



Decreased numbers of gastric, colorectal, lung, and breast cancer surgeries performed in 17 cancer-designated hospitals in Gunma Prefecture of Japan during the COVID-19 pandemic

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Abstract

Purpose This study aims to clarify the influence of the COVID-19 pandemic on cancer surgery in Gunma Prefecture.

Methods A total of 9839 cases (1406 gastric cancer, 3569 colorectal cancer, 1614 lung cancer, and 3250 breast cancer) from 17 hospitals in Gunma Prefecture were investigated. We compared the number of surgical cases, proportion of cases found by screening, and cStage at the time of the first visit by month in 2020 and 2021 with those in 2019.

Results The rate of decline in cancer surgery was 8.9% in 2020 compared with 2019 ($p=0.0052$). Compared with the same month of 2019, in some months of 2020 and 2021, significant decreases were observed in the number of surgeries for gastric and colorectal cancer, the percentage of surgical cases detected by screening in all four cancers, and the proportion of cancers with a relatively early cStage in gastric and breast cancer.

Conclusions The number of surgical cases of the four cancer types detected by cancer screening decreased in Gunma Prefecture owing to the influence of the COVID-19 pandemic. Furthermore, for some cancer types, the number of operations performed in patients with early-stage cancer is also decreased.

Keywords COVID-19 · Pandemic · Cancer surgery · Gunma Prefecture · Cancer screening

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Introduction

Coronavirus disease 2019 (COVID-19) is an extremely infectious disease caused by acute respiratory syndrome coronavirus 2 (SARS-CoV-2) and is responsible for the ongoing worldwide pandemic [1]. Regarding the spread of COVID-19 infection in Japan, the first infected case was confirmed in January 2020. As of December 2021, the lives of the population have been severely restricted under four periods of state of emergency. In Japan, vaccination began in February 2021, but the infection has not completely subsided, and the number of infected people is still increasing worldwide.

The spread of COVID-19 has dramatically restricted the delivery of standard medical care to surgical patients [2] and has had a major impact on cancer screening [3]. Because of the spread of COVID-19 infection, there is concern that people who should receive certain treatments, such as surgery, cannot obtain access, or that the timing of treatment may be delayed. Researchers in the United Kingdom have reported that the effects of the spread of COVID-19 infection may reduce the survival rate of cancer in the future [4]. A recent study using the National Clinical Database (NCD) of Japan revealed that the numbers of most oncological procedures decreased in 2020 as a result of the COVID-19 pandemic [5]. However, no studies at the prefectural level have investigated in detail the number of surgical transitions, the proportion of cancer screening cases, or the degree of cancer progression in surgical cases. Therefore, we conducted this study in the hope that by alerting the public, the prospect of cancer patients missing treatment opportunities can be avoided.

We previously reported the first part of this study in another Japanese journal [6]. In the second part presented herein, we extended the study period and investigated the opportunity for cancer detection (screening or non-screening) as well as the cStage at the time of detection. The purpose of this study was to clarify the influence of the COVID-19 pandemic on cancer surgery in Gunma Prefecture.

Patients and methods

In Gunma Prefecture, there are 17 cancer-designated hospitals. A total of 9839 cases (1406 gastric cancer, 3569 colorectal cancer, 1614 lung cancer, and 3250 breast cancer) from these 17 hospitals were investigated. The survey period was January 2019 to March 2021.

We compared the number of surgical cases in 2019 (before reporting of the first infected case in Japan) and

2020 as well as the number in each month of 2020 and 2021 with those in the same month in 2019. The triggers for discovering cases were divided into screening and non-screening, and the numbers of cases with and without screening in 2019 and 2020 were compared. The percentage of surgical cases detected via screening by month from January 2020 to March 2021 was compared with the average percentage in 2019 as a pre-pandemic control. We also investigated the cStage at the time of the first visit. The percentage of cStage of surgical cases by month from January 2020 to March 2021 was compared with the average in 2019. We investigated the percentage of cStage I/cStage I–IV in gastric cancer, cStage 0–II/cStage 0–IV in colorectal cancer, cStage 0, I/cStage 0–IV in lung cancer, and cStage 0/cStage 0–IV in breast cancer.

The comparison was analyzed by Wilcoxon's signed-rank test and Fisher's exact test using the EZR software tool [7]. Differences were considered significant if the *p* value was less than 0.05. We compared difference of the surgical cases and the proportion of specific tumor stages by monthly. The situations of the COVID-19 pandemic and the national and prefectural measures implemented to prevent spread at that time differed substantially among months, so we compared the change by month, not in total. Our results do not reflect all of the changes, but they do show that the probability of type I errors at each monthly change was < 0.05. All statistical analyses were performed by an epidemiologist (one of the authors, H.K.).

As this survey did not have access to individual patient data and all questionnaires were conducted on a voluntary basis, the requirement for Institutional Review Board approval was waived.

Results

The comparison of the number of surgical cases in 2019 and 2020 and by each month

The number of surgical cases with gastric, colorectal, lung, and breast cancer by month from January 2019 to March 2021 is shown in Fig. 1. During this period, a state of emergency in Japan was declared twice (from April 7 to May 25 in 2020 and from January 8 to March 21 in 2021) in urban areas, including Tokyo. In Gunma Prefecture, a state of emergency was declared once, from April 16 to May 14 in 2020. Table 1 summarizes the comparison of the surgical case numbers between 2019 and 2020. From January to December 2019, a total of 4551 cancer surgeries were performed overall. In contrast, in the same month of 2020, there were 4148 operations, a significant decrease of 8.9%. The rate of decrease differed depending on the type of cancer, with the largest decrease noted in the number of surgical

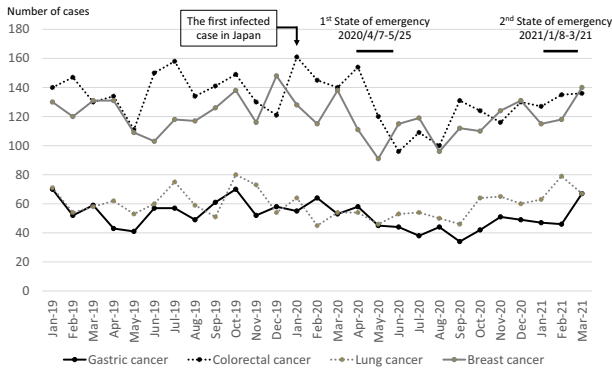


Fig. 1 Number of surgical cases with gastric, colorectal, lung, and breast cancer by month from January 2019 to March 2021

Table 1 A comparison of the numbers of surgical cases in 2019 and 2020

	Gastric	Colorectal	Lung	Breast	All
Total					
2019	669	1645	750	1487	4551
2020	577	1526	655	1390	4148
%	86.2	92.8	87.3	93.5	91.1
<i>p</i> value	n.s.	0.0436	n.s.	n.s.	0.0052
Screening					
2019	214	441	306	525	1486
2020	170	362	220	466	1218
%	79.4	82.1	71.9	88.8	82.0
<i>p</i> value	n.s.	0.0083	n.s.	n.s.	0.0015
Non-screening					
2019	455	1204	444	962	3065
2020	407	1164	435	924	2930
%	89.5	96.7	98.0	96.0	95.6
<i>p</i> value	n.s.	n.s.	n.s.	n.s.	n.s.

n.s. not significant

cases of gastric cancer at 13.8%, followed by lung cancer at 12.7%, colorectal cancer at 7.2%, and breast cancer at 6.5%; the decrease was significant only in colorectal cancer. On comparing screening cases, there was a significant decrease in all and colorectal cases, whereas no significant decrease was observed in the non-screening cases.

Figure 2 shows the percentage of surgical cases by month from January 2020 to March 2021 compared with the same month in 2019. For gastric cancer (Fig. 2A), the number of surgeries decreased from June 2020, with significant reductions in September and October 2020. For colorectal cancer (Fig. 2B), there was a significant decrease in June and August 2020, and a downward trend started from June 2020, similar to gastric cancer. For lung cancer (Fig. 2C), the number of surgeries slightly decreased throughout 2020, but not significantly.

Conversely, in February 2021, there was a significant increase in the number of procedures. For breast cancer (Fig. 2D), although there was a decrease in the number of surgeries for several months of 2020 and 2021, none was significant.

Proportion of screening/non-screening cases by month

Figure 3 presents the percentage of surgical cases detected by screening, by month from January 2020 to March 2021 compared with the average in 2019. For gastric cancer (Fig. 3A), from April to November 2020, the rate was low compared with the average screening detection rate of 32.0% in 2019. Furthermore, a significant decrease was seen in August 2020 and a significant increase in December 2020. For colorectal cancer (Fig. 3B), the proportion of colorectal cancers found by screening showed a significant decrease in June and July 2020, compared with the average of 26.8% in 2019. Conversely, there was a significant increase in January and March 2021. For lung cancer (Fig. 3C), the average proportion of cancers detected by screening was 40.8% in 2019, and a significant decrease was observed in June, July, and August 2020 and in March 2021. For breast cancer (Fig. 3D), the rate of cancer detected by screening was significantly reduced in July 2020 compared with the average of 35.3% in 2019.

Proportion of cStage by month

The percentage of cStage diagnoses for surgical cases by month from January 2020 to March 2021 compared with the average in 2019 is shown in Fig. 4. Regarding the stage of gastric cancer (Fig. 4A), as the rate fluctuated only in cStage I, we compared cStage I with others. In October 2020, the percentage of cStage I decreased significantly compared with the average percentage in 2019 (49.9%). Concerning the stage of colorectal cancer (Fig. 4B), when divided into cStage 0–II and cStage III and IV, the rates of cStage 0–II decreased slightly from June to December 2020, but the change was not significant. For lung cancer, cStage I was overwhelmingly large (Fig. 4C), so staging was classified into cStage 0, I, and cStage II–IV. There was a slight but not significant decrease in cStage 0, I in May 2020. Regarding the stage classification of breast cancer (Fig. 4D), the average percentage of cStage 0 was 23.8% in 2019, and there was a significant decrease compared with this figure in April, June, July, and August 2020.

Discussion

In this study, we asked 17 cancer treatment cooperation facilities in Gunma Prefecture to conduct a questionnaire survey and received responses from all hospitals. There was some

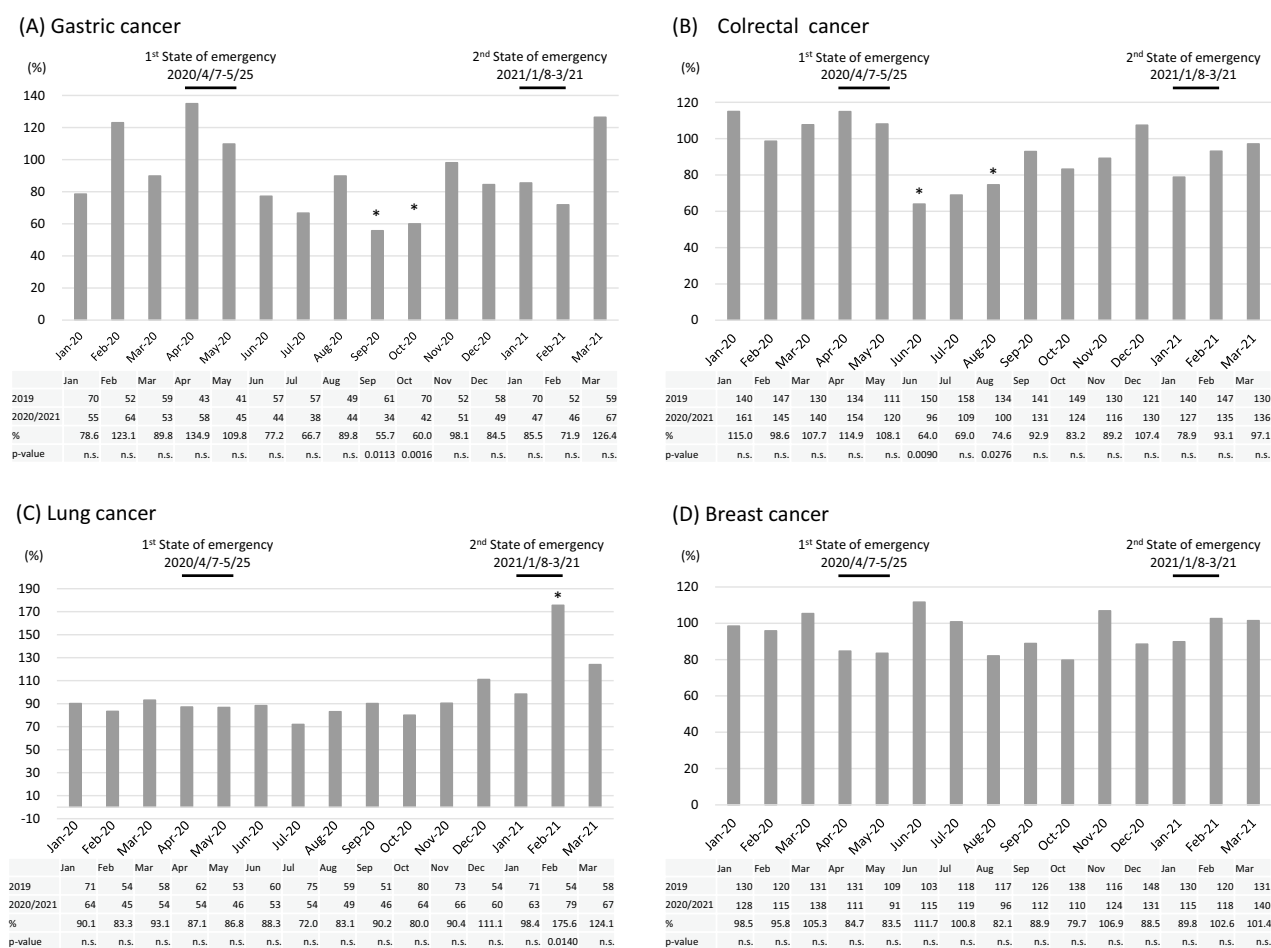


Fig. 2 Percentage of surgical cases by month from January 2020 to March 2021 compared with the same month in 2019. **A** Gastric cancer. **B** Colorectal cancer. **C** Lung cancer. **D** Breast cancer. *n.s.* not significant. The asterisks indicate $p < 0.05$

difference in the influence of the pandemic on the number of cancer surgeries among hospitals. The 17 hospitals consisted of one university hospital and one cancer specialty hospital, while others were general hospitals. The main emergency center of the prefecture was located at one of the general hospitals. We were able to note some differences in the influence of the COVID-19 pandemic among these hospitals. As mentioned in a previous report [6], the number of surgical cases with cancer accumulated in this study is equivalent to that investigated in the whole of Gunma Prefecture in the past. Therefore, it is presumed that our present results fully reflect the trend in cancer surgery in Gunma Prefecture overall. In the comparison between 2019 and 2020, a significant decrease in total surgical cases and screening cases was observed in 2020, but not in non-screening cases, indicating that the decrease in surgical cases found in 2020 was mainly due to the decrease in screening cases.

Tokunaga et al. reported that the number of gastric cancer surgeries was lower than that in the previous year in

62 hospitals from May 2020 to August 2020 [8]. During the COVID-19 pandemic, people considered susceptible to COVID-19 infection might have refrained from receiving cancer screening, including endoscopy. Furthermore, some local governments stopped or suspended offering endoscopic screening during the pandemic, also leading to a further decrease in the number of surgeries. In the present study, the number of surgeries significantly decreased a couple of months after the first declaration of a state of emergency. The percentage of surgical cases detected by screening was also significantly reduced in the same period and conversely increased at the end of 2020. Of concern, the ratio of cStage I among cStage I–IV patients was significantly decreased in October 2020. These results suggest that a temporary decrease in cancer screening might have resulted in a decrease in early cancer detection.

The COVID-19 pandemic has reportedly led to a sustained reduction in the number of people referred, diagnosed, and treated for colorectal cancer [9], and screening

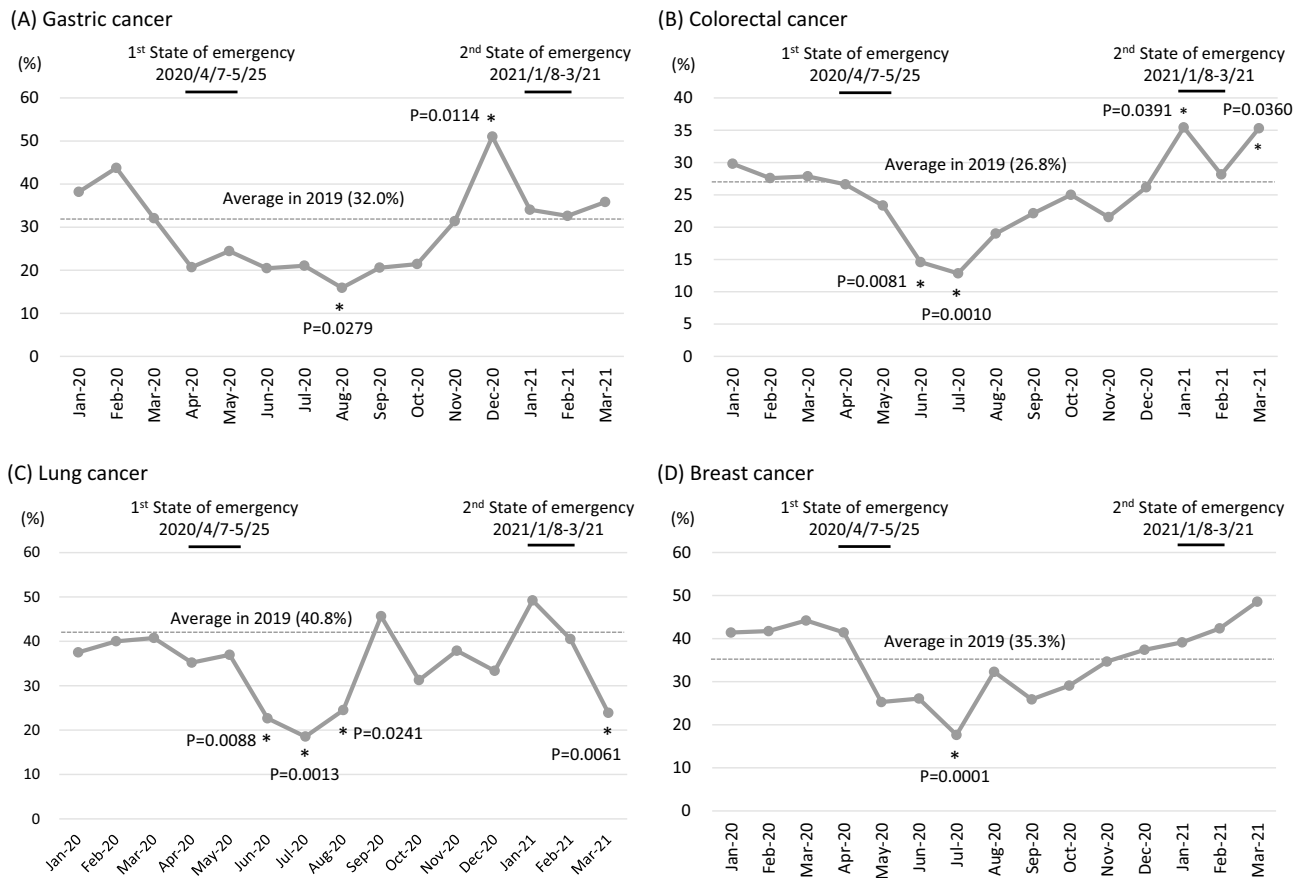


Fig. 3 Percentage of surgical cases detected by screening by month from January 2020 to March 2021 compared with average in 2019. **A** Gastric cancer. **B** Colorectal cancer. **C** Lung cancer. **D** Breast cancer. The asterisks indicate $p < 0.05$

delays may significantly increase the number of advanced cases as well as mortality [10]. It has also been reported that the delayed discovery of colorectal cancer in patients via screening during the pandemic resulted in an increase in obstructive colorectal cancer [11]. Our results show that a reduced proportion of screening cases as well as the total number of surgical cases was apparent a couple of months after the first state of emergency. We also discovered an increased proportion of screening cases in the first quarter of 2021 despite the second state of emergency being declared. These data suggest that the medical and administrative systems for the COVID-19 pandemic had been established and that cancer screening was being carried out appropriately. A review article recommended that elective surgery for colorectal cancer patients not be postponed for longer than 4 weeks, as available evidence suggests that extended delays in diagnoses are associated with poorer outcomes [12]. Although our results showed that there was no remarkable change in the cStage of colorectal cancer during the study period, further observations will be required to evaluate the influence of screening delay.

Of the four cancer types included in this study, lung cancer had the highest rate of detection by cancer screening before the pandemic period. It was reported that COVID-19 caused a significant disruption in lung cancer screening, leading to a decrease in new patients screened and an increased proportion of nodules suggestive of malignancy once screening resumed [13]. In New York City, there was an increase in Stage IV lung disease concomitant with easing of restrictions by lockdown [14]. In the present study, there was a decrease in the proportion of screening cases with lung cancer in some months following the pandemic. Extended longitudinal studies must be conducted to determine whether the pandemic will lead to increases in the proportion of patients with advanced lung cancer.

Regarding breast cancer, there was a decreased proportion of screening cases in August 2020. By contrast, multiple months between April 2020 and January 2021 showed a significant decrease in the proportion of cStage 0. The cause of this decrease is difficult to explain solely by the decrease in cancer screening cases and may have been primarily due to triage, whereby surgeons may have postponed

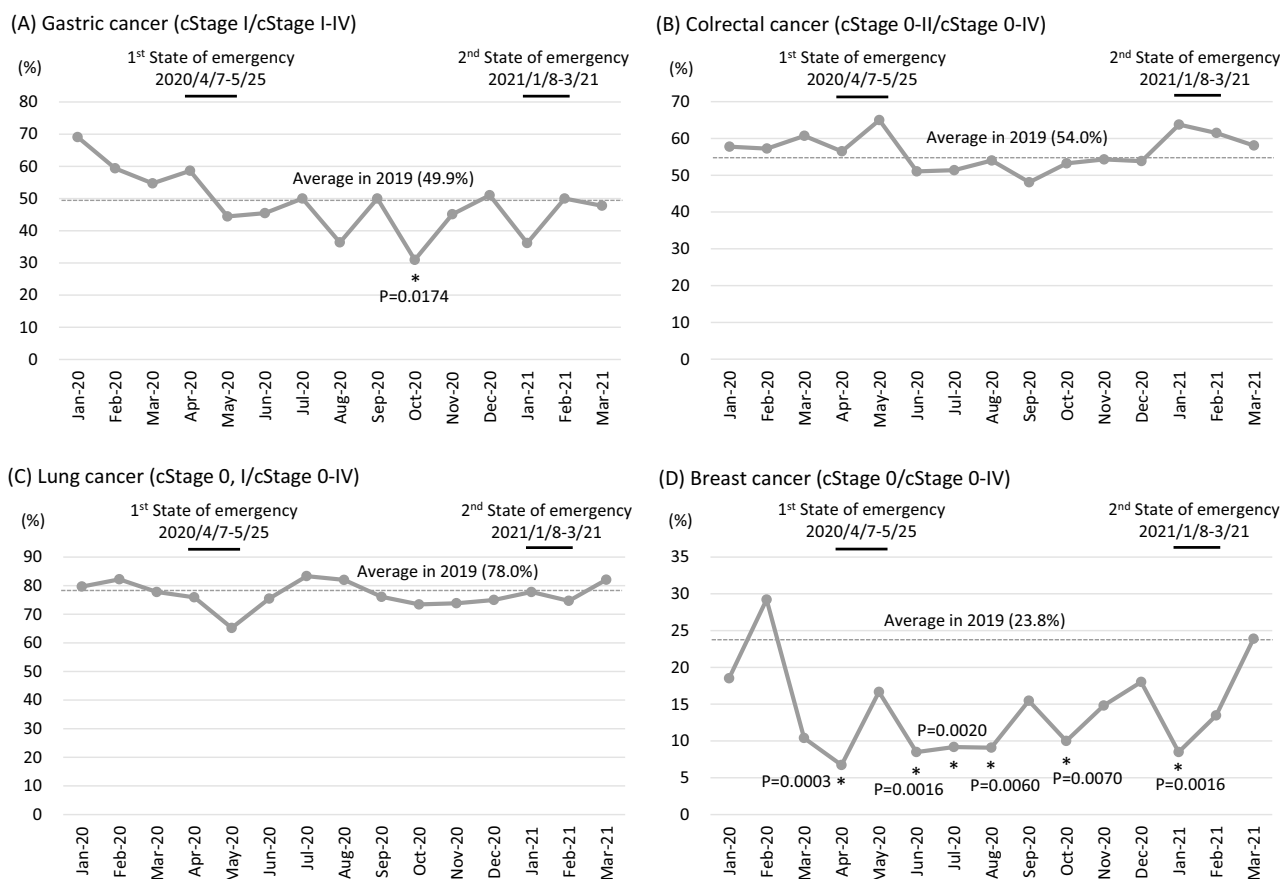


Fig. 4 Percentage of cStage of surgical cases by month from January 2020 to March 2021 compared with average in 2019. **A** Gastric cancer (cStage I/cStage I-IV). **B** Colorectal cancer (cStage 0-II/cStage

0-IV). **C** Lung cancer (cStage 0, I/cStage 0-IV). **D** Breast cancer (cStage 0/cStage 0-IV). The asterisks indicate $p < 0.05$.

surgery for cStage 0 patients. A multicenter cohort study and a population-based study in the Netherlands revealed that the temporary halt of screening for breast cancer resulted in fewer surgical procedures and a pronounced decrease in surgery for the lower tumor stages [15, 16]. The Japan Breast Cancer Society has published recommendations for the management of patients with breast cancer during the COVID-19 pandemic [17]. Proper management in line with guidance is important for preventing the deterioration of breast cancer outcomes.

Several limitations associated with the present study warrant mention. First, the survey was limited to only four types of cancer. We felt that the influence of the COVID-19 pandemic on cancer surgery in Japan could be evaluated by investigating cancer types with a high prevalence as well as a relatively high detection rate by screening. Similar investigations should thus be conducted for other cancer types as a next step. Second, this study focused only on surgery in the treatment of cancer. If we investigated not only surgery but also the number of cases of endoscopic treatment and chemotherapy during the same period, the overall trend in

cancer treatment in Gunma Prefecture would be able to be evaluated in greater detail. Third, this research was restricted to Gunma Prefecture. In Japan, changes in the number of cancer surgeries can be clarified through national projects, such as cancer registration and the NCD [18], but it may take years to clarify the actual situation contrived by the COVID-19 pandemic.

We conclude that the number of surgical cases detected by cancer screening for the four cancer types investigated in this study decreased in Gunma Prefecture due to the influence of the COVID-19 pandemic. Furthermore, the number of operations for patients with lower-stage cancer decreased in some cancer types. Given the concern that treatment outcomes of cancer patients will deteriorate, appropriate awareness of cancer screening is necessary, even more so during the COVID-19 pandemic.

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Declarations

Conflict of interest The authors have no relevant financial or non-financial interests to disclose.

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