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ORIGINAL RESEARCH

Impact of the COVID-19 Pandemic on Colorectal Cancer Characteristics and Overall Survival: A Population-Based Analysis of Kuwait Cancer Registry Data

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Abstract

Background: The COVID-19 pandemic substantially disrupted cancer care worldwide. In Kuwait, colorectal cancer (CRC) is the second most commonly diagnosed cancer. This study evaluated differences in patient and tumor characteristics, treatment patterns, and four-year survival outcomes among Kuwaiti patients with CRC diagnosed before, during, and after the COVID-19 pandemic. **Methods:** A retrospective analysis was conducted using data from the Kuwait Cancer Registry (KCR). A total of 582 Kuwaiti patients with CRC were included and categorized into three cohorts according to year of diagnosis: 2019 (pre-pandemic, n = 199), 2020 (pandemic, n = 181), and 2021 (post-pandemic, n = 202). The KCR database provided demographic, clinical, and tumor-related information. Data were exported from CanReg-5 to Microsoft Access and SPSS for statistical analysis. **Results:** The number of newly diagnosed CRC cases decreased by 9% in 2020 compared with 2019 and by 10.4% compared with 2021. Patient status at last follow-up differed significantly across the three periods, with fewer patients recorded as alive during the pandemic period ($p = 0.015$). Compared with 2021, CRC-related mortality during the pandemic period was 44.1% higher. The proportion of stage IV disease at diagnosis increased by 12.7% in 2020 compared with 2021, whereas the proportion of stage III disease increased by 65.1% in 2021. Treatment patterns also changed during the pandemic, with fewer patients undergoing surgery or receiving chemotherapy and a relative increase in radiotherapy. However, no statistically significant difference in survival was observed among the three cohorts ($p = 0.107$). **Conclusion:** The COVID-19 pandemic was associated with changes in CRC diagnosis, disease stage at presentation, treatment patterns, and mortality in Kuwait. The reduction in newly diagnosed cases, increased proportion of stage IV disease, and higher CRC-related mortality during the pandemic suggest potential delays in diagnosis and treatment. Continued monitoring of CRC outcomes and strategies to minimize the impact of future healthcare disruptions are warranted.

Keywords: COVID-19 pandemic; colorectal cancer; cancer diagnosis; survival; mortality; Kuwait Cancer Registry

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Introduction

In December 2019, severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) emerged in Wuhan, China, causing coronavirus disease 2019 (COVID-19). The virus rapidly spread worldwide, primarily through respiratory transmission [1]. The World Health Organization (WHO) declared the outbreak a Public Health Emergency of International Concern on January 30, 2020, and subsequently characterized COVID-19 as a pandemic on March 11, 2020 [2]. In Kuwait, the first confirmed cases were reported on February 24, 2020, among travelers returning from Iran. Kuwait subsequently implemented strict public health measures, including partial and complete curfews and suspension of activities across most government sectors, with exceptions for essential and emergency services [3, 4].

The COVID-19 pandemic substantially disrupted healthcare systems worldwide, including in Kuwait. Hospitals were required to reorganize services and reallocate resources to manage the rapidly increasing number of patients with COVID-19. Consequently,

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outpatient services, elective procedures, and diagnostic investigations were reduced or postponed, potentially delaying the diagnosis and treatment of chronic diseases. Cancer care was similarly affected, with screening programs and diagnostic procedures declining in many countries. In particular, screening colonoscopy and elective endoscopic procedures were reduced or temporarily suspended in some settings to minimize the risk of viral transmission and preserve healthcare resources [4-6].

Colorectal cancer (CRC) is the third most commonly diagnosed cancer and the second leading cause of cancer-related mortality worldwide. In Kuwait, CRC represents a major public health concern and is among the leading causes of cancer-related morbidity and mortality in both men and women. The incidence of CRC has increased substantially over recent decades. In 2021, CRC accounted for 15.7% of all newly diagnosed cancers among Kuwaiti men and 9.1% among Kuwaiti women, while the reported CRC-related mortality rate was 7.5 per 100,000 population in 2018 [7-9].

The COVID-19 pandemic may have affected CRC outcomes through multiple mechanisms, including reduced screening, delayed diagnostic evaluation, changes in treatment delivery, and restricted access to healthcare services. Such disruptions may have resulted in diagnosis at more advanced stages and adversely affected short-term outcomes.

Therefore, this study compared the clinical and pathological characteristics, treatment patterns, mortality, and survival outcomes of newly diagnosed CRC patients during the COVID-19 pandemic (2020) with those diagnosed before (2019) and after (2021) the pandemic. By evaluating changes in diagnosis, disease stage, treatment, and survival across these periods, the study aimed to assess the potential impact of pandemic-related healthcare disruptions on CRC care in Kuwait and provide evidence to inform preparedness for similar healthcare crises in the future.

Materials and Methods

Data Source

This retrospective cohort study was conducted using data from the Kuwait Cancer Registry (KCR). A total of 582 Kuwaiti patients diagnosed with colorectal cancer (CRC) between January 2019 and December 2021 were identified. The KCR database contains comprehensive demographic, clinical, pathological, treatment, and follow-up information.

The extracted variables included age, sex, residence, date of diagnosis, date of last follow-up, vital status at last follow-up, tumor topography and morphology according to the International Classification of Diseases for Oncology, Third Edition (ICD-O-3), extent of disease according to the Surveillance, Epidemiology, and End Results (SEER) classification, clinical and pathological T, N, and M categories, and treatment information, including surgery, radiotherapy, chemotherapy, hormonal therapy, and immunotherapy. Data were based on the KCR database backup dated March 16, 2025. Data were exported from CanReg-5 to Microsoft Access and SPSS for analysis. Selected variables, including morphology, extent of disease, and TNM categories, were recoded to facilitate statistical analysis.

Study Population

The study included 582 Kuwaiti patients with CRC registered in the KCR between January 2019 and December 2021. These years represented the pre-pandemic (2019), pandemic (2020), and post-pandemic (2021) periods, respectively. All eligible CRC cases registered during the study period were considered. Non-Kuwaiti patients and cases of lymphoma were excluded from the analysis.

Statistical Analysis

Monthly and annual trends in the number of newly diagnosed CRC cases were assessed. Statistical analyses were performed using IBM SPSS Statistics version 24.0 (IBM Corp., Armonk, NY, USA). Continuous variables were summarized as mean ± standard deviation or median and range, as appropriate, while categorical variables were presented as frequencies and percentages.

Associations between categorical variables were assessed using the chi-square test or Fisher's exact test, as appropriate. Cancer-specific mortality was analyzed by treating deaths from causes other than CRC as censored observations. Overall survival was estimated using the Kaplan–Meier method, and survival distributions between groups were compared using the log-rank (Mantel–Cox) test. A two-sided p-value <0.05 was considered statistically significant, and $p<0.01$ was considered highly statistically significant [10].

Results

A total of 582 Kuwaiti patients with newly diagnosed CRC were identified between January 2019 and December 2021. Of these, 199 patients were diagnosed in 2019 (pre-pandemic; 100 women and 99 men), 181 in 2020 (pandemic; 88 women and 93 men), and 202 in 2021 (post-pandemic). Demographic and clinical characteristics of the study population are summarized in Table 1.

The number of newly diagnosed CRC cases decreased by 9% in 2020 compared with 2019 and by 10.4% compared with 2021. The number of male patients decreased by 6.1% and 9.7% compared with 2019 and 2021, respectively, while the number of female patients decreased by 12% and 11.1%, respectively. However, the distribution of patients by sex did not differ significantly across the three periods ($p = 0.945$) (Table 1).

The number of patients aged ≥70 years decreased by 16.7% compared with 2019 and by 15.1% compared with 2021, with the most pronounced decline occurring during April and May 2020 (Figure 1). The number of patients aged 50–59 years decreased by 10.4% and 12.2% compared with 2019 and 2021, respectively. Among patients aged 40–49 years, the number of cases decreased by 8.3% compared with 2019 and by 26.7% compared with 2021. However, the distribution of CRC cases across age

groups did not differ significantly among the three periods (p = 0.998) (Table 1).

Regarding place of residence, the number of patients from Hawalli decreased by 19.7% compared with 2019 and by 26.9% compared with 2021. The number of patients residing in the Capital Governorate decreased by 13% and 11.1% compared with 2019 and 2021, respectively. However, the distribution of patients by residence did not differ significantly across the three periods (p = 0.809) (Table 1).

At last follow-up, the number of patients recorded as alive decreased by 7.7% compared with 2019 and by 21.6% compared with 2021. The number of deaths from all causes decreased by 12.3% compared with 2019 but increased by 42.9% compared with 2021. Overall patient status at last follow-up differed significantly across the three periods (p = 0.015). In contrast, CRC-specific mortality decreased by 9.3% in 2020 compared with 2019 but increased by 44.1% compared with 2021; this difference was not statistically significant (p = 0.639) (Table 1).

Patients were followed until August 2025. The median follow-up duration was 36.4 months (range, 0–77 months). The median survival for patients diagnosed in 2020 was 65.8 months. Six-month overall survival rates were 89.6%, 89.5%, and 91.0% for patients diagnosed in 2019, 2020, and 2021, respectively. At 12 months, the corresponding survival rates were 86.3%, 84.6%, and 87.3%. The four-year overall survival rates were 67.4%, 69.6%, and 67.4% for patients diagnosed in 2019, 2020, and 2021, respectively (Figure 2; Table 2). Kaplan–Meier survival analysis showed no statistically significant difference in overall survival among the three diagnostic periods (log-rank p = 0.107) (Table 2; Figure 2).

Tumor Topography, Stage at Diagnosis, and Treatment

Regarding tumor topography (primary site), the proportion of colon tumors decreased by 14.6% in 2020 compared with 2019 and by 7.5% compared with 2021. Rectosigmoid tumors decreased by 44% compared with 2021. In contrast, the proportion of rectal tumors increased by 12.5% in 2020 compared with 2019 and 4.7%. However, the annual variation in the distribution of CRC cases according to primary tumor site was not statistically significant (p = 0.252) (Table 3).

Figure 3 illustrates a notable absence of stage I diagnoses from mid-April to mid-May 2020. The number of localized tumors decreased by 3% compared with 2019 and by 23.1% compared with 2021 (Table 2). Stage II tumors decreased by 18% compared with 2019 and by 2.4% compared with 2021, with a reduction in cases observed between April and June 2020 (Figure 3). The number of patients diagnosed with stage III disease decreased by 10.4% compared with 2019 and by 39.4% compared with 2021. The number of patients with stage IV disease decreased by 6.1% compared with 2019 but was 12.7% higher than in 2021. Nevertheless, the annual differences in the distribution of patients according to extent of disease and stage at diagnosis were not statistically significant (p = 0.630 and p = 0.290, respectively).

During the COVID-19 pandemic, the number of patients receiving surgery and chemotherapy decreased by 8.3% and 1.8%, respectively, compared with 2019. Compared with 2021, surgical treatment and chemotherapy decreased by 2.9% and 11.3%, respectively, in 2020. In contrast, the number of patients receiving

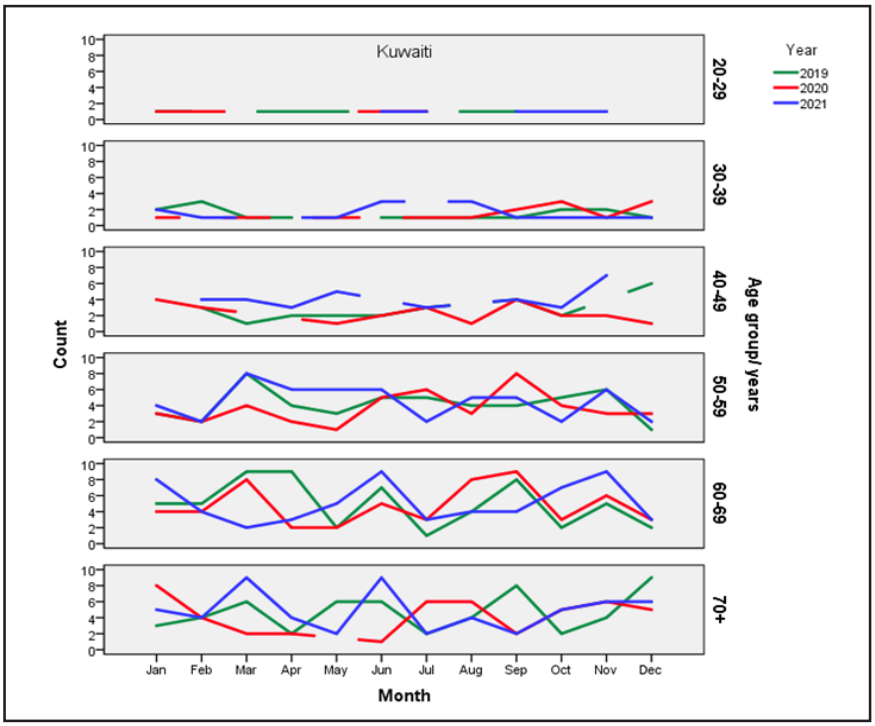


Figure 1. Monthly Trends in the Number of Newly Diagnosed Kuwaiti Patients with Colorectal Cancer (CRC) by Age Group, January 2019–December 2021. The lines represent the annual distribution of CRC cases in 2019, 2020, and 2021.

Table 1. Trends in the Characteristics of Kuwaiti Patients with Colorectal Cancer before, during, and after the COVID-19 Pandemic

Characteristic	2019, n (%)	2020, n (%)	2021, n (%)	χ^2	P value	Change, 2019–2020 (%)	Change, 2020–2021 (%)
Total	199 (100)	181 (100)	202 (100)	—	—	-9.0	-10.4
Sex				0.112	0.945		
Male	99 (49.8)	93 (51.3)	103 (51.0)			-6.1	-9.7
Female	100 (50.2)	88 (48.7)	99 (49.0)			-12.0	-11.1
Age group (years)				1.715	0.998		
20–29	3 (1.5)	2 (1.1)	3 (1.5)			-33.3	-33.3
30–39	13 (6.5)	14 (7.7)	13 (6.4)			7.7	7.7
40–49	24 (12.1)	22 (12.2)	30 (14.9)			-8.3	-26.7
50–59	48 (24.1)	43 (23.8)	49 (24.3)			-10.4	-12.2
60–69	57 (28.6)	55 (30.4)	55 (27.2)			-3.5	0
≥70	54 (27.1)	45 (24.9)	53 (26.2)			-16.7	-15.1
Residence				7.683	0.809		
Ahmadi	17 (8.7)	15 (8.6)	20 (9.9)			-11.8	-25.0
Capital	46 (23.2)	40 (22.1)	45 (22.3)			-13.0	-11.1
Farwaniya	34 (17.1)	31 (17.1)	33 (16.3)			-8.8	-6.1
Hawalli	61 (30.7)	49 (27.1)	67 (33.2)			-19.7	-26.9
Jahra	12 (6.0)	15 (8.3)	18 (8.9)			25	-16.7
Mubarak Alkabeer	12 (6.0)	14 (7.7)	7 (3.5)			16.7	100
Not reported	18 (9.0)	17 (9.4)	12 (5.9)			-5.6	41.7
Status at last follow-up				8.441	0.015*		
Alive	142 (71.4)	131 (72.4)	167 (82.7)			-7.7	-21.6
Dead	57 (28.6)	50 (27.6)	35 (17.3)			-12.3	42.9
Cause of death†				0.895	0.639		
Cancer	54 (94.7)	49 (98.0)	34 (97.1)			-9.3	44.1
Other	3 (5.3)	1 (2.0)	1 (2.9)			-66.7	0

CRC, colorectal cancer.

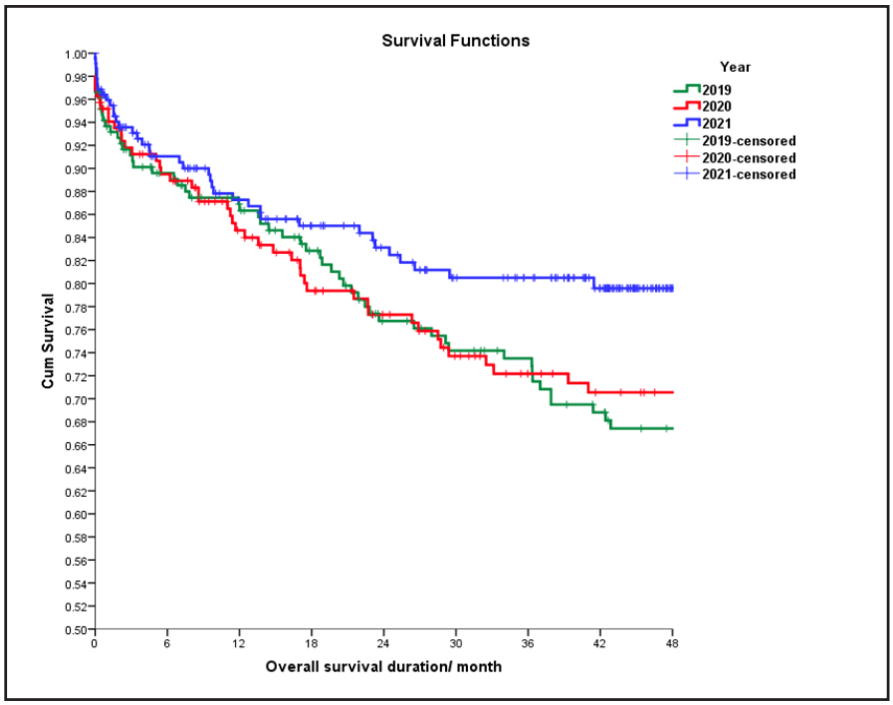


Figure 2. Kaplan–Meier Overall Survival Curves for Kuwaiti Patients with Colorectal Cancer Diagnosed in 2019, 2020, and 2021. Survival distributions were compared using the log-rank test.

Table 2. Overall Survival of Kuwaiti Patients with Colorectal Cancer before, during, and after the COVID-19 Pandemic

Year	6-month survival (%)	12-month survival (%)	24-month survival (%)	36-month survival (%)	48-month survival (%)	Log-rank χ^2	P value
2019	89.6	86.3	76.7	73.5	67.4	4.466	0.107
2020	89.5	84.6	77.3	72.2	70.5		
2021	91	87.3	83.1	80.5	69.6		

Note: Overall survival was compared among the three study periods using the Kaplan–Meier method and log-rank test. A two-sided $P < 0.05$ was considered statistically significant.

radiotherapy increased by 2.9% compared with 2019 and 2021 (Table 1). As shown in Figure 4, the decline in treatment provision coincided with the lockdown period in April and May 2020. However, the observed changes in treatment modalities across 2019–2021 were not statistically significant (Table 3).

Discussion

The COVID-19 pandemic placed unprecedented pressure on healthcare systems worldwide. Following the declaration of COVID-19 as a pandemic by the World Health Organization (WHO), healthcare resources were rapidly redirected toward pandemic-related care, disrupting routine diagnostic and therapeutic services, including cancer care [1]. Hospital beds, healthcare personnel, intensive care capacity, and other resources were reallocated to meet the increased demand associated with COVID-19. Consequently, some healthcare facilities restricted or postponed non-emergency services and elective procedures. At the same time, concerns about SARS-CoV-2 infection may have discouraged patients from seeking medical attention, potentially resulting in delayed presentation and more advanced disease at diagnosis [11].

In the present study, the number of newly diagnosed CRC cases decreased in 2020 compared with both 2019 and 2021 across most age groups and in both sexes. The most pronounced reduction occurred between April and June 2020, coinciding with the national lockdown period (Figure 1). Although the annual differences were not statistically significant, the temporal pattern suggests a substantial disruption in CRC diagnostic services during the early phase of the pandemic. Similar reductions in newly diagnosed CRC cases have been reported internationally, including in Spain, Brazil, and Hong Kong [12, 13]. In Italy, an 11.9% reduction in CRC diagnoses was reported during 2020, which is comparable to the reduction observed in the present study [14]. Collectively, these findings suggest that the pandemic may have temporarily disrupted access to CRC diagnostic pathways, including clinical consultations, endoscopic evaluation, and referral for diagnostic investigations.

A marked reduction in newly diagnosed CRC cases

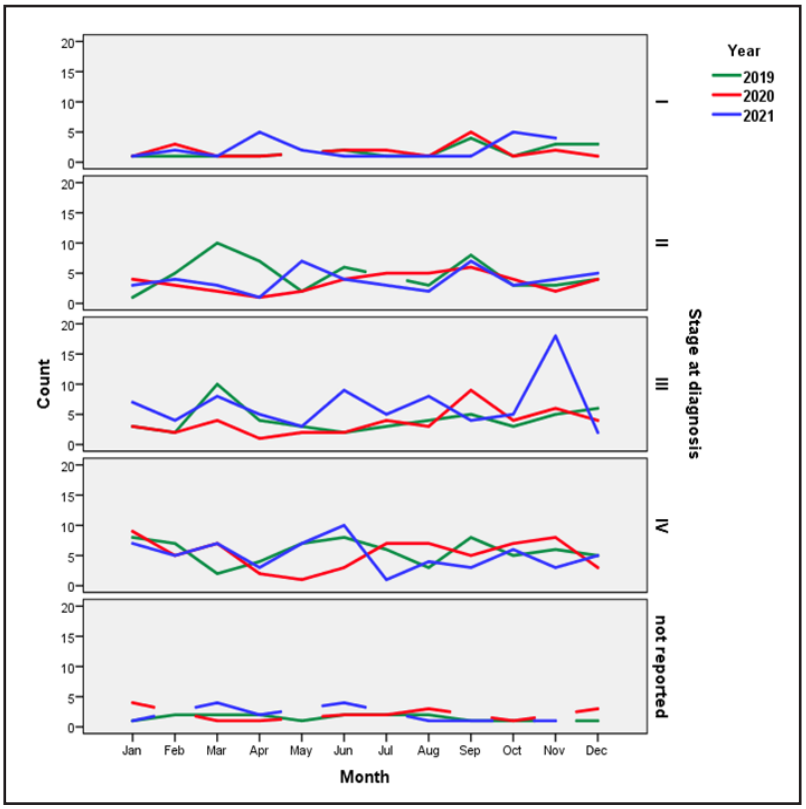


Figure 3. Monthly Trends in the Number of Newly Diagnosed Kuwaiti Patients with Colorectal Cancer According to Stage at Diagnosis, January 2019–December 2021.

Table 3. Trends in Tumor Characteristics of Kuwaiti Patients with Colorectal Cancer before, during, and after the COVID-19 Pandemic

Tumor characteristic	2019, n (%)	2020, n (%)	2021, n (%)	χ^2	P value	Change, 2019–2020 (%)	Change, 2020–2021 (%)
Total	199 (100)	181 (100)	202 (100)	—	—	-9.0	-10.4
Primary tumor site				5.4	0.252		
Colon	144 (72.5)	123 (67.9)	133 (65.8)			-14.6	-7.5
Rectosigmoid	14 (7.0)	14 (7.7)	25 (12.4)			0	-44.0
Rectum	40 (20.1)	45 (24.9)	43 (21.3)			12.5	4.7
Extent of disease (SEER)				4.3	0.630		
Localized	23 (11.6)	20 (11.0)	26 (12.9)			-13.0	-23.1
Regional	93 (46.7)	82 (45.3)	108 (53.5)			-11.8	-24.1
Distant metastasis	66 (33.2)	62 (34.3)	55 (27.2)			-6.1	12.7
Not reported	16 (8.0)	16 (8.8)	13 (6.4)			0	23.1
Stage at diagnosis				9.7	0.290		
I	18 (9.0)	19 (10.5)	22 (10.9)			5.6	-13.6
II	50 (25.1)	41 (22.7)	42 (20.8)			-18.0	-2.4
III	48 (24.1)	43 (23.8)	71 (35.1)			-10.4	-39.4
IV	66 (33.2)	62 (34.3)	55 (27.2)			-6.1	12.7
Not reported	16 (8.0)	16 (8.8)	13 (6.4)			0	23.1
Treatment							
Surgery	145 (72.9)	133 (73.5)	137 (67.8)	1.9	0.397	-8.3	-2.9
Radiotherapy	35 (17.6)	36 (19.9)	35 (17.3)	1.1	0.571	2.9	2.9
Chemotherapy	112 (56.3)	110 (60.8)	124 (61.4)	1.3	0.530	-1.8	-11.3

Abbreviations: CRC, colorectal cancer; SEER, Surveillance, Epidemiology, and End Results.

was also observed among residents of Hawalli and Capital governorates during 2020. This geographic variation may partly reflect differences in population density, mobility, healthcare-seeking behavior, and the implementation or impact of public health restrictions. Both governorates contain densely populated urban areas with substantial non-citizen populations, who may have experienced particular barriers to healthcare access during the pandemic [15]. However, because the present study did not directly assess individual-level healthcare utilization or socioeconomic characteristics, this interpretation should be considered cautiously.

The findings regarding patient status at the last follow-up further highlight the potential clinical consequences of the disruption in cancer care. The number of patients who were alive at the last follow-

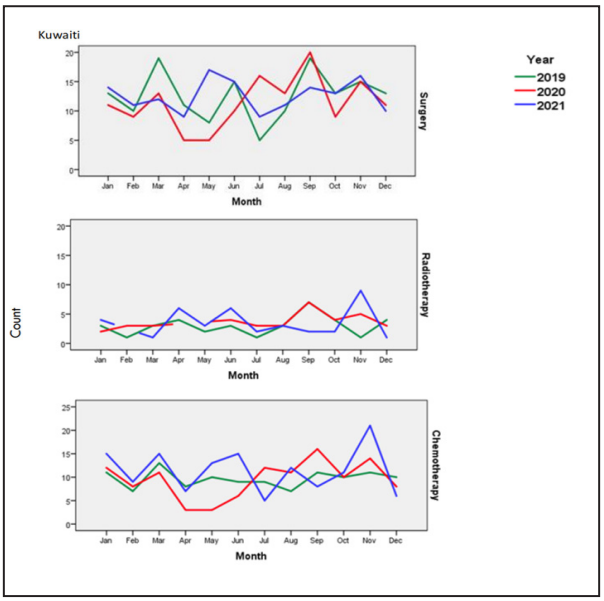


Figure 4. Monthly Trends in the Number of Kuwaiti Patients with Colorectal Cancer According to Treatment Modality, January 2019–December 2021.

up was significantly lower in 2020 than in 2019 and 2021, while CRC-related deaths were significantly more frequent in 2020 than in 2021 ($p = 0.015$). The observed mortality was 30.9% higher during the pandemic than in 2021. Several mechanisms may have contributed to this pattern. Delays in diagnosis and treatment can allow disease progression and may reduce opportunities for timely curative intervention. In addition, patients with cancer may have been particularly vulnerable to severe COVID-19 infection because of advanced age, comorbidities, malignancy-related immunosuppression, or treatment-related effects. Nevertheless, the present study cannot determine whether the increased mortality was directly attributable to COVID-19 infection, delayed cancer care, disease progression, or other concurrent factors. Therefore, these findings should be interpreted as an association between the pandemic period and observed changes in CRC outcomes rather than evidence of a direct causal relationship.

In agreement with our findings, Maringe et al. estimated that CRC mortality in the United Kingdom increased by approximately 15.3%–16.6% as a consequence of diagnostic delays associated with the COVID-19 pandemic [16, 17]. In addition, studies from China reported higher rates of COVID-19 infection among patients with cancer undergoing surgical or chemotherapy treatment than among individuals without cancer (39% vs. 8%), as well as higher rates of severe infection (75% vs. 43%) [18]. These findings highlight the particular vulnerability of patients with cancer during the pandemic and the potential challenges associated with maintaining timely cancer care while minimizing the risk of SARS-CoV-2 infection.

Evidence also suggests that delays in surgical treatment of CRC may adversely affect clinical outcomes. Prolonged intervals between diagnosis and surgical resection may delay definitive staging and the initiation of adjuvant or neoadjuvant treatment, particularly in patients with advanced disease [17]. Therefore, disruption of surgical pathways during the pandemic may have had implications beyond the immediate delay in operative management.

In the present study, no statistically significant difference was observed in the distribution of primary tumor sites across the three study periods. This finding is consistent with the report by Taulean et al., who similarly found no significant differences in tumor location between the studied periods, with left-sided colon tumors, including rectal tumors, being the most frequently observed sites overall [11]. These findings suggest that, despite the disruption of diagnostic services during the pandemic, the overall anatomical distribution of newly diagnosed CRC remained relatively stable.

Nevertheless, the proportion of rectal tumors increased by 9.3% in 2020 compared with 2019 and by 2.3% compared with 2021. Although this difference was not statistically significant, one possible explanation is that rectal cancers may produce more readily recognizable symptoms than some colon cancers. Rectal bleeding, visible blood in the stool, altered bowel habits, and tenesmus may prompt patients to seek medical attention earlier, whereas colon cancers, particularly right-sided tumors, may initially present with less specific manifestations such as fatigue, abdominal discomfort, or iron-deficiency anemia [19, 20]. This potential explanation should, however, be interpreted cautiously because symptom characteristics and healthcare-seeking behavior were not directly evaluated in the present study.

The temporal distribution of stage at diagnosis showed a notable absence of stage I CRC diagnoses between April and June 2020, coinciding with the lockdown period (Figure 2). In addition, stage IV disease was more frequently diagnosed in 2020 than in 2021, whereas the number of stage III diagnoses increased in 2021 compared with 2020. Although the differences in stage distribution were not statistically significant, these temporal patterns may be consistent with disruption of diagnostic pathways during the pandemic and the subsequent resumption of healthcare services. A delay in diagnosis could result in some patients being diagnosed at a more advanced stage; however, the observational design of the present study does not allow this relationship to be established causally.

Previous studies provide support for this interpretation. Speichinger et al. reported an association between diagnostic delays and a higher frequency of pT4 CRC, suggesting that prolonged diagnostic intervals may allow tumor progression [21]. Similarly, Castonguay et al. found that restricted access to healthcare during the pandemic was associated with a greater proportion of patients presenting with later-stage disease [22]. Feier et al. also reported that pandemic-related delays in seeking medical care were associated with more advanced tumor stages and greater clinical complexity, potentially limiting available treatment options [23]. Taken together, these findings suggest that interruptions in diagnostic pathways may have contributed to changes in the stage profile of CRC during the pandemic, although the magnitude of this effect may vary across healthcare settings.

A shift in treatment patterns was also observed in our study. Surgical treatment decreased by 9.5% in 2020 compared with 2019 and by approximately 3% compared with 2021. Similar reductions in CRC surgery during the pandemic have been reported by Han et al. [24] and Miyo et al., who observed a 10.4% reduction in surgical procedures in Japan [25]. Santoro et al. additionally reported delays in surgical intervention among 70.9% of participants during the pandemic [26]. These findings are consistent with the broader disruption of elective and semi-elective surgical services during the early stages of the pandemic, when operating-room capacity, hospital beds, personnel, and perioperative resources were frequently redirected toward COVID-19 care.

In contrast, radiotherapy utilization increased during 2020 in the present study. This increase may partly reflect the higher proportion of rectal tumors diagnosed during this period, as radiotherapy has an established role in the management of locally advanced rectal cancer and in selected patients with metastatic or symptomatic disease [24]. However, other pandemic-related factors, including treatment prioritization, changes in surgical capacity, and the adoption of alternative treatment strategies, may also have influenced radiotherapy utilization. Therefore, the

observed increase should not be attributed solely to the distribution of tumor sites.

Finally, survival analysis did not demonstrate a statistically significant difference among the three study periods. This finding is consistent with previous reports that similarly did not identify significant short-term differences in survival during the pandemic period [11, 23, 26, 27, 28]. The absence of a statistically significant difference does not necessarily indicate that the pandemic had no effect on long-term CRC outcomes. Cancer survival is influenced by multiple factors, including stage at diagnosis, treatment initiation and completion, tumor biology, comorbidities, and duration of follow-up. Moreover, some consequences of diagnostic and treatment delays may become apparent only after a longer follow-up period. Continued monitoring of patients diagnosed during and after the pandemic may therefore be necessary to determine whether the observed disruptions translate into measurable differences in long-term survival.

However, these findings differ from those of several previous studies. Peacock et al. and Yarikkaya et al. reported adverse effects of pandemic-related delays in CRC diagnosis and treatment on survival outcomes [29]. This discrepancy may be attributable to differences in patient characteristics, disease stage, treatment patterns, follow-up duration, or the capacity of individual healthcare systems to adapt to pandemic-related disruptions. The impact of the pandemic was unlikely to have been uniform across patients or healthcare settings, particularly given differences in healthcare accessibility, resource allocation, and the implementation of mitigation strategies.

Although our study did not demonstrate a statistically significant difference in overall survival among the three study periods during the available follow-up, this finding does not exclude the possibility of delayed effects on CRC outcomes. The consequences of diagnostic and treatment delays may become evident only after a longer period of follow-up. Therefore, longitudinal studies with extended follow-up are warranted to determine whether the disruptions observed during the COVID-19 pandemic have translated into clinically meaningful differences in long-term CRC survival and other oncological outcomes [22].

In conclusion, the COVID-19 pandemic was associated with substantial temporal changes in the diagnosis and management of CRC, particularly during the lockdown period. The reduction in newly diagnosed cases and changes in stage distribution and treatment utilization suggest disruption of routine CRC care during the pandemic. However, the observed differences in tumor site, stage at diagnosis, and treatment modalities were not statistically significant, and no significant difference in overall survival was identified among the study periods. These findings suggest that, although CRC services were disrupted during the pandemic, a measurable short-term effect on overall survival was not demonstrated within the available follow-up period. Continued surveillance and longer-term follow-up are needed to determine whether the observed disruptions have delayed consequences for CRC outcomes.

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None.

Conflict of Interest

Author declares no conflict of interest.

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