, ML.

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### Data availability

The datasets generated and/or analyzed during the current study are available from the corresponding author on reasonable request.

### Declarations

### Ethical approval and consent to participate

This study was performed in accordance with the Helsinki Declaration, and approval was obtained from the Institutional Review Board of Jeonbuk National University Hospital (Approval No. CUH 2023-07-001-003). A written consent form was obtained from each participant voluntarily before data collection. Participants were also assured that their data would be treated confidentially and anonymously, with all personal identifiers removed before data analysis.

### **Consent for publication**

Not applicable.

### Presentation

This study received the Outstanding Oral Presentation Award (\$100) at the 2024 Summer Academic Conference of the Korean Society of Adult Nursing, held on July 5, 2024.

### **Competing interests**

The authors declare no competing interests.

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### References

- International Agency for Research on Cancer (IARC). Global Burden of Colorectal Cancer in 2020 and 2040: Incidence and Mortality Estimates from GLOBOCAN. https://www.iarc.who.int/news-events/global-burden-of-colore ctal-cancer-in-2020-and-2040-incidence-and-mortality-estimates-from-glob ocan/ (2022). Accessed 20th Nov 2024.
- American Cancer Society. Colorectal cancer early detection, diagnosis, and staging. https://www.cancer.org/content/dam/CRC/PDF/Public/8606.00.pdf (2024). Accessed 20th Nov 2024.
- Jung KU, Kim HO, Kim H. Epidemiology, risk factors, and prevention of colorectal cancer-an english version. J Anus Rectum Colon. 2022;6(4):231–8. https://doi.org/10.23922/jarc.2022-050.
- Siegel RL, Wagle NS, Cercek A, Smith RA, Jemal A. Colorectal cancer statistics, 2023. CA Cancer J Clin. 2023;73(3):233–54. https://doi.org/10.3322/caac.2177
- Thompson T, Ketcher D, Gray TF, Kent EE. The dyadic cancer outcomes framework: a general framework of the effects of cancer on patients and informal caregivers. Soc Sci Med. 2021;287:114357. https://doi.org/10.1016/j.socscime d.2021.114357.
- Bailey CR, George ML. Colorectal cancer surgery: is further research necessary? Anaesthesia. 2022;77(7):748–50. https://doi.org/10.1111/anae.15706.
- Tang WSW, Chiang LLC, Kwang KW, Zhang MWB. Prevalence of depression and its potential contributing factors in patients with enterostomy: a metaanalytical review. Front Psychiatr. 2022;13. https://doi.org/10.3389/fpsyt.2022. 1001232.
- Jin Y, Ma H, Jimenez-Herrera M. Self-disgust and stigma both mediate the relationship between stoma acceptance and stoma care self-efficacy. J Adv Nurs. 2020;76(10):2547–58. https://doi.org/10.1111/jan.14457.
- Lorig K. Self-management of chronic illness: a model for the future. Generations. 1993;17(3):11–4. https://www.jstor.org/stable/44877774.
- Howell D, Harth T, Brown J, Bennett C, Boyko S. Self-management education interventions for patients with cancer: a systematic review. Support Care Cancer. 2017;25(4):1323–55. https://doi.org/10.1007/s00520-016-3500-.
- Wang TJ, Chang SC, Hsu HH, Huang CS, Lin TR, Lin YP, et al. Efficacy of a self-management program on quality of life in colorectal cancer patients: a randomized controlled trial. Eur J Oncol Nurs. 2003;67:102431.
- Jin Y, Li X, Ma H, Xiong L, Zhao M, Wang H. Dyadic effects of perceived stress, relationship satisfaction and distress disclosure on emotional distress in colorectal cancer patients and their family caregivers: an actor-partner interdependence mediation model. Asia Pac J Oncol Nurs. 2024;11(10):100580. htt ps://doi.org/10.1016/j.apjon.2024.100580.
- Vellone E, Riegel B, Alvaro R. A situation-specific theory of caregiver contributions to heart failure self-care. J Cardiovasc Nurs. 2019;34(2):16673. https://doi .org/10.1097/JCN.00000000000549.
- Bae KR, Yu J. Family caregivers' experiences related to fear of cancer recurrence in caring for cancer survivors. Asia Pac J Oncol Nurs. 2023;23(2):64–74. h ttps://doi.org/10.5388/aon.2023.23.2.64.
- Lin H, Lin R, Lin L, Dai X, Lin N. Associations between preparedness, perceived stress, depression, and quality of life in family caregivers of patients with a temporary enterostomy. Eur J Oncol Nurs. 2024;70:102557. https://doi.org/10. 1016/j.ejon.2024.102557.
- Petursdottir AB, Rayens MK, Sigurdardottir V, Svavarsdottir EK. Long-term effect of receiving a family strengths-oriented intervention on family cancer caregiver stress, anxiety, and depression symptoms: a longitudinal quasiexperimental study. J Fam Nurs. 2021;27(2):114–23. https://doi.org/10.1177/1 074840721994332.
- 17. Ha KM. The role of confucianism in South Korea's emergency management system. Disasters. 2018;42(4):804–22. https://doi.org/10.1111/disa.12283.
- Cook WL, Kenny DA. The actor–partner interdependence model: a model of bidirectional effects in developmental studies. Int J Behav Dev. 2005;29(2):101–9. https://doi.org/10.1080/01650250444000405
- Kim YM, Lee JE. Dyadic effects of psychological health on quality of life in patients with colorectal cancer and caregivers: a systematic review and metaanalysis. Semin Oncol Nurs. 2023;39(5):151477.
- Goldzweig G, Hubert A, Walach N, Brenner B, Perry S, Andritsch E, Baider L. Gender and psychological distress among middle- and older-aged colorectal cancer patients and their spouses: an unexpected outcome. Crit Rev Oncol Hematol. 2009;70(1):71–82.
- Lin Y, Luo X, Li J, Xu Y, Li Q. The dyadic relationship of benefit finding and its impact on quality of life in colorectal cancer survivor and spousal caregiver couples. Support Care Cancer. 2021;29(3):1477–86.

- 22. Christopher Westland J. Lower bounds on sample size in structural equation modeling. Electron Commer Res Appl. 2010;9(6):476–87.
- 23. The WHOQOL Group. Development of the world health organization WHOQOL-BREF quality of life assessment. Psychol Med. 1998;28(3):551–8.
- Riegel B, Barbaranelli C, Sethares KA, Daus M, Moser DK, Miller JL, et al. Development and initial testing of the self-care of chronic illness inventory. J Adv Nurs. 2018;74(10):2465–76.
- Vellone E, Lorini S, Ausili D, Alvaro R, Di Mauro S, De Marinis MG, et al. Psychometric characteristics of the caregiver contribution to self-care of chronic illness inventory. J Adv Nurs. 2020;76(9):2434–45.
- 26. Lovibond SH, Lovibond PF. Manual for the depression anxiety stress scales. 2nd ed. Sydney: Psychology Foundation of Australia; 1995.
- Ledermann T, Macho S, Kenny DA. Assessing mediation in dyadic data using the actor-partner interdependence model. Struct Equation Modeling: Multidisciplinary J. 2011;18(4):595–612. https://doi.org/10.1080/10705511.2011.60 7099.
- Ellis KR, Oh S, Hecht HK. Symptom distress and quality of life among black Americans with cancer and their family caregivers. Psychooncology. 2021;30(8):1356–65. https://doi.org/10.1002/pon.5691.
- Papadopoulou A, Govina O, Tsatsou I, Mantzorou M, Mantoudi A, Tsiou C, et al. Quality of life, distress, anxiety and depression of ambulatory cancer patients receiving chemotherapy. Med Pharm Rep. 2022;95(4):418–29. https:/ /doi.org/10.15386/mpr-2458.
- Han CJ, Yang GS, Syrjala K. Symptom experiences in colorectal cancer survivors after cancer treatments: a systematic review and meta-analysis. Cancer Nurs. 2020;43(3):E132–58. https://doi.org/10.1097/NCC.00000000000785.
- Mols F, Schoormans D, de Hingh I, Oerlemans S, Husson O. Symptoms of anxiety and depression among colorectal cancer survivors from the population-based, longitudinal PROFILES registry: prevalence, predictors, and impact on quality of life. Cancer. 2018;124(12):2621–8. https://doi.org/10.100 2/cncr.31369.
- Lynch BM, Steginga SK, Hawkes AL, Pakenham KI, Dunn J. Describing and predicting psychological distress after colorectal cancer. Cancer. 2008;112(6):1363–70. https://doi.org/10.1002/cncr.23300.
- Gonzalez-Saenz de Tejada M, Bilbao A, Bare M, Briones E, Sarasqueta C, et al. Association between social support, functional status, and change in healthrelated quality of life and changes in anxiety and depression in colorectal cancer patients. Psychooncology. 2017;26(9):1263–69. https://doi.org/10.100 2/pon.4303.
- 34. Wang ZX, Zhao TY, Zheng XY, Cao X, Shen Y. Warning-and-alert embedded health education on colostomy care for colon cancer patients and their

caregivers. J Nurs Sci. 2018;33:73–5. https://doi.org/10.3870/j.issn.1001-4152.2 018.08.073.

- Wan SW, Chong CS, Jee XP, Pikkarainen M, He H-G. Perioperative experiences and needs of patients who undergo colorectal cancer surgery and their family caregivers: a qualitative study. Support Care Cancer. 2022;30:5401–10. http s://doi.org/10.1007/s00520-022-06963-1.
- Cui P, Yang M, Hu H, Cheng C, Chen X, et al. The impact of caregiver burden on quality of life in family caregivers of patients with advanced cancer: a moderated mediation analysis of the role of psychological distress and family resilience. BMC Public Health. 2024;24:817. https://doi.org/10.1186/s12889-02 4-18321-3.
- Li Q, Lin Y, Xu Y, Zhou H. The impact of depression and anxiety on quality of life in Chinese cancer patient-family caregiver dyads, a cross-sectional study. Health Qual Life Outcomes. 2018;16:230. https://doi.org/10.1186/s12955-01 8-1051-3.
- Secinti E, Fischer IC, Brennan EA, Christon L, Balliet W. The efficacy of psychosocial interventions for cancer caregiver burden: a systematic review and meta-analysis of randomized controlled trials. Clin Psychol Rev. 2023;99:102237.
- Lim HA, Tan JY, Chua J, Yoong RK, Lim SE, Kua EH, et al. Quality of life of family caregivers of cancer patients in Singapore and globally. Singap Med J. 2017;58(5):258–61. https://doi.org/10.11622/smedj.2016083.
- Iovino P, De Maria M, Corvese F, Giordano V, Alvaro R, Vellone E, et al. The influence of patient and caregiver depression on patient self-care and caregiver contribution to self-care in ostomy: a dyadic analysis. J Clin Nurs. 2023;32(17–18):6441–9. https://doi.org/10.1111/jocn.16676.
- Aktas N, Baykara ZG. Determination of quality of life and self-care agency in patients who underwent colorectal cancer surgery: a prospective descriptive study. Wound Manag Prev. 2021;67(1):18–26.
- Caggianelli G, Alivernini F, Chirico A, Iovino P, Lucidi F, Uchmanowicz I, et al. The relationship between caregiver contribution to self-care and patient quality of life in heart failure: a longitudinal mediation analysis. PLoS ONE. 2024;19(3):e0300101. https://doi.org/10.1371/journal.pone.0300101.
- Hill B. Stoma care: procedures, appliances and nursing considerations. Br J Nurs. 2020;29(22):S14–S19. https://doi.org/10.12968/bjon.2020.29.22.S14. PMID: 33325296.

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