JJCO Japanese Journal of Clinical Oncology

Japanese Journal of Clinical Oncology, 2022, 1–10
https://doi.org/10.1093/jjco/hyac129
Public Health Report

OXFORD

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Impact of the COVID-19 pandemic on the diagnosis of cancer in Japan: analysis of hospital-based cancer registries

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Received 24 February 2022; Editorial Decision 17 July 2022; Accepted 19 July 2022

Abstract

Background: There is significant concern that cancer care is adversely impacted due to the coronavirus disease pandemic. Using the national database, we document the impact of the pandemic on cancer diagnosis in Japan.

Methods: Data from 735 hospital-based cancer registries, covering >70% of newly diagnosed cases, were analysed. We compared trends during 2016–2019 and those in 2020 by the type of cancer, diagnostic process, stage and 13 prefectures as requiring special precautions to prevent the spread of infection.

Results: Overall, the number of patients who began treatment decreased by 1.9% in 2020 as compared with the average number during 2016–2019. A sharp decline of 13.8% was observed for stomach cases. The decline in cases (22.0% decrease for all cancers) was more pronounced in May. Cancer screening and resulting detection decreased significantly in 2020 (8.1–24.3%). Case registrations of stage I and II gastric cancer, stage II intrahepatic cholangiocarcinoma, stage II oesophageal cancer, stage 0 and I laryngeal cancer and stage II gallbladder cancer decreased by >10% compared with those in 2018 and 2019. The trends in cancer cases by area of residence indicated a decline in 13 prefectures in May 2020 compared with other areas.

Conclusions: The number of cancer diagnoses decreased during the year 2020 under coronavirus pandemic, especially right after the Japanese government declared the first state of emergency in April. We need to carefully observe the consequences of these decrease in diagnosis, or perhaps the delay in care, on patient survival or population mortality.

Key words: treatment, real-world data, neoplasms, hospital-based cancer registries, COVID-19

Introduction

The World Health Organization declared the coronavirus disease 2019 (COVID-19) a 'Public Health Emergency of International Concern' in January 2020. Since then, there has been a significant concern that COVID-19 has had a negative impact on cancer care (1). The primary concern was that people may refrain from consulting with a specialist even if they had symptoms, as they were concerned about getting infected with severe acute respiratory syndrome coronavirus 2 in clinical settings. Early simulation studies warned that the delay in care will have led to the substantial increase in the number of avoidable cancer deaths (2–6). Long-term effects of the COVID-19 pandemic can have a significant impact on cancer patient survival (2,6). Furthermore, recent reports on cancer care in several countries, including those from England and New Zealand, have reported that COVID-19 has led to a sustained reduction (40–63%) in the number of people referred, diagnosed and treated in the first half of 2020 (7–9). Although there is oscillation in the number of infected people, COVID-19 continues to be a major public health issue as of January 2022.

In Japan, the number of infected people increased since the first case was reported on 15 January 2020. The government declared the first state of emergency on 7 April 2020 and extended it until 25 May 2020 (10). The government also issued a notice to temporarily suspend or to postpone screening and health check-up services, including cancer screening, conducted in municipalities (11). A single-facility study reported that the number of inpatients and outpatients decreased during this first state of emergency (12). Kuzuu et al. reported that significantly fewer patients with stage I gastric and colorectal cancers were diagnosed in two hospitals in Kanagawa, during this period (13). In addition, the analysis of surgeries using the National Clinical Database reported that the number of most oncological (e.g. gastrectomy) and cardiovascular procedures (e.g. valve replacement + valve plasty) decreased in 2020 (14). These studies indicated that the effects of the COVID-19 pandemic might differ depending on cancer type.

In 2020, the number of people with COVID-19 in Japan varied monthly and between areas (10). As such, the number of people with COVID-19 was relatively high in large cities, such as Tokyo and Osaka, and tended to be low in rural areas. To address the needs of patients with cancer, especially when considering cancer treatment during future epidemics of emerging infectious diseases, we need to learn from the experience of COVID-19 in detail.

The purpose of this study was to clarify the impact of the COVID-19 pandemic on the diagnosis and detection of cancer in Japan by the type of cancer and prefecture, using the hospital-based cancer registries (HBCR), which register >70% of all new cancer cases in Japan.

Patients and methods

Data source

We used the national HBCR data from 735 hospitals, including all cancer care hospitals designated by the Ministry of Health, Labour and Welfare in Japan and other participating hospitals, which provided all data for cancer cases during 2016–2020. The HBCR database covers ~72% of patients newly diagnosed with cancer in Japan (15). Trained cancer registrars in a hospital registered each cancer case in the HBCR based on standardized rules and criteria (16). The HBCR includes information on demographic characteristics (sex and date of birth) and tumour characteristics [topography, morphology and the eighth Union for International Cancer Control (UICC) tumour node metastasis (TNM) Classification of Malignant Tumours stage). The National Cancer Center has published an annual cancer registry report since 2007. In addition to the routine statistical report, the 2020 report provided a comparison of the monthly trend of cancer cases during the COVID-19 pandemic. This study is based on this specific section of the 2020 report (17).

Identification of cancer cases

In Japan, patients can choose and have free access to hospitals where they want to receive cancer treatment. In the HBCR database, the class of case (COC) shows how the hospital was involved in the cancer treatment of the patients. For example, if a patient is diagnosed with cancer at 'Hospital A' and starts the first course treatment at 'Hospital B', the COC at 'Hospital A' is registered as a 'diagnosis only'. The HBCR does not collect identifiable information, such as names or unique numbers, of these patients. Thus, to avoid duplication, cases that started their first course of treatment in the registered hospitals were extracted from the HBCR database and the number of cases was compared by the month of diagnosis. To compare the number of cases by stage, epithelial cancers were selected because the UICC TNM classification does not apply to non-epithelial cancers, depending on the cancer site (17). From the cases diagnosed in 2018, the stage information was registered based on the eighth edition of the UICC TNM classification (18). Therefore, we used the data of cases diagnosed between 2018 and 2020 for the comparison of enrolment numbers by stage. Both the clinical and pathological UICC TNM classifications are registered in the HBCR. However, the pathological stage is not recorded for patients who receive chemotherapy or radiation therapy before undergoing surgical resection. In this analysis, we used a summary stage combining clinical and pathological stages; the pathological stage was used for patients who had this information available, whereas the clinical stage was used for those who lacked pathological stage information (19).

Data analysis

We defined the years 2016–2019 as the pre-COVID period, the most recent years before the COVID-19 pandemic, which would best predict the linear and seasonal patterns of cancer registries in 2020 in the absence of a pandemic. We compared the number of cases and monthly trends in 2020 with the average in the last 4 years by cancer site and route of detection (screening cases and non-screening cases). The non-screening cases included subjective symptoms and case which was detected by some tests during consultation with other disease. Data from cases diagnosed in 2018–2020 were used to compare the number of registered cases by summary stage. Using the detection process, we analysed five (stomach, lung, breast, colon/rectum and cervix uteri) cancers for which cancer screening is recommended by the Japanese government guidance. The number of registrations by stage was analysed for 18 common cancers (stomach cancer, colon cancer, hepatocellular carcinoma, intrahepatic cholangiocarcinoma, small cell lung cancer, non-small cell lung cancer, breast cancer, oesophageal cancer, pancreatic cancer, prostate cancer, cervical cancer, endometrial cancer, bladder cancer, laryngeal cancer, gallbladder cancer, kidney cancer, renal pelvis and ureter cancer and ovarian cancer) in Japan. In April 2020, the Ministry of Health, Labour and Welfare designated 13 prefectures (Tokyo, Osaka, Hokkaido, Ibaraki, Saitama, Chiba, Kanagawa, Ishikawa, Gifu, Aiti, Kyoto,

Table 1. The number of cases by cancer site

	The number of cases in 2020	The number of cases during 2016–2019 (average)	Difference in cases in 2020 and in 2016–2019	Proportionate difference
All cancers	765 201	780 054	–14 853	-1.9
Stomach, C16	76 756	89 063	−12 307	-13.8
Larynx, C32	4291	4762	−471	-9.9
Thyroid, C73	10 050	10 654	−604	-5.7
Liver, C22	22 208	23 428	−1220	-5.2
Cervix uteri, C53	26 890	28 157	−1267	-4.5
Colon, rectum, C18–20	120 453	125 807	−5354	-4.3
Prostate, C61	55 178	57 230	−2052	-3.6
Oesophagus, C15	22 556	23 280	−724	-3.1
Skin, C43–44	23 798	24 451	−653	-2.7
Multiple myeloma, C88–90	5221	5333	−112	-2.1
Gallbladder, bible duct, C23–24	13 961	14 248	−287	-2.0
Bones, joint and articular cartilage, C40–41	3073	3083	−10	-0.3
Kidney and other urinary organs, C64–66, 68	22 855	22 847	8	0.0
Ovary, C56	10 122	10 102	20	0.2
Brain, nervous system, C70–72	17 789	17 701	88	0.5
Lung, trachea, C33–34	90 096	89 538	558	0.6
Bladder, C67	29 310	28 922	388	1.3
Breast, C50	74 679	73 658	1021	1.4
Oral cavity and pharynx, C00–14	20 406	19 760	646	3.3
Malignant lymphoma, C81–85, C96	27 763	26 245	1518	5.8
Corpus uteri, C54	15 109	14 174	935	6.6
Pancreas, C25	29 312	27 143	2169	8.0
Leukaemia, C91–95	11 411	9765	1646	16.9

Hyogo and Fukuoka) as requiring special precautions to prevent the spread of infection (area under special precautions) among 47 prefectures. In this study, we compared the case registrations and cancer trends for each of these 13 prefectures (special precaution area) and other prefectures. We also compared the number of registrations for all cancer between 2019 and 2020 by hospital type. All statistical analyses were performed using Stata software (ver. 16.0; Stata Corporation, Texas, USA).

Ethical considerations

This work was conducted as part of the official operation of the Center for Cancer Registries, National Cancer Center, according to the Operational Guidelines of HBCRs issued by the Ministry of Health, Labour and Welfare, based on the Cancer Registry Act. All data included in this study are publicly available on the Cancer Information Service website of the National Cancer Center (17) According to the research ethics guidelines in Japan, studies operated by the law are exempted from ethical reviews. Thus, the need for informed consent was waived.

Results

In total, 3 885 417 cases diagnosed between 2016 and 2020 were included in the analysis. Overall, 765 201 cancer patients initiated treatment in 735 hospitals in 2020, indicating a 5.8% decrease from 2019 and a 1.9% decrease compared with the average number during 2016–2019 (Table 1). The number of cases reported in 12 of 23 cancer sites (namely; cancers of the stomach, larynx, thyroid, liver, cervix uteri, colon/rectum, prostate, oesophagus, skin, multiple myeloma, gallbladder, and bone, joint and articular cartilage) declined in 2020, compared with the average in the last 4 years. At the same time, the number of leukaemia and pancreatic cancer cases increased in 2020. The sharp decline was observed in cancers of the stomach (13.8%), followed by cancers of the larynx (9.9%). Looking at the monthly trends, there was a sharp decline in case registrations in May 2020 (22.0% for all cancers) (Fig. 1). Upon analysing case registration by area of residence, the rate of decline was slightly high in 13 prefectures (specific caution area) in May 2020 compared with other areas; however, this difference was not observed in the subsequent months (Fig. 2). The expected decrease in the number of cancer cases was 8.2% if the situation in May would continue, although the observed decline for the entire year of 2020 was 2.2%.

The number of cases detected by screening for the five cancer sites which the Japanese government recommended in 2020 ranged from 8.1 to 24.3%, lower than the average number in the past 4 years (Table 2). Analysis by cancer site indicated that the decrease was by 24.3% for cancers of the stomach in 2020, compared with the average value in the past 4 years. Compared with the monthly average during 2016–2019, the number of cases detected by screening decreased significantly between May and August, during which the first and second wave of COVID-19 pandemic occurred in Japan, and then gradually recovered towards December (Fig. 3). The number of cancer cases detected via non-screening cases including subjective symptoms and case which was detected by some tests during consultation with other disease also declined in May and August. The number of case registrations for the entire year (2020) was almost the same as the average number in the last 4 years, with an exception only in the case of stomach cancers (a decrease of 11.0%). Among the five cancer sites, the highest percentage of

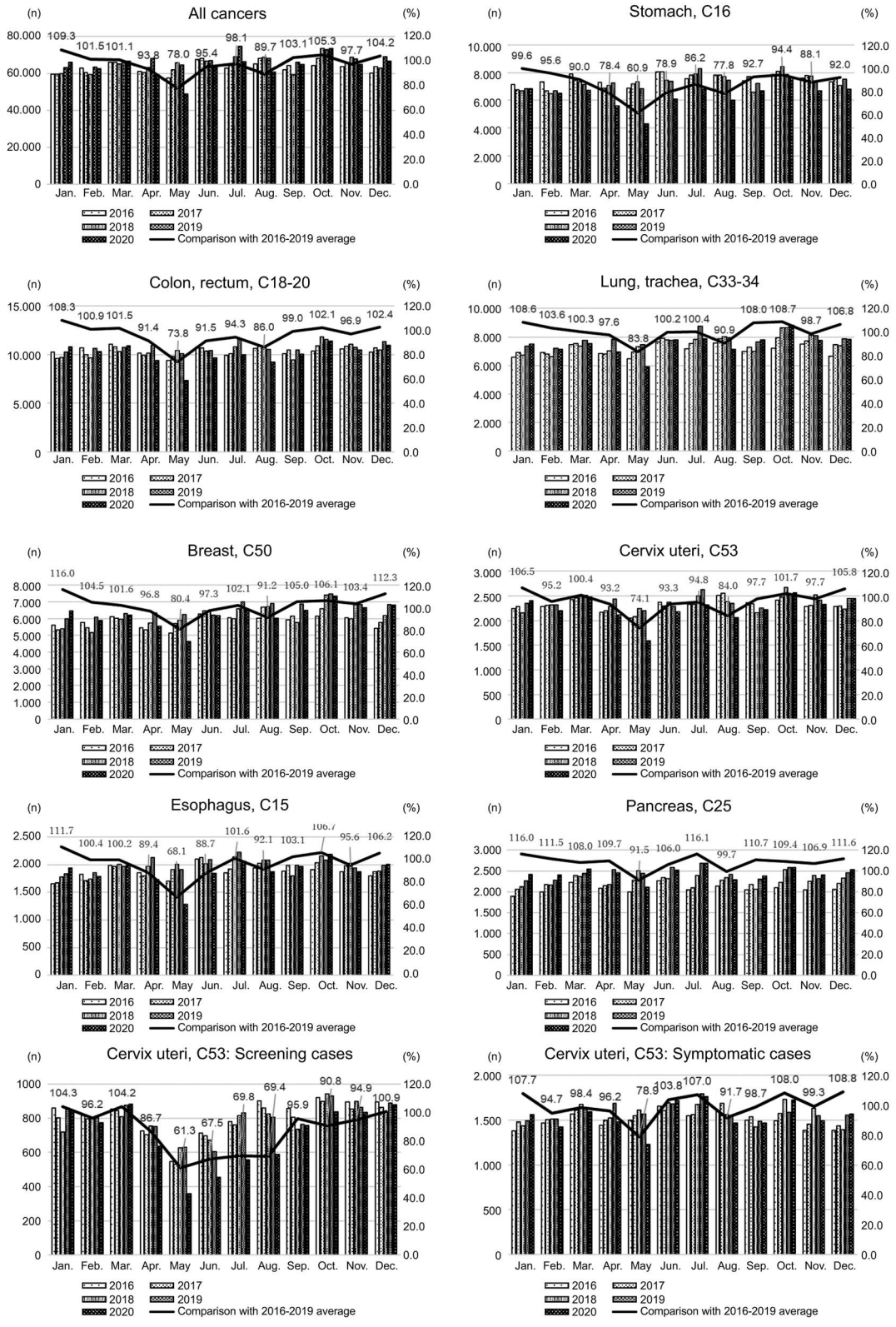

Figure 1. The number of cases diagnosed by the month of diagnosis (all cancer and major 7 cancer site)

cases with unknown route of detection was cervix cancer (1.3% in 2020); the percentage of an unknown case in all other sites was < 1.0%.

For the five (gastric, colorectal, non-small cell lung cancer, oesophageal and laryngeal) cancer types, the number of registrations in 2020 was lower than the average number during 2018–2019 in

Table 2. The number of cases by the process of detection

	The number of cases in 2020	The number of cases during 2016–2019 (average)	Difference in cases in 2020 and 2016–2019	Proportionate difference
All cancers				
Screening cases	113 442	129 010	−15 568	-12.1
Symptomatic cases	651 759	651 044	715	0.1
Stomach, C16				
Screening cases	14 152	18 690	−4538	-24.3
Symptomatic cases	62 604	70 373	−7769	-11.0
Colon, rectum, C18–20				
Screening cases	23 839	27 536	−3697	-13.4
Symptomatic cases	96 614	98 271	−1657	-1.7
Lung, trachea, C33–34				
Screening cases	14 704	16 291	−1587	-9.7
Symptomatic cases	75 392	73 247	2145	2.9
Breast, C50				
Screening cases	18 715	20 359	−1644	-8.1
Symptomatic cases	55 964	53 300	2664	5.0
Cervix uteri, C53				
Screening cases	8401	9558	−1157	-12.1
Symptomatic cases	18 489	18 599	−110	-0.6

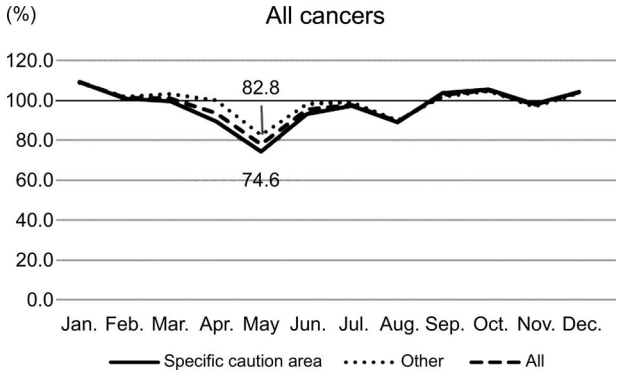

Figure 2. The number of cases diagnosed by the month of diagnosis (specific caution area). Specific caution area: 13 prefectures (Tokyo, Osaka, Hokkaido, Ibaraki, Saitama, Chiba, Kanagawa, Ishikawa, Gifu, Aiti, Kyoto, Hyogo and Fukuoka)

all stages, I–IV (Table 3). The number of case registrations for stage I and II gastric cancer, stage II intrahepatic cholangiocarcinoma, stage II oesophageal cancer, stage 0 and I laryngeal cancer and stage II gallbladder cancer decreased by >10%, compared with that in the past 2 years (2018 and 2019). The number of case registrations for stage I pancreatic cancer (26.5%), stage 0 gallbladder cancer (15.1%) and stage IV bladder cancer (13.7%) increased by >10%, compared with that in the previous 2 years. Among the 18 cancers, the highest percentage of cases with unknown stage was renal pelvis and ureter cancer (5.0% in 2020); the percentage cases with unknown stage in all other cancers were <4.0%.

The percentage change in registrations in 2020 compared with 2019 varied by hospital type. The number of registrations in the designated cancer care hospitals by the Ministry of Health, Labour and Welfare decreased by an average of 5.3% in 2020 compared with 2019. In contrast, other cancer hospitals showed an average decrease of 4.0% in the hospitals designated by the prefectures and 4.7% in other hospitals.

Discussion

This analysis of nationwide registry-based data was conducted to compare previous cancer registrations to assess the impact of the COVID-19 epidemic on cancer care in Japan in the year 2020. Consistent with the findings of previous reports from other countries, including the United Kingdom and New Zealand (7–9,20–22), this study illustrated that the number of cancer cases decreased significantly during the first wave of COVID-19, and this decrease was observed regardless of prefectures (specific caution area). Screening for cancer cases along with the number of non-screening cases including consultations due to subjective symptoms decreased during the first wave of the pandemic. It is likely that some patients refrained from availing health services. In the early stages of the COVID-19 pandemic, many aspects such as effective prevention and risk factors and treatment methods were unclear. We did not know whether to postpone health services. Now that effective vaccines and treatment are available, we should encourage people to seek care when necessary, such as cancer screening and treatment at the right time.

In the first wave of the COVID-19 pandemic, early detection was substantially affected. When many countries worldwide implemented a lock-down policy, Japan declared the first state of emergency in April and May and asked people to stay home. Furthermore, the Ministry of Health, Labour and Welfare issued a statement to temporarily suspend or to postpone cancer screening (11). The Japan Gastroenterological Endoscopy Society recommended that non-urgent gastrointestinal endoscopy, such as those for screening purposes and for mild symptoms, should be postponed (23). Compliance to these recommendations may explain the sharp drop that we observed in the number of stomach cancer cases diagnosed in May, and the number of cases for the year 2020 was lower than usual. As the majority of gastric cancer cases in Japan are diagnosed in early stages (62% are stage I in 2019) (24), the influence of these national movements

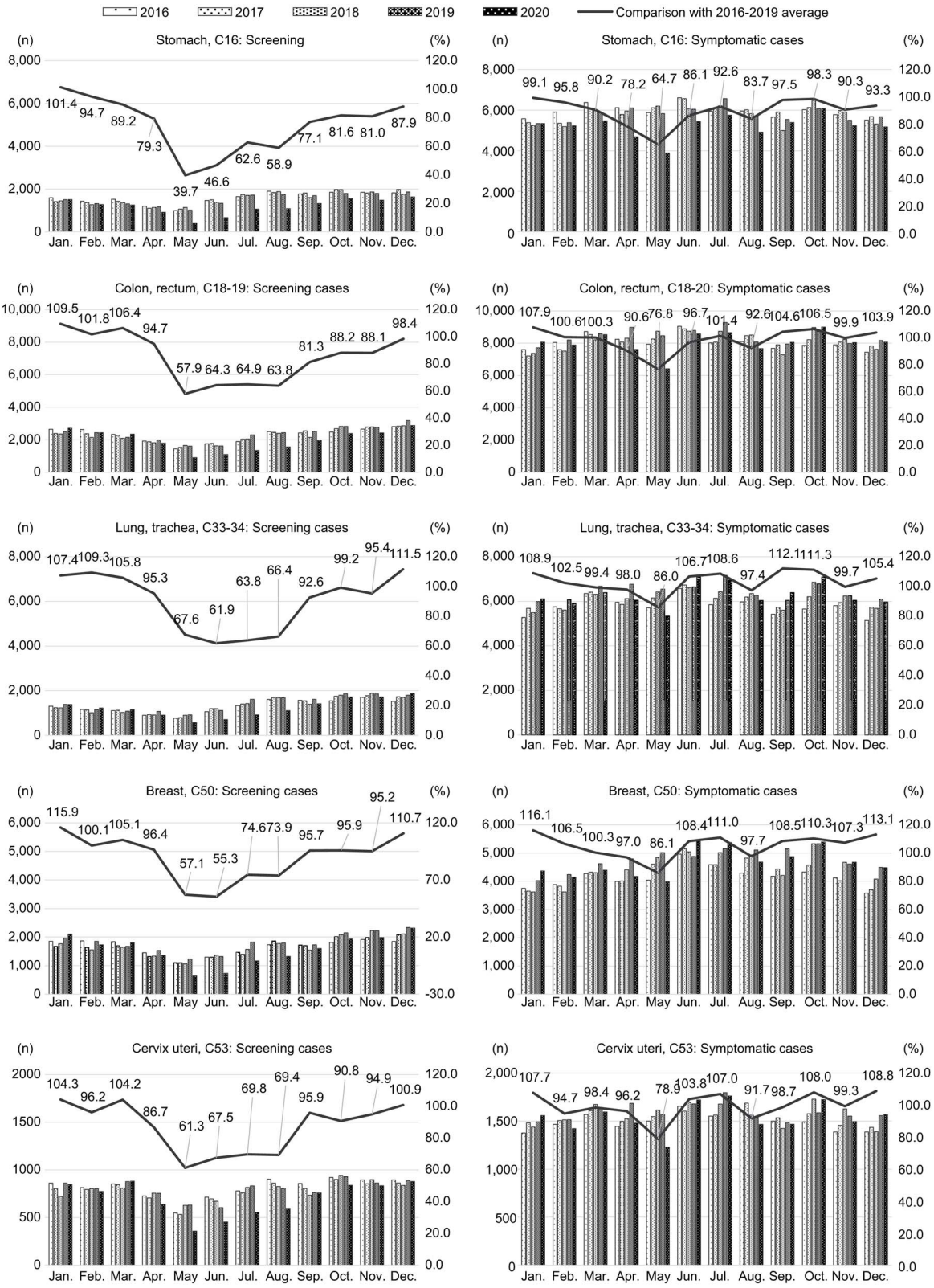

Figure 3. The number of cases registered monthly owing to cancer screening or others

Table 3. The number of cases by summary stage

	The number of cases in 2020	The number of cases during 2018–2019 (average)	Difference in the cases	Proportionate difference
Stomach cancer				
Stage I	45 356	53 570	−8214	-15.3
Stage II	6061	7040	−979	-13.9
Stage III	7176	7907	−731	-9.2
Stage IV	13 753	14 606	−853	-5.8
Colon cancer				
Stage 0	31 105	34 108	−3003	-8.8
Stage I	22 611	24 037	−1426	-5.9
Stage II	22 251	23 328	−1077	-4.6
Stage III	22 009	22 972	−963	-4.2
Stage IV	17 753	17 826	−73	-0.4
Hepatocellular carcinoma				
Stage I	8813	9263	−450	-4.9
Stage II	4511	4965	−454	-9.1
Stage III	2814	3028	−214	-7.1
Stage IV	1680	1657	23	1.4
Intrahepatic cholangiocarcinoma				
Stage I	562	594	−32	-5.4
Stage II	699	786	−87	-11.1
Stage III	735	707	28	4.0
Stage IV	1453	1380	73	5.3
Small cell lung cancer				
Stage I	600	582	18	3.1
Stage II	521	553	−32	-5.8
Stage III	2012	2124	−112	-5.3
Stage IV	4445	4633	−188	-4.1
Non-small cell lung cancer				
Stage 0	3087	3357	−270	-8.0
Stage I	32 488	32 929	−441	-1.3
Stage II	6668	7122	−454	-6.4
Stage III	12 914	13 297	−383	-2.9
Stage IV	24 497	24 679	−182	-0.7
Breast cancer				
Stage 0	9834	10 222	−388	-3.8
Stage I	30 332	31 532	−1200	-3.8
Stage II	22 165	22 737	−572	-2.5
Stage III	7516	7519	−3	0.0
Stage IV	4295	4065	230	5.7
Oesophageal cancer				
Stage 0	2615	2860	−245	-8.6
Stage I	8460	9105	−645	-7.1
Stage II	2334	2597	−263	-10.1
Stage III	3196	3226	−30	-0.9
Stage IV	4897	4999	−102	-2.0
Pancreatic cancer				
Stage 0	742	722	20	2.8
Stage I	6044	4777	1267	26.5
Stage II	4093	4361	−268	-6.1
Stage III	1822	1704	118	6.9
Stage IV	12 350	12 314	36	0.3
Prostate cancer				
Stage I	19 031	21 128	−2097	-9.9
Stage II	15 991	16 982	−991	-5.8
Stage III	9233	9804	−571	-5.8
Stage IV	10 162	10 111	51	0.5
Cervical cancer				
Stage 0	18 175	19 414	−1239	-6.4
Stage I	3552	3867	−315	-8.1

(*Continued*)

Table 3. Continued

	The number of cases in 2020	The number of cases during 2018–2019 (average)	Difference in the cases	Proportionate difference
Stage II	1397	1466	−69	-4.7
Stage III	2338	2379	−41	-1.7
Stage IV	1289	1266	23	1.8
Endometrial cancer				
Stage I	10 312	9999	313	3.1
Stage II	827	777	50	6.4
Stage III	1863	1864	−1	-0.1
Stage IV	1333	1295	38	2.9
Bladder cancer				
Stage 0	14 464	14 760	−296	-2.0
Stage I	7378	7399	−21	-0.3
Stage II	3350	3148	202	6.4
Stage III	2353	2249	104	4.6
Stage IV	1044	918	126	13.7
Laryngeal cancer				
Stage 0	285	346	−61	-17.6
Stage I	1620	1908	−288	-15.1
Stage II	906	971	−65	-6.7
Stage III	645	674	−29	-4.3
Stage IV	810	839	−29	-3.5
Gallbladder cancer				
Stage 0	298	259	39	15.1
Stage I	481	537	−56	-10.4
Stage II	754	835	−81	-9.7
Stage III	968	1034	−66	-6.4
Stage IV	2201	2311	−110	-4.8
Kidney cancer				
Stage I	10 465	10 813	−348	-3.2
Stage II	660	638	22	3.4
Stage III	1770	1814	−44	-2.4
Stage IV	1872	1739	133	7.6
Renal pelvis and ureter cancer				
Stage 0	1507	1395	112	8.0
Stage I	1153	1099	54	4.9
Stage II	892	884	8	0.9
Stage III	1682	1662	20	1.2
Stage IV	2056	2066	−10	-0.5
Ovarian cancer				
Stage I	5597	5653	−56	-1.0
Stage II	789	837	−48	-5.7
Stage III	2986	2960	26	0.9
Stage IV	1849	1781	68	3.8

was large. A similar effect was observed for other cancer types, for which screening is recommended. In contrast, the number of some cancer cases including leukaemia, pancreas, corpus uteri increased. This can be influenced by changes in the cancer registration system in Japan. Since the Cancer Registration Act came into effect in 2016, the registration targets of the HBCR were more clarified and the registration rules were reviewed. From 2016 to 2019, the number of registrations to the HBCR trended slightly upward. This will be considered to be due to more accurate registration rather than a true increase in the number of cancer patients. In addition, the number of pancreatic cases did not decrease, as suggested in a previous study (14). Pancreatic cancer is asymptomatic in the early stages. Therefore, in many cases, cancer progresses before it is detected. According to the Japanese HBCR cancer statistics in 2019, ∼40% of pancreatic cancer cases were detected at stage IV (24).

A previous study conducted in Kanagawa in 2020 reported the possibility of fewer cases detected for gastrointestinal cancer and that colorectal cancer may be diagnosed only at a more advanced stage (13). The results of our study showed that the number of cases was lower than usual at all stages, although the proportion of decrease in stage 0 to I cancer cases was large. Using a nationwide database, colorectal cancer was not found to be diagnosed at a more advanced stage. Future studies need to investigate the effects of delayed cancer detection at a relatively early stage.

Our study has some limitations. First, the HBCR data mainly covered relatively large hospitals, such as designated cancer care

hospitals. Although the data cover >70% of new cases in Japan, we could not determine whether patients visited other hospitals that treat the remaining 30% of the cases. In 2020, > 90% of the designated cancer care hospitals were treating patients with COVID-19 infections. (25) There is a possibility that the decrease in the number of cases we observed in our data may be due to the patients moving to other hospitals. Future studies using population-based cancer registry may shed light on the comprehensive dynamics during the pandemic. Second, although the number of cases has decreased, especially for relatively early-stage cancers, the effect on survival or mortality due to decreased screening remains unknown. Simulation studies have also indicated that advanced cancer and cancer-related deaths would increase after the COVID-19 pandemic (2,4,6), although these results need confirmation by real data in later years. Third, this study is based on the published report of the nationwide HBCRs. Therefore, additional analysis such as standardization of age distribution and statistical test was not included. These analyses should be performed after official permission for the secondary data analysis. Fourth, some people have some symptoms but still receive a cancer screening. Therefore, it is possible that some of the cases detected during screening may include those with symptoms. Finally, this report only covers the first year of the pandemic in Japan. Although the government declared a state of emergency and social activities were substantially reduced from April to May, the reduction was mainly voluntary. Our findings have limited generalizability to the different future situations in Japan with respect to the pandemic and cancer burden. The trends in cancer diagnosis may differ greatly in 2021 and beyond. We need to continuously monitor trends in cancer screening, diagnosis and treatment as well as outcomes, and to perhaps prepare guidelines for unforeseen conditions that can affect cancer management.

Conclusion

This study showed that the number of reported cancer cases decreased significantly during the first COVID-19 pandemic, regardless of cancer type, detection process, stage and prefecture. In the early stages of the pandemic, the epidemiology of COVID-19 was unclear. In addition to changes in the level of cancer screening, it is likely that patients did not seek health care at hospitals even if they had subjective symptoms and that hospitals were unable to handle the patient load. It is important that hospitals implement appropriate measures to control infections. Policies are required to increase awareness about infection prevention and the significance of early screening and addressing symptoms for better management and survival.

Funding

This study was supported by the Cancer Research and Development Fund of the National Cancer Centre, Japan (2020–A–20).

Conflict of interest

All authors were employed by the National Cancer Center, Japan and in charge of operating hospital-based cancer registry.

Acknowledgements

We thank the tumour registrars in the hospitals for their great work in registering data that enabled our analysis. We also thank Kondo S for his work in collecting HBCR data from the hospitals.

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