Acute Medicine & Surgery 2020; **7**: e485 doi: 10.1002/ams2.485

Original Article

Epidemiological profile of emergency medical services in Japan: a population-based descriptive study in 2016

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Aim: The aim of our study is to describe the characteristics of patients who use emergency medical services (EMS), EMS performance, and regional variations in Japan.

Methods: We undertook a nationwide, population-based, descriptive review of anonymized ambulance transport records obtained from the Fire and Disaster Management Agency in Japan. All emergency patients transported to emergency medical institutions by EMS personnel from January to December 2016 were enrolled in this study, excluding patients who were not transported.

Results: During the study period, 5,097,838 patients were transported to a hospital. Their median age was 69 years, 51.4% were male, and 56.5% were over 65 years old. Median durations from EMS call to EMS arrival on scene were similar among the regions, ranging from 7 to 9 min. However, the longest median duration from EMS call to hospital arrival was 38 min, and the shortest was 31 min across the regions. Among all patients, 350,865 (6.9%) were assessed as being in a severe condition, 14,410 (0.3%) were in very severe condition, and 74,780 (1.5%) were confirmed to be dead at the time of initial medical examination in the emergency department.

Conclusions: We described the characteristics of emergency patients and EMS performance in Japan. This registry serves as a basis for providing relevant information to improve prehospital emergency medical systems.

Key words: Emergency medical service, epidemiology, prehospital care

INTRODUCTION

AN EMERGENCY MEDICAL services (EMS) system is a critical component of a health-care safety net, especially in countries with substantial ageing populations such as Japan.[1] Understanding EMS demands and the characteristics of patients transported to medical institutions can help hospitals and government improve the efficiency of the services. For example, ambulance response time and time to hospital arrival are essential quality indicators for EMS systems.[2] Early definitive interventions in emergency departments (EDs) can provide better outcomes.[3–5] These time components are also fundamental and could be valuable from a patient-oriented perspective. Furthermore, knowledge of geographical variations in a homogenous health-care system could provide further insight into the efficient allocation of EMS resources. Real-world epidemiological study is fundamental to improving the current EMS system and performance in Japan.

Although peer-reviewed articles on prehospital care are increasing, there is little scientific research describing comprehensive patients' characteristics in prehospital emergency situations and EMS performance or that explores regional variations.[6,7] The large population-based research on

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Received 24 Oct, 2019; accepted 25 Dec, 2019
Funding Information
No Funding information provided.

prehospital care in a highly ageing society is lacking. This study aimed to describe the characteristics of patients who used EMS, EMS performance, and regional variations in Japan.

METHODS

Study design and setting

WE UNDERTOOK A nationwide, population-based, descriptive review of anonymized ambulance transport records in Japan. The observation period was from 1 January 1 to 31 December, 2016. The medical institutional review board of Osaka University approved this study and waived the need for informed consent because all analyses used anonymous data (approval no. 19219).

Emergency medical system in Japan

The EMS system in Japan is operated by local fire departments and is activated by a 1-1-9 call from anywhere in Japan.[8] In 2016, there were 733 fire department headquarters and 1,714 fire stations with 6,210 ambulances throughout Japan.[9] Life support is provided 24 h a day. Usually, each ambulance has a crew of three emergency providers including at least one Emergency Life-Saving Technician, a highly-trained prehospital emergency care provider.[10] The EMS personnel at the scene select hospitals for patient transport, including tertiary care hospitals, which have the capability of managing patients with life-threatening conditions. Local medical control councils consisting of emergency physicians and experts in each area in Japan have an important role in securing the quality of care provided by EMS personnel in prehospital settings and carrying out follow-up assessments of EMS procedures.[11]

Designated emergency hospitals are open and staffed 24 h a day by emergency physicians and are certified by prefectural governments. Tertiary care hospitals are certified by prefectural governments based on their expertise and ability to provide the highest quality of care for serious acute illnesses and severe trauma.[12] During the study period, there were 3,848 designated emergency hospitals in Japan, of which 284 were tertiary care hospitals. Table 1 summarizes regional variations in geographic characteristics in Japan.

Data sources and participants

The data used in the present study were obtained from the Fire and Disaster Management Agency of the Ministry of Internal Affairs and Communications in Japan after all personal identifiers were removed. Ambulance transport records

Table 1. Regional variations and characteristics of geographic areas in Japan

Characteristic	Total	Hokkaido	Tohoku	Kanto	Chubu	Kansai	Chugoku	Shikoku	Kyushu/Okinawa
Population†	127,094,745	5,381,733	8,982,807	42,995,031	21,460,410	22,541,298	7,438,037	3,845,534	14,449,895
Area, km^2‡	377,947.54	83,423.82	66,925.23	32,429.62	66,805.09	33,125.70	31,921.80	18,803.63	44,512.65
Population density, people/km^2‡	336.3	64.5	134.2	1,325.80	321.2	680.5	233	204.5	324.6
No. of fire stations§	4,844	385	496	1,247	874	758	341	169	574
No. of fire departments§	733	58	72	135	144	108	51	51	114
No. of designated emergency hospitals¶	3,848	244	275	998	596	712	305	180	538
No. of tertiary care hospitals¶	284	12	20	80	58	46	23	12	33

†Ministry of Internal Affairs and Communications, https://www.stat.go.jp/english/index.html
‡Geospatial Information Authority of Japan, http://www.gsi.go.jp/ENGLISH/index.html
§Fire and Disaster Management Agency, http://www.fdma.go.jp/en/
¶Ministry of Health, Labour and Welfare, https://www.mhlw.go.jp/english/index.html

are collected annually for statistical and administrative purposes in all prefectures with a standardized electronic form. Each EMS authority submits the record to the local fire stations. All emergency patients who required EMS for transport by ambulance to a particular institution in 2016 were captured. Data from the Tokyo Fire Department were separately collected with extra information, including patients who were not transported, and merged with data from other prefectures later. Of the 47 prefectures in Japan, 46 prefectures only provided information of patients who were transported by EMS. Tokyo prefecture (Tokyo Fire Department) also included information of patients who were not transported. Therefore, in order to conduct a fair comparison, we specifically excluded the data of patients in Tokyo who were not transported. We also excluded the data of patients who were transported between hospitals.

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), reason for the EMS call (fire accident, natural disaster, water-related accident, motor vehicle accident, industrial accident, sports-related accident, falls and other injury, assault, self-inflicted injury, acute illness, and others), hospital type (tertiary care hospital or not), time of day, time course of transport, and severity as assessed by a physician in the receiving hospital's ED. Severity was stratified as follows: mild (patients whose injury or illness did not require hospitalization), moderate (patients who required hospitalization but whose condition was not severe), severe (patients with a potentially life-threatening condition), very severe (patients with cardiopulmonary arrest or just prior to cardiopulmonary arrest), dead (patients confirmed to be dead at the initial medical examination), and other (patients not diagnosed by a physician, patients with an unclear condition, or people transported to another location). These 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.

Analysis

Continuous variables are presented as the median and interquartile range and categorical variables as counts and percentages. We categorized age into eight groups: <28 days (infant), 28 days to 6 years (young children), 7–17 years (children), 18–64 years (adults), 65–74 years, 75–84 years, 85–94 years, and ≥95 years. We divided time of day of the EMS call into daytime (09:00 to 16:59, regular business hours) and night-time (17:00 to 08:59). Descriptive statistics were calculated using SPSS version 25.0J (IBM, Armonk, NY, USA).

Data were also stratified by geographic region. We divided the prefectures in Japan into eight often classified regions to describe geographical variations, Hokkaido, Tohoku, Kanto, Chubu, Kansai, Chugoku, Shikoku, and Kyushu/Okinawa regions, which are commonly used for administrative purposes (Fig. 1).[13] Regional characteristics are described in Table 1. Kanto is the most populated region, followed by Kansai and Chubu. Hokkaido has the lowest population density among them. In addition, we stratified patient characteristics and outcomes by sex and age group (<18 years, 18–64 years, and ≥65 years).

We did not apply any statistical test because of the nature of nationwide population-based descriptive design.

RESULTS

OVER THE STUDY period, 5,707,177 EMS dispatches were documented in Japan. Excluding 90,645 patients in the Tokyo Fire Department data who were not transported and 518,694 interhospital transports overall, 5,097,838 patients were eligible for analysis (Fig. 2).

Patient characteristics and their regional variations are summarized in Table 2. Patient characteristics were mostly similar across the regions. The overall median patient age was 69 years (interquartile range, 44–82 years), 51.4% of the patients were male, 56.5% were aged over 65 years, and people aged 75–84 years comprised the largest group. The most frequent location of the event was a private residence (61.8%), followed by a public place (19.1%). Acute illness was the most frequent reason for an EMS call (70.8%) followed by falls and other injury (16.6%). Approximately 20% of the patients were transported to tertiary care hospitals. More patients were transported by ambulance during the night-time than daytime. Although these trends were similar among regions, age distributions were slightly different. Median ages in the Kanto and Kansai regions were younger (67 and 68 years, respectively) than those in the other regions. The proportion of patients aged over 85 years was lower in the Kanto and Kansai regions than in the other regions. We provide patient characteristics and regional variations stratified by sex and age group in Table S1. Patient characteristics and outcomes stratified by sex and age group were similar among regions.

The median durations from EMS call to EMS arrival on scene were similar among regions, ranging from 7 to 9 min, but the median durations from EMS call to EMS arrival to a medical facility ranged from 31 to 38 min. Transport time of

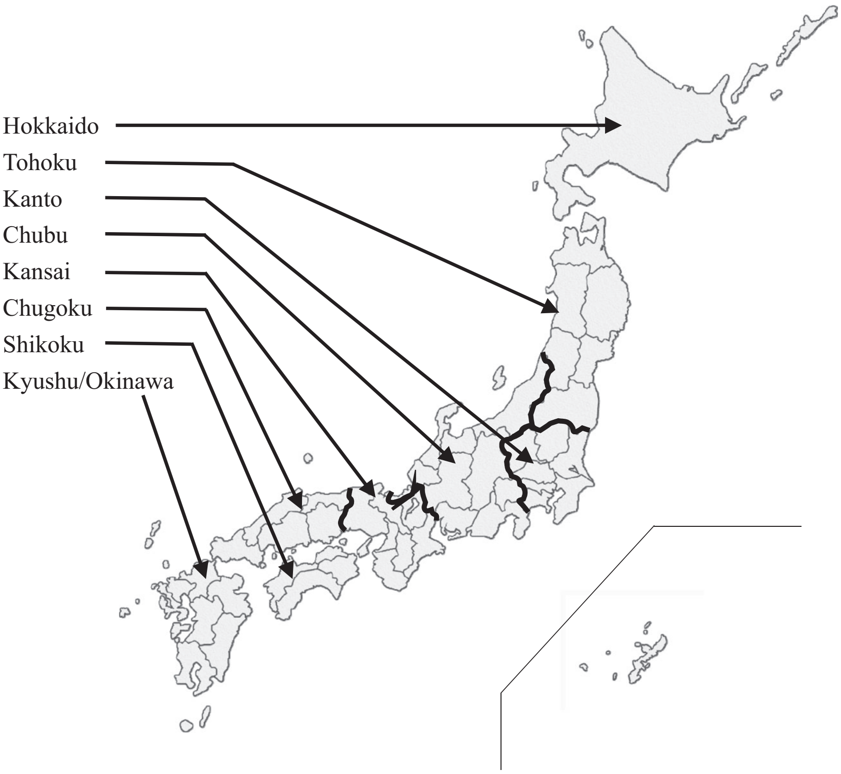

Fig. 1. Eight regions of Japan, commonly used for administrative purposes.

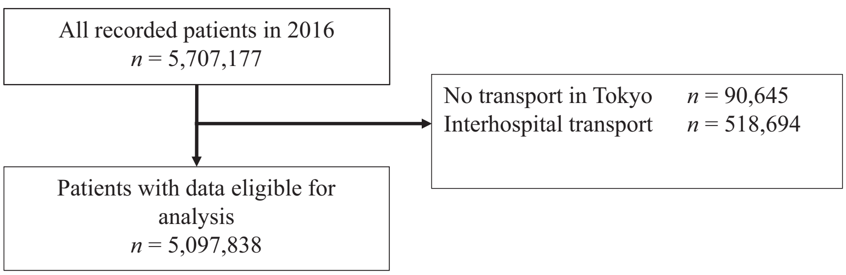

Fig. 2. Patient flow in this study of patients who used emergency medical services in Japan in 2016.

patients to medical facilities was shortest in the Kyushu/Okinawa region and longest in the Kanto region; the median difference across the regions was 7 min.

Table 3 shows patient severity as initially assessed by a physician in the ED of the total population and stratified by sex and age group. In the total population, the severity of most patients was classified as mild (53.4%), followed by moderate (37.3%). During the study period, 350,865 patients (6.9%) were assessed as being in a severe condition, 14,410 (0.3%) were in a very severe condition, and 74,780 (1.5%) were confirmed to be dead at the time of initial medical examination in the ED. The Kansai and Kanto regions had more patients with a mild condition compared to the other regions. More than 2% of patients in the Tohoku and Hokkaido regions were confirmed to be dead in the ED. The distributions of severity stratified by sex and age group were similar among regions.

DISCUSSION

IN THIS NATIONWIDE population-based study of Japan in 2016, we reported on the characteristics of patients who used EMS, the performance of EMS, and regional variations. Age distributions and severity of the patients as assessed by a physician in the ED differed across regions. The median time from EMS call to EMS arrival on the scene was 8 min with a 1-min difference across the regions. However, we observed a median 7-min difference across the regions in the time from EMS call to hospital arrival. More than half of the patients who used ambulances were assessed

Table 2. Characteristics of patients who used emergency medical services (EMS) in Japan in 2016 and their regional variations

Characteristic	Total n = 5,097,838	Hokkaido n = 195,370	Tohoku n = 299,201	Kanto n = 1,799,443	Chubu n = 781,306	Kansai n = 1,034,204	Chugoku n = 271,837	Shikoku n = 153,632	Kyushu/Okinawa n = 562,845
Age, years, median (IQR)	69 (44–82)	70 (48–82)	72 (51–83)	67 (40–81)	70 (46–83)	68 (43–81)	71 (48–83)	71 (50–83)	70 (47–83)
Age group, *n* (%)									
<28 days	2,736 (0.05)	97 (0.05)	178 (0.06)	965 (0.05)	430 (0.06)	518 (0.05)	156 (0.06)	53 (0.03)	339 (0.06)
28 days to 6 years	254,182 (5.0)	8,088 (4.1)	11,207 (3.7)	101,635 (5.6)	35,718 (4.6)	55,682 (5.4)	11,155 (4.1)	5,848 (3.8)	24,849 (4.4)
7 to 17 years	192,352 (3.8)	5,925 (3.0)	10,077 (3.4)	68,272 (3.8)	29,699 (3.8)	40,958 (4.0)	10,267 (3.8)	5,513 (3.6)	21,641 (3.8)
18 to 64 years	1,769,392 (34.7)	66,503 (34.0)	95,358 (31.9)	677,086 (37.6)	254,530 (32.6)	354,507 (34.3)	85,847 (31.6)	48,398 (31.5)	187,163 (33.3)
65 to 74 years	822,938 (16.1)	32,674 (16.7)	47,141 (15.8)	283,285 (15.7)	126,954 (16.2)	171,773 (16.6)	45,045 (16.6)	26,669 (17.4)	89,397 (15.9)
75 to 84 years	1,135,805 (22.3)	44,709 (22.9)	70,208 (23.5)	378,471 (21.0)	180,400 (23.1)	237,304 (22.9)	62,341 (22.9)	35,680 (23.2)	126,692 (22.5)
85 to 94 years	817,975 (16.0)	33,209 (17.0)	58,337 (19.5)	257,438 (14.3)	136,216 (17.4)	154,931 (15.0)	50,214 (18.5)	28,205 (18.4)	99,425 (17.7)
95 years or older	102,454 (2.0)	4,165 (2.1)	6,695 (2.2)	32,287 (1.8)	17,359 (2.2)	18,531 (1.8)	6,812 (2.5)	3,266 (2.1)	13,339 (2.4)
Not available	4 (0.0)	0 (0)	0 (0)	4 (0.0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Sex, *n* (%)									
Male	2,618,869 (51.4)	93,491 (47.9)	153,674 (51.4)	936,723 (52.1)	407,758 (52.2)	529,147 (51.2)	138,530 (51.0)	77,272 (50.3)	282,274 (50.2)
Female	2,467,656 (48.4)	97,759 (50.0)	144,838 (48.4)	862,458 (47.9)	373,334 (47.8)	503,258 (48.7)	131,646 (48.4)	74,644 (48.6)	279,519 (49.7)
Not available	11,313 (0.2)	3,920 (2.0)	688 (0.2)	262 (0.01)	214 (0.03)	1,799 (0.2)	1,661 (0.6)	1,716 (1.1)	1,052 (0.2)
Location, *n* (%)									
Private residence	3,151,405 (61.8)	125,461 (64.2)	191,894 (64.1)	1,129,157 (62.8)	481,378 (61.6)	645,956 (62.5)	135,864 (50.0)	94,991 (61.8)	346,714 (61.6)
Public place	971,932 (19.1)	39,859 (20.4)	50,918 (17.0)	340,392 (18.9)	154,131 (19.7)	187,655 (18.1)	57,634 (21.2)	26,910 (17.5)	114,433 (20.3)
Road	730,641 (14.3)	21,529 (11.0)	36,193 (12.1)	270,679 (15.0)	109,283 (14.0)	161,806 (15.6)	30,973 (11.4)	24,214 (15.8)	75,964 (13.5)
Workspace	136,538 (2.7)	6,088 (3.1)	8,488 (2.8)	46,343 (2.6)	24,503 (3.1)	24,115 (2.3)	7,049 (2.6)	3,732 (2.4)	16,220 (2.9)
Other	107,318 (2.1)	2,433 (1.2)	11,708 (3.9)	12,868 (0.7)	12,011 (1.5)	14,682 (1.4)	40,317 (14.8)	3,785 (2.5)	9,514 (1.7)
Not available	4 (0.0)	0 (0)	0 (0)	4 (0.0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Reason for EMS call, *n* (%)									
Acute illness	3,607,508 (70.8)	142,914 (73.2)	220,443 (73.7)	1,273,457 (70.8)	550,925 (70.5)	726,239 (70.2)	189,186 (69.6)	104,936 (68.3)	399,408 (71.0)
Falls and other injury	847,128 (16.6)	32,756 (16.8)	42,771 (14.3)	306,136 (17.0)	125,540 (16.1)	172,417 (16.7)	46,406 (17.1)	26,283 (17.1)	94,819 (16.8)
Motor vehicle accident	473,412 (9.3)	12,546 (6.4)	26,017 (8.7)	157,995 (8.8)	79,075 (10.1)	102,753 (9.9)	27,806 (10.2)	17,645 (11.5)	49,575 (8.8)
Industrial accident	50,789 (1.0)	2,411 (1.2)	3,060 (1.0)	17,125 (1.0)	8,797 (1.1)	10,151 (1.0)	2,643 (1.0)	1,492 (1.0)	5,110 (0.9)
Sports-related accident	40,671 (0.8)	1,231 (0.6)	2,559 (0.9)	14,952 (0.8)	6,511 (0.8)	7,293 (0.7)	2,217 (0.8)	1,136 (0.7)	4,772 (0.8)
Self-inflicted injury	37,086 (0.7)	1,974 (1.0)	2,447 (0.8)	12,433 (0.7)	5,765 (0.7)	7,286 (0.7)	1,817 (0.7)	1,138 (0.7)	4,226 (0.8)
Assault	27,251 (0.5)	727 (0.4)	1,031 (0.3)	12,491 (0.7)	2,862 (0.4)	6,243 (0.6)	958 (0.4)	613 (0.4)	2,326 (0.4)
Fire accident	5,265 (0.1)	244 (0.1)	379 (0.1)	1,900 (0.1)	776 (0.1)	969 (0.09)	337 (0.1)	141 (0.09)	519 (0.09)

Table 2. (Continued)

Characteristic	Total n = 5,097,838	Hokkaido n = 195,370	Tohoku n = 299,201	Kanto n = 1,799,443	Chubu n = 781,306	Kansai n = 1,034,204	Chugoku n = 271,837	Shikoku n = 153,632	Kyushu/Okinawa n = 562,845
Water-related accident	2,346 (0.05)	72 (0.04)	122 (0.04)	837 (0.05)	356 (0.05)	257 (0.02)	170 (0.06)	120 (0.08)	412 (0.07)
Natural disaster	670 (0.01)	30 (0.02)	77 (0.03)	122 (0.01)	62 (0.01)	29 (0.0)	40 (0.01)	10 (0.0)	300 (0.05)
Other	5,712 (0.1)	465 (0.2)	295 (0.1)	1,995 (0.1)	637 (0.08)	567 (0.05)	257 (0.09)	118 (0.08)	1,378 (0.2)
Transferred to tertiary care hospital, *n* (%)	1,079,313 (21.2)	29,425 (15.1)	51,281 (17.1)	395,912 (22.0)	261,303 (33.4)	160,505 (15.5)	56,776 (20.9)	31,642 (20.6)	92,469 (16.4)
Time of day, *n* (%)									
Daytime (9:00 to 16:59)	2,125,325 (41.7)	83,095 (42.5)	122,840 (41.1)	724,159 (40.2)	337,360 (43.2)	438,509 (42.4)	117,950 (43.4)	65,715 (42.8)	235,697 (41.9)
Nighttime (17:00 to 8:59)	2,900,059 (56.9)	111,693 (57.2)	165,694 (55.4)	1,014,098 (56.4)	443,946 (56.8)	595,694 (57.6)	153,887 (56.6)	87,915 (57.2)	327,132 (58.1)
Not available	72,454 (1.4)	582 (0.3)	10,667 (3.6)	61,186 (3.4)	0 (0)	1 (0.0)	0 (0)	2 (0.0)	16 (0.0)
Length of time, min, median (IQR)									
From EMS call to EMS arrival on scene	8 (6–10)	7 (5–9)	8 (6–10)	9 (7–11)	8 (6–9)	7 (6–9)	8 (6–10)	8 (6–10)	8 (6–10)
From EMS call to hospital arrival	34 (27–43)	33 (26–42)	36 (28–46)	38 (31–47)	31 (25–39)	32 (26–40)	34 (27–44)	32 (25–41)	31 (25–39)

IQR, interquartile range.

Table 3. Regional variations in initial patient assessment by a physician in emergency departments (ED) in Japan, 2016

Characteristics	Total *n* = 5,097,838	Hokkaido *n* = 195,370	Tohoku *n* = 299,201	Kanto *n* = 1,799,443	Chubu *n* = 781,306	Kansai *n* = 1,034,204	Chugoku *n* = 271,837	Shikoku *n* = 153,632	Kyushu/Okinawa *n* = 562,845
Severity as assessed by physician in ED, *n* (%)									
Mild	2,721,039 (53.4)	100,716 (51.6)	137,328 (45.9)	987,640 (54.9)	412,477 (52.8)	636,256 (61.5)	126,339 (46.5)	78,264 (50.9)	242,019 (43.0)
Moderate	1,934,000 (37.3)	73,055 (37.4)	116,712 (39.0)	669,603 (37.2)	295,723 (37.8)	341,397 (33.0)	116,203 (42.7)	55,436 (36.1)	265,871 (47.2)
Severe	350,865 (6.9)	16,839 (8.6)	36,115 (12.1)	114,393 (6.4)	57,472 (7.4)	40,306 (3.9)	23,095 (8.5)	16,353 (10.6)	46,292 (8.2)
Very severe	14,410 (0.3)	166 (0.08)	637 (0.2)	5,881 (0.3)	2,677 (0.3)	2,173 (0.2)	1,378 (0.5)	391 (0.3)	1,107 (0.2)
Dead	74,780 (1.5)	4,469 (2.3)	8,356 (2.8)	21,416 (1.2)	12,327 (1.6)	13,874 (1.3)	4,744 (1.7)	2,999 (2.0)	6,595 (1.2)
Other	2,740 (0.05)	125 (0.06)	53 (0.02)	506 (0.03)	630 (0.08)	198 (0.02)	78 (0.03)	189 (0.1)	961 (0.2)
Not available	4 (0.0)	0 (0)	0 (0)	4 (0.0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Male, <18 years	*n* = 266,157	*n* = 8,096	*n* = 12,482	*n* = 101,489	*n* = 39,089	*n* = 57,865	*n* = 12,747	*n* = 6,761	*n* = 27,628
Mild	209,180 (78.6)	6,249 (77.2)	8,948 (71.7)	82,092 (80.9)	29,174 (74.6)	49,060 (84.8)	9,197 (72.2)	5,029 (74.4)	19,431 (70.3)
Moderate	52,981 (19.9)	1,711 (21.1)	3,272 (26.2)	17,912 (17.6)	9,283 (23.7)	8,284 (14.3)	3,261 (25.6)	1,589 (23.5)	7,669 (27.8)
Severe	3,275 (1.2)	104 (1.3)	210 (1.7)	1,283 (1.3)	516 (1.3)	365 (0.6)	236 (1.9)	113 (1.7)	448 (1.6)
Very severe	134 (0.05)	1 (0.01)	6 (0.05)	40 (0.04)	30 (0.08)	25 (0.04)	12 (0.09)	5 (0.07)	15 (0.05)
Dead	447 (0.2)	26 (0.3)	40 (0.3)	123 (0.1)	55 (0.1)	111 (0.2)	32 (0.3)	21 (0.3)	39 (0.1)
Other	140 (0.05)	5 (0.06)	6 (0.05)	39 (0.04)	31 (0.08)	20 (0.03)	9 (0.07)	4 (0.06)	26 (0.09)
Not available	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Male, 18–64 years	*n* = 978,829	*n* = 33,927	*n* = 54,178	*n* = 375,032	*n* = 143,695	*n* = 193,648	*n* = 48,227	*n* = 26,731	*n* = 103,391
Mild	611,408 (62.5)	20,789 (61.3)	29,555 (54.6)	236,610 (63.1)	90,066 (62.7)	137,784 (71.2)	27,541 (57.1)	16,347 (61.2)	52,716 (51.0)
Moderate	302,595 (30.9)	10,043 (29.6)	18,619 (34.4)	114,764 (30.6)	43,555 (30.3)	48,255 (24.9)	16,824 (34.9)	7,781 (29.1)	42,754 (41.4)
Severe	53,214 (5.4)	2,476 (7.3)	5,001 (9.2)	20,077 (5.4)	8,165 (5.7)	5,556 (2.9)	3,140 (6.5)	2,163 (8.1)	6,636 (6.4)
Very severe	2,167 (0.2)	22 (0.06)	93 (0.2)	913 (0.2)	368 (0.3)	325 (0.2)	201 (0.4)	53 (0.2)	192 (0.2)
Dead	8,769 (0.9)	567 (1.7)	895 (1.7)	2,536 (0.7)	1,401 (1.0)	1,649 (0.9)	504 (1.0)	357 (1.3)	860 (0.8)
Other	676 (0.07)	30 (0.09)	15 (0.03)	132 (0.04)	140 (0.1)	79 (0.04)	17 (0.04)	30 (0.1)	233 (0.2)
Not available	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Male, ≥65 years	*n* = 1,373,883	*n* = 51,468	*n* = 87,014	*n* = 460,202	*n* = 224,974	*n* = 277,634	*n* = 77,556	*n* = 43,780	*n* = 151,255
Mild	568,074 (41.3)	19,804 (38.5)	31,232 (35.9)	190,894 (41.5)	94,337 (41.9)	136,405 (49.1)	27,928 (36.0)	17,669 (40.4)	49,805 (32.9)
Moderate	636,422 (46.3)	23,843 (46.3)	38,507 (44.3)	214,188 (46.5)	101,728 (45.2)	119,534 (43.1)	38,519 (49.7)	18,542 (42.4)	81,561 (53.9)
Severe	130,414 (9.5)	5,868 (11.4)	13,369 (15.4)	43,428 (9.4)	22,107 (9.8)	14,774 (5.3)	8,412 (10.8)	6,074 (13.9)	16,382 (10.8)
Very severe	5,945 (0.4)	67 (0.1)	257 (0.3)	2,413 (0.5)	1,159 (0.5)	895 (0.3)	588 (0.8)	153 (0.3)	413 (0.3)
Dead	32,253 (2.3)	1,855 (3.6)	3,637 (4.2)	9,172 (2.0)	5,446 (2.4)	5,989 (2.2)	2,093 (2.7)	1,301 (3.0)	2,760 (1.8)
Other	775 (0.06)	31 (0.06)	12 (0.01)	107 (0.02)	197 (0.09)	37 (0.01)	16 (0.02)	41 (0.09)	334 (0.2)
Not available	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Female, <18 years	*n* = 182,269	*n* = 5,790	*n* = 8,944	*n* = 69,354	*n* = 26,747	*n* = 39,111	*n* = 8,647	*n* = 4,553	*n* = 19,123
Mild	144,601 (79.3)	4,464 (77.1)	6,468 (72.3)	56,464 (81.4)	20,286 (75.8)	33,379 (85.3)	6,355 (73.5)	3,542 (77.8)	13,643 (71.3)
Moderate	35,123 (19.3)	1,234 (21.3)	2,306 (25.8)	11,876 (17.1)	6,041 (22.6)	5,448 (13.9)	2,144 (24.8)	932 (20.5)	5,142 (26.9)
Severe	2,050 (1.1)	65 (1.1)	130 (1.5)	887 (1.3)	333 (1.2)	188 (0.5)	117 (1.4)	61 (1.3)	269 (1.4)
Very severe	83 (0.05)	1 (0.02)	2 (0.02)	32 (0.05)	19 (0.07)	17 (0.04)	5 (0.06)	1 (0.02)	6 (0.03)
Dead	309 (0.2)	19 (0.3)	32 (0.4)	75 (0.1)	47 (0.2)	68 (0.2)	20 (0.2)	12 (0.3)	36 (0.2)

Table 3. (Continued)

Characteristics	Total *n* = 5,097,838	Hokkaido *n* = 195,370	Tohoku *n* = 299,201	Kanto *n* = 1,799,443	Chubu *n* = 781,306	Kansai *n* = 1,034,204	Chugoku *n* = 271,837	Shikoku *n* = 153,632	Kyushu/Okinawa *n* = 562,845
Other	103 (0.06)	7 (0.1)	6 (0.07)	20 (0.03)	21 (0.08)	11 (0.03)	6 (0.07)	5 (0.1)	27 (0.1)
Not available	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Female, 18–64 years	*n* = 787,086	*n* = 31,458	*n* = 40,994	*n* = 301,953	*n* = 110,773	*n* = 160,108	*n* = 37,081	*n* = 21,234	*n* = 83,485
Mild	546,157 (69.4)	22,153 (70.4)	25,668 (62.6)	208,507 (69.1)	77,636 (70.1)	125,153 (78.2)	23,768 (64.1)	14,814 (69.8)	48,458 (58.0)
Moderate	211,425 (26.9)	7,706 (24.5)	12,626 (30.8)	82,760 (27.4)	28,779 (26.0)	31,450 (19.6)	11,475 (30.9)	5,173 (24.4)	31,456 (37.7)
Severe	24,584 (3.1)	1,334 (4.2)	2,335 (5.7)	9,071 (3.0)	3,570 (3.2)	2,638 (1.6)	1,527 (4.1)	1,070 (5.0)	3,039 (3.6)
Very severe	987 (0.1)	10 (0.03)	35 (0.09)	466 (0.2)	166 (0.2)	121 (0.08)	91 (0.2)	28 (0.1)	70 (0.08)
Dead	3,555 (0.5)	239 (0.8)	323 (0.8)	1,048 (0.3)	546 (0.5)	718 (0.4)	209 (0.6)	128 (0.6)	344 (0.4)
Other	378 (0.05)	16 (0.05)	7 (0.02)	101 (0.03)	76 (0.07)	28 (0.02)	11 (0.03)	21 (0.1)	118 (0.1)
Not available	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Female, 65 years or older	*n* = 1,498,301	*n* = 60,711	*n* = 94,900	*n* = 491,151	*n* = 235,814	*n* = 304,039	*n* = 85,918	*n* = 48,857	*n* = 176,911
Mild	636,260 (42.5)	25,527 (42.0)	35,099 (37.0)	212,932 (43.3)	100,888 (42.8)	153,343 (50.4)	30,867 (35.9)	20,087 (41.1)	57,517 (32.5)
Moderate	691,008 (46.1)	26,958 (44.4)	41,142 (43.4)	228,002 (46.4)	106,228 (45.0)	127,965 (42.1)	43,173 (50.2)	20,733 (42.4)	96,807 (54.7)
Severe	136,010 (9.1)	6,443 (10.6)	14,982 (15.8)	39,637 (8.1)	22,767 (9.7)	16,600 (5.5)	9,518 (11.1)	6,657 (13.6)	19,406 (11.0)
Very severe	5,064 (0.3)	60 (0.1)	244 (0.3)	2,016 (0.4)	935 (0.4)	788 (0.3)	460 (0.5)	150 (0.3)	411 (0.2)
Dead	29,333 (2.0)	1,687 (2.8)	3,426 (3.6)	8,458 (1.7)	4,831 (2.0)	5,320 (1.8)	1,884 (2.2)	1,177 (2.4)	2,550 (1.4)
Other	626 (0.04)	36 (0.06)	7 (0.007)	106 (0.02)	165 (0.07)	23 (0.008)	16 (0.02)	53 (0.1)	220 (0.1)
Not available	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)

Dead, patients confirmed to be dead at the time of initial medical examination; Mild, patients whose injury or illness did not require hospitalization; Moderate, patients who required hospitalization but whose condition was not severe; Other, patients who had not been diagnosed by physician, patients whose conditions were not clear, or people who were transported to another location; Severe, patients with potentially life-threatening conditions; Very severe, patients in cardiopulmonary arrest or just prior to cardiopulmonary arrest.

to be in a mild condition and less than 10% of the total population was classified as being in a severe or very severe condition. Patients using EMS services in the Kanto and Kansai regions were younger, and their severities appeared milder than those in other regions. However, median time from EMS call to hospital arrival in the Kanto region was the longest, whereas that in the Kansai region was shorter than in most other regions.

Because EMS practices on the scene and during transport vary among countries, comparing the times to EMS arrival and to hospital arrival with previous international studies could be difficult.[14,15] However, we observed that the overall median time from EMS call to EMS arrival on scene was similar to that of other developed countries as a recent systematic review to determine EMS response time showed that Asia, America, and Europe had median response times ranging from 7 to 11 min.[16] A previous systematic review showed significantly shorter transport times in urban areas than rural areas, whereas the median time to hospital arrival in the most populated region in Japan, the Kanto region, was the longest.[17] Multiple potential factors could affect the time to hospital arrival, such as patient age and the distribution of medical institutions and specialized hospitals, such as stroke centers.[18]

Furthermore, combining prehospital data with external data resources could be beneficial in further investigations.[19] The Osaka Emergency Information Research Intelligent Operation Network System, which collects patient characteristics, EMS information, and in-hospital outcome in Osaka, is an example of such a database linkage that can help to improve prehospital care.[20] It might be worthwhile to merge the prehospital data with public administrative databases such as the National Database of Health Insurance Claims and Specific Health Checkups of Japan and the Diagnosis Procedure Combination database, and large databases established by multicenter registries such as the Japanese Association for Acute Medicine – Out-of-hospital Cardiac Arrest registry.[19] Such linkage could be useful in assessing other important prehospital issues such as unnecessary ambulance calls, prehospital interventions, frequent callers, and the distribution of hospitals.[21,22]

The present research into ambulance transport records has several strengths. First, this study covered the entire population of Japan. Building a population-based database itself is important and useful for understanding the prehospital burden and providing better prehospital care. Second, to the best of our knowledge, this research is the largest resource for determining the public health burden of prehospital care in an ageing society. Finally, the use of uniform data collection for reporting emergency patients, the large sample size, and a population-based design were intended to keep these potential sources of biases to a minimum. Although the Fire and Disaster Management Agency provides annual reports in Japanese, this study provides fundamental information for non-Japanese readers in the field as well as regional variations to help improving prehospital care in Japan.[23]

However, this study has some limitations. First, we did not obtain information on patient outcomes after hospital arrival. Therefore, the actual severity and prognosis of the patients is unclear. Second, these results might not be generalizable as this study was carried out only in Japan where the EMS system is different from other countries. Nevertheless, we have provided nationwide, comprehensive data with which to assess the EMS systems and regional variations in their performance. Revealing real-world data of the characteristics of emergency patients and EMS performance is essential to improve prehospital systems in Japan.

CONCLUSION

FROM OUR NATIONWIDE, population-based study of Japan, we assessed comprehensive data on the characteristics of emergency patients, EMS performance, and underlying regional variations. By understanding the demographic data of these patients in Japan, our findings can help inform the planning of services and improve prehospital emergency medical systems in Japan.

ACKNOWLEDGEMENTS

THE AUTHORS GRATEFULLY acknowledge receipt of the ambulance transport records data from the Fire and Disaster Management Agency. This study was undertaken as a project to prevent young adult suicide in Osaka. It was supported by the Clinical Investigator's Research Project of the Osaka University Graduate School of Medicine.

DISCLOSURE

Approval of the research protocol: The protocol was approved by the Ethics Committee of Osaka University as the corresponding institution.
Informed consent: The requirement for informed consent of patients was waived.
Registry and the registration no. of the study/trial: N/A.
Animal studies: N/A.
Conflict of interest: None.

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SUPPORTING INFORMATION

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

Table S1. Patient characteristics and their regional variations by sex and age group