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EDITORIAL

- 2867 Oncolytic virotherapy for hepatocellular carcinoma: A potent immunotherapeutic landscape
Xiao R, Jin H, Huang F, Huang B, Wang H, Wang YG
- 2877 Can the preoperative prognostic nutritional index be used as a postoperative predictor of gastric or gastroesophageal junction adenocarcinoma?
Feng YW, Wang HY, Lin Q
- 2881 Esophageal cancer: A global challenge requiring tailored strategies
Cheng CY, Hao WR, Cheng TH
- 2884 Effectiveness of transarterial chemoembolization in combination with lenvatinib and programmed cell death protein-1 inhibition for unresectable hepatocellular carcinoma
Chisthi MM
- 2888 Maximizing therapeutic outcomes in hepatocellular carcinoma: Insights into combinatorial strategies
Ilhan Y, Ergun Y
- 2894 Human β -defensin-1 activates autophagy in human colon cancer cells *via* regulation of long non-coding RNA TCONS_00014506
Eid N, Davamani F

REVIEW

- 2902 Role of molecular biology in the management of pancreatic cancer
Boileve A, Smolenschi C, Lambert A, Boige V, Tarabay A, Valery M, Fuerea A, Pudlarz T, Conroy T, Hollebecque A, Ducreux M

MINIREVIEWS

- 2915 Advances in immunotherapy of M2 macrophages and gastrointestinal stromal tumor
Wang XK, Yang X, Yao TH, Tao PX, Jia GJ, Sun DX, Yi L, Gu YH

ORIGINAL ARTICLE**Case Control Study**

- 2925 Disparities in the diagnosis and treatment of colorectal cancer among patients with disabilities
Kim KB, Shin DW, Yeob KE, Kim SY, Han JH, Park SM, Park JH, Park JH

Retrospective Study

- 2941 Effectiveness and safety of sequential transarterial chemoembolization and microwave ablation for subphrenic hepatocellular carcinoma: A comprehensive evaluation
Zhu ZY, Qian Z, Qin ZQ, Xie B, Wei JZ, Yang PP, Yuan M

2952 Combined use of dexmedetomidine and nalbuphine in laparoscopic radical gastrectomy for gastric cancer
Zhao GG, Lou C, Gao RL, Lei FX, Zhao J

2960 Development and validation of a nomogram for predicting lymph node metastasis in early gastric cancer
He JY, Cao MX, Li EZ, Hu C, Zhang YQ, Zhang RL, Cheng XD, Xu ZY

Observational Study

2971 Comprehensive serum proteomics profiles and potential protein biomarkers for the early detection of advanced adenoma and colorectal cancer
Tan C, Qin G, Wang QQ, Li KM, Zhou YC, Yao SK

Clinical and Translational Research

2988 Network pharmacology- and molecular docking-based exploration of the molecular mechanism underlying Jianpi Yiwei Recipe treatment of gastric cancer
Chen P, Wu HY

2999 Survival disparities among racial groups with hepatic malignant tumors
Han D, Zhang ZY, Deng JY, Du HB

3011 Adipocytes impact on gastric cancer progression: Prognostic insights and molecular features
Shang JR, Zhu J, Bai L, Kulabiek D, Zhai XX, Zheng X, Qian J

3032 Integrated single-cell and bulk RNA sequencing revealed an epigenetic signature predicts prognosis and tumor microenvironment colorectal cancer heterogeneity
Liu HX, Feng J, Jiang JJ, Shen WJ, Zheng Y, Liu G, Gao XY

3055 Causal effects of genetic birth weight and gestational age on adult esophageal diseases: Mendelian randomization study
Ruan LC, Zhang Y, Su L, Zhu LX, Wang SL, Guo Q, Wan BG, Qiu SY, Hu S, Wei YP, Zheng QL

3069 Prognostic significance of exportin-5 in hepatocellular carcinoma
Li H, Li F, Wang BS, Zhu BL

3082 BCAR3 and BCAR3-related competing endogenous RNA expression in hepatocellular carcinoma and their prognostic value
Shi HQ, Huang S, Ma XY, Tan ZJ, Luo R, Luo B, Zhang W, Shi L, Zhong XL, Lü MH, Chen X, Tang XW

3097 Glycolysis-related five-gene signature correlates with prognosis and immune infiltration in gastric cancer
Meng XY, Yang D, Zhang B, Zhang T, Zheng ZC, Zhao Y

Basic Study

3118 Kombo knife combined with sorafenib in liver cancer treatment: Efficacy and safety under immune function influence
Cao Y, Li PP, Qiao BL, Li QW

3158 Yiqi Jiedu Huayu decoction inhibits precancerous lesions of chronic atrophic gastritis by inhibiting NLRP3 inflammasome-mediated pyroptosis
Zhou P, Zheng ZH, Wan T, Liao CW, Wu J

- 3169** Multi-Omics analysis elucidates tumor microenvironment and intratumor microbes of angiogenesis subtypes in colon cancer
Yang Y, Qiu YT, Li WK, Cui ZL, Teng S, Wang YD, Wu J
- 3193** Baitouweng decoction suppresses growth of esophageal carcinoma cells through miR-495-3p/BUB1/STAT3 axis
Yang H, Chen XW, Song XJ, Du HY, Si FC
- 3211** Weiwei Decoction alleviates gastric intestinal metaplasia through the olfactomedin 4/nucleotide-binding oligomerization domain 1/caudal-type homeobox gene 2 signaling pathway
Zhou DS, Zhang WJ, Song SY, Hong XX, Yang WQ, Li JJ, Xu JQ, Kang JY, Cai TT, Xu YF, Guo SJ, Pan HF, Li HW
- 3230** Aldehyde dehydrogenase 2 family member repression promotes colorectal cancer progression by JNK/p38 MAPK pathways-mediated apoptosis and DNA damage
Yu M, Chen Q, Lu YP
- 3241** RBM5 suppresses proliferation, metastasis and glycolysis of colorectal cancer cells *via* stabilizing phosphatase and tensin homolog mRNA
Wang CX, Liu F, Wang Y
- 3256** Immune effect and prognosis of transcatheter arterial chemoembolization and tyrosine kinase inhibitors therapy in patients with hepatocellular carcinoma
Guo Y, Li RC, Xia WL, Yang X, Zhu WB, Li FT, Hu HT, Li HL
- 3270** N6-methyladenosine modification of hypoxia-inducible factor-1 α regulates *Helicobacter pylori*-associated gastric cancer *via* the PI3K/ AKT pathway
An TY, Hu QM, Ni P, Hua YQ, Wang D, Duan GC, Chen SY, Jia B
- 3284** Canopy FGF signaling regulator 3 affects prognosis, immune infiltration, and PI3K/ AKT pathway in colon adenocarcinoma
Gao XC, Zhou BH, Ji ZX, Li Q, Liu HN

META-ANALYSIS

- 3299** Clinical and pathological features of advanced rectal cancer with submesenteric root lymph node metastasis: Meta-analysis
Wang Q, Zhu FX, Shi M
- 3308** Clinical benefits of transarterial chemoembolization combined with tyrosine kinase and immune checkpoint inhibitors for unresectable hepatocellular carcinoma
Han F, Wang XH, Xu CZ

SCIENTOMETRICS

- 3321** Research trends and hotspots in the immune microenvironment related to hepatocellular carcinoma: A bibliometric and visualization study
Zhang DY, Bai FH

CASE REPORT

- 3331** Gastric cancer metastatic to the breast: A case report
Liu JH, Dhamija G, Jiang Y, He D, Zhou XC
- 3341** Rare infiltrative primary hepatic angiosarcoma: A case report and review of literature
Lin XJ, Luo HC
- 3350** Metachronous multifocal carcinoma: A case report
Wan DD, Li XJ, Wang XR, Liu TX
- 3357** BRAF K601E-mutated metastatic colorectal cancer in response to combination therapy with encorafenib, binimetinib, and cetuximab: A case report
Sasaki M, Shimura T, Nishie H, Kuroyanagi K, Kanno T, Fukusada S, Sugimura N, Mizuno Y, Nukui T, Uno K, Kojima Y, Nishigaki R, Tanaka M, Ozeki K, Kubota E, Kataoka H

LETTER TO THE EDITOR

- 3364** Challenges in early detection and endoscopic resection of esophageal cancer: There is a long way to go
Liu S, Chen LX, Ye LS, Hu B

ABOUT COVER

Editorial Board Member of *World Journal of Gastrointestinal Oncology*, Meysam Ebrahimifar, MSc, PhD, Research Assistant Professor, Department of Toxicology, Islamic Azad University, Isfahan 1477893855, Iran.
 ebrahimifar67@gmail.com

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The primary aim of *World Journal of Gastrointestinal Oncology* (*WJGO*, *World J Gastrointest Oncol*) is to provide scholars and readers from various fields of gastrointestinal oncology with a platform to publish high-quality basic and clinical research articles and communicate their research findings online.

WJGO mainly publishes articles reporting research results and findings obtained in the field of gastrointestinal oncology and covering a wide range of topics including liver cell adenoma, gastric neoplasms, appendiceal neoplasms, biliary tract neoplasms, hepatocellular carcinoma, pancreatic carcinoma, cecal neoplasms, colonic neoplasms, colorectal neoplasms, duodenal neoplasms, esophageal neoplasms, gallbladder neoplasms, *etc.*

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Case Control Study

Disparities in the diagnosis and treatment of colorectal cancer among patients with disabilities

Ki Bae Kim, Dong Wook Shin, Kyoung Eun Yeob, So Young Kim, Joung-Ho Han, Seon Mee Park, Jong Heon Park, Jong Hyock Park

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Ki Bae Kim, Joung-Ho Han, Seon Mee Park, Department of Internal Medicine, Chungbuk National University Hospital, Chungbuk National University, Cheongju 28644, South Korea

Dong Wook Shin, Supportive Care Center/Department of Family Medicine, Samsung Medical Center, Sungkyunkwan University School of Medicine, Seoul 06351, South Korea

Dong Wook Shin, Department of Digital Health, SAIHST, Sungkyunkwan University, Seoul 06355, South Korea

Kyoung Eun Yeob, So Young Kim, Jong Hyock Park, Institute of Health & Science Convergence, Chungbuk National University, Cheongju 28644, South Korea

So Young Kim, Jong Hyock Park, Department of Public Health and Preventive Medicine, Chungbuk National University Hospital, Cheongju 28644, South Korea

Jong Heon Park, Big Data Steering Department, National Health Insurance Service, Wonju 26464, South Korea

Jong Hyock Park, College of Medicine/Graduate School of Health Science Business Convergence, Chungbuk National University, Cheongju 28644, South Korea

Jong Hyock Park, Department of Preventive Medicine, College of Medicine, Chungbuk National University, Cheongju 28644, South Korea

Co-first authors: Ki Bae Kim and Dong Wook Shin.

Corresponding author: Jong Hyock Park, PhD, Professor, College of Medicine/Graduate School of Health Science Business Convergence, Chungbuk National University, 1 Chungdae-ro, Seowon-gu, Cheongju 28644, South Korea. jonghyock@gmail.com

Abstract

BACKGROUND

Little is known about disparities in diagnosis and treatment among colorectal cancer (CRC) patients with and without disabilities.

AIM

To investigate the patterns of diagnosis, treatment, and survival for people with and without disabilities who had CRC.

METHODS

We performed a retrospective analysis using the Korean National Health Insurance Service database, disability registration data, and Korean Central Cancer Registry data. The analysis included 21449 patients with disabilities who were diagnosed with CRC and 86492 control patients diagnosed with CRC.

RESULTS

The overall distribution of CRC stage was not affected by disability status. Subjects with disabilities were less likely than those without disabilities to undergo surgery [adjusted odds ratio (aOR): 0.85; 95% confidence interval (95% CI): 0.82-0.88], chemotherapy (aOR: 0.84; 95% CI: 0.81-0.87), or radiotherapy (aOR: 0.90; 95% CI: 0.84-0.95). The rate of no treatment was higher in patients with disabilities than in those without disabilities (aOR: 1.48; 95% CI: 1.41-1.55). The overall mortality rate was higher in patients with disabilities [adjusted hazard ratio (aHR): 1.24; 95% CI: 1.22-1.28], particularly severe disabilities (aHR: 1.57; 95% CI: 1.51-1.63), than in those without disabilities.

CONCLUSION

Patients with severe disabilities tended to have a late or unknown diagnosis. Patients with CRC and disabilities had lower rates of treatment with almost all modalities compared with those without disabilities. During the follow-up period, the mortality rate was higher in patients with disabilities than in those without disabilities. The diagnosis and treatment of CRC need improvement in patients with disabilities.

Key Words: Colorectal cancer; Disability; Stage; Treatment; Survival

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Core Tip: Little is known about disparities in diagnosis, treatment, and survival among colorectal-cancer patients with and without disabilities. The overall distribution of colorectal cancer (CRC) stage was not affected by disability status. But disability affected the timing of diagnosis, treatment, and mortality, and this trend was more severe in cases of severe disability. Further research is needed to develop guidelines to ensure equal diagnosis and treatment of CRC in disabled and non-disabled patients.

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INTRODUCTION

Colorectal cancer (CRC) is the second leading cause of cancer death worldwide and the third leading cause of cancer death in South Korea[1-5]. Timely identification and proper treatment are essential to reduce the morbidity and mortality rate of CRC[6,7].

Socially marginalized groups, like those with low income or from ethnic minorities, frequently experience delayed cancer diagnoses, receive less comprehensive or unsuitable treatment, and have shorter survival times compared to those with better social circumstances[1-5,8]. There are no clear or consistent guidelines for diagnosis and treatment, catering to patients with various disability states or cancer types[9-11].

Few studies have investigated the disparities in the diagnosis and treatment of CRC according to disability status, mainly because of a lack of information on disabilities in existing databases[11-15]. Studies conducted in the United States that used the Surveillance, Epidemiology, and End Results (SEER)-Medicare/Social Security Disability Insurance (SSDI) database examined differences in cancer stage at diagnosis and survival in patients < 65 years of age[11] and investigated disparities in treatment and survival among patients with stage I CRC[9]. Even when diagnosed at the same stage, patients with disabilities had a greater likelihood of cancer-related death compared to patients without disabilities, which was attributable to treatment differences[11].

Although the largest of its kind to date, the studies mentioned above had certain limitations: (1) The use of Medicare/SSDI status as a measure of disability may not accurately capture all individuals with disabilities (*e.g.*, individuals with disabilities who work are not eligible for medicare/SSDI); (2) they investigated only patients < 65 years of age, which restricts the sample's representativeness; (3) healthcare access differed according to disability status (a considerable portion of patients without disabilities are under- or uninsured); (4) analyses of treatment were limited to stage I cancer, and chemotherapy information was not available; (5) only five disabilities were analyzed (*i.e.*, visual and hearing disabilities were not included); and (6) information on disability severity was not available.

The population of South Korea is covered by universal health insurance, and the copay for cancer work-up and treatment is only 5%, with a maximum copay for low-income individuals of approximately 1000 USD as of 2016[16]. In addition, South Korea has a national disability registration system, which defines disability type and severity according

to preset criteria and medical diagnosis[17]. These are optimal conditions for examining disparities in CRC care related to disabilities. Using an administrative database, we investigated disparities in the diagnosis, treatment, and survival of patients with CRC according to disability in South Korea.

MATERIALS AND METHODS

Study setting and data source

The Korean National Health Insurance Service: The Korean National Health Insurance Service (NHIS) provides public health insurance for 97% of South Koreans, and insurance premiums are based on income level. Almost 3% of the population with the lowest income is covered by Medicaid, which is funded by general taxation. Healthcare providers primarily receive reimbursement for their medical services through a fee-for-service model. Consequently, the NHIS contains all the requisite data for reimbursement, including disease codes, diagnostic tests and treatments, and prescription medications from inpatient and outpatient services. It also encompasses demographic data (*e.g.*, age, sex, place of residence, and income status) for all South Koreans. The NHIS database is available for research upon approval, and its data have been used in a number of epidemiological and health policy studies[18-20]. Details of the database are available elsewhere[21,22]. The NHIS provides a free biennial cardiovascular health screening, which consists of a questionnaire on past medical history and health behaviors, anthropometric measurements, and laboratory tests, to individuals > 40 years of age and all employees irrespective of age[18].

The South Korean Disability Registration System: In 1988, the South Korean government established a national registration system for people with disabilities to determine the level of welfare benefits, based on the type and severity of disability. The legislation specifies 15 types of disability: Limb, brain, visual, auditory, linguistic, facial, kidney, heart, liver, respiratory system, ostomy, epilepsy, intellectual, autistic, and mental disabilities. The severity of a disability is legally classified into six levels and is assessed based on functional loss and clinical impairment by a medical specialist [23]. In this study, disabilities were classified as: (1) Physical impairment (limb disability and facial disfigurement); (2) communication impairment (visual, auditory, or linguistic disability); (3) brain impairment; (4) mental impairment (intellectual, autistic, or mental disability); (5) cardiopulmonary impairment (heart or lung disability); and (6) other internal organ impairment (disability due to renal disease, liver disease, respiratory disease, epilepsy, or ostomy). We dichotomized disability severity into severe (grades 1-3) and mild (grades 4-6)[24].

The South Korean Cancer Registration System: The Korean Central Cancer Registry (KCCR) is a government-sponsored, nationwide cancer registry that contains data on age at diagnosis, sex, date of diagnosis, cancer site, and SEER summary stage (*in situ* and local, regional, distant, and unknown).

Study subjects

First, we linked the Korean NHIS database to national disability registration data and selected three control subjects for each patient with any registered disability, diagnosed between 2009 and 2013, by age and sex matching. Second, cancer registration data from the KCCR were linked for all subjects in the NHIS disability study dataset. The study population included all subjects diagnosed with CRC (International Classification of Disease codes C18-20 and D01) between January 1, 2005 and December 31, 2013 ($n = 21449$ with disabilities and 86492 without disabilities). We excluded patients who were < 19 years of age at the time of diagnosis or index date ($n = 0$ and 3, respectively), had a history of other cancers before the diagnosis of CRC ($n = 1600$ and 4245, respectively), or had missing data ($n = 185$ and 1175, respectively). The final sample consisted of 100733 CRC patients, among whom 19664 had disabilities and 81069 did not (control subjects). Finally, we linked the dataset to mortality data from the Korean National Statistical Office; these data include the date and cause of death. To investigate the survival of CRC patients who underwent surgery with curative intent, the surgery subset comprised subjects with localized or locoregional CRC who underwent surgery. Patients with heart and lung disabilities were excluded because those disabilities may preclude surgery and could significantly affect perioperative mortality if surgery is performed. Finally, 73099 subjects (13532 with disabilities and 59567 without disabilities) comprised the surgery subset (Figure 1). Approval was obtained from the Institutional Review Board of Chungbuk National University (IRB No. CBNU-201708-BM-501-01). The requirement for informed consent was waived because this study was based on a secondary data source: An administrative database.

Statistical analysis

Summary statistics are presented according to disability status (*i.e.*, the presence or absence of disabilities, and according to the six disability categories and disability severity). Cancer stage at diagnosis and treatment received were analyzed by chi-squared test. Chemotherapy and radiation therapy were considered binary variables because of the variety and complexity of the regimens and variable compliance. The relative probability of receiving a treatment (*i.e.*, endoscopic removal, surgery, chemotherapy, and radiotherapy) or no treatment was assessed by logistic regression analyses with adjustments for age, sex, income level, place of residence, Charlson comorbidity index[25], and cancer stage. The correction variables we chose were based on the results of previous studies[18,20,24]. Cox proportional hazards regression analysis was conducted to estimate the hazard ratios for overall and CRC-specific mortality of patients with *vs* those without disabilities. Survival duration was calculated from the date of CRC diagnosis until that of death (including CRC death), censoring (*e.g.*, outmigration), or the last follow-up (December 31, 2015). The multivariate model included age, sex, income level, place of residence, Charlson comorbidity index, cancer stage, and treatment received. The analyses

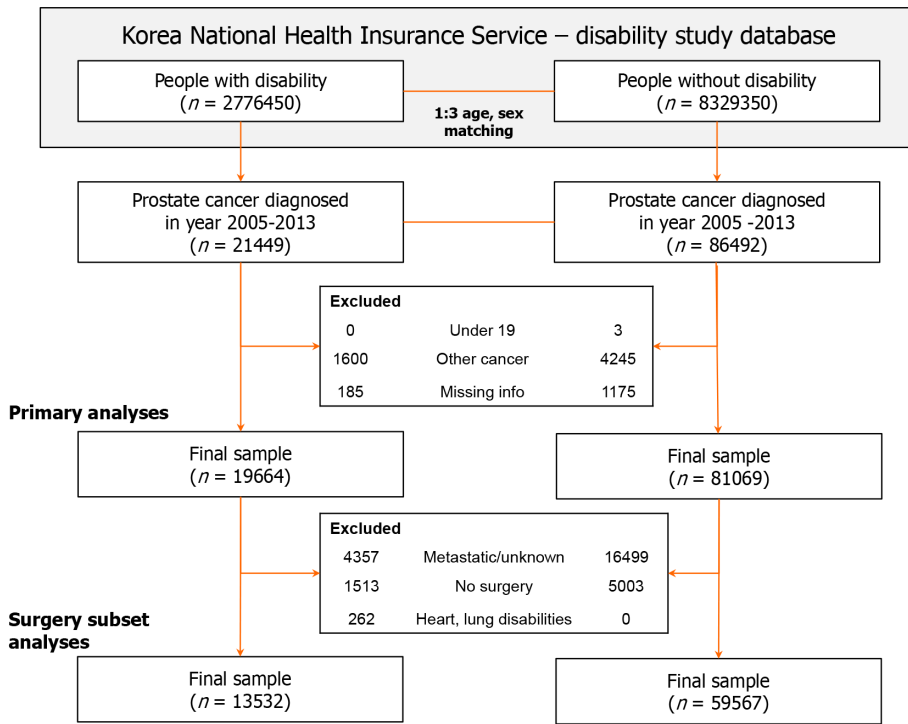


Figure 1 Study subjects.

were repeated using the surgery subset. Analyses were performed using SAS statistical software (v9.4; SAS Institute, Cary, NC, United States). Values of *P* < 0.05 were considered indicative of statistical significance.

RESULTS

Study participants

CRC patients with disabilities were comparable with the control subjects in terms of mean age (68.4 years *vs* 68.6 years) and sex distribution (female: 32.9% *vs* 33.8%). CRC patients with disabilities exhibited a higher prevalence of comorbidities and a greater mean Charlson comorbidity index score (2.4 *vs* 2.1). Additionally, they were more prone to lower income levels and residing in non-metropolitan areas compared to those without disabilities (Table 1).

Stage at diagnosis according to disability status

The stage distribution was similar between patients with and those without disabilities. However, patients with severe disabilities were slightly more likely to be diagnosed at an advanced stage (12.6% *vs* 11.6%) or to have an unknown stage (9.5% *vs* 8.8%), particularly those with mental impairment (12.7%), brain impairment (12.2%), or communication impairment (12.0%) (Table 2).

Treatment received according to disability

The rate of endoscopic resection differed insignificantly between subjects with and those without disabilities [14.5% *vs* 14.2%, respectively; adjusted odds ratio (aOR): 1.02, 95% confidence interval (95%CI): 0.95-1.05]. However, subjects with disabilities were less likely than those without disabilities to undergo surgery (68.1% *vs* 72.5%), chemotherapy (30.0% *vs* 33.9%), or radiotherapy (9.9% *vs* 11.8%) [aOR (95%CI): 0.85 [0.82-0.88] for surgery, 0.84 (0.81-0.87) for chemotherapy, and 0.90 (0.84-0.95) for radiotherapy]. This trend was more evident in subjects with severe disabilities [aOR (95%CI): 0.74 (0.70-0.79) for surgery, 0.70 (0.66-0.75) for chemotherapy, and 0.87 (0.78-0.96) for radiotherapy] compared with those with mild disabilities. The rate of no treatment was higher in subjects with disabilities (13.0% *vs* 9.2%; aOR: 1.48, 95%CI: 1.41-1.55), including those with severe disabilities (17.0%; aOR: 2.02; 95%CI: 1.89-2.17).

Subjects with severe physical impairment were less likely to undergo surgery (aOR: 0.79; 95%CI: 0.72-0.87) or chemotherapy (aOR: 0.81; 95%CI: 0.73-0.89), but not radiotherapy or endoscopic mucosal resection compared with those without disabilities. People with severe communication impairment were less likely to receive chemotherapy compared with those without disabilities (aOR: 0.86; 95%CI: 0.73-0.89). Subjects with severe brain impairment or severe mental impairment were less likely to receive all types of treatment compared with those without disabilities. Subjects with severe cardiopulmonary impairment had a lower likelihood of undergoing surgery (aOR: 0.78; 95%CI: 0.62-0.98) but a higher likelihood of receiving radiotherapy (aOR: 1.47; 95%CI: 1.04-2.08) compared with those without disabilities (Table 3). The treatments according to stage at diagnosis are listed in Supplementary Tables 1 and 2.

Table 1 Characteristics of colorectal cancer patients with and without disabilities, *n* (%)

	People without disabilities	People with disability	By disability grade		By disability type					
			Grades 1-3	Grades 4-6	Physical	Communication	Brain	Mental	Cardiopulmonary	Others
All subject, <i>n</i>	81069	19664	6517	13147	10727	5267	2013	463	386	808
Age, yr										
Mean (SD)	68.6 (10.4)	68.4 (10.5)	67.8 (10.8)	68.8 (10.3)	67.3 (10.2)	71.6 (10.4)	70.4 (9.3)	58.1 (11.5)	69.2 (8.2)	64.5 (10.7)
19-40	700 (0.9)	163 (0.8)	80 (1.2)	83 (0.6)	81 (0.8)	19 (0.4)	7 (0.3)	36 (7.8)	0 (0)	20 (2.5)
40-65	27937 (34.5)	6992 (35.6)	2452 (37.6)	4540 (34.5)	4274 (39.8)	1375 (26.1)	533 (26.5)	303 (65.4)	120 (31.1)	387 (47.9)
65-75	31156 (38.4)	7411 (37.7)	2396 (36.8)	5015 (38.1)	4078 (38.0)	1903 (36.1)	872 (43.3)	101 (21.8)	188 (48.7)	269 (33.3)
75-	21276 (26.2)	5098 (25.9)	1589 (24.4)	3509 (26.7)	2294 (21.4)	1970 (37.4)	601 (29.9)	23 (5.0)	78 (20.2)	132 (16.3)
Female sex	27371 (33.8)	6460 (32.9)	1928 (29.6)	4532 (34.5)	3717 (34.7)	1612 (30.6)	604 (30.0)	180 (38.9)	57 (14.8)	290 (35.9)
Charlson comorbidity Score										
Mean (SD)	2.1 (1.1)	2.4 (1.2)	2.6 (1.2)	2.3 (1.2)	2.3 (1.2)	2.3 (1.2)	2.8 (1.2)	2.1 (1.1)	2.5 (1.2)	3.3 (1.0)
0	31441 (38.8)	5390 (27.4)	1597 (24.5)	3793 (28.9)	3255 (30.3)	1601 (30.4)	228 (11.3)	203 (43.8)	33 (8.5)	70 (8.7)
1	20410 (25.2)	4501 (22.9)	1304 (20.0)	3197 (24.3)	2571 (24.0)	1281 (24.3)	395 (19.6)	114 (24.6)	87 (22.5)	53 (6.6)
2	12609 (15.6)	3288 (16.7)	1099 (16.9)	2189 (16.7)	1785 (16.6)	900 (17.1)	331 (16.4)	64 (13.8)	93 (24.1)	115 (14.2)
3	7370 (9.1)	2378 (12.1)	779 (12.0)	1599 (12.2)	1240 (11.6)	596 (11.3)	317 (15.7)	36 (7.8)	71 (18.4)	118 (14.6)
≥ 4	9239 (11.4)	4107 (20.9)	1738 (26.7)	2369 (18.0)	1876 (17.5)	889 (16.9)	742 (36.9)	46 (9.9)	102 (26.4)	452 (55.9)
Comorbidity										
Hypertension	38225 (47.2)	10902 (55.4)	3798 (58.3)	7104 (54.0)	5550 (51.7)	2832 (53.8)	1580 (78.5)	131 (28.3)	241 (62.4)	568 (70.3)
Diabetes mellitus	19632 (24.2)	6039 (30.7)	2169 (33.3)	3870 (29.4)	3109 (29.0)	1531 (29.1)	776 (38.5)	82 (17.7)	148 (38.3)	393 (48.6)
Coronary heart disease	9014 (11.1)	2737 (13.9)	1046 (16.1)	1691 (12.9)	1343 (12.5)	697 (13.2)	300 (14.9)	25 (5.4)	143 (37.0)	229 (28.3)
Stroke	4240 (5.2)	2377 (12.1)	1130 (17.3)	1247 (9.5)	789 (7.4)	466 (8.8)	998 (49.6)	24 (5.2)	28 (7.3)	72 (8.9)
COPD	19331 (23.8)	5691 (28.9)	1879 (28.8)	3812 (29.0)	3002 (28.0)	1585 (30.1)	522 (25.9)	89 (19.2)	267 (69.2)	226 (28.0)
Income										
Medical aid	3816 (4.7)	2536 (12.9)	1329 (20.4)	1207 (9.2)	1155 (10.8)	636 (12.1)	287 (14.3)	254 (54.9)	59 (15.3)	145 (17.9)
1 st quartile (lowest)	13784 (17.0)	3430 (17.4)	955 (14.7)	2475 (18.8)	2019 (18.8)	929 (17.6)	255 (12.7)	51 (11.0)	51 (13.2)	125 (15.5)
2 nd quartile	13123 (16.2)	3067 (15.6)	946 (14.5)	2121 (16.1)	1759 (16.4)	807 (15.3)	272 (13.5)	46 (9.9)	63 (16.3)	120 (14.9)
3 rd quartile	18562 (22.9)	4177 (21.2)	1288 (19.8)	2889 (22.0)	2352 (21.9)	1081 (20.5)	455 (22.6)	55 (11.9)	90 (23.3)	144 (17.8)
4 th quartile (highest)	31784 (39.2)	6454 (32.8)	1999 (30.7)	4455 (33.9)	3442 (32.1)	1814 (34.4)	744 (37.0)	57 (12.3)	123 (31.9)	274 (33.9)

Place of residence										
Metropolitan	46929 (57.9)	10620 (54.0)	3585 (55.0)	7035 (53.5)	5646 (52.6)	2825 (53.6)	1198 (59.5)	221 (47.7)	210 (54.4)	520 (64.4)
City	22329 (27.5)	6009 (30.6)	1983 (30.4)	4026 (30.6)	3341 (31.1)	1633 (31.0)	549 (27.3)	147 (31.7)	120 (31.1)	219 (27.1)
Rural	11811 (14.6)	3035 (15.4)	949 (14.6)	2086 (15.9)	1740 (16.2)	809 (15.4)	266 (13.2)	95 (20.5)	56 (14.5)	69 (8.5)
Type of cancer										
Colon	44269 (54.6)	10985 (55.9)	3711 (56.9)	7274 (55.3)	5876 (54.8)	2949 (56.0)	1182 (58.7)	278 (60.0)	224 (58)	476 (58.9)
Rectosigmoid	6123 (7.6)	1591 (8.1)	530 (8.1)	1061 (8.1)	860 (8.0)	449 (8.5)	164 (8.1)	46 (9.9)	24 (6.2)	48 (5.9)
Rectum	30677 (37.8)	7088 (36.0)	2276 (34.9)	4812 (36.6)	3991 (37.2)	1869 (35.5)	667 (33.1)	139 (30.0)	138 (35.8)	284 (35.1)
Clinical disease status										
Localized	29934 (36.9)	7322 (37.2)	2283 (35.0)	5039 (38.3)	4201 (39.2)	1829 (34.7)	664 (33.0)	123 (26.6)	150 (38.9)	355 (43.9)
Locoregional	34636 (42.7)	7985 (40.6)	2617 (40.2)	5368 (40.8)	4319 (40.3)	2243 (42.6)	832 (41.3)	193 (41.7)	142 (36.8)	256 (31.7)
Metastatic	9387 (11.6)	2484 (12.6)	889 (13.6)	1595 (12.1)	1279 (11.9)	681 (12.9)	298 (14.8)	88 (19.0)	50 (13.0)	88 (10.9)
Unknown	7112 (8.8)	1873 (9.5)	728 (11.2)	1145 (8.7)	928 (8.7)	514 (9.8)	219 (10.9)	59 (12.7)	44 (11.4)	109 (13.5)
Treatment within 6 months of diagnosis										
Polypectomy, EMR, or ESD	11527 (14.2)	2849 (14.5)	877 (13.5)	1972 (15.0)	1683 (15.7)	677 (12.9)	223 (11.1)	43 (9.3)	63 (16.3)	160 (19.8)
Surgery only	31118 (38.4)	7611 (38.7)	2492 (38.2)	5119 (38.9)	4052 (37.8)	2132 (40.5)	801 (39.8)	162 (35.0)	147 (38.1)	317 (39.2)
Surgery + RT	2959 (3.6)	587 (3.0)	170 (2.6)	417 (3.2)	347 (3.2)	149 (2.8)	50 (2.5)	11 (2.4)	15 (3.9)	15 (1.9)
Surgery + Chemo	19409 (23.9)	4140 (21.1)	1233 (18.9)	2907 (22.1)	2467 (23.0)	1058 (20.1)	329 (16.3)	113 (24.4)	68 (17.6)	105 (13.0)
Surgery + CCRT	5339 (6.6)	1034 (5.3)	310 (4.8)	724 (5.5)	617 (5.8)	284 (5.4)	79 (3.9)	17 (3.7)	20 (5.2)	17 (2.1)
CCRT	691 (0.9)	171 (0.9)	68 (1.0)	103 (0.8)	82 (0.8)	50 (0.9)	15 (0.7)	4 (0.9)	11 (2.8)	9 (1.1)
Chemo only	2023 (2.5)	558 (2.8)	201 (3.1)	357 (2.7)	300 (2.8)	134 (2.5)	65 (3.2)	23 (5.0)	12 (3.1)	24 (3.0)
RT only	557 (0.7)	155 (0.8)	58 (0.9)	97 (0.7)	82 (0.8)	44 (0.8)	11 (0.5)	4 (0.9)	5 (1.3)	9 (1.1)
No treatment	7446 (9.2)	2559 (13.0)	1108 (17.0)	1451 (11.0)	1097 (10.2)	739 (14.0)	440 (21.9)	86 (18.6)	45 (11.7)	152 (18.8)
Screening subset, <i>n</i>	18760	3866	856	3010	2447	1072	216	27	53	51
Smoking										
Current	5935 (31.6)	1161 (30.0)	267 (31.2)	894 (29.7)	754 (30.8)	319 (29.8)	58 (26.9)	9 (33.3)	7 (13.2)	14 (27.5)
Past	5146 (27.4)	1054 (27.3)	223 (26.1)	831 (27.6)	664 (27.1)	290 (27.1)	64 (29.6)	6 (22.2)	21 (39.6)	9 (17.6)
Non	7679 (40.9)	1651 (42.7)	366 (42.8)	1285 (42.7)	1029 (42.1)	463 (43.2)	94 (43.5)	12 (44.4)	25 (47.2)	28 (54.9)
Alcohol intake										

Non-drinker	2082 (11.1)	596 (15.4)	151 (17.6)	445 (14.8)	353 (14.4)	149 (13.9)	47 (21.8)	11 (40.7)	19 (35.8)	17 (33.3)
Social amount	16096 (85.8)	3128 (80.9)	681 (79.6)	2447 (81.3)	2007 (82.0)	873 (81.4)	168 (77.8)	15 (55.6)	33 (62.3)	32 (62.7)
Heavy drinker	582 (3.1)	142 (3.7)	24 (2.8)	118 (3.9)	87 (3.6)	50 (4.7)	1 (0.5)	1 (3.7)	1 (1.9)	2 (3.9)
BMI, kg/m ²										
< 18.5	484 (2.6)	100 (2.6)	39 (4.6)	61 (2)	52 (2.1)	34 (3.2)	6 (2.8)	2 (7.4)	6 (11.3)	0 (0)
18.5-23.0	6105 (32.5)	1260 (32.6)	314 (36.7)	946 (31.4)	760 (31.1)	367 (34.2)	77 (35.6)	11 (40.7)	24 (45.3)	21 (41.2)
23.0-25.0	5227 (27.9)	1009 (26.1)	201 (23.5)	808 (26.8)	650 (26.6)	281 (26.2)	49 (22.7)	8 (29.6)	10 (18.9)	11 (21.6)
25.0-30.0	6438 (34.3)	1347 (34.8)	270 (31.5)	1077 (35.8)	878 (35.9)	358 (33.4)	77 (35.6)	6 (22.2)	12 (22.6)	16 (31.4)
≥ 30.0	506 (2.7)	150 (3.9)	32 (3.7)	118 (3.9)	107 (4.4)	32 (3.0)	7 (3.2)	0 (0)	1 (1.9)	3 (5.9)

SD: Standard deviation; COPD: Chronic obstructive pulmonary disease; RT: Radiotherapy.

Table 2 Distribution of cancer stage by disability, n (%)

	All	By cancer stage				P value
		Localized	Locoregional	Distant	Unknown	
No. of patients	100733	37256 (37.0)	42621 (42.3)	11871 (11.8)	8985 (8.9)	
People without disabilities	81069	29934 (36.9)	34636 (42.7)	9387 (11.6)	7112 (8.8)	< 0.0001
People with disability	19664	7322 (37.2)	7985 (40.6)	2484 (12.6)	1873 (9.5)	
By disability grades						
Severe (Grades 1-3)	6517	2283 (35.0)	2617 (40.2)	889 (13.6)	728 (11.2)	< 0.0001
Mild (Grades 4-6)	13147	5039 (38.3)	5368 (40.8)	1595 (12.1)	1145 (8.7)	< 0.0001
Grade 1	986	309 (31.3)	365 (37.0)	170 (17.2)	142 (14.4)	
Grade 2	2402	872 (36.3)	953 (39.7)	299 (12.4)	278 (11.6)	
Grade 3	3129	1102 (35.2)	1299 (41.5)	420 (13.4)	308 (9.8)	
Grade 4	3531	1276 (36.1)	1447 (41.0)	470 (13.3)	338 (9.6)	
Grade 5	4695	1812 (38.6)	1888 (40.2)	573 (12.2)	422 (9.0)	
Grade 6	4921	1951 (39.6)	2033 (41.3)	552 (11.2)	385 (7.8)	
By disability types						
Physical						
Grades 1-3	2306	853 (37.0)	937 (40.6)	293 (12.7)	223 (9.7)	
Grades 4-6	8421	3348 (39.8)	3382 (40.2)	986 (11.7)	705 (8.4)	
Communication						
Grades 1-3	1423	464 (32.6)	596 (41.9)	192 (13.5)	171 (12.0)	
Grades 4-6	3844	1365 (35.5)	1647 (42.8)	489 (12.7)	343 (8.9)	
Brain						
Grades 1-3	1400	438 (31.3)	572 (40.9)	219 (15.6)	171 (12.2)	
Grades 4-6	613	226 (36.9)	260 (42.4)	79 (12.9)	48 (7.8)	
Mental						
Grades 1-3	463	123 (26.6)	193 (41.7)	88 (19.0)	59 (12.7)	
Grades 4-6	-	-	-	-	-	

Cardiopulmonary					
Grades 1-3	385	149 (38.7)	142 (36.9)	50 (13.0)	44 (11.4)
Grades 4-6	1	1 (100.0)	0 (0.0)	0 (0.0)	
Others					
Grades 1-3	540	256 (47.4)	177 (32.8)	47 (8.7)	60 (11.1)
Grades 4-6	268	99 (36.9)	79 (29.5)	41 (15.3)	49 (18.3)

Survival according to disability status

Over a mean follow-up of 6.3 years, 34.5% of the subjects died. The overall mortality risk was higher in CRC patients with disabilities than in those without disabilities [adjusted hazard ratio (aHR): 1.24; 95%CI: 1.21-1.28]. This difference was even greater among subjects with severe disabilities (aHR: 1.57; 95%CI: 1.51-1.63), but less prevalent in those with mild disabilities (aHR: 1.10; 95%CI: 1.06-1.13). Among subjects with severe disabilities, the mortality risk was markedly higher in those with internal organ (aHR: 2.43; 95%CI: 2.18-2.72), mental (aHR: 2.23; 95%CI: 1.95-2.55), or brain (aHR: 1.95; 95%CI: 1.82-2.09) impairment and was slightly higher in those with physical (aHR: 1.31; 95%CI: 1.23-1.40) or communication (aHR: 1.25; 95%CI: 1.15-1.35) impairment. Regarding CRC-specific mortality, 70.2% (24365 of 34716) of all deaths were linked to CRC. Similar values were obtained when the analysis was limited to participants of the screening program, with further adjustments for smoking, alcohol, and body mass index (aHR: 3 model) (Table 4, Supplementary Tables 3 and 4).

Survival according to disability in patients with localized disease who underwent curative surgery

The overall mortality rate was higher in CRC patients with disabilities than in those with no disabilities (aHR: 1.23; 95%CI: 1.19-1.28). This difference was markedly higher among patients with severe disabilities (aHR: 1.62; 95%CI: 1.54-1.72) and slightly higher among those with mild disabilities (aHR: 1.09; 95%CI: 1.04-1.14). Among the subjects with severe disabilities, the mortality risk was significantly higher among those with internal organ (aHR: 3.22; 95%CI: 2.81-3.70), mental (aHR: 2.02; 95%CI: 1.63-2.50), or brain (aHR: 2.01; 95%CI: 1.82-2.23) impairment and was slightly higher among those with physical (aHR: 1.31; 95%CI: 1.19-1.44) or communication (aHR: 1.27; 95%CI: 1.13-1.43) impairment. Again, estimates were consistent with CRC-specific mortality when the analysis was limited to participants of the screening program (Table 5, Supplementary Tables 5 and 6).

DISCUSSION

To our knowledge, this is the first study to analyze the diagnosis, treatment, and mortality rate of CRC associated with disabilities. This study included a large, representative population, which encompassed a wide range of disabilities, and involved objective assessments of disabilities.

The distribution of CRC stage was similar between disabled and non-disabled subjects, but the more severe the mental, brain, or communication disability, the later the diagnosis. An unknown stage indicates that the patient did not undergo adequate diagnostic testing to develop an appropriate treatment plan. Disability itself does not preclude cancer treatment, suggesting that society's attitude hampers the treatment of disabled patients with CRC.

The rates of endoscopic resection were similar for subjects with and those without disabilities, possibly because endoscopic resection requires shorter hospitalization compared with other treatments[26]. By contrast, subjects with disabilities, and particularly those with severe disabilities, undergo surgery, chemotherapy, and radiotherapy less frequently. Subjects with disabilities, and particularly those with severe disabilities were more likely not to be treated. Subjects with physical disabilities had lower rates of surgery and chemotherapy, but similar rates of radiotherapy and endoscopic resection, compared with those without physical disabilities. Subjects with communication disabilities were unlikely to receive chemotherapy. Communication barriers can hinder effective communication with healthcare providers, making it harder to assess their condition, determine treatment options. Healthcare providers can assume that subjects with communication disabilities are unable to understand and participate in complex treatment such as chemotherapy and they cannot tolerate chemotherapy-related side effects[27]. The rates of all treatments were lower among patients with brain and mental disabilities than among those without disabilities, possibly because treatment decisions are made by medical staff and caregivers without patient involvement[28]. Compared with subjects without disabilities, those with cardiopulmonary disabilities had lower and higher rates of surgery and radiotherapy, respectively, because of concerns about postoperative morbidity and mortality.

The lower treatment rates among subjects with disabilities may have several causes. First, physical, sensory, or communication challenges may prevent individuals with disabilities from accessing healthcare facilities and services. Lack of accessibility for patients in wheelchairs, inadequate provision for those with sensory impairments, or communication difficulties could hamper access to care[29,30]. Second, healthcare professionals and personnel may have unfavorable attitudes, prejudices, and preconceptions that restrict patients with disabilities from receiving healthcare[31]. These beliefs may result in unfair treatment or presumptions about the prospects and quality of life of people with disabilities. Third, the ability of healthcare professionals to handle the medical requirements of people with disabilities may be limited[32]. This may make it difficult to offer individuals with impairments suitable alternative treatments.

Table 3 Odds ratio for polypectomy, surgery, chemotherapy, radiotherapy, and no treatment

Overall mortality	Total No.	Polypectomy, EMR, ESD				Surgery+				CT+				RT+				No treatment			
		No	Yes	Model 1	Model 2	No	Yes	Model 1	Model 2	No	Yes	Model 1	Model 2	No	Yes	Model 1	Model 2	No	Yes	Model 1	Model 2
Disability																					
Non-disabled patients	81069	69542	11527	REF	REF	22244	58825	REF	REF	53607	27462	REF	REF	71523	9546	REF	REF	73623	7446	REF	REF
Disabled patients	19664	16815	2849	1.022 (0.978-1.069)	0.998 (0.951-1.048)	6292	13372	0.804 (0.777-0.831)	0.848 (0.817-0.88)	13761	5903	0.837 (0.81-0.866)	0.837 (0.805-0.87)	17717	1947	0.823 (0.782-0.867)	0.895 (0.844-0.950)	17105	2559	1.479 (1.410-1.552)	1.389 (1.318-1.464)
By disability severity																					
Grades 1-3	6517	5640	877	0.938 (0.871-1.010)	0.909 (0.839-0.986)	2312	4205	0.688 (0.652-0.725)	0.743 (0.700-0.789)	4705	1812	0.752 (0.711-0.795)	0.703 (0.660-0.749)	5911	606	0.768 (0.705-0.837)	0.866 (0.784-0.956)	5409	1108	2.025 (1.891-2.170)	1.884 (1.744-2.034)
Grades 4-6	13147	11175	1972	1.065 (1.011-1.121)	1.041 (0.984-1.101)	3980	9167	0.871 (0.837-0.907)	0.904 (0.865-0.945)	9056	4091	0.882 (0.848-0.918)	0.908 (0.868-0.949)	11806	1341	0.851 (0.801-0.904)	0.909 (0.849-0.974)	11696	1451	1.227 (1.156-1.302)	1.166 (1.093-1.243)
Grade 1	986	879	107	0.735 (0.601-0.899)	0.741 (0.598-0.918)	415	571	0.520 (0.458-0.591)	0.592 (0.513-0.684)	756	230	0.594 (0.512-0.689)	0.508 (0.431-0.598)	910	76	0.626 (0.495-0.792)	0.772 (0.594-1.004)	731	255	3.452 (2.987-3.988)	2.913 (2.476-3.428)
Grade 2	2402	2061	341	0.998 (0.889-1.121)	0.941 (0.829-1.068)	877	1525	0.657 (0.604-0.715)	0.718 (0.653-0.789)	1786	616	0.673 (0.614-0.739)	0.655 (0.591-0.727)	2209	193	0.655 (0.564-0.760)	0.811 (0.686-0.959)	1982	420	2.095 (1.881-2.334)	1.917 (1.701-2.160)
Grade 3	3129	2700	429	0.959 (0.864-1.063)	0.937 (0.838-1.049)	1020	2109	0.782 (0.724-0.844)	0.821 (0.755-0.894)	2163	966	0.872 (0.807-0.942)	0.811 (0.743-0.884)	2792	337	0.904 (0.806-1.015)	0.927 (0.813-1.058)	2696	433	1.588 (1.431-1.762)	1.555 (1.388-1.742)
Grade 4	3531	3038	493	0.979 (0.888-1.079)	1.040 (0.936-1.155)	1097	2434	0.839 (0.780-0.902)	0.891 (0.823-0.966)	2478	1053	0.830 (0.771-0.893)	0.871 (0.802-0.946)	3193	338	0.793 (0.708-0.889)	0.893 (0.784-1.016)	3075	456	1.466 (1.325-1.622)	1.242 (1.113-1.385)
Grade 5	4695	4007	688	1.036 (0.953-1.126)	1.018 (0.931-1.114)	1460	3235	0.838 (0.786-0.893)	0.889 (0.829-0.953)	3298	1397	0.827 (0.775-0.882)	0.896 (0.833-0.963)	4240	455	0.804 (0.728-0.888)	0.882 (0.788-0.986)	4136	559	1.336 (1.220-1.464)	1.190 (1.078-1.314)
Grade 6	4921	4130	791	1.155 (1.068-1.250)	1.062 (0.975-1.157)	1423	3498	0.930 (0.872-0.991)	0.928 (0.866-0.994)	3280	1641	0.977 (0.919-1.038)	0.944 (0.881-1.011)	4373	548	0.939 (0.857-1.029)	0.944 (0.851-1.048)	4485	436	0.961 (0.869-1.064)	1.076 (0.966-1.198)
By disability type																					
Physical																					

Grades 1-3	2306	1968	338	1.036 (0.922-1.165)	0.966 (0.851-1.097)	763	1543	0.765 (0.700-0.835)	0.791 (0.717-0.871)	1573	733	0.910 (0.832-0.994)	0.806 (0.729-0.891)	2058	248	0.903 (0.790-1.032)	0.894 (0.768-1.041)	1997	309	1.530 (1.354-1.729)	1.636 (1.431-1.870)
Grades 4-6	8421	7076	1345	1.147 (1.078-1.220)	1.100 (1.028-1.176)	2481	5940	0.905 (0.862-0.951)	0.925 (0.877-0.977)	5688	2733	0.938 (0.894-0.984)	0.937 (0.887-0.989)	7541	880	0.874 (0.813-0.941)	0.895 (0.824-0.973)	7633	788	1.021 (0.945-1.103)	1.028 (0.946-1.116)
Communication																					
Grades 1-3	1423	1255	168	0.808 (0.687-0.950)	0.883 (0.743-1.050)	460	963	0.792 (0.708-0.886)	0.888 (0.784-1.005)	1012	411	0.793 (0.706-0.890)	0.855 (0.751-0.973)	1291	132	0.766 (0.640-0.917)	0.907 (0.74-	1193	230	1.906 (1.652-2.200)	1.429 (1.221-1.671)
Grades 4-6	3844	3335	509	0.921 (0.837-1.013)	0.967 (0.872-1.072)	1184	2660	0.850 (0.792-0.911)	0.899 (0.832-0.971)	2729	1115	0.798 (0.743-0.856)	0.883 (0.816-0.957)	3449	395	0.858 (0.772-0.954)	1.008 (0.893-1.138)	3335	509	1.509 (1.371-1.662)	1.266 (1.141-1.406)
Brain																					
Grades 1-3	1400	1260	140	0.670 (0.562-0.799)	0.684 (0.568-0.824)	560	840	0.567 (0.509-0.632)	0.606 (0.537-0.685)	1089	311	0.557 (0.491-0.633)	0.537 (0.467-0.617)	1295	105	0.607 (0.497-0.742)	0.758 (0.606-0.948)	1046	354	3.346 (2.959-3.784)	2.935 (2.557-3.370)
Grades 4-6	613	530	83	0.945 (0.749-1.192)	0.898 (0.699-1.153)	194	419	0.817 (0.688-0.969)	0.838 (0.695-1.012)	436	177	0.792 (0.665-0.944)	0.808 (0.664-0.982)	563	50	0.665 (0.498-0.889)	0.792 (0.573-1.093)	527	86	1.614 (1.283-2.029)	1.651 (1.287-2.119)
Mental																					
Grades 1-3	463	420	43	0.618 (0.451-0.846)	0.696 (0.498-0.973)	160	303	0.716 (0.591-0.868)	0.773 (0.622-0.960)	306	157	1.002 (0.826-1.215)	0.588 (0.475-0.728)	427	36	0.632 (0.449-0.888)	0.627 (0.428-0.919)	377	86	2.256 (1.782-2.854)	2.366 (1.827-3.064)
Grades 4-6																					
Cardiopulmonary																					
Grades 1-3	385	323	62	1.158 (0.882-1.521)	0.970 (0.724-1.301)	135	250	0.700 (0.568-0.864)	0.780 (0.620-0.981)	274	111	0.791 (0.634-0.986)	0.828 (0.648-1.059)	334	51	1.144 (0.851-1.537)	1.471 (1.039-2.081)	340	45	1.309 (0.958-1.788)	1.304 (0.934-1.822)
Grades 4-6	1	0	1	-	-	1	0	-	-	1	0	-	-	1	0	-	-	1	0	-	-
Other																					
Grades 1-3	540	414	126	1.836 (1.503-2.244)	1.387 (1.111-1.731)	234	306	0.494 (0.417-0.587)	0.573 (0.474-0.693)	451	89	0.385 (0.307-0.484)	0.406 (0.317-0.520)	506	34	0.503 (0.356-0.713)	0.691 (0.469-1.018)	456	84	1.821 (1.441-2.301)	1.858 (1.441-2.396)
Grades 4-6	268	234	34	0.877 (0.611-1.257)	0.659 (0.451-0.962)	120	148	0.466 (0.366-0.594)	0.579 (0.444-0.756)	202	66	0.638 (0.483-0.842)	0.579 (0.426-0.787)	252	16	0.476 (0.287-0.789)	0.412 (0.241-0.706)	200	68	3.362 (2.551-4.431)	3.286 (2.415-4.472)

Model 1 is unadjusted and model 2 is adjusted for age, sex, income level, place of residence, Charlson comorbidity index, and cancer stage. EMR: Endoscopic mucosal resection; ESD: Endoscopic submucosal dissection; CT: Computed tomography; RT: Radiotherapy.

Fourth, access to and quality of healthcare are typically limited for people with disabilities, reducing the likelihood of receiving all required treatments[33]. Socioeconomic variables, a lack of comprehensive insurance coverage, and deficient social support networks can affect these discrepancies[34]. Finally, patients with disabilities may have trouble expressing their medical requirements, preferences, and treatment objectives[35]. This may result in poor or no treatment as a result of miscommunication or misunderstanding. To address these issues, a concerted effort is needed to increase access to healthcare, strengthen training in the provision of care to people with disabilities, and promote an equitable healthcare system. It is critical that patients with disabilities have equitable access to treatments and that medical professionals receive adequate training in the care of such patients.

In this study, the overall mortality rate was higher in CRC patients with disabilities (aHR: 1.24), particularly those with severe disabilities (aHR: 1.57), than in those without disabilities. The disparities were especially apparent among patients with internal organ disabilities (aHR: 2.43), mental impairment (aHR: 2.23), or brain impairment (aHR: 1.95). Because most deaths in this study were caused by CRC, the overall mortality and CRC mortality rates were similar. This may be because of a high rate of complications or bad health behaviors, lower rate of intensive treatment (*e.g.*, less surgery and reduced doses of chemotherapeutics or radiation), lower rate of intensive care, poor self-management or compliance, and poor social support or living conditions. Promotion of socioeconomic support, as well as training programs for the caregivers of patients with disabilities could reduce disparities in treatment outcomes.

The overall and CRC mortality rates of patients who underwent curative surgery were higher among those with disabilities (aHR: 1.23) and significantly higher among those with severe disabilities (aHR: 1.62). Patients with physical disabilities had a significantly higher mortality rate (aHR: 3.22), indicating a higher risk of surgery or surgery because of physical function limitations, postoperative self-care or rehabilitation, and less intensive adjuvant therapy. Patients with brain (aHR: 2.01) or mental (aHR: 2.02) disabilities had high mortality rates, indicating that an inadequate understanding of the disease and self-management and/or poorly focused adjuvant therapy can hamper postoperative care. Subjects with communication disabilities did not show disproportionate treatment results. Selection of the most appropriate surgical modality, postoperative treatment (*e.g.*, pulmonary rehabilitation and self-treatment), and adjuvant treatment would reduce the treatment discrepancies between disabled and non-disabled patients with CRC.

This study had several limitations. First, it is unclear why some patients did not undergo diagnostic testing for staging or treatment (*e.g.*, patient or family rejection, economic/transportation problems, or clinician judgment). Second, we did not have sufficient clinical information on preoperative function, treatment intensity (*e.g.*, chemotherapy dose or radiotherapy frequency), or compliance with postoperative care and self-care. Third, the presence or absence of children or spouses in need of care could be variables, but in the data used in this study, there were no variables that could confirm this, so correction could not be made. In future studies, we will further examine the status of caring family members (children, spouse, *etc.*) as data and proceed with the study using propensity score matching.

CONCLUSION

In summary, patients with CRC with disabilities, particularly those with severe disabilities, were treated less aggressively compared with those without disabilities. Disability should not interfere with diagnosis and treatment in patients with

Table 4 Overall and colorectal cancer-specific mortality by disability

Overall mortality	Overall mortality				Cancer-specific mortality			
	Total No.	No. of death	Incidence rate (per 1000 PY)	Adjusted HR (95%CI)	Total No.	No. of death	Incidence rate (per 1000 PY)	Adjusted HR (95%CI)
Disability								
Non-disabled patients	81069	26908	51.3	REF	81069	19011	36.3	REF
Disabled patients	19664	7808	70.9	1.244 (1.213-1.277)	19664	5354	48.6	1.192 (1.156-1.229)
By disability severity								
Grades 1-3	6517	3181	94.8	1.569 (1.512-1.630)	6517	2091	62.3	1.430 (1.366-1.498)
Grades 4-6	13147	4627	60.5	1.095 (1.061-1.130)	13147	3263	42.7	1.081 (1.042-1.123)
Grade 1	986	553	124.4	1.853 (1.702-2.017)	986	408	91.8	1.831 (1.659-2.022)
Grade 2	2402	1260	105.0	1.731 (1.634-1.833)	2402	775	64.6	1.502 (1.397-1.616)
Grade 3	3129	1368	79.9	1.372 (1.299-1.449)	3129	908	53.0	1.259 (1.177-1.346)
Grade 4	3531	1415	72.1	1.202 (1.139-1.269)	3531	1004	51.2	1.194 (1.120-1.272)
Grade 5	4695	1704	63.8	1.097 (1.044-1.152)	4695	1213	45.4	1.092 (1.030-1.157)
Grade 6	4921	1508	50.0	1.011 (0.960-1.065)	4921	1046	34.7	0.984 (0.924-1.047)
By disability type								
Physical								
Grades 1-3	2306	912	68.3	1.311 (1.227-1.401)	2306	649	48.6	1.290 (1.192-1.396)
Grades 4-6	8421	2675	53.0	1.044 (1.003-1.087)	8421	1914	37.9	1.042 (0.994-1.093)
Communication								
Grades 1-3	1423	659	85.9	1.245 (1.152-1.346)	1423	446	58.1	1.170 (1.065-1.286)
Grades 4-6	3844	1562	73.0	1.136 (1.080-1.196)	3844	1091	51.0	1.115 (1.048-1.185)
Brain								
Grades 1-3	1400	853	144.7	1.947 (1.817-2.086)	1400	601	101.9	1.897 (1.747-2.060)
Grades 4-6	613	275	88.4	1.490 (1.322-1.678)	613	178	57.3	1.369 (1.181-1.588)
Mental								
Grades 1-3	463	219	102.1	2.230 (1.948-2.553)	463	173	80.6	2.074 (1.781-2.417)
Grades 4-6	-	-	-	-	-	-	-	-
Cardiopulmonary								
Grades 1-3	385	212	110.1	1.754 (1.532-2.008)	385	107	55.6	1.257 (1.039-1.520)
Grades 4-6	1	1	740.9	19.971 (2.836-140.612)	1	1	740.9	40.45 (5.691-287.489)
Others								

Grades 1-3	540	326	126.2	2.434 (2.179-2.719)	540	115	44.5	1.318 (1.096-1.586)
Grades 4-6	268	114	74.0	1.191 (0.990-1.432)	268	79	51.3	1.167 (0.935-1.456)

Adjusted for age, sex, Charlson comorbidity index, income level, place of residence, clinical disease status, type of surgery, and treatment, cancer stage, and type of cancer. 95%CI: 95% confidence interval; HR: Hazard ratio.

Table 5 Overall and colorectal cancer-specific mortality with local and locoregional who underwent surgery by disability

Overall mortality	Overall mortality				Cancer-specific mortality			
	Total No.	No. of death	Incidence rate (per 1000 PY)	Adjusted HR (95%CI)	Total No.	No. of death	Incidence rate (per 1000 PY)	Adjusted HR (95%CI)
Disability								
Non-disabled patients	59567	13842	32.7	REF	59567	8024	19.0	REF
Disabled patients	13532	3669	42.5	1.234 (1.189-1.280)	13532	2021	23.4	1.171 (1.114-1.23)
By disability severity								
Grades 1-3	4045	1400	56.3	1.624 (1.535-1.717)	4045	733	29.5	1.453 (1.345-1.569)
Grades 4-6	9487	2269	36.9	1.086 (1.038-1.135)	9487	1288	20.9	1.059 (0.998-1.123)
Grade 1	539	191	59.0	1.677 (1.452-1.936)	539	116	35.8	1.698 (1.411-2.042)
Grade 2	1522	624	70.6	1.993 (1.837-2.162)	1522	295	33.4	1.638 (1.456-1.842)
Grade 3	1984	585	45.8	1.349 (1.242-1.467)	1984	322	25.2	1.260 (1.127-1.410)
Grade 4	2459	671	43.1	1.182 (1.094-1.278)	2459	392	25.2	1.181 (1.067-1.308)
Grade 5	3342	827	38.7	1.118 (1.042-1.200)	3342	476	22.3	1.104 (1.006-1.212)
Grade 6	3686	771	31.3	0.988 (0.918-1.062)	3686	420	17.1	0.927 (0.840-1.023)
By disability type								
Physical								
Grades 1-3	1601	429	40.8	1.310 (1.189-1.443)	1601	251	23.9	1.303 (1.148-1.479)
Grades 4-6	6204	1300	31.8	1.009 (0.953-1.069)	6204	756	18.5	0.995 (0.923-1.072)
Communication								
Grades 1-3	940	299	49.1	1.270 (1.132-1.425)	940	166	27.3	1.211 (1.038-1.413)
Grades 4-6	2697	780	45.6	1.145 (1.065-1.231)	2697	434	25.4	1.113 (1.010-1.226)
Brain								
Grades 1-3	844	376	81.1	2.014 (1.816-2.233)	844	210	45.3	1.938 (1.688-2.226)
Grades 4-6	438	144	56.7	1.555 (1.319-1.834)	438	75	29.5	1.420 (1.131-1.784)
Mental								

Grades 1-3	281	86	53.5	2.016 (1.626-2.499)	281	56	34.8	1.811 (1.387-2.365)
Grades 4-6								
Others								
Grades 1-3	379	210	104.6	3.224 (2.807-3.704)	379	50	24.9	1.459 (1.102-1.931)
Grades 4-6	148	45	46.3	1.974 (1.473-2.647)	148	23	23.7	1.775 (1.178-2.674)

Adjusted for age, sex, Charlson comorbidity index, income level, place of residence, clinical disease status, type of surgery, and treatment, type of cancer. 95%CI: 95% confidence interval; HR: Hazard ratio.

CRC. Education for medical professionals and for disabled patients and their families is needed to overcome the perception that disability has a negative impact on the diagnosis and treatment of CRC. Further research is needed to develop guidelines to ensure equal diagnosis and treatment of CRC in disabled and non-disabled patients.

FOOTNOTES

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Country of origin: South Korea

ORCID number: Ki Bae Kim [0000-0001-6372-432X](https://orcid.org/0000-0001-6372-432X); So Young Kim [0000-0003-2258-7490](https://orcid.org/0000-0003-2258-7490); Jung-Ho Han [0000-0003-4469-9215](https://orcid.org/0000-0003-4469-9215); Seon Mee Park [0000-0002-5835-2741](https://orcid.org/0000-0002-5835-2741); Jong Heon Park [0000-0002-4749-5878](https://orcid.org/0000-0002-4749-5878); Jong Hyock Park [0000-0003-3247-0827](https://orcid.org/0000-0003-3247-0827).

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