Surgical Oncology Insight 1 (2024) 100014

Contents lists available at ScienceDirect

Surgical Oncology Insight

journal homepage: www.surgoncinsight.org

Original Article

The effect of the pandemic on colorectal cancer in the United States: An increased disease burden

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ARTICLE INFO

Keywords:
Colon cancer
Rectal cancer
Sars-Cov2
Pandemic
NCDB

ABSTRACT

Background: The COVID-19 pandemic posed an unprecedented global threat to healthcare systems, causing delays in colorectal cancer (CRC) diagnoses. This study aims to assess the impact of COVID-19 on the presentation of cancer stages in the U.S.

Methods: Data from the national cancer database (2015–2020) were analyzed, categorizing patients into pre-COVID (2015–2019) and COVID (2020) groups for evaluation.

Results: In the COVID group, patients with colon cancer had a notably higher prevalence of Clinical stage IV disease at diagnosis, accompanied by an increased incidence of metastatic disease (Clinical stage IV C, 12.9% vs. 4.5%, $p < 0.001$). Similar trends were observed for rectal cancer (Clinical stage IV C, 2.2% vs. 0.8%, $p < 0.001$). Black patients, those with specific insurance status (Medicaid or not insured vs. private insurance), and patients in the COVID cohort were significantly associated with worse clinical stages in both colon and rectal cancer on multivariable analysis.

Conclusion: The impact of COVID-19 has led to a notable surge in advanced-stage colorectal cancer diagnoses, with ongoing repercussions anticipated. Colorectal surgeons should devise strategies to address this issue and establish pandemic preparedness measures for future healthcare crises.

Introduction

The outbreak of the SARS-COV-2 global pandemic, announced by the World Health Organization (WHO) in March 2020, represented an unprecedented threat to healthcare systems worldwide.

On March 13, 2020, the United States declared a national emergency to fight this new biohazard. It established policies limiting person-to-person contacts and adopted relocation strategies of staff and health care resources. Several scientific societies also endorsed a cautionary stance that recommended delaying routine cancer screening tests to slow down and reduce the transmission of the infection [1]. These measures affected the daily hospital practice, reducing the number of cancer screenings, diagnoses, and treatments[2].In several countries outside the US, screening programs were suspended entirely [3]. This phenomenon was especially noteworthy for colorectal cancer (CRC), where a reduction in screening activities from 28% to 100% was reported in different countries and at other times after the onset of the pandemic[4].

This reduction was also confirmed in the National Cancer Database (NCDB), one of the largest cancer registries in the world, where a decrease of 14.4% in cancer diagnosis during the first year of the pandemic was detected [5]. The number of cases per year reported in this database has always been reliably stable. However, this trend was subverted entirely by Covid-19 [6].

While numerous studies have extensively described this decrease in CRC screening and diagnosis, its precise impact remains inadequately explored. Our hypothesis suggests that this decline in CRC screening might result in an increased number of advanced-stage diseases diagnosed in 2020 compared to previous years and a high burden of disease in the future.

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https://doi.org/10.1016/j.soi.2024.100014
Received 31 January 2024; Received in revised form 5 February 2024; Accepted 5 February 2024

Methods

This study reviewed cases from NCDB, a national database that collects data on 1.5 million new cancer cases each year, representing more than 70% of all cases in the U.S. Data of adult patients (18 years or older) affected by CRC cancer from 2015 to 2020 were collected. These patients were divided into two groups: the first group (pre-COVID) included patients from 2015 to 2019, and the second group (COVID) included patients from 2020 when the world faced the COVID-19 threat.

Given the substantial volume of observations, which frequently yielded statistically significant differences, the authors considered a difference as "clinically" relevant if its p-value was ≤ 0.05 and the difference between percentages was $\geq 1\%$.

Different variables from the NCDB were considered: age at diagnosis, sex, race, Spanish or Hispanic origin, Charlson Deyo Score, income, and percentage of no high school degree clinical TNM classification with the clinical stage, grade of the disease, pathologic TNM classification with pathologic stage, insurance status, use of chemotherapy and radiotherapy.

Statistical methods

Categorical variables were reported as numbers and percentages, while continuous variables were reported as mean ± standard deviation.

For the comparison between categorical and ordinal variables, the χ^2 and Cochran Armitage Trend tests were used as appropriate; for continuous variables, the Wilcoxon rank sum test was employed. A multivariable logistic regression model was constructed to evaluate the association between stage III-IV disease and the socioeconomic variables included in the analysis. Results are reported stratified by primary site of colon and rectum cancers.

All statistical analyses were performed using SAS version 9.4 (SAS Institute., Cary, NC).

Results

The colon cancer population (Table 1) included 278,210 patients divided as follows: 233,907 in the pre-COVID group and 44,303 in the COVID group. Upon evaluating the proportion of colon cancer cases diagnosed each year from 2015 to 2020, there was a significant reduction in colon cancer diagnoses in the pandemic's year (44303 cases,15.9%) compared to the previous year (52438, 18.9%). The complete list of variables is reported in Table 1. Patients in the COVID group were younger at the time of diagnosis (65.8 ± 13.8 vs. 66.2 ± 13.7 years, $p < 0.0001$), with a higher proportion of male patients (51.0% vs. 50.2%, $p = 0.005$), and were more likely to have a Charlson Deyo Score ≥ 2 (14.2% vs. 12.4%, $p < 0.0001$). COVID patients had a higher proportion of clinical T0/Tis (9.7% vs. 6.8%), cT1 (32.6% vs. 30.7%), and cT4 (23.7% vs. 20.8%) ($p < 0.0001$). Clinical M1 cases were more common among the COVID cohort (25.1% vs. 23.6%, $p < 0.0001$). There was a considerable increase in Clinical stage IV cancer (59.6% vs. 55.5%, $p < 0.001$) with a higher rate of clinical stage IV C cases in the COVID cohort (12.9% vs. 4.5%, $p < 0.0001$). The COVID group had a higher rate of pathological T1 (11.0% vs. 8.9%) and pT4 (25.6% vs. 23.9%), disease with lower rates of pT2 and pT3 disease. Higher rates of pathologic stages I (18.2% vs. 16.4%), III A (6.9% vs. 4.6%), and IV C (5.8% vs. 2.5%) were seen during the COVID time compared with pre-COVID ($p < 0.0001$). No difference was found with regard to use of radiation and chemotherapy.

A multivariable logistic regression (Table 2) was constructed to assess the association between socioeconomic factors and cancer clinical stage III-IV (Table 3). Predictors for worse clinical stage included being a part of the COVID cohort (OR = 1.13, 95% CI:1.08, 1.17; $p < 0.001$), black race (OR = 1.37,95% CI:1.32, 1.43; $p < 0.001$), or of other race compared to white patients (OR = 1.14, 95% CI:1.03, 1.26; $p = 0.015$), being insured with Medicaid (OR = 1.40, 95% CI:1.33, 1.48; $p < 0.001$) or not insured (OR = 1.59,95% CI: 1.46, 1.73; $p < 0.001$) compared to private insurance. This analysis also presented an inversely proportional relationship between yearly income and worse disease stage.

The rectal cancer population (Table 3) included 92,829 patients: 15,052 in the COVID group and 77,777 in the pre-COVID cohort. The proportion of colon cancer cases diagnosed each year from 2015 to 2020 was evaluated and a significant reduction in rectal cancer diagnoses was found between the COVID year (15,052; 16.2%) and the previous year (17,904; 19.3%). Between the two groups, there was no difference in age or gender. Patients in the COVID group were more likely to have a Charlson Deyo Score ≥ 2 (8.8% vs. 7.6%, $p < 0.0001$). The COVID group had more clinical T4 (20.1% vs. 14.8%) cases ($p < 0.0001$), with a higher rate of N2 cases (21.0% vs. 15.5%, $p < 0.0001$). The COVID cohort had a higher number of clinical stages III A (4.9% vs. 3.9%), III B (29.8% vs. 28.6%), and IV C (2.2% vs. 0.8%) ($p < 0.0001$). At the pathologic stage, the COVID group had more T1 (34.9% vs. 16.9%), T4 (7.4% vs. 6.6%) ($p < 0.0001$), N2 (13.4% vs. 10.9%, $p < 0.001$) and M1 cases (20.4% vs. 18.0%, $p < 0.0001$). The following pathological stages were significantly more common in the COVID group ($p < 0.0001$): I (32.1% vs. 27.0), II B (1.1% vs. 0.7%), III A (8.5% vs. 6.3%), IV A (14.6% vs. 12.6%), IV B (8.1% vs. 6.3%), IV C (4.0% vs. 0.7%). Fewer patients received surgical treatment in the COVID group (55.4% vs. 60.3%, $p < 0.0001$); however, they received more chemotherapy (46.7% vs. 44.9%). No difference in radiotherapy was found.

A multivariable logistic regression (Table 4) was constructed, to assess the association between socioeconomic factors and cancer clinical stage III-IV (Table 4). Predictors of the worse clinical stage included being a part of the COVID cohort (OR = 1.11, 95% CI:1.06, 1.16; $p < 0.001$), having black race (OR = 1.18, 95% CI: 1.11, 1.25; $p < 0.001$), being insured with Medicaid (OR = 1.40, 95% CI: 1.31, 1.48; $p < 0.001$) or not insured (OR = 1.67, 95% CI: 1.52, 1.84; $p < 0.001$) compared to private insurance. One difference seen between the colon cancer analysis included that no significance was found between income and stage of disease.

Discussion

To understand the initial effect of the pandemic on CRC presentation, our research relied on the NCDB. According to our hypothesis, within NCDB participating hospitals there was a notable rise in advanced-stage CRC diagnoses in 2020, with a higher metastatic disease prevalence than in prior years. Similar findings have been reported in other countries, indicating a global impact of the pandemic on CRC[8–11]. This surge in advanced cancer cases was primarily attributed to reduced CRC screening and delays in colonoscopic exams, especially for patients with positive fecal immunochemical tests [12, 13]. This deficit in cancer screening was a global phenomenon[4] and it was estimated to be equal to 3.8 million for CRC in the U.S.[14].

Nevertheless, the disruption in routine cancer surveillance was not the sole factor in this change in CRC stage presentation. Czeisler et al.[15] surveyed in June 2020 on 4975 adults in the US. They discovered that 40.9% of respondents avoided seeking medical care during the pandemic due to fear of contracting COVID-19, including 12.0% who avoided urgent or emergency care and 31.5% who avoided routine maintenance. The fear of infection's impact was further demonstrated by Lange et al. [16] who reported that, after the introduction in March 2020 of the stay-at-home orders to reduce the burden on the U.S. healthcare system, emergency department (ED) visits declined by a staggering 42%[17]. The number of ED visits for myocardial infarction decreased by 23%, and for stroke, a reduction of 20% was reported in the first months of the pandemic. After this initial drop, the ED visits for these two conditions increased but remained below the pre-pandemic

Table 1
Colon cancer data.

	pre-COVID (2015-2019) (N = 233907)	COVID (2020) (N = 44303)	Total (N = 278210)	p value
Age at Dx				< 0.0001[1]
N	233907	44303	278210	
Mean (SD)	66.2 (13.7)	65.8 (13.8)	66.2 (13.7)	
Sex				0.0053[2]
Male	117507 (50.2%)	22576 (51.0%)	140083 (50.4%)	
Female	116400 (49.8%)	21727 (49.0%)	138127 (49.6%)	
Race				< 0.0001[2]
Missing	2072	435	2507	
White	186345 (80.4%)	34989 (79.8%)	221334 (80.3%)	
Black	31930 (13.8%)	6120 (14.0%)	38050 (13.8%)	
Asian	9203 (4.0%)	1763 (4.0%)	10966 (4.0%)	
Other	4357 (1.9%)	996 (2.3%)	5353 (1.9%)	
Spanish Hispanic Origin				< 0.0001[2]
Missing	4278	744	5022	
Non-Spanish Non-Hispanic	212994 (92.8%)	40140 (92.2%)	253134 (92.7%)	
Spanish Hispanic	16635 (7.2%)	3419 (7.8%)	20054 (7.3%)	
Charlson Deyo Score				< 0.0001[3]
0	163652 (70.0%)	30255 (68.3%)	193907 (69.7%)	
1	41229 (17.6%)	7756 (17.5%)	48985 (17.6%)	
2 +	29026 (12.4%)	6292 (14.2%)	35318 (12.7%)	
Clinical T Category				< 0.0001[3]
Missing	181844	35701	217545	
cT0/cTis	3566 (6.8%)	833 (9.7%)	4399 (7.3%)	
cT1	15988 (30.7%)	2805 (32.6%)	18793 (31.0%)	
cT2	5380 (10.3%)	761 (8.8%)	6141 (10.1%)	
cT3	16274 (31.3%)	2168 (25.2%)	18442 (30.4%)	
cT4	10855 (20.8%)	2035 (23.7%)	12890 (21.2%)	
Clinical N Category				< 0.0001[3]
Missing	69250	17293	86543	
cN0	137818 (83.7%)	22989 (85.1%)	160807 (83.9%)	
cN1	21078 (12.8%)	3133 (11.6%)	24211 (12.6%)	
cN2	5761 (3.5%)	888 (3.3%)	6649 (3.5%)	
Clinical M Category				< 0.0001[2]
Missing	34911	9264	44175	
cM0	152032 (76.4%)	26250 (74.9%)	178282 (76.2%)	
cM1	46964 (23.6%)	8789 (25.1%)	55753 (23.8%)	
Clinical Stage Group				< 0.0001[3]
Missing	149207	29539	178746	
Stage 0	2871 (3.4%)	665 (4.5%)	3536 (3.6%)	
Stage I	16986 (20.1%)	2916 (19.8%)	19902 (20.0%)	
Stage IIA	8206 (9.7%)	950 (6.4%)	9156 (9.2%)	
Stage IIB	1068 (1.3%)	176 (1.2%)	1244 (1.3%)	
Stage IIC	1928 (2.3%)	307 (2.1%)	2235 (2.2%)	
Stage II total	11202 (13.3%)	1433 (9.7%)	12635 (12.7%)	
Stage IIIA	1387 (1.6%)	240 (1.6%)	1627 (1.6%)	
Stage IIIB	3878 (4.6%)	564 (3.8%)	4442 (4.5%)	
Stage IIIC	1412 (1.7%)	157 (1.1%)	1569 (1.6%)	
Stage III total	6677 (7.9%)	961 (6.5%)	7638 (7.7%)	
Stage IVA	22326 (26.4%)	3922 (26.6%)	26248 (26.4%)	
Stage IVB	16241 (19.2%)	2124 (14.4%)	18365 (18.5%)	
Stage IVC	3829 (4.5%)	1902 (12.9%)	5731 (5.8%)	
IV NOS	4568 (5.4%)	841 (5.7%)	5409 (5.4%)	
Stage IV total	46964 (55.5%)	8789 (59.6%)	55753 (56.1%)	
Pathologic T Category				< 0.0001[3]
Missing	39409	8566	47975	
pT0/pTis	2241 (1.2%)	556 (1.6%)	2797 (1.2%)	
pT1	17387 (8.9%)	3931 (11.0%)	21318 (9.3%)	
pT2	24920 (12.8%)	4450 (12.5%)	29370 (12.8%)	
pT3	103526 (53.2%)	17668 (49.4%)	121194 (52.6%)	
pT4	46424 (23.9%)	9132 (25.6%)	55556 (24.1%)	
Pathologic N Category				0.0001[3]
Missing	40263	8773	49036	
pN0	104536 (54.0%)	19573 (55.1%)	124109 (54.2%)	
pN1	54460 (28.1%)	9840 (27.7%)	64300 (28.1%)	
pN2	34648 (17.9%)	6117 (17.2%)	40765 (17.8%)	
Pathologic M Category				< 0.0001[2]
Missing	56561	6321	62882	
pM0	137550 (77.6%)	30722 (80.9%)	168272 (78.1%)	
pM1	39796 (22.4%)	7260 (19.1%)	47056 (21.9%)	

(*continued on next page*)

Table 1 (*continued*)

	pre-COVID (2015-2019) (N = 233907)	COVID (2020) (N = 44303)	Total (N = 278210)	p value
Pathologic Stage Group				< 0.0001[3]
Missing	63545	8602	72147	
Stage 0	1310 (0.8%)	354 (1.0%)	1664 (0.8%)	
Stage I	28019 (16.4%)	6484 (18.2%)	34503 (16.7%)	
Stage IIA	40846 (24.0%)	8689 (24.3%)	49535 (24.0%)	
Stage IIB	5863 (3.4%)	1454 (4.1%)	7317 (3.6%)	
Stage IIC	3657 (2.1%)	788 (2.2%)	4445 (2.2%)	
Stage II total	50366 (29.5%)	10931 (30.6%)	61297 (29.8%)	
Stage IIIA	7808 (4.6%)	2456 (6.9%)	10264 (5.0%)	
Stage IIIB	34438 (20.2%)	7298 (20.4%)	41736 (20.3%)	
Stage IIIC	8626 (5.1%)	918 (2.6%)	9544 (4.6%)	
Stage III total	50872 (29.1%)	10672 (29.9%)	61544 (29.9%)	
Stage IVA	20379 (12.0%)	3239 (9.1%)	23618 (11.5%)	
Stage IVB	12560 (7.4%)	1450 (4.1%)	14010 (6.8%)	
Stage IVC	4235 (2.5%)	2065 (5.8%)	6300 (3.1%)	
IV NOS	2621 (1.5%)	506 (1.4%)	3127 (1.5%)	
Stage IV total	39795 (23.4%)	7260 (20.4%)	47055 (22.9%)	
Surgery Type (at the reporting facility)				< 0.0001[2]
Missing	28	4	32	
None	49608 (21.2%)	9504 (21.5%)	59112 (21.2%)	
Chemotherapy (at the reporting facility)				0.5045[2]
Missing	21658	3863	25521	
No	148444 (69.9%)	28216 (69.8%)	176660 (69.9%)	
Yes	63805 (30.1%)	12224 (30.2%)	76029 (30.1%)	
Radiation (at the reporting facility)				0.0011[2]
Missing	2784	248	3032	
No	227466 (98.4%)	43450 (98.6%)	270916 (98.5%)	
Yes	3657 (1.6%)	605 (1.4%)	4262 (1.5%)	

[1]Wilcoxon[2]Chi-Square[3]Armitage Trend Test N = number SD = standard deviation NOS = not otherwise specified
Values are n (%) unless otherwise indicated

levels; other studies from countries outside the US supported these findings. [18–25].

Another significant contributor to this increase in advanced-stage CRC reported in 2020 was canceling elective surgical procedures due to the pandemic. During the initial months 2020, over twenty-one million surgical procedures were estimated to have been canceled worldwide [26, 27] This decision was made out of concern for patients, potential postoperative infections, and the surgical staff about intraoperative exposure to surgical smoke [28]. Unfortunately, this led to delays in cancer treatments for many patients, despite recommendations from governments and surgical societies that oncological curative surgeries should proceed whenever possible[29]. However, even with these

Table 2
Multivariable Logistic Regression model predicting clinical stage 3 or 4 disease.

Variable	Level	Odds ratio	95% Confidence Limits		p-value
Year (Group)	COVID vs pre-COVID	1.126	1.081	1.172	< 0.001
Age (per 10 years)		0.855	0.844	0.867	< 0.001
Race	Asian vs White	1.022	0.949	1.101	0.561
	Black vs White	1.374	1.316	1.434	< 0.001
	Other vs White	1.136	1.025	1.260	0.015
	Unknown vs White	1.099	0.944	1.279	0.225
Ethnicity	Spanish Hispanic vs Non-Spanish Non-Hispanic	0.995	0.940	1.054	0.870
	Unknown vs Non-Spanish Non-Hispanic	0.749	0.676	0.831	< 0.001
Charlson Deyo Score	1 vs 0	0.941	0.906	0.977	0.002
	2 + vs 0	0.872	0.833	0.914	< 0.001
Insurance Status	Medicaid vs Private insurance	1.401	1.325	1.482	< 0.001
	Medicare vs Private insurance	1.021	0.981	1.062	0.312
	Not insured vs Private insurance	1.591	1.461	1.733	< 0.001
	Other government vs Private insurance	1.198	1.047	1.370	0.009
	Unknown vs Private insurance	1.119	0.992	1.263	0.068
Income	46277 - 57856 vs 74063 +	1.087	1.041	1.136	< 0.001
	57857 - 74062 vs 74063 +	1.059	1.017	1.102	0.005
	< 46277 vs 74063 +	1.073	1.020	1.129	0.006
	Unknown vs 74063 +	1.176	0.916	1.510	0.203
% No HSD	15.3 + vs < 5.0	0.981	0.929	1.035	0.478
	5.0-9.0 vs < 5.0	1.027	0.984	1.073	0.222
	9.1-15.2 vs < 5.0	0.981	0.936	1.028	0.420
	Unknown vs < 5.0	0.923	0.690	1.235	0.588
Miles between patient's residence and hospital who reported case (per 100 miles)		1.058	1.042	1.075	< 0.001

Table 3
Rectal cancer data.

	pre-COVID (2015-2019) (N = 77777)	COVID (2020) (N = 15052)	Total (N = 92829)	p value
Age at Dx				0.1476[1]
N	77777	15052	92829	
Mean (SD)	61.4 (13.1)	61.2 (13.0)	61.4 (13.1)	
Sex				0.4431[2]
Male	47895 (61.6%)	9319 (61.9%)	57214 (61.6%)	
Female	29882 (38.4%)	5733 (38.1%)	35615 (38.4%)	
Race				0.0002[2]
Missing	740	162	902	
White	64639 (83.9%)	12352 (83.0%)	76991 (83.8%)	
Black	7153 (9.3%)	1406 (9.4%)	8559 (9.3%)	
Asian	3586 (4.7%)	730 (4.9%)	4316 (4.7%)	
Other	1659 (2.2%)	402 (2.7%)	2061 (2.2%)	
Spanish Hispanic Origin				0.0108[2]
Missing	1391	279	1670	
Non-Spanish Non-Hispanic	70031 (91.7%)	13450 (91.0%)	83481 (91.6%)	
Spanish Hispanic	6355 (8.3%)	1323 (9.0%)	7678 (8.4%)	
Charlson Deyo Score				< 0.0001[3]
0	60303 (77.5%)	11484 (76.3%)	71787 (77.3%)	
1	11582 (14.9%)	2247 (14.9%)	13829 (14.9%)	
2 +	5892 (7.6%)	1321 (8.8%)	7213 (7.8%)	
Clinical T Category				< 0.0001[3]
Missing	19774	3484	23258	
cT0/cTis	580 (1.0%)	134 (1.2%)	714 (1.0%)	
cT1	5103 (8.8%)	1006 (8.7%)	6109 (8.8%)	
cT2	7408 (12.8%)	1427 (12.3%)	8835 (12.7%)	
cT3	36336 (62.6%)	6678 (57.7%)	43014 (61.8%)	
cT4	8576 (14.8%)	2323 (20.1%)	10899 (15.7%)	
Clinical N Category				< 0.0001[3]
Missing	8638	1934	10572	
cN0	35016 (50.6%)	5987 (45.6%)	41003 (49.8%)	
cN1	23419 (33.9%)	4370 (33.3%)	27789 (33.8%)	
cN2	10704 (15.5%)	2761 (21.0%)	13465 (16.4%)	
Clinical M Category				0.1217[2]
Missing	3919	832	4751	
cM0	59450 (80.5%)	11366 (79.9%)	70816 (80.4%)	
cM1	14408 (19.5%)	2854 (20.1%)	17262 (19.6%)	
Clinical Stage Group				< 0.0001[3]
Missing	17374	3549	20923	
Stage 0	500 (0.8%)	116 (1.0%)	616 (0.9%)	
Stage I	8629 (14.3%)	1673 (14.5%)	10302 (14.3%)	
Stage IIA	12421 (20.6%)	1951 (17.0%)	14372 (20.0%)	
Stage IIB	472 (0.8%)	108 (0.9%)	580 (0.8%)	
Stage IIC	1126 (1.9%)	242 (2.1%)	1368 (1.9%)	
Stage II total	14019 (23.3%)	2301 (20%)	16.320 (22.7%)	
Stage IIIA	2366 (3.9%)	564 (4.9%)	2930 (4.1%)	
Stage IIIB	17280 (28.6%)	3433 (29.8%)	20713 (28.8%)	
Stage IIIC	3201 (5.3%)	562 (4.9%)	3763 (5.2%)	
Stage III total	22847 (37.8%)	4559 (39.6%)	27406 (38.1%)	
Stage IVA	7748 (12.8%)	1496 (13.0%)	9244 (12.9%)	
Stage IVB	5051 (8.4%)	870 (7.6%)	5921 (8.2%)	
Stage IVC	502 (0.8%)	253 (2.2%)	755 (1.0%)	
IV NOS	1107 (1.8%)	235 (2.0%)	1342 (1.9%)	
Stage IV total	(23.8%)	(24.8%)	(24%)	
Pathologic T Category				< 0.0001[3]
Missing	39760	11495	51255	
pT0/cTis	3747 (9.9%)	117 (3.3%)	3864 (9.3%)	
pT1	6436 (16.9%)	1240 (34.9%)	7676 (18.5%)	
pT2	9793 (25.8%)	838 (23.6%)	10631 (25.6%)	
pT3	15534 (40.9%)	1099 (30.9%)	16633 (40.0%)	
pT4	2507 (6.6%)	263 (7.4%)	2770 (6.7%)	
Pathologic N Category				0.0004[3]
Missing	42208	12239	54447	
pN0	22825 (64.2%)	1742 (61.9%)	24567 (64.0%)	
pN1	8875 (25.0%)	695 (24.7%)	9570 (24.9%)	
pN2	3869 (10.9%)	376 (13.4%)	4245 (11.1%)	
Pathologic M Category				0.0001[2]
Missing	42347	10614	52961	
pM0	29044 (82.0%)	3534 (79.6%)	32578 (81.7%)	
pM1	6386 (18.0%)	904 (20.4%)	7290 (18.3%)	

(*continued on next page*)

Table 3 (*continued*)

	pre-COVID (2015-2019) (N = 77777)	COVID (2020) (N = 15052)	Total (N = 92829)	p value
Pathologic Stage Group				< 0.0001[3]
Missing	47948	11892	59840	
Stage 0	2003 (6.7%)	39 (1.2%)	2042 (6.2%)	
Stage I	8039 (27.0%)	1014 (32.1%)	9053 (27.4%)	
Stage IIA	5214 (17.5%)	438 (13.9%)	5652 (17.1%)	
Stage IIB	217 (0.7%)	34 (1.1%)	251 (0.8%)	
Stage IIC	395 (1.3%)	15 (0.5%)	410 (1.2%)	
Stage II total	5826 (19.5%)	487 (15.5%)	6313 (19.1%)	
Stage IIIA	1865 (6.3%)	269 (8.5%)	2134 (6.5%)	
Stage IIIB	4769 (16.0%)	430 (13.6%)	5199 (15.8%)	
Stage IIIC	941 (3.2%)	17 (0.5%)	958 (2.9%)	
Stage III total	7575 (25.5%)	716 (22.6%)	8291 (25.2%)	
Stage IVA	3764 (12.6%)	460 (14.6%)	4224 (12.8%)	
Stage IVB	1890 (6.3%)	255 (8.1%)	2145 (6.5%)	
Stage IVC	216 (0.7%)	125 (4.0%)	341 (1.0%)	
IV NOS	516 (1.7%)	64 (2.0%)	580 (1.8%)	
Stage IV total	6386 (21.3%)	904 (28.7%)	7290 (22.1%)	
Surgery Type (at the reporting facility)				< 0.0001[2]
Missing	32	12	44	
None	30891 (39.7%)	6714 (44.6%)	37605 (40.5%)	
Chemotherapy (at the reporting facility)				0.0001[2]
Missing	3625	673	4298	
No	40894 (55.1%)	7668 (53.3%)	48562 (54.9%)	
Yes	33258 (44.9%)	6711 (46.7%)	39969 (45.1%)	
Radiation (at the reporting facility)				0.5279[2]
Missing	1522	183	1705	
No	43060 (56.5%)	8438 (56.7%)	51498 (56.5%)	
Yes	33195 (43.5%)	6431 (43.3%)	39626 (43.5%)	

[1]Wilcoxon [2]Chi-Square [3]Armitage Trend Test N = number SD= standard deviation NOS= not otherwise specified
Values are n (%) unless otherwise indicated

recommendations, not all patients were able to receive the necessary surgical treatments.

Our results showed that although COVID-19 had a substantial impact on the stage of presentation of malignancies, it is essential to specify that this impact was not equal among the U.S. population.

Several inequities were found: the segment of the population most afflicted by advanced-stage CRC were Black patients, people with no medical insurance or insured with Medicaid. An inversely proportional association was found for colon cancer between the stage of disease and annual income. Racial disparities in CRC presentation are well-recognized, with Black patients typically presenting at more advanced disease stages and experiencing worse outcomes[30–32]. Income level is

Table 4
Multivariable Logistic Regression model predicting clinical stage 3 or 4 disease.

Variable	Level	Estimate	95% Confidence Limits		p-value
Year (Group)	COVID vs pre-COVID	1.106	1.057	1.157	< 0.001
Age (per 10 years)		0.801	0.787	0.815	< 0.001
Race	Asian vs White	1.044	0.963	1.131	0.293
	Black vs White	1.178	1.109	1.252	< 0.001
	Other vs White	1.069	0.952	1.200	0.257
	Unknown vs White	0.994	0.829	1.190	0.944
Ethnicity	Spanish Hispanic vs Non-Spanish Non-Hispanic	1.034	0.968	1.104	0.318
	Unknown vs Non-Spanish Non-Hispanic	0.885	0.777	1.008	0.066
Charlson Deyo Score	1 vs 0	0.922	0.879	0.966	< 0.001
	2 + vs 0	0.766	0.718	0.816	< 0.001
Insurance Status	Medicaid vs Private insurance	1.395	1.313	1.482	< 0.001
	Medicare vs Private insurance	1.048	0.999	1.099	0.053
	Not insured vs Private insurance	1.672	1.517	1.842	< 0.001
	Other government vs Private insurance	1.043	0.916	1.187	0.528
	Unknown vs Private insurance	1.131	0.972	1.315	0.111
Income	46277 - 57856 vs 74063 +	0.975	0.926	1.026	0.325
	57857 - 74062 vs 74063 +	0.976	0.931	1.023	0.313
	< 46277 vs 74063 +	0.943	0.888	1.002	0.058
	Unknown vs 74063 +	0.711	0.541	0.934	0.014
% No HSD	15.3 + vs < 5.0	1.044	0.980	1.113	0.184
	5.0-9.0 vs < 5.0	0.970	0.922	1.020	0.238
	9.1-15.2 vs < 5.0	1.008	0.954	1.065	0.771
	Unknown vs < 5.0	1.576	1.136	2.186	0.007
Miles between patient's residence and hospital who reported case (per 100 miles)		1.001	0.986	1.017	0.879

another established factor contributing to advanced-stage CRC diagnoses at presentation, primarily due to reduced access to healthcare services, making individuals less likely to undergo curative surgery or receive specialized care. The pandemic significantly exacerbated these pre-existing inequities[33, 34].

A limitation of this paper is that the results obtained in this study only describe the initial impact of the first nine months of the COVID-19 pandemic on CRC. To assess its true and lasting effects, a new analysis incorporating data from 2021 to 2025, when available, will be necessary to provide a more comprehensive understanding of its impact.

Other relevant limitations of this study are its retrospective design, the presence of statistically significant differences that may not always translate into clinical significance, the relatively short time frame in the COVID-19 group, which primarily captures the initial impact of COVID-19 on CRC, and the presence of missing data for some variables in the NCDB.

Conclusion

COVID-19 led to an increase in the incidence of advanced-stage colorectal cancer at presentation, particularly affecting vulnerable populations. This tail of advanced disease will impact the healthcare system for years. Future preparedness requires targeted strategies to improve time from first symptom to equitable screenings, especially for socioeconomically disadvantaged individuals, enhancing resilience against future health crises.

Synopsis

In 2020, the COVID-19 pandemic heightened diagnoses of advanced-stage colorectal cancer, marked by increased metastatic diseases. Pronounced staging disparities disproportionately impacted Black patients, the uninsured, and Medicaid recipients, underscoring the pressing need for targeted interventions in these vulnerable populations.

Funding

This research did not receive external funding.

Ethical statement

The study received approval from the Institutional Review Board in compliance with The Code of Ethics of the World Medical Association. This study followed the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) Statement guidelines for reporting observational studies[7].

Declaration of Competing Interest

The authors declare no conflict of interest.

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