Original Article

Impact of the COVID-19 pandemic and subsequent social restrictions on ambulance calls for suicidal and nonsuicidal self-harm: a population-based study in Osaka prefecture, Japan

Shunichiro Nakao,1 Yusuke Katayama,1 Kenta Tanaka,2 Tetsuhisa Kitamura,2 Tomoya Hirose,1 Jotaro Tachino,1 Taku Iwami,3 Takeshi Shimazu,4 Jun Oda,1 and Tetsuya Matsuoka5

1Department of Traumatology and Acute Critical Medicine, Osaka University Graduate School of Medicine, Osaka, Japan, 2Division of Environmental Medicine and Population Sciences, Department of Social and Environmental Medicine, Osaka University Graduate School of Medicine, Osaka, Japan, 3Department of Preventive Services, School of Public Health, Kyoto University, Kyoto, Japan, 4Osaka General Medical Center, Osaka, Japan, and 5Rinku General Medical Center, Osaka, Japan

Aim: Self-harm is a common ambulance call and is potentially affected by the COVID-19 pandemic. The aim of this study was to investigate whether the incidence of ambulance transport due to self-harm increased in 2020.

Methods: We undertook a population-based observational study using a database from the Osaka prefectural government. Ambulance transport of patients due to self-harm from 2016 through 2020 was investigated. We estimated adjusted incidence rate ratios using a Poisson regression model to compare the annual incidence rates of ambulance transport in 2017–2020 with those in 2016. We also provided age-stratified analysis.

Results: We analyzed 13,648 patients. There was no difference in the incidence of ambulance transport due to self-harm in 2017, 2018, 2019, and 2020 compared with 2016. In the age group of 20–29 years, despite no difference in 2017–2019 compared with 2016, we found a 13.8% increase in the incidence of ambulance transport due to self-harm in 2020 (adjusted incidence rate ratio, 1.138; 95% confidence interval, 1.025–1.265).

Conclusions: Although there was no difference in the incidence of ambulance transport due to self-harm in 2017–2019, that in 2020 increased in the age group of 20–29 years.

Key words: Ambulance transport, COVID-19 pandemic, mental health, population-based research, self-harm

INTRODUCTION

The coronavirus disease 2019 (COVID-19) pandemic was declared by the World Health Organization in March 2020 and has become a global public health emergency.1,2 Many countries implemented a variety of nonpharmaceutical interventions (NPIs) to control the pandemic, including lockdowns, travel restrictions, and social distancing.3,4 A previous systematic review supported physical distancing and wearing of face masks to reduce the risk of infection.5 Although it is necessary to control the person-to-person transmission of and reduce the morbidity and mortality caused by COVID-19, restrictions on the activities of people by these infection control measures can affect their mental health as opportunities for social and physical interaction with others are important for maintaining mental health. Furthermore, economic activity would have to be restrained, unemployment would increase, and life would become more difficult. Unemployment and
increased economic burdens can significantly affect mental health problems. In the COVID-19 pandemic, there is an urgent need for research on mental health problems and to find ways to mitigate their consequences.

Self-harm is a common reason for an ambulance call and a significant public health concern. Some reports describe decreased hospital presentation for self-harm after the introduction of lockdown in England and decreased mental health presentations to emergency departments as the number of COVID-19 patients increased in Western Australia. However, there are several reports worldwide that suggest an increase in the incidence of self-harm during the COVID-19 pandemic. The COVID-19 pandemic has imposed a tremendous burden on the emergency medical services (EMS) in Japan. Because the number of COVID-19 patients rapidly increased in April 2020, the Japanese government declared a state of emergency that applied to prefectures with surging numbers of infections, including Tokyo and Osaka. Japanese municipal governments had also implemented NPIs, such as the temporary closure of schools, promoting telework, refraining from going out, cancelling large-scale events, and requesting restaurants and bars to temporarily close.

The COVID-19 pandemic and these behavioral restrictions have potentially had some impact on ambulance calls related to suicidal and nonsuicidal self-harm in Japan. However, there is still insufficient information available on the impact of the COVID-19 pandemic on ambulance calls due to mental health problems. The aim of this study was to investigate whether the incidence of patients with suicidal and nonsuicidal self-harm who were brought to the emergency departments by ambulance increased in 2020 compared to previous years. The age-stratified incidence rates were also calculated to identify the vulnerable age groups.

METHODS

Study design, setting, and data sources

We undertook a population-based observational study using the database from the ORION (Osaka emergency information Research Intelligent Operation Network) system, which is a comprehensive area-based database operated by the Osaka prefectural government. The ORION includes the following information on patients transported by fire departments in Osaka prefecture: ambulance calls, ambulance transport records, Utstein template for cardiopulmonary arrest, hospital selection and transport criteria, and hospital information on main diagnoses and treatment. The database covers the entire area of Osaka prefecture (population, 8.82 million; area, 1899 km²), and the system has been in operation since January 2013, with hospital data also being collected since January 2015. The ORION database included information on ambulance transport records, which were collected for administrative purposes with a standardized electronic form. The data were completed by EMS personnel and then transferred to the information center at the local fire department. If the data were incomplete, they were returned to the relevant EMS personnel for completion. The health-care system in Japan has been based on universal health coverage since 1961, and the ambulance service in Japan is a public service completely free of charge.

The medical institutional review board of Osaka University Graduate School of Medicine approved this study and waived the need for informed consent because all analyses used anonymous data (approval no. 15003).

Population

We included all emergency patients in the ORION database with a record of self-harm as the reason for transport during 2016 through 2020. “Self-harm” was one of the selectable reasons for transport by EMS personnel and was defined as any act of self-poisoning or self-injury regardless of suicidal ideation. This decision was made by EMS personnel based on on-site observations and an EMS interview with the patient. We excluded patients who were transported within 21 days between hospitals as their survival data were unknown, those with missing survival data, and those who left hospital without being seen by a physician.

Variables

Data were collected using standardized data collection forms and included age, sex, location of the event (private residence, public place, road, workspace, and others), time of the event (time of day, day of week, and month of year), main diagnosis at the emergency department to identify methods of self-harm, disposition on arrival day, 21-day outcomes after admission, and 21-day in-hospital mortality. We categorized age into eight groups: 19 years and younger, 20–29 years, 30–39 years, 40–49 years, 50–59 years, 60–69 years, 70–79 years, and 80 years and older. Time of day was categorized into four periods: 0:00 to 5:59, 6:00 to 11:59, 12:00 to 17:59, and 18:00 to 23:59. Day of the week was categorized as weekday (Monday to Friday) or weekend (Saturday or Sunday). We categorized the method of self-harm as the following groups based on the main diagnosis at the emergency department: self-poisoning, trauma, hanging/asphyxiation, burn, and unknown. In case the main diagnosis did not reflect the method of self-harm (e.g., pneumonitis...
due to solids and liquids), it was categorized as unknown. Disposition on arrival day and 21-day outcome after admission were both categorized as admission, discharge, and death.

**Statistical analysis**

Continuous variables are presented as the median and interquartile range and categorical variables as counts and percentages. Incidence rates of ambulance transport due to self-harm per 100,000 person-years were calculated using annual population reports from Osaka prefecture. To compare the incidence rates of ambulance transport due to self-harm and all-cause in-hospital mortality within 21 days in 2017 through 2020 with those in 2016, we estimated unadjusted and adjusted incidence rate ratios (IRR) with 95% confidence intervals (CIs) using a Poisson regression model with a log (population) offset term for population of Osaka prefecture in 2019. The covariates included in adjusted analyses were age groups, sex, and month of year. We calculated age-stratified IRRs for ambulance transport due to self-harm to identify the vulnerable age groups. We also estimated IRRs stratified by sex. In addition, we calculated IRRs comparing between remaining pairs of years.

All tests were two-tailed, and P values of less than 0.05 were considered to indicate statistical significance. All statistical analyses were undertaken with R Statistical Software (version 3.6.2; R Foundation for Statistical Computing, Vienna, Austria).

**RESULTS**

**Study patients**

FIGURE 1 shows the patient flow of the study. During the study period, 2,333,651 ambulance transports were recorded in the ORION database and 14,827 emergency patients were transported due to self-harm. Among them, 13,648 patients were eligible for this study. There were 2,760 patients in 2016, 2,753 patients in 2017, 2,592 patients in 2018, 2,720 patients in 2019, and 2,841 patients in 2020. The incidence rate of ambulance transport was 30.9 cases per 100,000 person-years in the total population; the incidence rates in each year were 31.3, 31.2, 29.4, 30.7, and 32.1 in 2016, 2017, 2018, and 2019, respectively. Patient characteristics and their yearly trends are summarized in Table 1. The median age of the overall patient population was 40 years (interquartile range, 26–53 years). The largest age group was 20–29 years (23.7%), followed by 40–49 years (19.5%). Female patients (68.1%) were more than twice as frequent as male patients (31.9%). Most of the self-harm patients were transported from private residences (82.7%). The most common time of day was 18:00 to 23:59 (31.6%), followed by 12:00 to 17:59 (24.9%). The most common month of the year was September (9.4%), followed by July (9.2%). The most frequent method of self-harm was self-poisoning (44.2%). Overall, 21-day in-hospital mortality was 15.7%, and 21-day in-hospital mortality in each year was 15.1%, 15.5%, 16.7%, 14.7%, and 16.6% in 2016, 2017, 2018, 2019, and 2020, respectively.

**Analyses of IRR for self-harm and mortality**

Table 2 shows the results of analyses for incidence rates of ambulance transport due to self-harm. Compared with the numbers of ambulance transports due to self-harm in 2016, there was no statistically significant difference in the incidence of ambulance transport due to self-harm in 2017 (adjusted IRR, 1.010; 95% CI, 0.958–1.065; P = 0.712), 2018 (adjusted IRR, 0.983; 95% CI, 0.931–1.037; P = 0.525), 2019 (adjusted IRR, 0.992; 95% CI, 0.941–1.046; P = 0.766), or 2020 (adjusted IRR, 1.030; 95% CI, 0.978–1.086; P = 0.268). Table 3 shows the results of analyses for 21-day in-hospital mortality. Compared with the 21-day in-hospital mortality in 2016, there was no statistically significant difference in that in 2017 (adjusted IRR, 0.982; 95% CI, 0.958–1.065; P = 0.712), 2018 (adjusted IRR, 0.995; 95% CI, 0.931–1.037; P = 0.525), 2019 (adjusted IRR, 0.973; 95% CI, 0.941–1.046; P = 0.766), or 2020 (adjusted IRR, 0.976; 95% CI, 0.978–1.086; P = 0.268). Comparisons between remaining pairs of years showed no statistically significant difference (Table S4).

**Incidence rate ratios by age group**

Table 4 describes the results of analyses for age-stratified incidence rates of ambulance transport due to self-harm. In the age group of 20–29 years, compared with the incidence of ambulance transport due to self-harm in 2016, there was no statistically significant difference in the incidence in 2017 (adjusted IRR, 0.993; 95% CI, 0.889–1.109; P = 0.899), 2018 (adjusted IRR, 1.012; 95% CI, 0.905–1.131; P = 0.836), or 2019 (adjusted IRR, 1.031; 95% CI, 0.924–1.150; P = 0.590). However, there was a 13.8% increase in the incidence of ambulance transport due to self-harm in 2020 (adjusted IRR, 1.138; 95% CI, 1.025–1.265; P = 0.016), which was statistically significant (Table 4). In the age group of 40–49 years, there was also a statistically significant increase in the incidence of ambulance transport due to self-harm in 2017 (adjusted IRR, 1.128; 95% CI, 1.006–1.265; P = 0.040), but the difference was not statistically significant in other years. We did not observe any
statistically significant difference in incidence rates among the other age groups.

In the analyses stratified by sex, we did not observe any difference in the incidence of ambulance transport due to self-harm (see Table S1, which shows overall in-hospital mortality rate ratios for all-cause in-hospital mortality within 21 days from 2016 through 2020 by sex). In the analyses stratified by age and sex, although there was no difference in any age group in male patients, the incidence of ambulance transport due to self-harm in female patients increased statistically significantly in the age group of 20–29 in 2020 (adjusted IRR, 1.170; 95% CI, 1.037–1.320; \(P = 0.011\)) and in the age group of 40–49 years in 2017 (adjusted IRR, 1.203; 95% CI, 1.047–1.383; \(P = 0.009\)), but it decreased in the age group of 30–39 years in 2018 (adjusted IRR, 0.865; 95% CI, 0.749–0.998; \(P = 0.047\)) compared with the incidence of ambulance transport due to self-harm in 2016 (see Tables S2 and S3, which show incidence rate ratios of patients with self-harm from 2016 through 2020 by age group in male and female patients). Comparisons between remaining pairs of years showed the same trends with these results (Table S5).

**DISCUSSION**

We reported the comprehensive analysis of the characteristics of patients with ambulance transport due to self-harm and investigated the incidence rates from 2016 through 2020 using a population-based database. We did not observe a statistically significant difference in the incidence rates of ambulance transport due to self-harm and 21-day in-hospital mortality in these patients in 2017 through 2020 compared to those in 2016. However, in the age group of 20–29 years, the adjusted IRR of the incidence rate of ambulance transport due to self-harm was significantly greater in 2020 than in 2016. The subgroup analysis by sex showed the same trend in female patients but not in male patients.

In 2020, the COVID-19 pandemic and the related government responses could have affected mental health in the young population. A systematic review of surveys undertaken with the general public reported that the COVID-19 pandemic caused anxiety, depression, and psychological stress.\(^\text{22}\) Fake news on social media and wrong information disseminated on mass media are a growing problem, and especially young people might be negatively affected.\(^\text{23}\) The increased strain on childcare due to temporary closure of schools, refraining from going out, and cancelling of large-scale events could also affect young adults. Our study suggested that the age group of 20–29 years could be more vulnerable to mental health problems brought about by the COVID-19 pandemic and the related environmental changes than other age groups.

Although the reason for the increase in ambulance transport due to self-harm in the age group of 20–29 years in 2020 remains unclear, our study showed this age group to be the largest of all the age groups and suggested that urgent interventions in mental health-care for the young population are required as NPIs and behavioral restrictions still appear to be necessary to control the COVID-19 pandemic in Japan. Promoting timely access to mental health-care and enhancing financial and social support could contribute to decrease the incidence of self-harm.\(^\text{24}\) Moreover, a previous study argued that many acute care hospitals in Japan were not able to provide appropriate psychiatric care for patients who engaged in self-harm.\(^\text{25}\) Initiating psychiatric care intervention in the emergency hospitals receiving these patients could help to improve patient care for those who visit the emergency department due to self-harm. Aside from infection control, modifying access to the diagnosis and treatment...
Table 1. Characteristics of patients transported by ambulance due to self-harm from 2016 through 2020, Osaka prefecture

| Characteristic                        | Total | 2016 | 2017 | 2018 | 2019 | 2020 |
|---------------------------------------|-------|------|------|------|------|------|
| **n = 13,648**                        |       |      |      |      |      |      |
| Incidence rate, cases per 100,000 person-years | 30.9  | 31.3 | 31.2 | 29.4 | 30.7 | 32.1 |
| Age, years; median, Q1–Q3             | 40    | 40   | 41   | 40   | 39   | 38   |
|                                        | 53    | 53   | 52   | 54   | 53   | 53   |
| Age group, years; n (%)               |       |      |      |      |      |      |
| ≤19                                   | 1,046 | 7.7  | 164  | 174  | 6.3  | 212  |
|                                       |       |      |      |      |      |      |
| 20–29                                 | 3,231 | 23.7 | 654  | 608  | 22.1 | 590  |
|                                       |       |      |      |      |      |      |
| 30–39                                 | 2,511 | 18.4 | 554  | 493  | 17.9 | 480  |
|                                       |       |      |      |      |      |      |
| 40–49                                 | 2,665 | 19.5 | 545  | 635  | 23.1 | 487  |
|                                       |       |      |      |      |      |      |
| 50–59                                 | 1,758 | 12.9 | 323  | 361  | 13.1 | 335  |
|                                       |       |      |      |      |      |      |
| 60–69                                 | 970   | 7.1  | 230  | 207  | 7.5  | 186  |
|                                       |       |      |      |      |      |      |
| 70–79                                 | 897   | 6.6  | 181  | 174  | 6.3  | 185  |
|                                       |       |      |      |      |      |      |
| ≥80                                   | 570   | 4.2  | 109  | 101  | 3.9  | 117  |
|                                       |       |      |      |      |      |      |
| Sex, n (%)                            |       |      |      |      |      |      |
| Male                                  | 4,351 | 31.9 | 907  | 843  | 32.5 | 834  |
|                                       |       |      |      |      |      |      |
| Female                                | 9,297 | 68.1 | 1,853| 1,749| 67.5 | 1,873|
|                                       |       |      |      |      |      |      |
| Location, n (%)                       |       |      |      |      |      |      |
| Private residence                     | 11,290| 82.7 | 2,287| 2,283| 82.9 | 2,152|
|                                       |       |      |      |      |      |      |
| Public place                          | 1,111 | 8.1  | 219  | 210  | 7.6  | 202  |
|                                       |       |      |      |      |      |      |
| Road                                  | 613   | 4.5  | 130  | 129  | 4.7  | 117  |
|                                       |       |      |      |      |      |      |
| Workplace                              | 116   | 0.8  | 24   | 24   | 0.9  | 19   |
|                                       |       |      |      |      |      |      |
| Other                                  | 518   | 3.8  | 100  | 107  | 3.6  | 102  |
|                                       |       |      |      |      |      |      |
| Time of day, n (%)                    |       |      |      |      |      |      |
| 0:00–5:59                             | 3,176 | 23.3 | 646  | 636  | 23.1 | 603  |
|                                       |       |      |      |      |      |      |
| 6:00–11:59                            | 2,758 | 20.2 | 542  | 590  | 21.4 | 552  |
|                                       |       |      |      |      |      |      |
| 12:00–17:59                           | 3,404 | 24.9 | 724  | 660  | 24.0 | 631  |
|                                       |       |      |      |      |      |      |
| 18:00–23:59                           | 4,310 | 31.6 | 848  | 867  | 31.5 | 806  |
|                                       |       |      |      |      |      |      |
| Day of week, n (%)                    |       |      |      |      |      |      |
| Weekday                               | 9,927 | 72.7 | 2,027| 1,989| 72.2 | 1,885|
|                                       |       |      |      |      |      |      |
| Weekend                                | 3,721 | 27.3 | 733  | 764  | 27.8 | 707  |
|                                       |       |      |      |      |      |      |
| Month, n (%)                          |       |      |      |      |      |      |
| Jan                                   | 1,082 | 7.9  | 222  | 234  | 8.5  | 208  |
|                                       |       |      |      |      |      |      |
| Feb                                   | 978   | 7.2  | 217  | 218  | 7.9  | 169  |
|                                       |       |      |      |      |      |      |
| Mar                                   | 1,101 | 8.1  | 225  | 210  | 7.6  | 204  |
|                                       |       |      |      |      |      |      |
| Apr                                   | 1,064 | 7.8  | 233  | 248  | 9.0  | 206  |
|                                       |       |      |      |      |      |      |
| May                                   | 1,184 | 8.7  | 233  | 263  | 9.6  | 219  |
|                                       |       |      |      |      |      |      |
| Jun                                   | 1,216 | 8.9  | 249  | 235  | 8.5  | 218  |
|                                       |       |      |      |      |      |      |
| Jul                                   | 1,256 | 9.2  | 218  | 250  | 9.1  | 241  |
|                                       |       |      |      |      |      |      |
| Aug                                   | 1,209 | 8.9  | 237  | 248  | 9.0  | 238  |
|                                       |       |      |      |      |      |      |
| Sep                                   | 1,280 | 9.4  | 263  | 243  | 8.8  | 250  |
|                                       |       |      |      |      |      |      |
| Oct                                   | 1,196 | 8.8  | 233  | 223  | 8.4  | 229  |
|                                       |       |      |      |      |      |      |
| Nov                                   | 1,068 | 7.8  | 246  | 196  | 7.1  | 215  |
|                                       |       |      |      |      |      |      |
| Dec                                   | 1,014 | 7.4  | 184  | 185  | 6.7  | 195  |
|                                       |       |      |      |      |      |      |
| Method of self-harm                   |       |      |      |      |      |      |
| Self-poisoning                        | 6,027 | 44.2 | 1,092| 1,143| 41.5 | 1,188|
|                                       |       |      |      |      |      |      |
| Self-injury                           | 3,869 | 28.3 | 782  | 798  | 28.3 | 789  |
|                                       |       |      |      |      |      |      |
| Hanging/asphyxiation                  | 349   | 2.6  | 64   | 60   | 2.3  | 63   |
|                                       |       |      |      |      |      |      |
| Burn                                  | 23    | 0.2  | 3    | 5    | 0.2  | 5    |
|                                       |       |      |      |      |      |      |
| Unknown                                | 3,380 | 24.8 | 819  | 756  | 27.5 | 623  |

© 2022 The Authors. Acute Medicine & Surgery published by John Wiley & Sons Australia, Ltd on behalf of Japanese Association for Acute Medicine.
of COVID-19, ensuring continuity of care for mental health service users, and paying attention to new patients with mental health problems could also address the mental health concerns in the public.26

We also observed increases in the overall incidence of self-harm in the age group of 40–49 years in 2017 and in the incidence of self-harm among female patients in this age group in 2017, along with a decrease in the incidence of self-harm in the age group of 30–39 years in 2018. Although the exact reason for these findings is unclear, it might be explained by the results of a previous study that showed an association between self-harm in midlife and financial problems.27 The number of corporate bankruptcies in Osaka prefecture peaked in 2017, which can cause

| Table 1. (Continued) |
|----------------------|
| Characteristic       | Total | 2016 | 2017 | 2018 | 2019 | 2020 |
| Disposition on arrival day, n (%) |       |      |      |      |      |      |
| Admission            | 5,934 | 43.5 | 1,119| 40.5 | 1,195| 43.4 |
| Discharge            | 6,263 | 45.9 | 1,347| 48.8 | 1,277| 46.4 |
| Death                | 1,451 | 10.6 | 294  | 10.7 | 281 | 10.2 |
| 21-day outcome after admission, n (%) |       |      |      |      |      |      |
| Admission            | 550   | 9.3  | 126  | 11.3 | 110 | 9.2  |
| Discharge            | 4,686 | 79.0 | 869  | 77.7 | 939 | 78.6 |
| Death                | 698   | 11.8 | 124  | 11.1 | 146 | 12.2 |
| 21-day in-hospital mortality, n (%) |       |      |      |      |      |      |
| Admission            | 2,149 | 15.7 | 418  | 15.1 | 427 | 15.5 |

| Table 2. Incidence rate ratios (IRR) of patients transported by ambulance due to self-harm, Osaka prefecture, by year |
|---------------------------------------------------------------|
| Years                           | Unadjusted IRR | 95% CI       | P value | Adjusted IRR | 95% CI       | P value |
| 2017 versus 2016                 | 1.000          | 0.949–1.054 | 0.994   | 1.010         | 0.958–1.065 | 0.712   |
| 2018 versus 2016                 | 0.942          | 0.893–0.994 | 0.028   | 0.983         | 0.931–1.037 | 0.525   |
| 2019 versus 2016                 | 0.983          | 0.933–1.037 | 0.538   | 0.992         | 0.941–1.046 | 0.766   |
| 2020 versus 2016                 | 1.028          | 0.975–1.083 | 0.310   | 1.030         | 0.978–1.086 | 0.268   |

Multivariate models were adjusted for age group, sex, and month.
Abbreviation: CI, confidence interval.

| Table 3. Overall mortality rate ratio for all-cause mortality within 21 days among patients transported by ambulance due to self-harm, Osaka prefecture, 2016–2020 |
|---------------------------------------------------------------|
| Years                           | Unadjusted IRR | 95% CI       | P-value | Adjusted IRR | 95% CI       | P-value |
| 2017 versus 2016                 | 0.972          | 0.849–1.112 | 0.677   | 0.982         | 0.858–1.125 | 0.795   |
| 2018 versus 2016                 | 0.999          | 0.873–1.142 | 0.984   | 0.995         | 0.869–1.139 | 0.941   |
| 2019 versus 2016                 | 0.978          | 0.853–1.121 | 0.748   | 0.973         | 0.847–1.116 | 0.691   |
| 2020 versus 2016                 | 0.995          | 0.872–1.135 | 0.936   | 0.976         | 0.854–1.114 | 0.716   |

Multivariate models were adjusted for age group, sex, and month.
Abbreviations: CI, confidence interval; IRR, incidence rate ratio.
financial difficulties in midlife, and was the lowest in 2018 during the study period, indicating that life for people of working age was more stable than in other years. This finding implies the importance of the ORION database as a population-based registry in emergency medicine.

Our study has several potential limitations. First, our database did not include information about the motivation for self-harm, such as suicidal intention. Therefore, we could not separately assess nonsuicidal self-harm and suicidal self-harm. Second, the reason for the transport of patients with

| Table 4. Incidence rate ratios of patients transported by ambulance due to self-harm, Osaka prefecture, 2016–2020, by age group |
|-----------------|-------------|----------------|----------------|--------|
| Age group, years | Frequency | Adjusted IRR | 95% CI         | P-value |
| ≤19              |            |               |                |        |
| 2017 versus 2016 | 174 versus 164 | 0.965 | 0.779–1.195 | 0.741 |
| 2018 versus 2016 | 212 versus 164 | 1.019 | 0.831–1.252 | 0.855 |
| 2019 versus 2016 | 244 versus 164 | 1.104 | 0.906–1.349 | 0.329 |
| 2020 versus 2016 | 252 versus 164 | 1.095 | 0.899–1.336 | 0.370 |
| 20–29            |            |               |                |        |
| 2017 versus 2016 | 608 versus 654 | 0.993 | 0.889–1.109 | 0.899 |
| 2018 versus 2016 | 590 versus 654 | 1.012 | 0.905–1.131 | 0.836 |
| 2019 versus 2016 | 636 versus 654 | 1.031 | 0.924–1.150 | 0.590 |
| 2020 versus 2016 | 743 versus 654 | 1.138 | 1.025–1.265 | 0.016 |
| 30–39            |            |               |                |        |
| 2017 versus 2016 | 493 versus 554 | 0.932 | 0.825–1.052 | 0.253 |
| 2018 versus 2016 | 480 versus 554 | 0.894 | 0.791–1.010 | 0.072 |
| 2019 versus 2016 | 501 versus 554 | 0.914 | 0.810–1.031 | 0.145 |
| 2020 versus 2016 | 483 versus 554 | 0.959 | 0.848–1.083 | 0.499 |
| 40–49            |            |               |                |        |
| 2017 versus 2016 | 635 versus 545 | 1.128 | 1.006–1.265 | 0.040 |
| 2018 versus 2016 | 487 versus 545 | 0.994 | 0.879–1.123 | 0.924 |
| 2019 versus 2016 | 514 versus 545 | 0.962 | 0.852–1.085 | 0.528 |
| 2020 versus 2016 | 484 versus 545 | 0.971 | 0.859–1.097 | 0.635 |
| 50–59            |            |               |                |        |
| 2017 versus 2016 | 361 versus 323 | 0.996 | 0.857–1.158 | 0.955 |
| 2018 versus 2016 | 335 versus 323 | 0.944 | 0.810–1.100 | 0.458 |
| 2019 versus 2016 | 362 versus 323 | 0.998 | 0.859–1.160 | 0.980 |
| 2020 versus 2016 | 377 versus 323 | 1.033 | 0.891–1.200 | 0.666 |
| 60–69            |            |               |                |        |
| 2017 versus 2016 | 207 versus 230 | 0.989 | 0.819–1.194 | 0.911 |
| 2018 versus 2016 | 186 versus 230 | 1.031 | 0.848–1.251 | 0.759 |
| 2019 versus 2016 | 168 versus 230 | 1.013 | 0.829–1.235 | 0.900 |
| 2020 versus 2016 | 179 versus 230 | 0.988 | 0.812–1.201 | 0.905 |
| 70–79            |            |               |                |        |
| 2017 versus 2016 | 174 versus 181 | 0.990 | 0.803–1.220 | 0.925 |
| 2018 versus 2016 | 185 versus 181 | 1.008 | 0.821–1.238 | 0.939 |
| 2019 versus 2016 | 167 versus 181 | 0.983 | 0.795–1.214 | 0.872 |
| 2020 versus 2016 | 190 versus 181 | 1.029 | 0.838–1.264 | 0.783 |
| ≥80              |            |               |                |        |
| 2017 versus 2016 | 101 versus 109 | 1.048 | 0.797–1.377 | 0.737 |
| 2018 versus 2016 | 117 versus 109 | 1.072 | 0.823–1.396 | 0.606 |
| 2019 versus 2016 | 115 versus 109 | 1.017 | 0.779–1.329 | 0.900 |
| 2020 versus 2016 | 128 versus 109 | 0.996 | 0.770–1.290 | 0.973 |

Multivariate models were adjusted for sex and month. Abbreviations: CI, confidence interval; IRR, incidence rate ratio.
severe trauma due to a fall from height could be misclassified as accidental injury if there was no evidence of self-harm at the scene. Because the selection of self-harm patients was based on on-site observations and an EMS interview within a limited period of time, misclassification is inevitable. Although incomplete data collection forms were returned to the relevant EMS personnel for completion, there was no extra process to validate it was truly “self-harm.” These could result in underestimation of the incidence of self-harm. Third, the information on the method of self-harm was limited and many of them remained unknown because the main diagnoses included in the ORION database were not always related with self-harm. Fourth, the results of the present study did not consider the frequency and intensity of self-harm. Finally, this study used a database that included patients only in Osaka prefecture. Therefore, our inferences might not be generalizable to other areas with different cultural backgrounds, medical systems, and policies. Despite these limitations, the results of the present population-based study are essential as the availability of epidemiological information to improve mental health-care is highly relevant from a policy standpoint.

CONCLUSIONS

FROM THE COMPREHENSIVE analysis of the characteristics of patients transported by ambulance due to self-harm from 2016 through 2020 using the ORION population-based database in Osaka prefecture, we did not observe a statistically significant difference in the incidence rates of ambulance transport due to self-harm and 21-day inhospital mortality. However, we found the age group of 20–29 years to be the largest age group, and the adjusted IRRs suggested that the incidence rate of ambulance transport due to self-harm in this age group increased in 2020.

ACKNOWLEDGMENTS

THE AUTHORS THANK the EMS providers, nurses, emergency physicians, and administrators for their cooperation in the ORION. The authors thank our colleagues from Osaka University Center of Medical Data Science and Advanced Clinical Epidemiology Investigator’s Research Project for providing their insight and expertise for our research. The authors acknowledge all the members of The Working Group to Analyse the Emergency Medical Care System in Osaka Prefecture and the staff of the Osaka Prefectural Government for their kind support. This study was supported by the Japan Society for the Promotion of Science KAKENHI (grant no. 21K09071).

DISCLOSURE

APPROVAL OF THE research protocol: The medical institutional review board of Osaka University Graduate School of Medicine approved this study and waived the need for informed consent because all analyses used anonymous data (approval no. 15003).

Informed consent: The requirement for informed consent of patients was waived.

Registry and registration no. of the study/trial: N/A.

Animal studies: N/A.

Conflict of interest: None.

REFERENCES

1 World Health Organization. WHO Director-General’s opening remarks at the media briefing on COVID-19 – 11; 2020.
2 Wang C, Horby PW, Hayden FG, Gao GF. A novel coronavirus outbreak of global health concern. Lancet. 2020; 395: 470–3.
3 Flaxman S, Mishra S, Gandy A et al. Estimating the effects of non-pharmaceutical interventions on COVID-19 in Europe. Nature 2020; 584: 257–61.
4 Lai S, Ruktanonchai NW, Zhou L et al. Effect of non-pharmaceutical interventions to contain COVID-19 in China. Nature 2020; 585: 410–3.
5 Chu DK, Akl EA, Duda S et al. Physical distancing, face masks, and eye protection to prevent person-to-person transmission of SARS-CoV-2 and COVID-19: a systematic review and meta-analysis. Lancet. 2020; 395: 1973–87.
6 Stuckler D, Basu S, Suhrcke M, Coutts A, McKee M. The public health effect of economic crises and alternative policy responses in Europe: an empirical analysis. Lancet. 2009; 374: 315–23.
7 Brennan GK. Multidisciplinary research priorities for the COVID-19 pandemic. Lancet Psychiatry 2020; 7: e41.
8 Hawton K, Casey D, Bale E et al. Self-harm during the early period of the COVID-19 pandemic in England: comparative trend analysis of hospital presentations. J. Affect. Disord. 2020; 282: 991–5.
9 Dragovic M, Pascu V, Hall T, Ingram J, Waters F. Emergency department mental health presentations before and during the COVID-19 outbreak in Western Australia. Australas. Psychiatry 2020; 28: 627–31.
10 Iob E, Steptoe A, Fancourt D. Abuse, self-harm and suicidal ideation in the UK during the COVID-19 pandemic. Br. J. Psychiatry 2020; 217: 543–6.
11 Jefsen OH, Rohde C, Nørremark B, Østergaard SD. COVID-19-related self-harm and suicidality among individuals with mental disorders. Acta Psychiatr. Scand. 2020; 142: 152–3.
12 Wang C, Pan R, Wan X et al. A longitudinal study on the mental health of general population during the COVID-19 epidemic in China. Brain Behav. Immun. 2020; 87: 40–8.

13 Currie JM, Schnell MK, Schwandt H, Zhang J. Trends in drug overdose mortality in ohio during the first 7 months of the COVID-19 pandemic. JAMA Netw. Open 2021; 4: e217112.

14 Henry N, Parthiban S, Farroha A. The effect of COVID-19 lockdown on the incidence of deliberate self-harm injuries presenting to the emergency room. Int. J. Psychiatry Med. 2021; 56: 266–77.

15 Katayama Y, Kiyohara K, Kitamura T, Hayashida S, Shimazu T. Influence of the COVID-19 pandemic on an emergency medical service system: a population-based, descriptive study in Osaka, Japan. Acute Med. Surg. 2020; 7: e534.

16 Okamoto J, Katayama Y, Kitamura T et al. Profile of the ORION (Osaka emergency information Research Intelligent Operation Network system) between 2015 and 2016 in Osaka, Japan: a population-based registry of emergency patients with both ambulance and in-hospital records. Acute Med. Surg 2018; 6: 12–24.

17 Nakao S, Katayama Y, Kitamura T et al. Epidemiological profile of emergency medical services in Japan: a population-based descriptive study in 2016. Acute Med. Surg. 2020; 7: e485.

18 Ikegami N, Yoo BK, Hashimoto H et al. Japanese universal health coverage: evolution, achievements, and challenges. Lancet. 2011; 378: 1106–15.

19 Katayama Y, Matsuyma T, Kitamura T et al. Prehospital characteristics, incidence trends, and outcome of emergency self-inflicted injury patients with gas substances: a population-based descriptive study in Osaka, Japan. Acute Med. Surg. 2020; 7: 1–8.

20 Matsuyama T, Kitamura T, Kiyohara K et al. Characteristics and outcomes of emergency patients with self-inflicted injuries: a report from ambulance records in Osaka City, Japan. Scand. J. Trauma Resusc. Emerg. Med. 2016; 24: 1–11.

21 Osaka prefecture. Annual Report: Population of Osaka Prefecture. [cited 30 Apr 2021]. Available from: https://www.pref.osaka.lg.jp/attach/3387/00014731/RInempou.pdf

22 Salari N, Hosseinian-Far A, Jalali R et al. Prevalence of stress, anxiety, depression among the general population during the COVID-19 pandemic: a systematic review and meta-analysis. Global and Health. 2020; 16: 1–11.

23 Shimizu K. 2019-nCoV, fake news, and racism. Lancet 2020; 395: 685–6.

24 Nomura S, Kawashima T, Yoneoaka D et al. Trends in suicide in Japan by gender during the COVID-19 pandemic, up to September 2020. Psychiatry Res. 2021; 295: 113622.

25 Ohbe H, Goto T, Yamazaki R et al. Clinical trajectories of suicide attempts and self-harm in patients admitted to acute-care hospitals in Japan: A nationwide inpatient database study. J. Epidemiol. 2021; 31: 231–6.

26 Moreno C, Wykes T, Galderisi S et al. How mental health care should change as a consequence of the COVID-19 pandemic. Lancet Psychiatry 2020; 7: 813–24.

27 TOKYO SHOKO RESEARCH. Annual Reports: Corporate bankruptcies in Japan. [cited 30 Apr 2021]. Available from: https://www.tsr-net.co.jp/news/status/yearly/index.html

28 Clements C, Hawton K, Geulayov G et al. Self-harm in mid-life: analysis using data from the multicentre study of self-harm in England. Br. J. Psychiatry 2019; 215: 600–7.

SUPPORTING INFORMATION

Additional Supporting Information may be found in the online version of this article at the publisher’s web-site:

Table S1. Overall mortality rate ratios for all-cause mortality within 21 days, 2016 through 2020, by sex.

Table S2. Incidence rate ratios of male patients with self-harm, 2016–2020, by age group.

Table S3. Incidence rate ratios of female patients with self-harm, 2016–2020, by age groups.

Table S4. Multiple comparisons in incidence rate ratios of patients with self-harm by year.

Table S5. Multiple comparisons in incidence rate ratios of patients with self-harm by age group.