Impact of COVID-19 infection rates on admissions for ambulatory care sensitive conditions: nationwide difference-in-difference design in Japan

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ABSTRACT

Objectives SARS-CoV-2 infection (COVID-19) has affected tertiary medical institutions and primary care. Admission for ambulatory care sensitive conditions (ACSCs) is an important indicator of primary care quality. However, no nationwide study, especially in Asia, has examined the association between admissions for ACSCs and local surges in COVID-19. This study aimed to examine how the number of admissions for ACSCs has changed in Japan between the areas with higher and lower rates of COVID-19 infection.

Design This was a retrospective two-stage cross-sectional study. We employed a difference-in-difference design to compare the number of hospital admissions for ACSCs between the areas with higher and lower rates of COVID-19 infection in Japan.

Setting The study used a nationwide database in Japan.

Participants All patients were aged 20 years and above and were admitted due to ACSCs during the study period between March and September 2019 (before the pandemic) and between March and September 2020 (during the pandemic).

Results The total number of ACSC admissions was 464 560 (276 530 in 2019 and 188 030 in 2020). The change in the number of admissions for ACSCs per 100 000 was not statistically significant between the areas with higher and lower rates of COVID-19 infection: 7.50 (95% CI −87.02 to 102.01). In addition, in acute, chronic and preventable ACSCs, the number of admissions per 100 000 individuals did not change significantly.

Conclusion Although admissions for ACSCs decreased during the COVID-19 pandemic, there was no significant change between the areas with higher and lower rates of COVID-19 infection. This implies that the COVID-19 pandemic affected the areas with higher infection rates and the areas with lower rates.

INTRODUCTION

SARS-CoV-2 infection (COVID-19) has spread worldwide at the end of 2019. The WHO declared a pandemic in March 2020.[1] The high incidence of critically ill patients requiring intensive care during this period is associated with a significant burden on tertiary care facilities.[2][3] COVID-19 has had an impact on primary care as well.[4] For

WHAT IS ALREADY KNOWN ON THIS TOPIC

⇒ Although ambulatory care sensitive conditions (ACSCs) is an important quality indicator of primary care, there is no nationwide study, especially in Asia, examining the association between admission for ACSCs and COVID-19 infection.

WHAT THIS STUDY ADDS

⇒ This study revealed the number of hospital admissions for total and acute/chronic/preventable ACSCs before and during the COVID-19 pandemic in Japan. Although admissions for ACSCs decreased during the COVID-19 pandemic, there was no significant change between the areas with higher and lower rates of COVID-19 infection.

HOW THIS STUDY MIGHT AFFECT RESEARCH, PRACTICE OR POLICY

⇒ The clinical implications of the study are that COVID-19 affects the areas with higher infection rates and the areas with lower rates.

example, in the Netherlands, the pandemic has changed patient behaviour by increasing the number of hospital visits for respiratory symptoms and has decreased visits for chronic conditions and face-to-face consultations, while increasing the use of telemedicine.[5]

The pandemic hit Japan slightly later. The first case of COVID-19 was reported in January 2020.[6] The state of emergency was declared in Hokkaido, which is the northern part of Japan.[6] Subsequently, the state of emergency was declared in April.[6] The total number of COVID-19 infections in Japan exceeded 10 000 people.[6]

Avoidable hospital admissions (admissions for ambulatory care sensitive conditions (ACSCs)) are defined as hospitalisation that is avoidable if appropriate primary care is provided.[7][8] Admissions for ACSCs have been employed as a quality indicator to assess primary care outcomes.[9][10] Even under the COVID-19 pandemic, offering
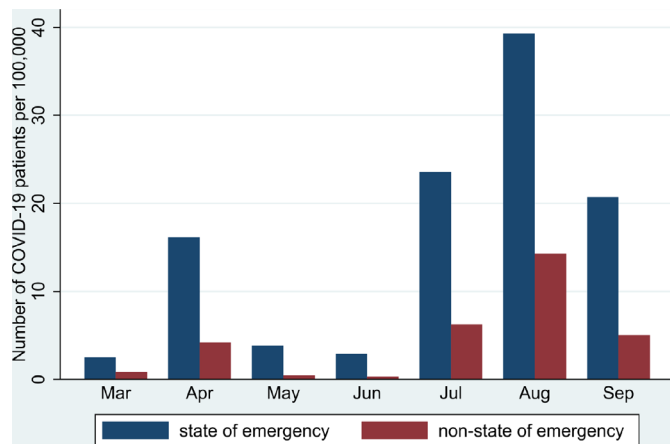
Figure 1 Number of COVID-19 patients per 100 000 people in prefectures with the state of emergency and without the state of emergency.

care for chronic diseases and prevention is an important aspect of primary care,[5] and appropriate control of admissions for ACSCs is essential to reduce the burden on secondary/tertiary care medical institutions.[11] The reason is that hospitals struggling with COVID-19 can be associated with poorer outcomes for other diseases[12–15] due to both COVID-19-specific factors and indirect factors.[13] On the other hand, increasing admission of patients with COVID-19 might suppress the hospitalisation due to other diseases especially, mild to moderate illnesses such as admissions for ACSCs. Although a study in one state in the USA reported that the number of admissions for ACSCs decreased during the pandemic,[16] there is no nationwide study, especially in Asia, examining the association between admission for ACSCs and COVID-19 infection. We hypothesised that the COVID-19 pandemic has increased admissions for ACSCs in epidemic areas due to primary care physicians' focus on patients with COVID-19 and patients' refraining from medical care.

This study aimed to examine: (1) How the total number of admissions for ACSCs has changed between the areas with higher and lower rates of COVID-19 infection and (2) How the number of admissions for acute ACSCs, chronic ACSCs and vaccine-preventable ACSCs has changed in Japan.

The results of the study would be useful to better understand how the COVID-19 pandemic has affected primary and secondary care in terms of ACSCs. In addition, describing admissions for ACSCs is important as basic information for analysing role-sharing between primary and secondary care during the pandemic.

METHODS
Design
We conducted a retrospective, two-stage, cross-sectional study.

Setting
We extracted data from the nationwide Japanese Diagnosis Procedure Combination (DPC) inpatient database[17 18] from March 2019 to September 2019 and the same period in 2020.

Participants
Inclusion criteria
All patients aged ≥20 years who were admitted due to ACSCs during the study period were eligible for inclusion. We only included the same hospitals in 2019 and 2020. There were no exclusion criteria in this study.

Data source
The DPC contains data from 7 million inpatients admitted to 1173 hospitals in 2019, which represents 50% of all discharges from acute care hospitals in Japan.[19] Hospital data were extracted from the Survey of Medical Institutions data in Japan.[19] The data include the main problems for admission, age, sex, postal code of a patient, procedures and treatment during hospitalisation, and length of stay. In this study, university hospitals and hospitals in the National Hospital Organisation were not included because they did not submit data at the time of data extraction. The organisation includes 140 hospitals and 52 600 beds in Japan.[20] The hospitals in the organisation mainly consist of tertiary medical centres.[20]

Data collection tools and procedures
The data included age, sex, diagnosis codes according to the International Classification of Diseases 10th Revision (ICD-10) and the Charlson Comorbidity Index (CCI),[21] and length of stay. We defined the period between March 2019 and September 2019 as before the COVID-19 pandemic and between March 2020 and September 2020 as after the start of the COVID-19 pandemic.

A main predictor of the study is 'the state of emergency' or not. This is an indicator of the areas with higher infection rates. In Japan, the declaration of the state of emergency is decided by the prime minister based on the bed occupancy rate for patients with COVID-19, the number of patients per 100 000 people, the number of new patients, etc, in each prefecture.[22] Under the state of emergency, people are requested to refrain from going out and travelling unnecessarily, avoid social gathering and to reduce commuting by telecommuting.[22] Also, restaurants that serve alcoholic beverages or have karaoke are asked to cooperate with closure requests and all other restaurants are requested to cooperate in closing by 20:00 hours.[22]

The Japanese government declared a state of emergency on 7 April 2020, for seven prefectures (Saitama, Chiba, Tokyo, Kanagawa, Osaka, Hyogo and Fukuoka), and the local government of the Hokkaido prefecture, the northern part of Japan, proclaimed the same on 28 February 2020. Although the Japanese government adopted measures for the entire country of Japan from 16 April, eight prefectures remained at the centre of the pandemic. Of the 47 prefectures in Japan, the patients

in the eight prefectures accounted for 72.5% of the total number of COVID-19 patients. We described the number of COVID-19 patients per 100 000 people in prefectures with the state of emergency and without the state of emergency in figure 1. Therefore, we compared data from these eight prefectures with those from other prefectures. The declaration of the state of emergency might be effective in reducing the reproduction number by requesting individuals to refrain from going out.[23]

Measures

The outcomes of this study were the numbers of the following four types of ACSCs per 100 000 people between the COVID-19 the areas with higher and lower rates of COVID-19 infection: (1) acute ACSCs (where early appropriate intervention can prevent more serious progression, eg, dehydration and gastroenteritis); (2) chronic ACSCs (where effective outpatient care can prevent exacerbation, eg, asthma, congestive heart failure and diabetes complications) (3) preventable ACSCs (where vaccination and other interventions can prevent illness, eg, influenza and pneumococcal pneumonia: the category

does not include COVID-19)[24] and (4) overall ACSCs (a composite of these three ACSCs). Table 1 lists the ICD-10 codes for the three ACSCs. Changes in the number of admissions for ACSCs in each month are described. In this study, we employed 19 ACSCs commonly used in the National Health Service in the UK.[24] The study excluded patients with COVID-19 from the number of admissions for ACSCs. We employed the population in Japan and each prefecture as of 1 October 2019 and 2020 due to data availability.[25]

Baseline data

We described age, sex, length of hospital stay and CCI of the patients admitted during the study period due to ACSCs.[19 21] We selected these variables based on the previous literature.[19 26]

Statistical analysis

Continuous variables were presented as mean, SD, median and IQR. Categorical variables were presented as numbers and percentages. We employed a difference-in-differences design to compare the number of

Table 1	ACSCs in this study: based on the National health service in the UK
Types of ACSCs	**ICD-10 code**
Acute ACSCs	
Dehydration and gastroenteritis	E86 K522 K528 K529
Pyelonephritis	N10 N11 N12 N136
Perforated/bleeding ulcer Cellulitis	K250 K251 K252 K254 K255 K256 K260 K261 K262 K264 K265 K266 K270 K271 K272 K274 K275 K276 K280 K281 K282 K284 K285 K286
Cellulitis	L03 L04 L080 L088 L089 L88 L980
Pelvic inflammatory diseases	N70 N73 N74
Ear, nose and throat infections	H66 H67 J02 J03 J06 J312
Dental conditions	A690 K02 K03 K04 K05 K06 K08 K098 K099 K12 K13
Convulsions and epilepsy	G40 G41 R56 O15
Gangrene	R02
Chronic ACSCs	
Asthma	J45 J46
Congestive heart failure	I110 I50 J81
Diabetes complication	E100 E101 E102 E103 E104 E105 E106 E107 E108 E110 E111 E112 E113 E114 E115 E116 E117 E118 E120 E121 E122 E123 E124 E125 E126 E127 E128 E130 E131 E132 E133 E134 E135 E136 E137 E138 E140 E141 E142 E143 E144 E145 E146 E147 E148
Chronic obstructive pulmonary disease	J20 J41 J42 J43 J47
Angina	I20 I240 I248 I249
Iron deficiency anaemia	D501 D508 D509
Hypertension	I10 I119
Nutritional deficiency	E40 E41 E42 E43 E550 E643
Preventable ACSCs	
Influenza and pneumonia	J10 J11 J13 J14 J153 J154 J157 J159 J168 J181 J188
Other vaccine preventable diseases	A35 A36 A37 A80 B05 B06 B161 B169 B180 B181 B26 G000 M014

.ACSCs, ambulatory care sensitive conditions; ICD-10, International Classification of Diseases, 10th Revision.

hospital admissions due to ACSCs between March 2019 and September 2019 (prepandemic) and March 2020 and September 2020 (during the pandemic).[19 26 27] As mentioned above, we compared prefectures under the state of emergency with prefectures not under the state of emergency. Also, as a subgroup analysis, we conducted a difference-in-difference analysis to compare the number of admissions for ACSCs each month in 2019 and 2020. All statistical analyses were conducted using StataCorp. 2017. Stata Statistical Software: Release 15., StataCorp. We conducted a difference-in-difference analysis by creating an interaction between time (2019 and 2020) and exposure (the state of emergency).[28]

RESULTS

The total number of ACSC admissions was 464 560 (276 530 in 2019 and 188 030 in 2020). Of the total number of admissions for ACSCs, the number of acute ACSCs was 143 074 (83 196 in 2019 and 59 878 in 2020), chronic ACSC admissions were 262 596 (153 495 in 2019 and

109 101 in 2020) and vaccine preventable ACSC admissions were 58 890 (39 839 in 2019 and 19 051 in 2020). In 2020, 74 959 ACSC admissions occurred in prefectures under the declared state of emergency. The total number of admissions for COVID-19 was 19 173 (male/female:11 128/8045) and the median age was 59 (IQR 39–78) years. Table 2 shows the characteristics of the participants.

Table 3 describes the changes in the number of ACSC admissions per 100 000 people before and during the COVID-19 pandemic. In prefectures under the state of emergency, the change in the number of admissions for ACSCs was not statistically significant: 7.50 (95% CI −87.02 to 102.01, p=0.873). Regarding acute, chronic and preventable ACSCs, the differences in the number of admissions were not significant: 2.57 (95% CI −38.54 to 43.69, p=0.901), 0.56 (95% CI −47.73 to 48.85, p=0.982), and 4.14 (95% CI −113.09 to 21.37), respectively.

Figure 2A–D shows the change in the number of admissions for ACSCs each month from March to September in 2019 and 2020.

Table 2 Characteristics of a cumulative total of the patients who were admitted due to ambulatory care sensitive conditions before and during COVID-19 pandemic in the prefectures declared a state of emergency and other areas

	Before COVID-19 pandemic		During COVID-19 pandemic	
	State of emergency	Others	State of emergency	Others
	115 672	160 858	74 959	113 071
Age, year, mean (SD)	73.1 (16.9)	74.1 (16.9)	74.0 (16.7)	75.0 (16.5)
Age, year, median (IQR)	77 (66–85)	78 (67–86)	78 (67–86)	79 (68–87)
Age category (%)				
20–24	1873 (1.6)	2344 (1.5)	1066 (1.4)	1349 (1.2)
25–29	1612 (1.4)	2104 (1.3)	979 (1.3)	1278 (1.1)
30–34	1620 (1.4)	2214 (1.4)	928 (1.2)	1292 (1.2)
35–39	1841 (1.6)	2442 (1.5)	1,082, (1.5)	1526 (1.4)
40–44	2426 (2.1)	3171 (2.0)	1415 (1.9)	2026 (1.8)
45–49	3556 (3.1)	4430 (2.8)	2210 (3.0)	3105 (2.8)
50–54	3945 (3.4)	4855 (3.0)	2608 (3.5)	3403 (3.0)
55–59	4473 (3.9)	5987 (3.7)	2883 (3.9)	3957 (3.5)
60–64	5517 (4.8)	7925 (5.0)	3497 (4.7)	5291 (4.7)
65–69	9090 (7.9)	12 833 (8.0)	5179 (6.9)	8247 (7.3)
70–74	12 739 (11.1)	16 586 (10.4)	8309 (11.1)	11,8111 (10.5)
75–79	16 764 (14.6)	21 199 (13.3)	10 506 (14.1)	14 659 (13.0)
80–84	18 432 (16.0)	24 721 (15.5)	11 922 (16.0)	17 644 (15.7)
85–89	18 432 (16.0)	26 287 (16.4)	11 886 (15.9)	18 985 (16.9)
90–94	10 657 (9.3)	17 415 (10.9)	7548 (10.1)	13 391 (11.9)
95-	3260 (2.8)	5532 (3.5)	2570 (3.5)	4468 (4.0)
Sex (%)				
Male	60 790 (52.6)	83 514 (51.9)	40 025 (53.4)	59 484 (52.6)
Female	54 882 (47.5)	77 344 (48.1)	34 934 (46.6)	53 587 (47.4)
Length of stay, median (IQR)	1 (1–3)	1 (1–3)	1 (1–4)	1 (1–4)
Charlson Comorbidity Index (IQR)	0 (0–2)	0 (0–2)	0 (0–2)	0 (0–2)

Table 3 Difference-in-differences analyses for changes in admissions for ambulatory care sensitive conditions (ACSCs) per 100 000 people in the prefectures declared a state of emergency and other areas

ACSCs	State of emergency		Other areas		Changes in admission for ACSCs by COVID-19	P value
	Before COVID-19	During COVID-19	Before COVID-19	During COVID-19		
Overall	188.52	132.80	248.20	200.33	7.50 (−87.02 to 102.01)	0.875
Acute	10.70	18.71	106.76	81.42	2.57 (−38.54 to 43.69)	0.901
Chronic	106.83	78.6	135.70	92.87	0.56 (−47.73 to 48.85)	0.982
Preventable	26.80	13.41	36.9	16.47	4.14 (−113.09 to 21.37)	0.634

DISCUSSION

This is a nationwide survey that describes admissions for ACSCs. A reduction in admissions for ACSCs due to the COVID-19 pandemic was not statistically significant between the areas with higher and lower rates of COVID-19 infection .

The results differed from our hypotheses. A possible reason may be the changes in individual lifestyle habits in both the areas with higher and lower rates of COVID-19 infection, such as wearing masks or washing hands, which can reduce or limit the number of acute and preventable ACSCs. In Japan, admissions for asthma also decreased, and one mechanism responsible

for this change was the adoption of these personal level hygiene measures.[29] In addition, 'staying home' to avoid contacting people affected by COVID-19[29 30] could be associated with a lack of significant changes in admissions for ACSCs all over Japan. Regarding preventable ACSCs, admission for influenza decreased in 2020 in Japan.[31] This could be associated with a reduction in preventable ACSCs in Japan. Second, regarding chronic ACSCs, a healthy lifestyle, even during the stay-home period, may have contributed to preventing an increase in the number of ACSC admissions. A small study in Japan reported that patients with diabetes had maintained or improved their dietary habits.[32] In addition,
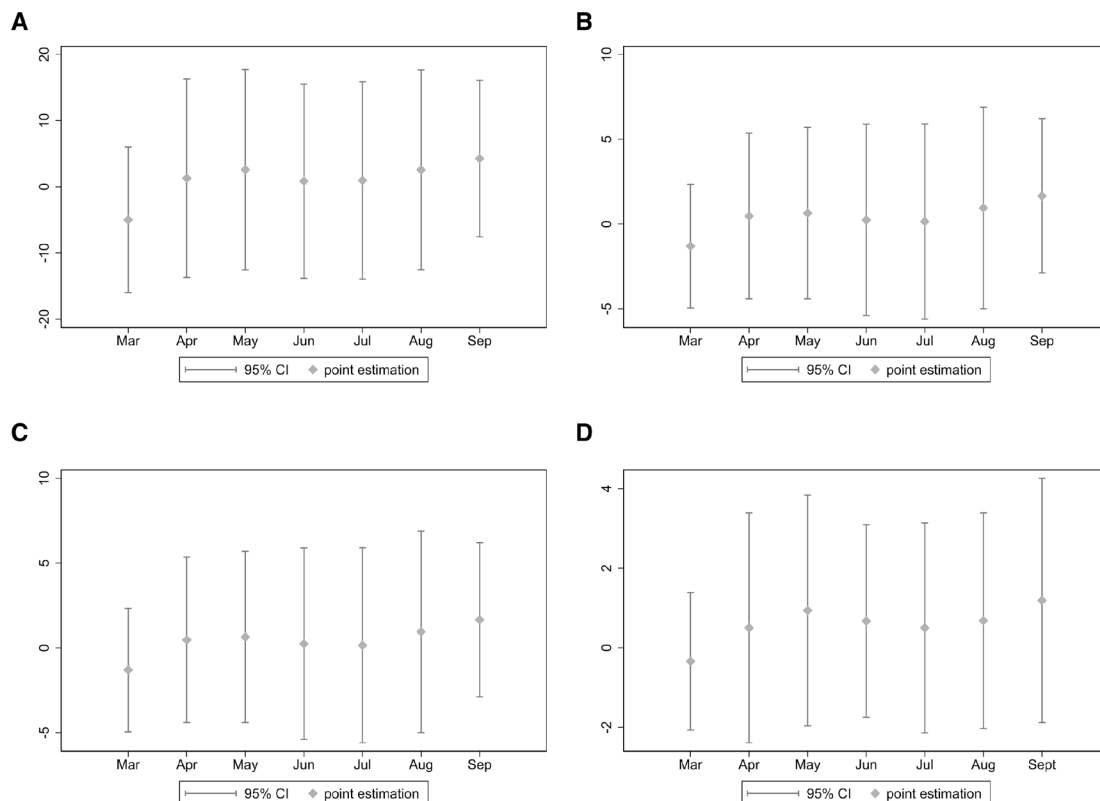

Figure 2 (A) Difference-in-differences analyses for changes in admissions for all ambulatory care sensitive conditions (ACSCs) per 100 000 people each month in the prefectures declared a state of emergency and other areas. (B) Difference-in-differences analyses for changes in admissions for acute ACSCs per 100 000 people each month in the prefectures declared a state of emergency and other areas. (C) Difference-in-differences analyses for changes in admissions for chronic ACSCs per 100 000 people each month in the prefectures declared a state of emergency and other areas. (D): Difference-in-differences analyses for changes in admissions for preventable ACSCs per 100 000 people each month in the prefectures declared a state of emergency and other areas.

patients might have avoided visiting hospitals to reduce the burden on medical institutions or to avoid contact with people with COVID-19[5 30] and thus might have implemented self-care. These changes might have occurred in both the areas with higher and lower rates of COVID-19 infection. Third, the Japanese government has provided hotels to non-critical patients with COVID-19 to prevent surges in hospital admissions.[30] This strategy might have been helpful in maintaining the quality of care in small-sized to medium-sized hospitals. Fourth, the impact of the pandemic on ACSC admissions might take a longer time. Thus, we must continuously evaluate the number of admissions for ACSCs.

The clinical implications of the study are that COVID-19 affects not only the areas with higher infection rates but also the areas with lower rates. Previous research has reported reductions in non-ACSC and ACSC hospitalisations during the COVID-19 pandemic. In addition, this study demonstrated that COVID-19 might influence healthcare use, even in the areas with lower infection rates. These results might be affected by multiple factors, such as changes in individual lifestyle, healthcare-seeking behaviour and health policy. In the areas with higher and lower rates of COVID-19 infection, primary care providers need to adjust to the change in healthcare use.

To the best of our knowledge, this is the first nationwide study to describe the impact of COVID-19 on ACSCs in the areas with higher and lower rates of COVID-19 infection. This study demonstrated the comprehensive status of ACSCs during the COVID-19 pandemic.

This study had some limitations. First, the definition of ACSCs in the study was developed in the UK[24] and its validity in Japan remains unclear.[19] There is currently no Japanese definition of ACSCs. As previous studies in Japan have employed the UK definition,[19 24 33] we used the same definition in this study. Second, this study did not include information on the socioeconomic status of patients, as admissions for ACSCs have been associated with lower socioeconomic status.[8] Since our dataset did not contain this information, our results need to be interpreted carefully. In addition, the lack of difference in admissions for ACSCs might be explained by the fear of exposure from going to the hospital.[34] To overcome this limitation, we need to consider the number of out-of-hospital mortalities due to ACSCs. However, there is no database to count the number of ACSCs in out-of-hospital settings in Japan. Lastly, because the study did not include university hospitals and hospitals of the National Hospital Organisation, we could not determine the status of admissions for ACSCs in these hospitals. The status in these tertiary care hospitals might change differently compared with community hospitals.

CONCLUSION

This study revealed the number of hospital admissions for total and acute/chronic/preventable ACSCs before and during the COVID-19 pandemic in Japan. Although admissions for ACSCs decreased during the COVID-19 pandemic, there was no significant change between the areas with higher and lower rates of COVID-19 infection. This implies that the COVID-19 pandemic affects the areas with higher infection rates and the areas with lower rates. Individual lifestyle habits, a patient's healthcare-seeking behaviour, and health policies may affect the results.

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