

Long-term incidence of depression in rectal cancer patients with or without stoma: a population-based cohort study

Hyun Jung Kim^{1,2}, Hyeong Sik Ahn^{1,2}, Woong Bae Ji³

¹Department of Preventive Medicine, Korea University College of Medicine, Seoul, Korea

²Institute for Evidence-based Medicine, Cochrane Collaboration, Seoul, Korea

³Division of Colon and Rectal Surgery, Department of Surgery, Korea University Ansan Hospital, Ansan, Korea

Purpose: Significant improvements have been made in the surgical treatment of rectal cancer with a higher sphincter-saving rate without compromising oncologic results. There have been studies about the quality of life of rectal cancer patients after surgery. However, no study has reported the long-term annual incidence of depression after rectal cancer surgery according to stoma status. The objective of this study was to determine the annual incidence of depression after rectal cancer surgery and the factors affecting it, especially the prevalence of depression according to the presence or duration of a stoma.

Methods: Using the Korea National Health Insurance Service database, patients who underwent radical surgery for rectal cancer from 2002 to 2019 were searched. We analyzed the incidence and risk factors of depression in patients who underwent radical surgery for rectal cancer according to stoma status.

Results: Annual incidence of depression in rectal cancer patients was decreasing annually for 15 years after surgery. There was no statistically significant difference in the incidence of depression according to the stoma status. However, the diagnosis of depression within 1 year after surgery was statistically significantly increased in the permanent stoma group.

Conclusion: There was no difference in the overall incidence of depressive disorders among patients with rectal cancer based on their stoma status. However, a permanent stoma seems to increase the incidence in the first year after surgery. Education and intensive assessments of depressive disorders in patients with permanent stoma within 1 year after surgery are needed, particularly for female patients who are under 50 years old.

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Key Words: Depression, Rectal neoplasms, Surgical stomas

INTRODUCTION

Colorectal cancer is one of the most common cancers in the world. In Korea, colorectal cancer is the 3rd most newly diagnosed cancer (44.5 patients per 100,000 people in 2018) [1]. Significant improvements have been made in surgical techniques and oncologic results for the treatment of rectal cancer in the past 20 years. With the introduction

of total mesorectal excision and the spread of preoperative chemoradiotherapy, local recurrence rate has significantly improved [2]. In addition, the sphincter-saving rate has been improved due to preoperative radiotherapy and technical advances in surgery for low rectal cancer such as intersphincteric resection [3]. However, rectal cancer itself and the resulting surgery may bring many quality-of-life (QOL) limitations. The resulting depressive mood may persist even

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Corresponding Author: Woong Bae Ji

Division of Colon and Rectal Surgery, Department of Surgery, Korea University Ansan Hospital, 123 Jeokgeum-ro, Danwon-gu, Ansan 15355, Korea

Tel: +82-31-412-4897, Fax: +82-31-412-4807

E-mail: wbjj@korea.ac.kr

ORCID: <https://orcid.org/0000-0001-7539-046X>

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after cure [4].

It has been reported that inflammation, chronic stress, cancer progression, and chemotherapy can also affect postoperative depression in rectal cancer patients [5]. Factors affecting QOL in rectal cancer patients also include low anterior resection syndrome (LARS) and the presence of stoma. Stoma patients may experience a significant number of technical, emotional, social, marital, and sexual difficulties [6]. Many studies have reported negative effects on body images, leading to increased anxiety and depression [7,8]. Not only stoma after sphincter-sacrificing rectal cancer surgery, but LARS may deteriorate the QOL after a sphincter-saving rectal cancer surgery [9]. There has been controversy over which is superior in QOL, but there may have been the unproven conviction that stoma more adversely affects QOL and that sphincter-saving surgery has superiority in all cases [10,11].

Although numerous studies have analyzed the effect of stoma on QOL, few studies have reported effects of stoma in rectal cancer patients. Some studies have shown that permanent stoma has a negative effect on QOL [12-14]. However, some studies on QOL of rectal cancer patients have suggested that the stoma itself has comparable effect on the QOL to patients without stoma after a rectal cancer surgery [11]. Rather than feeling just depressed due to stoma, finding out how many patients are actually diagnosed with depression can help predict significant clinical consequences of depression. Although many studies have used surveys related to the QOL and depression of rectal cancer patients, few studies on the actual morbidity of depression have been reported. In particular, since there was no study on long-term annual incidence of depression after surgery in rectal cancer patients, the objective of this study was to investigate annual incidence of depression after rectal cancer surgery and factors affecting it, especially the prevalence of depression according to the presence or duration of a stoma.

METHODS

The study protocol was approved by the Institutional Review Board of Korea University College of Medicine (No. KUIRB-2021-0357-01). This study was performed in accordance with the Declaration of Helsinki and written informed consent was waived due to its retrospective nature.

Data collection and searching

We analyzed the incidence of depression of rectal cancer patients using the Korea National Health Insurance Service (KNHIS) database. The KNHIS database contains patient demographics, International Classification of Disease (ICD)-based diagnostic codes, surgical and interventional codes, and prescription codes [15]. Personally identifiable information was deleted before analysis under the privacy protection law in

Korea.

Using data registered in the KNHIS database, patients diagnosed with rectal cancer from 2002 to 2019 who underwent surgical treatment were searched using the ICD-10 system. Among patients diagnosed with C20 code of ICD-10, patients who underwent surgery related to cancer were extracted. Depressive disorder was searched for patients diagnosed with depressive disorder (F32) and recurrent depressive disorder (F33) in ICD code system. Patients with stomas were searched for stoma-related surgical codes using surgical codes in the KNHIS database. In case of surgery involving stoma creation, patients were classified as having stoma. Stoma reversal-related surgery (stoma take-down or reversal of Hartmann operation) was defined as termination of stoma. Those who had stoma reversal-related surgery were defined as temporary stoma. Those who had no stoma reversal-related surgery and who had abdominoperineal resection (APR) were defined as permanent stoma. Socioeconomic level was classified based on health insurance payment standards. Analysis was divided into the 20th deciles at 5% intervals from medical benefits.

Statistical analysis

Covariates

Data were analyzed using other variables as covariates, including age, sex, radiotherapy (preoperative, postoperative, non), number of stoma-making surgeries (never, 1 time, 2 times, more than 3 times), socioeconomic status (Medicaid, 1-5, 6-10, 11-15, 16-20 quartiles), previous history of depression, and the presence or absence of the disease included in the Charlson comorbidity index (CCI) in each group.

Statistical analyses

To compare the demographic characteristics of individuals with and without stoma, we used the standardized difference between the 2 groups for both continuous and categorical variables. The absolute standardized difference of 0.10 or more indicates that covariates are imbalanced between groups. Follow-up started on the index date and was censored on the date of outcome occurrence, death, or last follow-up. The person-time at risk started on the index date and ended either at the time of depression diagnosis, at death, or at the end of the study period in 2019. We used the Kaplan-Meier method to estimate the cumulative incidences of depression. The incidences of depression with 95% confidence intervals (CI) were measured as the number of cases per 1,000 person-years. We measured incidence rate ratios (IRR) of depression in each group by using patients without a stoma as reference. The log-rank test was performed to examine differences in the risk for depression in the cohort. The IRR was used to examine the consistency over time.

Table 1. Baseline characteristics of patients included in this study

Characteristic	Total	No stoma		All stoma patients		Yes stoma		Standard difference ^{b)}
		No. of patients	63.26 ± 11.31	33,778	24,726	19,117	62.83 ± 11.26	
No. of patients	58,504							
Age at diagnosis	63.26 ± 11.31	63.00 ± 11.23		63.24 ± 11.42	0.00196			-0.15716
Sex								
Male	37,230	20,483 (60.64)		16,747 (67.73)	0.14829	13,222 (69.16)	3,525 (62.85)	0.13368
Female	21,274	13,295 (39.36)		7,979 (32.27)		5,895 (30.84)	2,084 (37.15)	
Age at diagnosis (yr)								
20-29	128	72 (0.21)		56 (0.23)	0.02902	45 (0.24)	11 (0.20)	0.19145
30-39	1,179	656 (1.94)		523 (2.12)		407 (2.13)	116 (2.07)	
40-49	5,627	3,176 (9.40)		2,451 (9.91)		1,944 (10.17)	507 (9.04)	
50-59	14,518	8,433 (24.97)		6,085 (24.61)		4,881 (25.53)	1,204 (21.47)	
60-69	18,151	10,593 (31.36)		7,558 (30.57)		5,943 (31.09)	1,615 (28.79)	
70-79	15,137	8,720 (25.82)		6,417 (25.95)		4,809 (25.16)	1,608 (28.67)	
≥80	3,764	2,128 (6.30)		1,636 (6.62)		1,088 (5.69)	548 (9.77)	
Socioeconomic status (quartile)								
Medicaid	2,520	1,400 (4.14)		1,120 (4.53)	0.07894	782 (4.09)	338 (6.03)	0.10676
1-5	10,839	6,150 (18.21)		4,689 (18.96)		3,577 (18.71)	1,112 (19.83)	
6-10	10,749	6,053 (17.92)		4,696 (18.99)		3,595 (18.81)	1,101 (19.63)	
11-15	13,965	7,919 (23.44)		6,046 (24.45)		4,756 (24.88)	1,290 (23.00)	
16-20	19,228	11,612 (34.38)		7,616 (30.80)		5,979 (31.28)	1,637 (29.19)	
Missing	1,203	644 (1.91)		559 (2.26)		428 (2.24)	131 (2.34)	
No. of stoma-making surgery								
Never	34,884	33,778 (100.00)		1,106 (4.47)	6.53548	0 (0)	0 (0)	0.36428
1	21,673	0 (0)		21,673 (87.65)		17,744 (92.82)	5,035 (89.77)	
2	1,731	0 (0)		1,731 (7.00)		1,206 (6.31)	525 (9.36)	
≥3	216	0 (0)		216 (0.87)		167 (0.87)	49 (0.87)	
Radiotherapy								
None	47,477	30,266 (89.60)		17,211 (69.61)	0.6025	13,043 (68.23)	4,168 (74.31)	0.18758
Within 6 mo before surgery	7,735	1,548 (4.58)		6,187 (25.02)		5,115 (26.76)	1,072 (19.11)	
Within 6 mo after surgery	3,292	1,964 (5.81)		1,328 (5.37)		959 (5.02)	369 (6.58)	
Death								
Survived	42,538	25,518 (75.55)		17,020 (68.83)	0.15022	14,071 (73.60)	2,949 (52.58)	0.4465
Dead	15,966	8,260 (24.45)		7,706 (31.17)		5,046 (26.40)	2,660 (47.42)	
Time of previous depression								
None	52,821	30,354 (89.86)		22,467 (90.86)	0.03391	17,311 (90.55)	5,156 (91.92)	0.0485
1 year before surgery	5,683	3,424 (10.14)		2,259 (9.14)		1,806 (9.45)	453 (8.08)	

Values are presented as number only, mean ± standard deviation, or number (%).
 A standard difference of >0.1 was considered as indicating a significant statistical difference.
^{a)}With stoma vs. no stoma, ^{b)}temporary vs. permanent.

The Cox proportional hazards models were used to compute the hazard ratios (HRs) accompanying 95% CIs after adjustment for confounders that are potentially associated with depression incidence, including age, sex, radiotherapy (preoperative, postoperative, non), number of stoma-making surgeries (never, 1 time, two times, more than 3 times), socioeconomic status (Medicaid, 1–5, 6–10, 11–15, 16–20 quartiles), previous history of depression and the CCI. We used Schoenfeld’s global test to test the proportional hazards assumption in the Cox proportional hazards model. We also conducted Cox regression analyses to examine differences in stoma type-depression associations according to age (<50 and ≥50 years) and survival period (<5 and ≥5 years). To correct bias due to cancer staging, sensitivity

analyses were conducted by dividing the presence or absence of radiation treatment and the prior diagnosis of depression.

In order to compare the occurrence of depression in the general population, a matched comparator group was established. The comparator group without colorectal cancer comprised subjects without a diagnosis of colorectal cancer matched by age, sex, and socioeconomic level in a 1:4 ratio in each year during the enrollment period (2002–2019). The index date for the patients with rectal cancer was defined as the first diagnosis of rectal cancer during the study period. For the comparator group, the index date was the mean of the index dates for the matched rectal cancer patients in the matching year. A stratified Cox proportional hazards regression model

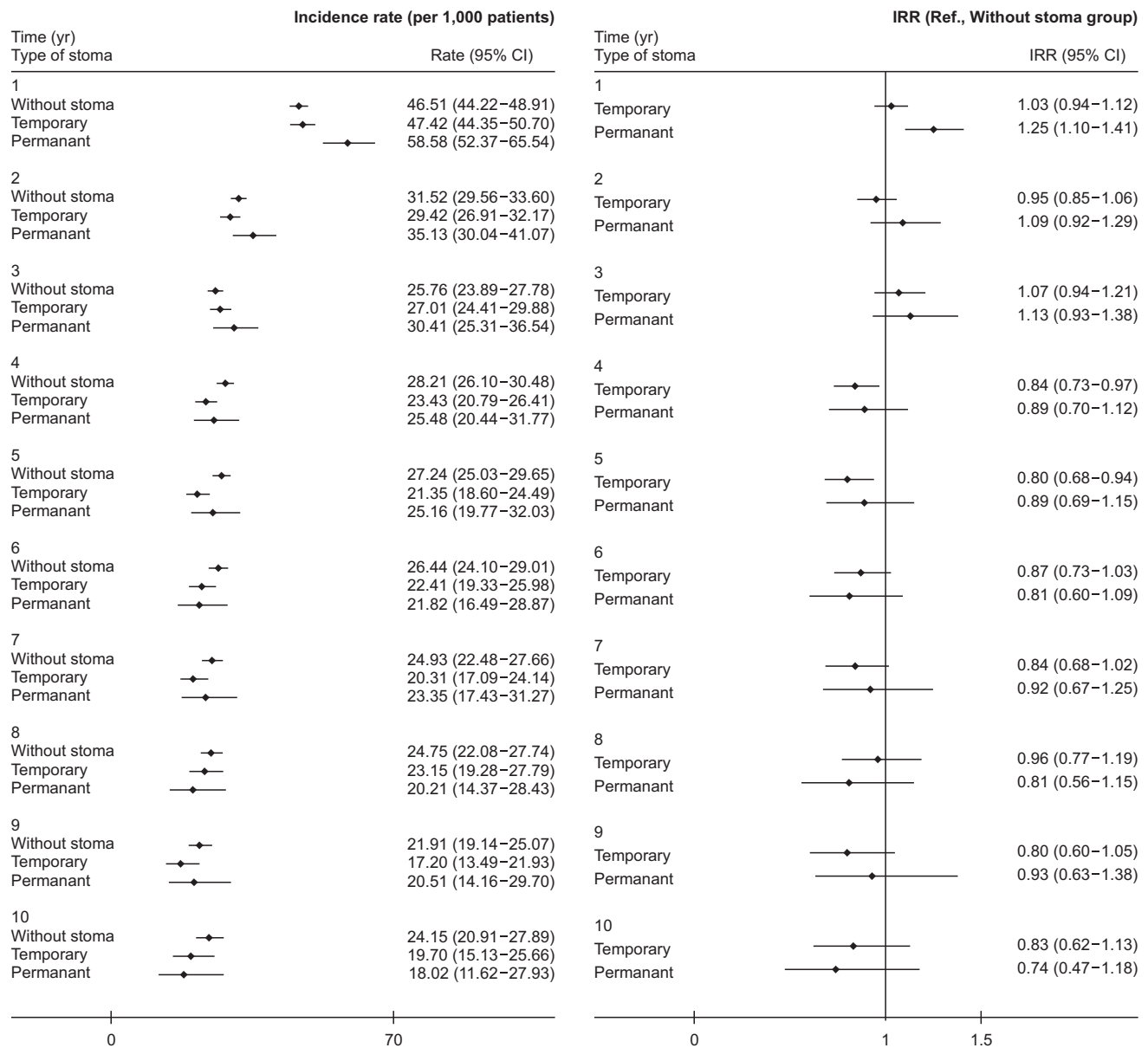


Fig. 1. The annual incidence of depressive disorder in rectal cancer and incidence rate ratio (IRR). Ref, reference; CI, confidence interval.

considering the matched study design was used to calculate the adjusted HR and corresponding 95% CI for the relationship between rectal cancer with/without stoma and subsequent risk of depression. We considered a P-value of <0.05 as significant and all statistical tests were 2-sided. All of these analyses were conducted using STATA statistical software (ver. 15.0, StataCorp).

RESULTS

Baseline characteristics

During the study period, 79,518 patients had surgical treatment for rectal cancer. Among them, 21,014 patients were excluded based on the exclusion criteria including 1,848 patients who were diagnosed with depression within 1 year before surgery (Supplementary Fig. 1). The mean age of these patients was 63.26 years (standard deviation [SD], 11.31). There were 37,230 males (63.64%). Among all patients, 33,778 (57.74%) had never had a stoma, 19,117 (32.68%) had a temporary stoma, and 5,609 (9.59%) had a permanent stoma. At the time of diagnosis, the most common age was those in their 60s (31.02%), followed by those in their 70s (25.87%) and 50s (24.82%).

Table 1 provides a comparison between all stoma patients and patients without a stoma, as well as between patients with temporary and permanent stomas within the stoma patient group. The number of cases of having a stoma was higher in males than in females (standard difference, 0.15). Patients who received radiation therapy were more likely to have stomas than those who did not (standard difference, 0.60). It was also found that stoma was more common in patients who died during the study period (standard difference, 0.15). There was no difference in the previous depression diagnosis 1 year prior to surgery between the patients with stoma and without stoma (standard difference, 0.03). Compared to the temporary stoma group, the permanent stoma group showed higher proportion of females patients, the patients with old age at diagnosis, the patients who underwent 2 or more surgeries to make stoma and the patients who did not receive radiation therapy (Table 1).

Incidence of depressive disorder according to stoma status in rectal cancer patients

Cumulative incidence throughout the study period of depression among rectal cancer patients was 18.98% in patients without stoma, 15.64% in those with a temporary stoma, and 18.42% in those with a permanent stoma. We investigated the incidence of depression over time after surgery during the study period. The incidence of depression per 1,000 person-year at 1, 3, and 5 years was 47.53, 25.76, and 27.24 in the no stoma group, 47.42, 27.01, and 21.35 in the temporary stoma group, and 58.58, 30.41, and 25.16 in the permanent stoma group (Supplementary Table 1). At 1 year after surgery, the number of patients who

were diagnosed with depressive disorder in the permanent stoma group was 58.58 per 1,000, which was significantly larger than that in the no stoma group or the temporary stoma group (IRR, 1.25; 95% CI, 1.10–1.41). However, it was not significantly different between 2 years and 15 years after surgery (Figs. 1, 2; Supplementary Table 1).

Risk factors of depressive disorder in rectal cancer patients

In all rectal cancer patients, more females than males were diagnosed with depression (HR, 1.19; 95% CI, 1.14–1.23). The incidence of depression showed no difference according to age. However, it was higher in males in their 70s and 80s than that in males in their 20s (HR, 2.76 for 70s and 2.99 for 80s) (Supplementary Table 2). The incidence of depression increased after rectal cancer surgery if there was a history of depression more than 1 year before surgery (HR, 2.34; 95% CI, 2.22–2.47). It increased when stoma-making surgeries were performed 2 times or more (HR, 1.21; 95% CI, 1.01–1.45 for 2 times and HR, 1.74; 95% CI, 1.29–2.36 for more than 3 times). The lower the socioeconomic level, the higher the incidence of depression. In addition, the incidence of depression was higher in patients with cerebrovascular disease, diabetes mellitus without chronic complication, and chronic pulmonary disease (Table 2).

To correct bias that can happen due to different cancer staging, subgroup analysis was performed by dividing the presence or absence of radiation treatment perioperatively and according to survival of more than 5 years. There were no significant differences in overall results (Supplementary Tables 3, 4). Although the wash-out period for depression was set to be 1 year, depression before 1 year might influence depression after surgery. Therefore, another analysis was conducted by dividing subjects by the presence or absence of depression more

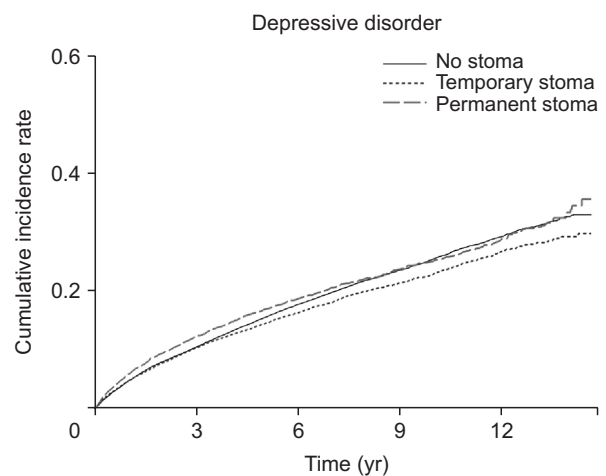


Fig. 2. Cumulative incidence of the depressive disorder according to stoma status.

Table 2. Risk of depressive disorder in patients with rectal cancer

Variable	HR (95% CI)	P>z
Female sex	1.19 (1.14–1.23)	0.00
Age (yr) (Ref., 20–29)		
30–39	0.78 (0.48–1.27)	0.32
40–49	0.85 (0.53–1.36)	0.50
50–59	1.01 (0.63–1.60)	0.97
60–69	1.20 (0.76–1.91)	0.44
70–79	1.54 (0.97–2.44)	0.07
≥80	1.51 (0.94–2.41)	0.09
Stoma type (Ref., no stoma)		
Temporary stoma	1.00 (0.87–1.15)	0.97
Permanent stoma	1.10 (0.94–1.29)	0.24
Previous diagnosis of depression (Ref., none)		
1 yr prior to the surgery	2.34 (2.22–2.47)	0.00
Radiotherapy (Ref., none)		
Preoperative	0.96 (0.89–1.02)	0.19
Postoperative	1.09 (1.00–1.19)	0.05
Number of stoma-making surgery (Ref., none)		
Once	0.94 (0.81–1.08)	0.37
Twice	1.21 (1.01–1.45)	0.04
More than 3	1.74 (1.29–2.36)	0.00
Socioeconomic status (quartile) (Ref., 16–20)		
Medicaid	1.52 (1.39–1.66)	0.00
1–5	1.07 (1.01–1.14)	0.02
6–10	1.05 (0.99–1.11)	0.10
11–15	1.04 (0.98–1.09)	0.20
Missing	0.98 (0.84–1.13)	0.75
Myocardial infarction	0.99 (0.67–1.46)	0.97
Congestive heart failure	1.36 (1.00–1.86)	0.05
Peripheral vascular disease	0.94 (0.63–1.41)	0.77
Cerebrovascular disease	1.52 (1.29–1.79)	0.00
Dementia	0.74 (0.45–1.23)	0.25
Chronic pulmonary disease	1.18 (1.01–1.39)	0.04
Rheumatic disease	1.28 (0.64–2.56)	0.49
Peptic ulcer disease	1.14 (0.98–1.34)	0.10
Mild liver disease	1.19 (0.96–1.48)	0.11
Diabetes without chronic complication	1.14 (1.02–1.27)	0.02
Diabetes with chronic complication	1.26 (0.99–1.59)	0.06
Hemiplegia or paraplegia	1.10 (0.71–1.72)	0.67
Renal disease	0.84 (0.54–1.30)	0.43
Moderate or severe liver disease	0.25 (0.04–1.80)	0.17
Metastatic solid tumor	1.08 (0.96–1.21)	0.20

HR, hazard ratio; CI, confidence interval; Ref, reference.

than 1 year before surgery. Similarly, there were no significant differences in overall results (Supplementary Table 5).

Risk factors of depressive disorder according to stoma status in rectal cancer patients

There was no difference in the incidence of depression according to the presence or absence of a stoma or whether it is temporary or permanent (Table 2). This trend showed similar results according to sex. However, when analyzed by age, it was

confirmed that depression was significantly increased in those under 50 years when they had a permanent stoma (HR, 1.85; 95% CI, 1.17–2.92) (Fig. 3, Supplementary Table 2).

DISCUSSION

This is the first study that provides long-term cumulative incidence of depressive disorder in rectal cancer according to stoma status using nationwide population-based data. It has

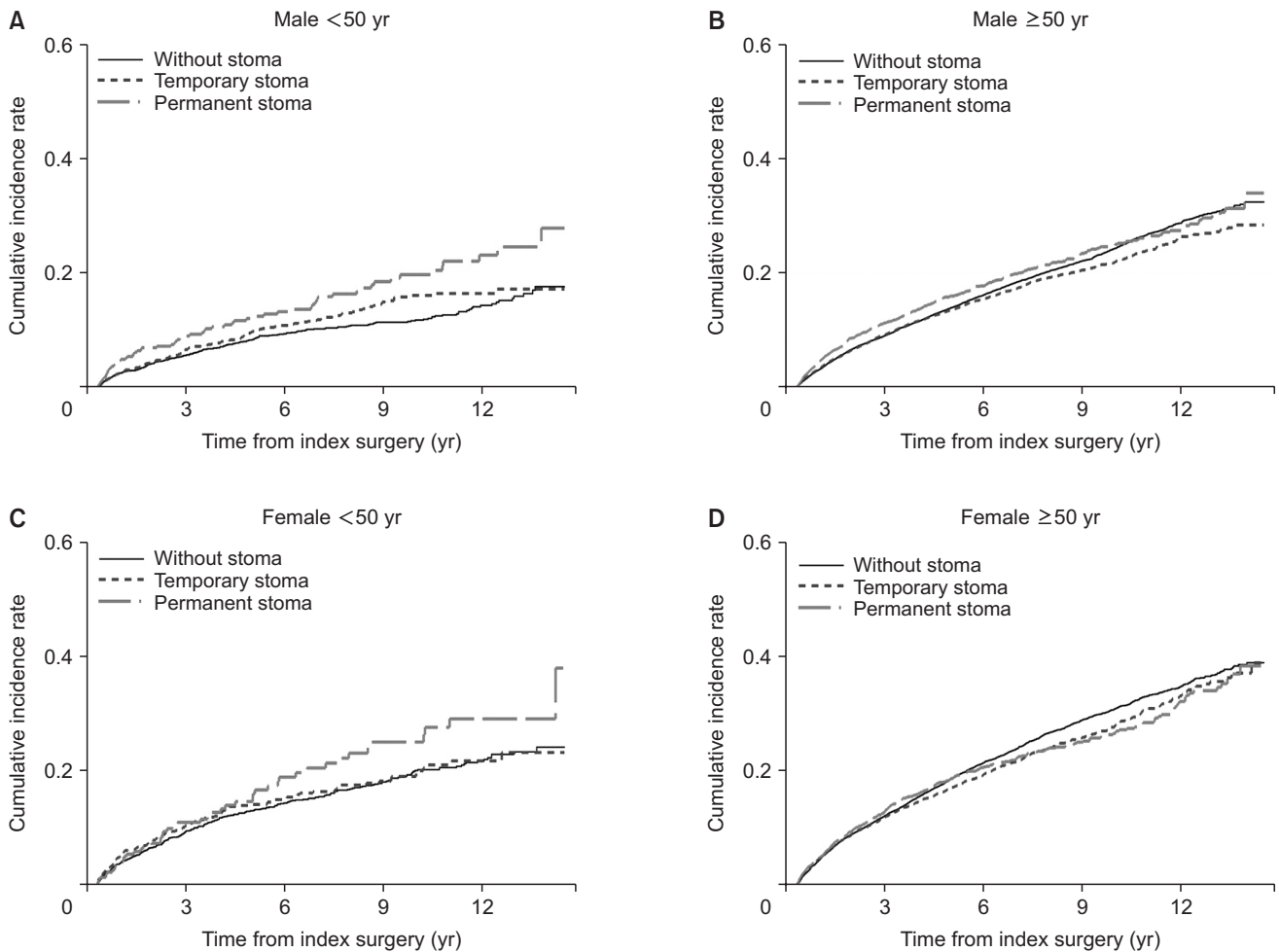


Fig. 3. Cumulative incidence of depressive disorder according to age and sex. (A) Male patients aged <50 years. (B) Male patients aged ≥50 years. (C) Female patients aged <50 years. (D) Female patients aged ≥50 years.

some important strengths. The first one is the reliability of the data that this study roots on. National Health Insurance covers almost 98% of the total population (approximately 50 million as of 2014) in Korea [16]. In Korea's national medical insurance system, when cancer is diagnosed, the deductible is only 5% of copayments. Therefore, data are highly reliable because of the strict review of cancer diagnosis and codes of cancer surgery and related prescriptions. Secondly, although there were studies comparing QOL at a certain point in time previously, this is the first study on long-term annual incidence of depression in rectal cancer patients.

In the United States, the prevalence of major depressive disorder in 2005 was 6.8%. It rose to 7.1% in 2018 [17]. The prevalence of depression in Korea in 2013 was 5.5%, which was similar to that in other high-income countries [18,19]. In a review of global prevalence of depression, the annual incidence of depressive disorder was found to be 2.4% [20]. When looking at results of our study, in the case of permanent stoma, it was found that the incidence of depressive disorder was about

twice that of the global data as it was 5.9% in the first year after surgery. However, it was confirmed that the annual incidence of depressive disorder decreased to the average global incidence from the 4th year (Supplementary Table 1). Risk factors for depression include females, the elderly, and high or low socioeconomic status [19]. Similarly, in our study, depression was more common in females and older adults. However, the incidence of depression was higher in the low group in terms of socioeconomic level. This might be due to a relatively high probability of having a permanent stoma if the socioeconomic level is low (Table 1).

Various factors can affect postoperative depression in rectal cancer patients. In general, there are psychological and social factors in the pathogenesis of various depression disorders in cancer patients. Inflammation, chronic stress, cancer progression, and chemotherapy can also affect depression [5]. Factors affecting QOL related to rectal cancer also include LARS and the presence of stoma. Stoma is generally made in 2 cases: (1) when the anal function is lost, such as abdominoperineal

excision or severe fecal incontinence; and (2) when there is diversion. If there is a high possibility of leakage after anastomosis after bowel resection, the end of the proximal intestine is taken out after anastomosis to improve the clinical course even if leakage occurs. Particularly after rectal cancer surgery, diverting stoma can be made because the anastomotic leakage rate is higher in rectal surgery than in the colon. Risk factors such as preoperative radiation, males, narrow pelvis, and low tumor location are associated with high leakage rate. Although diverting stoma does not reduce the leakage rate itself, stoma is made because it makes the clinical course better after leakage. Recently, concurrent chemoradiotherapy (CCRT) has increased since preoperative CCRT can decrease local recurrence rate in some rectal cancers, so diversion has increased accordingly.

Thorpe et al. [21] have studied physical and psychological adaptation processes after stoma surgery by interviewing patients at 3, 9, and 15 months after stoma surgery. They found that having a stoma can cause a collapse of the unconscious relationship between the self and the body that existed before the operation. They also found that having a stoma caused patients to develop negative emotions and distance themselves from their physical changes in order to regain a 'normal' self. However, they said that these changes showed an adaptation at the time of about 1 year after the operation. Another study has reported that there is no difference in scores among patients who are able to be assessed with the adjustment scoring at 4 months, 1 year, and 4 years after stoma surgery. It also reported that there was no difference in scoring regardless of whether the cause of the stoma was a benign disease or a malignant disease [22]. Researchers have also reported that a depressive mood can persist even for 5 years after surgery. Survivors after a rectal cancer surgery have an overall normal QOL, although their depression tends to increase more than that in the general population and appears to persist 5 years after surgery. This is thought to be the fear of recurrence after surgery and the stress of continuing diagnostic tests [23]. However, in this study, there was no difference in the diagnosis of depression depending on the presence or duration of a stoma.

Complications such as LARS might be associated with increased mood disorders in rectal cancer patients [24]. In a longitudinal cohort study of Scandinavian patients, about 63% and 56% of patients who recovered bowel continuity after rectal cancer surgery developed major LARS at 1 year and 2 years after surgery, respectively [25]. In a study comparing the QOL between APR patients and sphincter-saving surgery patients 1 year after rectal cancer surgery, there was no difference in overall QOL. However, a characteristic QOL decrease in APR patients was observed, although data after 1 year were not presented [26]. Walming et al. [13] have reported that in patients with resectable rectal cancer, the QOL immediately

after surgery was lowered, but recovered to the level of the general population after 1 and 2 years, in line with results of our study. Although follow-up was carried out only for 2 years after surgery in this study, and no analysis was made according to the presence or absence of stoma, they reported that poor bowel or stoma function is a risk factor for QOL deterioration. In our study, after the first year of adaptation period, the incidence of depression decreased regardless of the presence or type of stoma. It can be inferred that the depression is greater in the case of permanent stoma during the first year.

Our study found that the presence of a stoma did not have an impact on the overall incidence of depression. From 2 years after surgery, the same annual incidence of depression was observed regardless of the presence or absence of a stoma. However, within the first year following surgery, the permanent stoma group had a higher incidence of depression diagnosis compared to other groups. In the case of a permanent stoma, an increase in overall depression was observed in young females under 50 years of age. Therefore, it is necessary to educate about stoma before surgery and take active measures necessary for adaptation after surgery in cases predicted to have a permanent stoma or in young females. Patient education on stoma before and after rectal cancer surgery is an essential element of patient management for functional and psychological recovery of stoma patients. And we can also adopt preoperative psychological education, cognitive-behavioral therapy, and psychological support for stoma patients [7,27].

Studies targeting long-term survivors of colorectal cancer have reported that long-term factors affecting QOL even after full recovery from colorectal cancer are the presence of stoma, changes in bowel function, and cancer-related distress [23]. In a comparative analysis with the general population in this study, the annual incidence of depression was similar in the temporary stoma group and no stoma group from 5 years after surgery. In the permanent stoma group, all of them had a significantly higher depression diagnosis rate compared to the general population within three to 5 years after surgery. However, after 5 years, depression incidence in rectal cancer patients was similar to the general population regardless of the stoma status. This is probably because they became more and more free from cancer recurrences. Although there may be memories of cancer experiences, complications due to surgery, or changes in bowel function, it is interesting that after three to 5 years, regardless of the type of stoma, all of them became to have similar incidence rate of depression to the general population. Another interesting point is that the permanent stoma group had depression more often than the general population in the first year after surgery. However, they recovered to the general population level of depression incidence more quickly (3 years after surgery) than the temporary or no stoma group (Supplementary Fig. 2). These can be explained by reframing/

response shift. It is assumed that cancer survivors can establish new meanings of the QOL concept or change the composition of the QOL dimension [28,29].

After rectal cancer surgery, LARS might occur due to nerve injury and other factors. However, the effect of LARS on QOL reduction was unknown in this study. Many patients who had stoma after rectal cancer surgery might have had LARS after stoma was taken down. LARS is associated with low QOL. Some patients even rebuild stoma due to LARS. Therefore, the difference in depression occurrence in the permanent stoma group might have been offset to some extent because patients in the no stoma group and the temporary stoma group were affected by LARS. Interestingly, there was no difference in the incidence of depression according to the presence or absence of a permanent stoma. Difficulty due to bowel problems after rectal cancer surgery might have a counteracting effect or is related to reframing/response shift.

This study has some limitations. First, there was no correction for cancer staging. Patients with higher stages are more likely to have CCRT and stoma. In addition, the survival in such patients is likely to be lower. The higher the stage in the stoma group, the higher the recurrence and the more mood disorders. However, to correct for the effect of stage, we performed additional analysis according to the presence or absence of radiation treatment and survival of more than 5 years. Similarly, there was no difference in the incidence of depression. However, we still could not conduct an analysis including control for whether or not chemotherapy was given, and we could not control some situations such as Hartmann surgery in an emergency setting. Secondly, it was not possible to analyze many factors that could be related to the onset of depression, such as various events that could cause stress and emotional support from acquaintances. Thirdly, we did not control for other psychiatric conditions that could affect the diagnosis of depression. Lastly, similar to other psychiatric disorders, these cohort studies based on large samples may underestimate the true prevalence in the general population.

Despite these limitations, it is believed that this study using a large-scale database for the entire population of Korea provides

important information about the diagnostic pattern and risk of depression in rectal cancer patients.

In patients with rectal cancer, stoma was not related to the diagnosis of depression. However, the presence of postoperative permanent stoma seems to increase the incidence of depressive disorders in the first year after surgery. Also, permanent stoma increased the diagnosis of depression in young patients under 50 years of age. Additionally, depression was also found to be associated with recurrent stoma-making surgery. Thus, it is important to provide education before surgery and conduct intensive assessment of depressive disorders within 1 year after surgery.

SUPPLEMENTARY MATERIALS

Supplementary Tables 1–5 and Supplementary Figs. 1, 2 can be found via <https://doi.org/10.4174/astr.2023.104.6.303>.

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Conflict of Interest

No potential conflict of interest relevant to this article was reported.

ORCID iD

Hyun Jung Kim: <https://orcid.org/0000-0003-2018-2385>

Hyeong Sik Ahn: <https://orcid.org/0000-0002-2084-7466>

Woong Bae Ji: <https://orcid.org/0000-0001-7539-046X>

Author Contribution

Conceptualization, Investigation: WBJ

Formal Analysis, Methodology: HJK

Project Administration: HSA

Writing – Original Draft: WBJ

Writing – Review & Editing: HJK, HSA

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