Original Article

Impact of coronavirus disease 2019 on the mortality of patients who received emergency transportation: a population-based cross-sectional study

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Aim: The spread of coronavirus disease 2019 (COVID-19) has a widespread impact on emergency medical care systems. However, its effects on the mortality of emergency transportation patients are unclear. This population-based, cross-sectional study investigated how COVID-19 impacted the mortality and outcomes of emergency transportation patients.

Methods: We compared mortality in the emergency department and at day 21 after an emergency visit for patients transported by ambulance to medical facilities in the Osaka Prefecture, Japan, between January 29 and December 31, 2020 (first pandemic year) and between January 29 and December 31, 2019 (immediate pre-pandemic year; 804,718 patients in total), using multivariable analysis to adjust for potential confounders.

Results: During the first pandemic year, 50,446 fewer patients received emergency transportation compared with the immediate prepandemic year. Emergency department deaths increased by 603 during the first pandemic year (4,922 versus 4,319 deaths) and 640 within 21 days (14,569 versus 13,929 deaths). Multivariable analysis revealed an association between the first pandemic year and increased mortality rates among patients given emergency transportation compared with the immediate prepandemic year (odds ratio for emergency department deaths 1.31; 95% confidence interval 1.26–1.38; odds ratio for deaths within 21 days 1.17; 95% confidence interval 1.14–1.20).

Conclusions: The study results indicate that the spread of COVID-19 impacted the mortality of patients who received emergency transportation. Further studies are expected to clarify the impact of COVID-19 on emergency medical care systems.

Key words: COVID-19, emergency medical care system, epidemiology, mortality, pandemic

BACKGROUND

CORONAVIRUS DISEASE 2019 (COVID-19) is a worldwide pandemic, and in Japan, a cumulative total of approximately 470,000 patients with COVID-19 were hospitalized by the end of March 2021.[1] The spread of COVID-19 requires the commitment of medical resources.[2] Therefore, the spread of COVID-19 can have a widespread impact on the emergency medical system and affect patient mortality. However, to date, the impact of the COVID-19 pandemic on patients requiring emergency transport has focused primarily on changes in patient numbers alone, such as a decrease in the total number of individuals transported to the hospital,[3] a decrease in the number of patients with trauma transported,[4] and an increase in the transported number of patients with out-of-hospital cardiac arrest (OHCA).[5] The impact of COVID-19 on the mortality of patients requiring emergency medical care has only been investigated for specific diseases.[5–7]

This study aimed to determine the impact of COVID-19 on the mortality and outcomes of all patients, including patients without COVID-19, given emergency

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transportation. It compares data for patients transported by ambulance to medical facilities within the Osaka Prefecture, Japan, approximately 1 year before and after the COVID-19 outbreak.

METHODS

Study design, population, and setting

THIS population-based cross-sectional study compared the data of all patients transported to a medical facility in the Osaka Prefecture by ambulance from January 29, 2020, to December 31, 2020 (defined as the first pandemic year), with those of patients transported to a medical facility in the Osaka Prefecture by ambulance from January 29, 2019, to December 31, 2019 (defined as the immediate prepandemic year). All data were collected using the Osaka Emergency Information Research Intelligent Operation Network system (ORION) described below. Medical transfers and patients with unknown acuity determination from the ambulance service, destination facility, or disease due to missing data were excluded.

Prehospital care systems and emergency care systems in the Osaka Prefecture

The Osaka Prefecture has a population of 8,840,000 (as of 2020), 27 fire departments, and 249 ambulances in operation. Emergency medical facilities that accept emergency transportation are divided into tertiary medical facilities that provide medical care to severe emergency cases and secondary emergency medical facilities that provide medical care to mild and moderate emergency cases. The Osaka Prefecture has tertiary medical facilities at 18 locations and secondary medical facilities at 267 locations, and tertiary medical facilities were primarily involved in accepting severe COVID-19 cases. Medical institutions in the Osaka Prefecture have approximately 65,000 beds for general patients and 600 beds in intensive care wards.

In the Osaka Prefecture and throughout Japan, patients can request for the dispatch of an ambulance anytime free of charge. Once transported to a medical facility, the universal health insurance system guarantees that patients will receive a certain standard of medical care for free or at a modest price.

The Osaka Emergency Information Research Intelligent Operation Network system

The structure of ORION has been described in detail in previous reports.[8] In summary, ambulance crews in the Osaka Prefecture carry smartphones installed with the ORION app at dispatch and enter information into the app at the scene, including patient observations and their actions, which are collected on a server. The app can determine the acuity of a case automatically and displays a list of medical facilities as candidate destinations. The staff at the destination medical facility also enter information gathered on the patient after arrival, such as disease and outcome, into an ORION-compatible format. This information is also collected on a server. The server automatically connects information of a patient entered by ambulance crews and medical facility staff, thus enabling the collection of a series of data points on any patient given emergency transportation in the Osaka Prefecture, from before to after arrival at the hospital.

Outcomes

We compared the mortality of all patients transported by ambulance to medical facilities within the Osaka Prefecture during the first pandemic year with that of patients transported by ambulance to medical facilities within the Osaka Prefecture in the immediate prepandemic year as the primary outcome.

First, we compared patient characteristics and outcomes, including disease classification (per the International Statistical Classification of Diseases and Related Health Problems Tenth Edition [ICD-10]). As ORION is designed to record the final outcomes at day 21 after arrival,[8] 21-day mortality was used as the final outcome in this study.

Next, we set emergency department (ED) outcomes and 21-day mortality as endpoints. We evaluated the association between these and the year of transportation to determine the impact of COVID-19 on the outcomes of the patients who were provided with emergency transportation. For this evaluation, we selected confounding factors to potentially influence the mortality rates of patients transported to the hospital by ambulance. These factors were age, sex, day of transportation (weekday or holiday/weekend), the timing of transportation (daytime or nighttime), acuity, category of destination facility, and time required for transportation. Acuity was determined by the triage system used by the Osaka Prefecture, which is based on a prehospital application of the Canadian Triage and Acuity Scale (CTAS).[9] Acuity was determined using three levels: Red 1 (approximately equivalent to resuscitation in the CTAS), Red 2 (approximately equivalent to emergent in the CTAS), and Yellow (approximately equivalent to urgent, less urgent, and nonurgent in the CTAS). The time required for transportation was divided into 0–30, > 30–45, > 45–60, and >60 min.[10]

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Statistical analyses

Continuous and categorical variables are represented as medians and interquartile ranges and actual values and percentages, respectively. To understand patient characteristics in the first pandemic year and to evaluate the association between COVID-19 and death, we performed a logistic regression analysis adjusted simultaneously for the aforesaid explanatory variables and calculated the odds ratio (OR) and 95% confidence interval (CI). We also performed two sensitivity analyses using the same method, each limited to a specific period. The first of these periods was 4 weeks of the study period with the smallest cumulative total number of daily COVID-19 admissions (January 29 to February 25, 2020), defined as the bottom phase, which was compared with the same period in 2019 (January 29 to February 25, 2019). The second of these periods was 4 weeks with the largest cumulative total number of daily COVID-19 admissions (December 4 to December 31, 2020), defined as the peak phase, which we compared with the same period in 2019 (December 4 to December 31, 2019). Analyses were performed using the EZR with the R statistical computing software (R Software for Statistical Computing, Vienna, Austria). All analyses used two-tailed tests.

RESULTS

DURING THE first pandemic year in the Osaka Prefecture, 30,036 people were diagnosed with COVID-19, and the cumulative total number of daily hospital admissions was 103,263. In the first pandemic and immediate prepandemic years, 859,521 patients were transported by ambulance to a medical facility and recorded in ORION, of which 804,718 were included in this study. A total of 54,961 patients were excluded due to transfer to another hospital, missing data, or other reasons (Fig. 1). It was found that 50,446 fewer patients received emergency transportation during the first pandemic year compared with the same period in the previous year.

Table 1 shows the patient characteristics in the first pandemic and immediate prepandemic years. In the first pandemic year, patients were older (mean age [years]: 71 versus 70), there was a higher proportion of transportation on weekdays (67.4% versus 64.9%), a higher transportation proportion during the daytime (43.3% versus 42.2%), and patients with OHCA (1.8% versus 1.5%) and a lower proportion of patients were transported to a tertiary medical facility (14.4% versus 15.6%).

Table 2 compares the time required for transportation, disease, and outcomes. Compared with that in the immediate prepandemic year, the time needed for transportation was longer during the first pandemic year (time required [min]: 33 versus 32), with a higher proportion of transportation times over 60 min. Regarding ED outcomes, the mortality rate was higher in the first pandemic year (1.3% versus 1.0%), which corresponded to an increase of 603 deaths. The 21-day mortality rate was also higher in the first pandemic year (3.9% versus 3.0%), which corresponded to an increase of 640 deaths.

Table 3 shows a comparison of 21-day outcomes by major ICD-10 disease groups. For all disease groups except Injury/

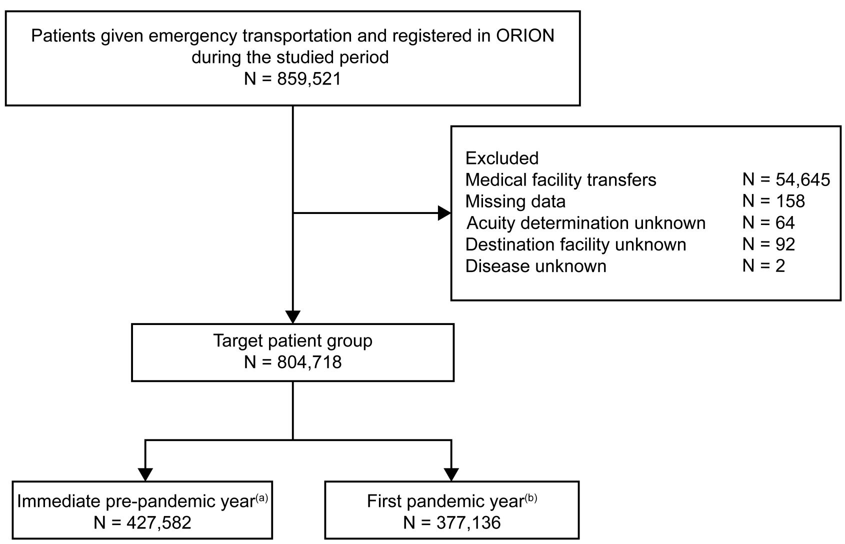

Fig. 1. Flowchart of the study design. [a]January 29 to December 31, 2019. [b]January 29 to December 31, 2020. ORION, Osaka Emergency Information Research Intelligent Operation Network system.

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Table 1. Patient characteristics among those given emergency transportation during the first pandemic and immediate prepandemic years

	Immediate prepandemic year (2019), (*n* = 427,582)	First pandemic year (2020), (*n* = 377,136)
Age, median (IQR)	70 (43–81)	71 (47–82)
Age category (in years), *n* (%)		
0–14	33,916 (7.9)	21,774 (5.8)
15–64	151,817 (35.5)	131,392 (34.8)
≥65	241,849 (56.6)	223,970 (59.4)
Male, *n* (%)	215,478 (50.4)	191,083 (50.7)
Day of transportation, *n* (%)		
Weekday	282,383 (64.9)	254,311 (67.4)
Holiday/Weekend	145,199 (35.1)	122,825 (32.6)
Timing, *n* (%)		
Daytime (9:00–16:59)	180,408 (42.2)	163,461 (43.3)
Nighttime (17:00–8:59)	247,174 (57.8)	213,675 (56.7)
Acuity, *n* (%)		
Red 1 (resuscitation)	26,600 (6.2)	24,505 (6.5)
Red 2 (emergent)	90,167 (21.1)	76,718 (20.3)
Yellow (urgent or below)	310,815 (72.7)	275,913 (73.2)
OHCA, *n* (%)	6,610 (1.5)	6,846 (1.8)
Category of destination facility, *n* (%)		
Tertiary medical facility	65,531 (15.3)	54,371 (14.4)
Secondary medical facility	362,051 (84.7)	322,765 (85.6)

IQR, interquartile range; OHCA, out-of-hospital cardiac arrest.

Table 2. Time required for transportation, diagnosed disease, and outcomes in the immediate prepandemic and first pandemic years

	Immediate prepandemic year (2019), (*n* = 427,582)	First pandemic year (2020), (*n* = 377,136)
Time required for transportation, min, median (IQR)	32 (26–39)	33 (27–40)
Window of time required, *n* (%)		
≤30 min	190,121 (44.5)	151,768 (40.2)
>30–45 min	184,472 (43.1)	168,481 (44.7)
>45–60 min	39,617 (9.3)	40,585 (10.8)
>60 min	13,372 (3.1)	16,302 (4.3)
Disease (ICD-10), *n* (%)		
Infectious/parasitic diseases (A/B)	17,525 (4.1)	13,967 (3.7)
Diseases of circulatory system (I)	45,922 (10.7)	44,463 (11.8)
Diseases of respiratory system (J)	36,071 (8.4)	27,145 (7.2)
Injury/External causes (S/T)	118,004 (27.6)	104,913 (27.8)
Other diseases	210,060 (49.1)	186,648 (49.5)
Emergency department outcome, *n* (%)		
Sent home	254,697 (59.6)	212,253 (56.3)
Admitted	162,596 (38.0)	154,268 (40.9)
Transferred	5,935 (1.4)	5,669 (1.5)
Death	4,319 (1.0)	4,922 (1.3)
Not examined	35 (0.0)	24 (0.0)
21-day survival, *n* (%)		
Survival	413,653 (96.7)	362,567 (96.1)
Discharged†	352,877 (82.5)	301,776 (80.0)
Continued hospitalization	60,776 (14.2)	60,791 (16.1)
Death	13,929 (3.3)	14,569 (3.9)

ICD-10, International Statistical Classification of Diseases and Related Health Problems Tenth Edition; IQR, interquartile range.
†Including patients who did not need hospitalization and went home.

External causes (S/T), mortality in the first pandemic year was higher than that in the immediate prepandemic year.

Table 4 shows the logistic regression analysis results for the association between COVID-19 and ED deaths. Compared with the immediate prepandemic year, the first pandemic year was associated with a higher ED mortality rate (OR 1.31; 95% CI 1.26–1.38). Transport to a tertiary facility was associated with a lower mortality (OR 0.81; 95% CI 0.77–0.86).

Table 5 shows the logistic regression analysis results for the association between COVID-19 and death within 21 days. Compared with the immediate prepandemic year, the first pandemic year was associated with a higher 21-day mortality rate (OR 1.17; 95% CI 1.14–1.20). Transportation to a tertiary facility was also associated with an elevated 21-day mortality rate (OR 1.46; 95% CI 1.41–1.51).

A sensitivity analysis was performed to compare the bottom and peak phases of the spread of COVID-19 in 2020 with the same periods in 2019. The peak phase was associated with higher ED and 21-day mortality rates, while there was no association between the bottom phase and higher mortality rates (Tables 4 and 5).

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Table 3. Year-on-year comparison of 21-day outcomes of patients given emergency transportation by major ICD-10 disease groups

	Infectious/parasitic diseases (A/B)		Diseases of circulatory system (I)		Diseases of respiratory system (J)		Injury/External causes (S/T)		Other diseases	
	Immediate prepandemic year (2019) (*n* = 17,525)	First pandemic year (2020) (*n* = 13,967)	Immediate prepandemic year (2019) (*n* = 45,922)	First pandemic year (2020) (*n* = 44,463)	Immediate prepandemic year (2019) (*n* = 36,071)	First pandemic year (2020) (*n* = 27,145)	Immediate prepandemic year (2019) (*n* = 118,004)	First pandemic year (2020) (*n* = 104,913)	Immediate prepandemic year (2019) (*n* = 210,060)	First pandemic year (2020) (*n* = 186,648)
Survival, *n* (%)	17,211 (98.2)	13,619 (97.5)	38,634 (84.1)	36,742 (82.6)	34,101 (94.5)	25,190 (92.8)	117,420 (99.5)	104,418 (99.5)	206,287 (98.2)	182,598 (97.8)
Discharged†, *n* (%)	16,074 (91.7)	12,159 (87.1)	25,653 (55.9)	23,634 (53.2)	24,933 (69.1)	17,168 (63.2)	100,310 (85.0)	87,328 (83.2)	185,908 (88.5)	161,488 (86.5)
Continued hospitalization, *n* (%)	1,137 (6.5)	1,460 (10.5)	12,981 (28.3)	13,108 (29.5)	9,168 (25.4)	8,022 (29.6)	17,110 (14.5)	17,090 (16.3)	20,379 (9.7)	21,110 (11.3)
Death, *n* (%)	314 (1.8)	348 (2.5)	7,288 (15.9)	7,721 (17.4)	1,970 (5.5)	1,955 (7.2)	584 (0.5)	495 (0.5)	3,773 (1.8)	4,050 (2.2)

ICD-10, International Statistical Classification of Diseases and Related Health Problems Tenth Edition.
†Including patients who did not need hospitalization and went home.

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Table 4. Association between COVID-19 and emergency department death adjusted for patient characteristics, time required for transportation, and disease

Patient characteristics, time required for transportation, disease	Main analysis†, OR (95% CI)	Sensitivity analysis (peak phase‡), OR (95% CI)	Sensitivity analysis (bottom phase§), OR (95% CI)
First pandemic year (versus immediate prepandemic year)	1.31 (1.26–1.38)	1.39 (1.21–1.59)	1.02 (0.88–1.17)
Age category (versus adult¶)			
Child††	0.13 (0.10–0.16)	0.12 (0.05–0.28)	0.08 (0.04–0.17)
Elderly‡‡	1.56 (1.47–1.66)	1.77 (1.46–2.15)	1.41 (1.16–1.71)
Male (versus female)	1.08 (1.03–1.13)	0.98 (0.85–1.12)	1.02 (0.89–1.17)
Holiday/Weekend (versus weekday)	1.03 (0.99–1.09)	1.12 (0.96–1.30)	0.91 (0.78–1.05)
Nighttime§§ (versus daytime¶¶)	1.54 (1.47–1.62)	1.74 (1.50–2.01)	1.62 (1.40–1.87)
Acuity (versus yellow)			
Red 1 (resuscitation)	259 (235–285)	200 (152–264)	230 (172–309)
Red 2 (emergent)	1.34 (1.12–1.59)	0.76 (0.42–1.40)	1.12 (0.64–1.94)
Tertiary medical facility (versus secondary facility)	0.81 (0.77–0.86)	0.73 (0.62–0.86)	0.84 (0.72–0.98)
Time required for transportation (versus $\leq$ 30 min)			
>30–45 min	0.50 (0.47–0.52)	0.56 (0.49–0.65)	0.46 (0.40–0.53)
>45–60 min	0.23 (0.21–0.26)	0.26 (0.19–0.35)	0.21 (0.15–0.30)
>60 min	0.13 (0.10–0.16)	0.07 (0.04–0.15)	0.12 (0.06–0.24)

CI, confidence interval; COVID-19, coronavirus disease 2019; OR, odds ratio.
†Analysis of the data obtained from January 29 to December 31, 2019 (immediate prepandemic year) and those obtained from January 29 to December 31, 2020 (first pandemic year).
‡Analysis of the data obtained from December 4 to December 31, 2019 (immediate prepandemic year) and those obtained from December 4 to December 31, 2020 (first pandemic year).
§Analysis of the data obtained from January 29 to February 25, 2019 (immediate prepandemic year) and those obtained from January 29 to February 25, 2020 (first pandemic year).
¶15–64 years.
††0–14 years.
‡‡≥65 years.
§§17:00 to 08:59.
¶¶09:00 to 16:59.

DISCUSSION

THIS population-based study indicated that the COVID-19 pandemic may have affected the mortality of patients who were provided with emergency transportation. We found that the first pandemic year was associated with higher ED and 21-day mortality rates. As fewer patients were transported to the ED in the first pandemic year compared with the immediate prepandemic year and the proportion of patients with the highest acuity (red 1) increased only slightly. These results suggest that the COVID-19 pandemic reduced the capacity of medical institutions in the Osaka Prefecture to treat emergency patients. The 603 more ED deaths that occurred in the first pandemic year compared with the previous year, which accounted for a large proportion of the increase in deaths within 21 days compared with the previous year (accounting for 94.2% of 640 deaths), suggests that the response capacity of ED may have been considerably reduced. The decline in ED response capacity may have been more severe in tertiary medical facilities. The proportion of transportation to tertiary medical facilities decreased during the first pandemic year despite transportation to a tertiary facility being associated with a reduced ED mortality rate. As tertiary medical facilities are principally responsible for treating patients with severe COVID-19 in the Osaka Prefecture, their treatment at tertiary facilities may impact the acceptance of patients who are seriously ill with other diseases into those facilities.

This study also indicated that the spread of COVID-19 changed the proportion of certain characteristics among

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Table 5. Association between the first pandemic year and 21-day mortality adjusted for patient characteristics, time required for transportation, and disease

Patient characteristics, time required for transportation, and disease	Main analysis†, OR (95% CI)	Sensitivity analysis (peak phase‡), OR (95% CI)	Sensitivity analysis (bottom phase§), OR (95% CI)
First pandemic year (versus immediate prepandemic year)	1.17 (1.14–1.20)	1.18 (1.09–1.29)	1.06 (0.97–1.15)
Age category (versus adult¶)			
Child††	0.10 (0.08–0.12)	0.10 (0.06–0.18)	0.10 (0.06–0.16)
Elderly‡‡	3.08 (2.98–3.20)	2.89 (2.58–3.24)	3.05 (2.70–3.44)
Male (versus female)	1.30 (1.26–1.33)	1.29 (1.19–1.40)	1.18 (1.08–1.28)
Holiday/Weekend (versus weekday)	0.97 (0.94–0.99)	1.01 (0.92–1.11)	0.94 (0.86–1.03)
Nighttime§§ (versus daytime¶¶)	0.98 (0.95–1.01)	1.02 (0.94–1.11)	1.00 (0.92–1.09)
Acuity (versus yellow)			
Red 1 (resuscitation)	22.8 (22.2–23.5)	23.1 (21.1–25.3)	24.0 (21.8–26.4)
Red 2 (emergent)	0.99 (0.95–1.04)	0.99 (0.87–1.13)	1.02 (0.89–1.16)
Tertiary medical facility (versus secondary facility)	1.46 (1.41–1.51)	1.34 (1.21–1.48)	1.56 (1.41–1.72)
Time required for transportation (versus ≤30 min)			
>30–45 min	0.76 (0.74–0.78)	0.80 (0.74–0.88)	0.76 (0.70–0.83)
>45–60 min	0.60 (0.57–0.63)	0.63 (0.54–0.73)	0.56 (0.48–0.66)
>60 min	0.54 (0.49–0.58)	0.59 (0.48–0.73)	0.42 (0.32–0.56)

CI, confidence interval; OR, odds ratio.
†Analysis of the data obtained from January 29 to December 31, 2019 (immediate prepandemic year) and those obtained from January 29 to December 31, 2020 (first pandemic year).
‡Analysis of the data obtained from December 4 to December 31, 2019 (immediate prepandemic year) and those obtained from December 4 to December 31, 2020 (first pandemic year).
§Analysis of the data obtained from January 29 to February 25, 2019 (immediate prepandemic year) and those obtained from January 29 to February 25, 2020 (first pandemic year).
¶15–64 years.
††0–14 years.
‡‡≥65 years.
§§17:00 to 08:59.
¶¶09:00 to 16:59.

patients provided emergency transportation. Interestingly, fewer patients were provided emergency transportation in the first pandemic year. The proportion of patients transported with the highest acuity (red 1) and on weekdays increased. A single-site investigation of patient characteristics among ED visits during an epidemic phase in Thailand found no change related to the day of transportation,[11] which differed from the findings of this study. However, the Thai study was conducted during a period of national lockdown. By contrast, Japan, including the Osaka Prefecture, took measures that led to restrictions on going out on specific days of the week and at specific times of the day, such as requesting restaurants to stop operations at night as well as requesting leisure facilities to close on holidays. This may have resulted in a COVID-19 increase in the proportion of patients who received emergency transportation on weekdays and in the daytime. The behavior of high acuity patients merits further discussion. Although some studies have reported no decrease in the proportion of high acuity patients visiting the ED during the pandemic phase,[12] others have shown worsening outcomes due to withholding of care.[13] Although the results of this study did not reveal whether high acuity patients refrained from emergency visits, some education of the general population is probably needed such that high acuity patients do not avoid requesting emergency care services.

This study investigated patients given emergency transportation that included mortality without focusing on specific diseases. As all Japanese citizens have equal access to a

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certain standard of medical care, these findings from a population-based study should also have implications for public health. Of particular note, this population-based study revealed that the COVID-19 epidemic affected the mortality of patients given emergency transportation.

This study had some limitations. First, we used a single year, 2019, to make a comparison, although there is no certainty that this could be a representative year before the pandemic. Second, this study only examined emergency transportation patients and gathered no data on ambulatory ED visits. Therefore, this study cannot be considered a thorough evaluation of preparedness for emergency patients. Third, as our work was an observational study, unknown confounding factors that impacted the results may have been overlooked. Finally, as we have no detailed data on patient severity evaluated after arrival, inpatient wards, treatment details after arrival, the date of confirmed outcome, and progress after day 21, this study was unable to assess medical care systems after transportation in detail.

CONCLUSIONS

IN CONCLUSION, THIS population-based study indicated an association between the COVID-19 pandemic and increased mortality rates among emergency transportation patients. The results of this study may provide fundamental findings helpful in clarifying the impact of COVID-19 and other potential infectious diseases on emergency medical care systems. Future studies on the treatment of emergency patients after they are brought to medical institutions and on changes in prognosis in specific situations, such as the state of emergency, are warranted to further clarify the impact on emergency medical systems.

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DISCLOSURES

APPROVAL OF THE Research Protocol with Approval No. and Committee Name: The protocol for this research project has been approved by a suitably constituted Ethics Committee of the institution and it conforms to the provisions of the Declaration of Helsinki; Ethics Committee of the Rinku General Medical Center, Approval No. 2020–024, as it complied with the ethical norms outlined in the Declaration of Helsinki.

Informed Consent: The requirement for informed consent was waived by the Rinku General Medical Center committee, as the collected data were anonymized, and personal information, such as name, date of birth, and address, was removed. All methods were performed in accordance with the relevant guidelines and regulations.

Registry and the Registration No. of the Study/trial: N/A.

Animal Studies: N/A.

Conflict of Interest: None declared.

AUTHOR CONTRIBUTIONS

SN AND TM conceived and designed the study. JM and YK supervised data collection. JM, YK, and TK managed the data, including quality control. SN and TM analyzed the data. SN drafted the manuscript, and all authors contributed substantially to its revision. TM takes responsibility for the paper as a whole. All authors read and approved the final manuscript.

DATA AVAILABILITY STATEMENT

THE DATA THAT support the findings of this study are available from the administration of Osaka Prefecture, but restrictions apply to the availability of these data, which were used under license for the current study, and so are not publicly available. Data are, however, available from the authors upon reasonable request and with permission of the administration of the Osaka Prefecture.

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