

Original Article

Ambulance dispatches to schools during a 5-year period in Fukui Prefecture

Yoshikazu Takinami¹ and Shinji Maeda²¹Department of Emergency and Critical Care Medicine, Faculty of Medicine, Shimane University, Izumo, Shimane, Japan, and ²Department of Internal Medicine, Infusion and Preventive Clinic, Hakata-ku, Fukuoka, Japan

Aim: To determine the characteristics and trends of medical emergencies during school activities by analyzing information provided by fire departments.

Methods: During a 5-year period from January 2009 to December 2013, all nine fire departments in Fukui Prefecture handled 850 emergencies at schools. We investigated the 850 cases with the age range of 0–63 years.

Results: It was found that 21.5% of ambulance dispatches to schools were on weekends and there were more dispatches for non-faculty members of all age groups on weekends than on weekdays. The percentage of weekend dispatches was particularly high for students aged ≥ 19 years. Emergency calls for junior high school students and younger students accounted for the majority of weekday calls. There were a total of 524 ambulance dispatches for the three categories “sprains, contusions, dislocations, and fractures” ($n = 245$), “seizures, epilepsy, and syncope” ($n = 171$), and “cuts, bruises, lacerations, trauma, amputations, and burns” ($n = 108$), with dispatches for these three categories accounting for 61.6% of all dispatches. Almost all dispatches for “heat stroke and dehydration” were during school hours and were concentrated between the months of July and September. Heat stroke was most common among high school students and most often occurred during the summer/fall season and on weekends.

Conclusion: Heat stroke was the fourth most frequent condition that required an ambulance dispatch after the above three conditions. Heat stroke is predictable, indicating that it is necessary to prevent heat stroke during high school club activities.

Key words: Emergency vehicle, heat stroke, public awareness, schools

INTRODUCTION

FUKUI PREFECTURE IS located in the Hokuriku region of Japan. As of 1 November, 2015, the population of Fukui Prefecture was 785,024;¹ it was ranked 43rd in Japan in terms of population size by prefecture. As of 1 August, 2015, there were 3,337 kindergarteners in 96 kindergartens, 4,245 pupils in 40 Centers for Early Childhood Education and Care, 43,298 students in 202 elementary schools, 23,136 junior high school students in 84 junior high schools, 23,026 high school students in 38 high schools, 991 students in 14 special schools, 1,851 students in 22 specialized training schools, 1,935 students in 17 vocational schools, and 11,220 students in junior

colleges and universities, including graduate schools, in Fukui Prefecture.² Fukui Prefecture is served by nine fire departments.

Children engage in various activities in educational environments from kindergartens to universities, and it is impossible to predict when and how children injure themselves or develop illness.³ According to the Japan Sport Council, the number of injuries and illnesses at nursery schools, kindergartens, elementary schools, junior high schools, high schools (full-time, part-time, and correspondence basis), and polytechnic schools in Japan was 1,097,377 (including 63 deaths) in 2013, 6.5% of which were covered by mutual aid accident insurance policies.⁴ However, no study has carefully investigated the causal factors for emergencies in schools. In this study, we analyzed information provided by fire departments to reveal the characteristics of ambulance dispatches to educational institutions. We determined the relationships between patient age groups and the day of the week of emergency requests, between patient age groups and categories of medical conditions, and between

Corresponding: Yoshikazu Takinami, MD, PhD, Department of Emergency and Critical Care Medicine, Faculty of Medicine, Shimane University, 89-1 Enya-cho, Izumo, Shimane 693-8501, Japan. E-mail: takinami@to.mitene.or.jp

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categories of medical conditions and time of emergency requests. We also aimed to investigate predictable and preventable diseases, if identified, in detail.

SUBJECTS AND METHODS

IN RESPONSE TO our request, the nine fire departments in Fukui Prefecture provided us with information on 1,104 ambulance dispatches to schools during a 5-year period from January 2009 to December 2013. In line with the classification by the fire department, questionnaire items were: date of emergency, day of the week, time of dispatch request, weather, emergency type (acute illness, general injury, sport-related accident, and traffic accident), patient age, sex, severity of the condition (mild, moderate, and severe), disease name, site of occurrence, and emergency situation in detail. We obtained information on a total of 1,104 emergency cases at schools, and after excluding dispatches related to local athletic events, youth sports club activities, emergencies that happened in dormitories, and emergencies involving the general public using school gymnasiums (as these were regarded as non-regular educational activities), this study investigated 850 students aged 0–63 years who had injuries and illnesses due to activities during regular school hours, club activities during after-school hours, or traffic accidents near the school during the morning or afternoon commute. There were 565 male patients (66.5%) and 285 female patients (33.5%). The average age was 14.6 ± 8.0 years. The condition names used in this study are the diagnoses made by physicians on duty in emergency departments after initial examinations and thus vary widely. Therefore, they were classified into five categories as follows: non-traumatic internal medical conditions (including pneumothorax, etc.) were classified as “non-traumatic medical conditions”; typical traumatic injuries excluding head and facial injuries were classified as “traumatic injuries”; sprains, contusions, dislocations, and fractures of sites other than the head or face were classified as “orthopedic injuries”; trauma, contusions, and fractures of the head and face were classified as “neurosurgical injuries”; and all other conditions including cardiopulmonary arrest (one case of hanging only), tracheostomy decannulation, and cases in which the patient was not transported were classified as “other”. More detailed categories are summarized in Table 1. We undertook a sub-analysis of environmental factors that contributed to “heat stroke and dehydration”, which is preventable, but not an internal medical condition influenced by an individual’s physical condition or an incidental injury that is not preventable.

We obtained anonymous data after gaining consent from the heads of the fire departments following careful

Table 1. Detailed classification of medical conditions requiring ambulance dispatches to schools in Fukui Prefecture, Japan (2009–2013)

Rank	Conditions	No. of people	Percentage
1	Sprains, contusions, dislocations, and fractures	245	28.8
2	Seizures, epilepsy, and syncope	171	20.1
3	Cuts, bruises, lacerations, trauma, amputations, and burns	108	12.7
4	Heat stroke and dehydration	74	8.7
5	Hyperventilation syndrome	60	7.1
6	Loss of consciousness and impairment of consciousness	36	4.2
7	Acute abdomen, nausea, and vomiting	28	3.3
8	Allergy-related condition	20	2.4
9	Headache	18	2.1
10	Cerebrovascular disease and concussion	12	1.4
11	Dizziness and staggering	9	1.1
12	Others	69	8.1
		850	100.0

explanation of the significance of the study, ethical considerations, and the rights of human subjects.

Statistical analysis was carried out using Stata/MP version 14.0 (Stata Corp., College Station, TX, USA), with statistical significance set at $P < 0.05$.

RESULTS

WHEN THE NUMBER of dispatches was examined by age group and by day, it was found that dispatches were most frequent on Saturday and Sunday, with dispatches on these days accounting for 21.5% of overall dispatches (183/850). For all age groups, namely, middle school students and younger students (85/443, 19.2%), high school students (76/311, 24.4%), and students aged ≥ 19 years (20/62, 32.3%), the percentage of dispatches on Saturdays and Sundays was higher than the percentage on any weekday. The percentage of weekend dispatches was higher for students aged ≥ 19 years than for any other age group. On weekdays between Monday and Friday, the number of emergency calls made was approximately the same,

with no relationship to the day of the week. The majority of weekday calls were for middle school students and younger students, followed by high school students, students aged ≥ 19 years, and school faculty members. When sex differences were examined for each age group, a significant sex difference in distribution across days of the week was found for high school students ($P = 0.043$) but not for any other age group (Table 2, sex comparison table not shown).

Next, the number of dispatches for conditions in each category were calculated for each age group. Of the total of 443 middle school students and younger students, 222 had an internal medical condition and 112 had an orthopedic injury. The distribution was similar for other age groups except for high school students, but almost all faculty members had an internal medical condition. A significant sex difference in the category distribution was found for students aged ≥ 19 years ($P = 0.007$) but not for any other age group (Table 3, sex comparison table not shown).

Among the detailed categories, the most frequent conditions requiring ambulance dispatch were “sprains, contusions, dislocations, and fractures” ($n = 245$). It was followed by “seizures, epilepsy, and syncope” ($n = 171$) and “cuts, bruises, lacerations, trauma, amputations, and burns” ($n = 108$). Dispatches for these three categories accounted for 61.6% of all dispatches. Dispatches for conditions in the top seven categories, which included the above-mentioned three categories along with “heat stroke and dehydration” ($n = 74$), “hyperventilation syndrome” ($n = 60$), “loss of consciousness and impairment of consciousness” ($n = 36$), and “acute abdomen, nausea, and vomiting” ($n = 28$), accounted for 84.9% of all dispatches.

Almost all dispatches for “heat stroke and dehydration”, one category within the top seven, were during school hours, with 63/74 dispatches (85.1%) occurring during school hours (6:00 AM to 5:00 PM) and 11/74 dispatches (14.9%) occurring after school hours (5:00 PM to 12:00 AM)

Table 2. Number of ambulance dispatches to schools in Fukui Prefecture, Japan (2009–2013) by day of the week and patient age group

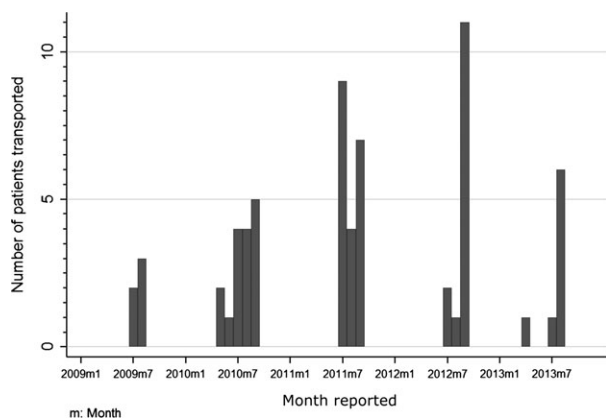
Day	Middle school students and younger students (age, 0–15 years)	High school students (age, 16–18 years)	≥ 19 years (students)	≥ 19 years (faculty)	Total
Monday	70 (15.8)	38 (12.2)	11 (17.7)	6 (17.6)	125 (14.7)
Tuesday	73 (16.5)	48 (15.4)	9 (14.5)	2 (5.9)	132 (15.5)
Wednesday	71 (16.0)	46 (14.8)	11 (17.7)	9 (26.5)	137 (16.1)
Thursday	70 (15.8)	51 (16.4)	8 (12.9)	5 (14.7)	134 (15.8)
Friday	74 (16.7)	52 (16.7)	3 (4.8)	10 (29.4)	139 (16.4)
Saturday/Sunday	85 (19.2)	76 (24.4)	20 (32.3)	2 (5.9)	183 (21.5)
Total	443 (100%)	311 (100%)	62 (100%)	34 (100%)	850 (100%)

Table 3. Relationship between broad classifications of medical conditions requiring ambulance dispatches to schools in Fukui Prefecture, Japan (2009–2013) and patient age group

	Middle school students and younger students (age, 0–15 years)	High school students (age, 16–18 years)	≥ 19 years (students)	≥ 19 years (faculty)	Total
Internal medical condition	222	172	32	24	450
Traumatic injury	25	8	0	1	34
Orthopedic injury	112	57	17	5	191
Neurosurgical injury	80	74	11	4	169
Other	4	0	2	0	6
Total	443	311	62	34	850

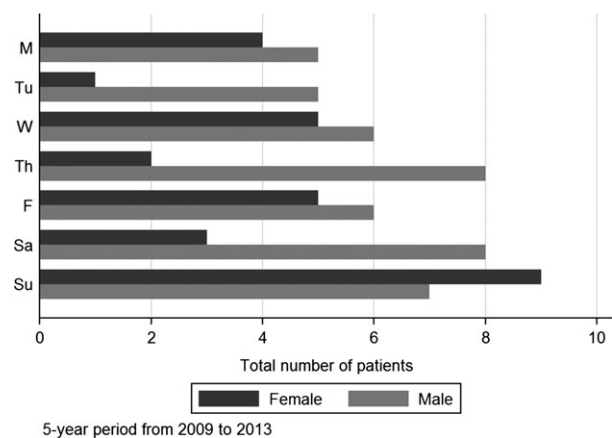
Table 4. Relationship between the top seven detailed classifications of medical conditions requiring ambulance dispatches to schools in Fukui Prefecture, Japan (2009–2013) and time of the request

Diagnosis	12:00 AM to 5:59 AM	During school hours (6:00 AM to 5:00 PM)	After class (5:01 PM to 11:59 PM)	Total
1 Sprains, contusions, dislocations, and fractures	1	199	45	245
2 Seizures, epilepsy, and syncope	0	158	13	171
3 Cuts, bruises, lacerations, trauma, amputations, and burns	0	90	18	108
4 Heat stroke and dehydration	0	63	11	74
5 Hyperventilation syndrome	1	42	17	60
6 Loss of consciousness and impairment of consciousness	0	33	3	36
7 Acute abdomen, nausea, and vomiting	0	22	6	28

**Fig. 1.** Number of students and faculty members diagnosed with heat stroke/dehydration and transported by ambulance in Fukui Prefecture, Japan. A total of 74 emergency transportations for heat stroke and dehydration were made by Fukui prefectural fire departments over the period from January 2009 to December 2013. Columns show number of dispatches by month. m1, January; m7, July.

(Table 4). Dispatches were concentrated between the months of July and September (Fig. 1). Incidents occurred most frequently on Sunday, followed by Saturday and then Wednesday (Fig. 2).

When multivariate analysis of factors related to heat stroke incidence was carried out, the odds ratio for high school students relative to middle school students was significantly higher at 3.28. The odds ratio for the summer/fall seasons relative to the winter/spring seasons was significantly higher at 12.6. The odds ratio for sunny days relative to rainy days was significantly higher at 5.87. The odds ratio for emergency calls on weekends relative to weekdays was significantly higher at 2.31. However, there were no significant differences in sex, time, or severity of condition at time of transport (Table 5).

**Fig. 2.** Number of students and faculty diagnosed with heat stroke/dehydration and transported by ambulance in Fukui Prefecture, Japan, by day of the week. A total of 74 patients were transported during the 5-year period from January 2009 to December 2013. Dark gray indicates female patients ($n = 29$), light gray indicates male patients ($n = 45$).

DISCUSSION

THE NUMBER OF residents of Fukui Prefecture in kindergarten through to college is 113,039. An ambulance is dispatched for children/young adults in this prefecture's schools an average of 170 times a year, making the dispatch rate 0.15%. According to the Japan Sport Council, 6.5% of people in this age group suffered an injury or illness in 2013;⁴ therefore, an ambulance was dispatched for 2.3% of injuries and illnesses that arose at schools.

Most ambulance dispatches for all non-faculty age groups were on weekends, which means that they were probably related to extracurricular activities such as clubs. There was very little variation in the number of ambulance dispatches for non-faculty members between weekdays, and this

Table 5. Multivariate analysis of factors related to occurrence of heat stroke requiring ambulance dispatches to schools in Fukui Prefecture, Japan (2009–2013)

Heat stroke	Odds ratio	SE	95% CI		P-value
			Low	High	
Age group					
Middle school students and younger students (age, 0–15 years)	1.00	Reference			
High school students (age, 16–18 years)	3.28	1.02	1.78	6.04	<0.001
≥19 years (faculty)	0.74	0.79	0.09	5.96	0.780
≥19 years (non-faculty)	2.40	1.35	0.79	7.25	0.120
Weather					
Rainy	1.00	Reference			
Cloudy	1.72	1.39	0.36	8.36	0.500
Snowing	1.00	†			
Sunny	5.87	4.34	1.37	25.04	0.017
Sex					
Male	1.00	Reference			
Female	1.45	0.42	0.81	2.57	0.210
Two time categories					
Outside of school hours (5:01 PM to 5:59 AM)	1.00	Reference			
During school hours (6:00 AM to 5:00 PM)	1.37	0.58	0.60	3.12	0.450
Severity of condition					
Mild	1.00	Reference			
Moderate to severe	0.94	0.27	0.53	1.66	0.830
Two categories of season					
Winter/spring	1.00	Reference			
Summer/fall	12.60	7.63	3.85	41.26	<0.001
Date of emergency call					
Weekday	1.00	Reference			
Weekend	2.31	0.81	1.16	4.60	0.017
Holiday	1.28	1.39	0.15	10.70	0.820

†The odds ratio for heat stroke on snowy days is 1.00, as there were no cases on those days. CI, confidence interval; SE, standard error.

number was lower for older students. This could be because students become more capable of preventing injury and illness as they grow. The percentage of weekend dispatches was particularly high for students aged ≥19 years. We believe that the reasons for this are that students aged ≥19 years are often off campus on weekdays because they have fewer classes they must attend on weekdays compared with younger students and because they spend long hours on campus on weekends for club activities. Furthermore, the strenuous training sessions and practice matches in which students participate on weekends probably increase their risk of injury and illness.

When the number of transported patients was compared between condition categories, internal medical conditions were the most frequent among all age groups, followed by orthopedic injuries (sprains, contusions, dislocations, and fractures). However, the absolute number of transported

patients was lower in the older age groups, which indicates that older students are monitoring their physical condition or taking measures against environmental factors. Dispatches for the top seven detailed condition categories accounted for 84.9% of all ambulance dispatches. Excluding “heat stroke and dehydration”, these were all injuries sustained during educational activities, chronic illness, or malaise. This indicates that there are limits to the extent that schools can ensure students are safe from accidents and spontaneous illness.

As “heat stroke and dehydration” are somewhat foreseeable and preventable, we undertook a multivariate analysis using incidence (1) and non-incidence (0) of “heat stroke and dehydration” as the response variable. We found significant differences between age groups (high school students), weather conditions (sunny), seasons (summer/fall), and emergency call day (weekends), which led us to judge these

as significant factors that influence “heat stroke and dehydration”.

Our findings that heat stroke most frequently occurred on sunny days, in the months of July through September, in the summer/fall seasons, and during school hours are consistent with data published by the Japan Sport Council,⁵ but our multivariate analysis in this study showed no significant difference in the time of occurrence. In the same publication, the Japan Sport Council also reported that heat stroke most frequently occurs during physical education class in elementary school students, whereas it almost always occurs during extracurricular activities such as club activities in middle school and high school students. In our study, we found significantly higher incidence among high school students than in any other age group. This indicates that students in the high school age group that engage in strenuous physical activity during club activities develop exertional heat stroke, with risk tending to be particularly high during weekend club activities. Students must be taught the importance of monitoring their physical condition, which could be accomplished by educating club organizers about heat stroke prevention, making shaded resting areas or hydration areas available at schools, or having school staff or parents ensure that students eat properly and get enough sleep.

CONCLUSION

DISPATCHES FOR CONDITIONS in the three categories “sprains, contusions, dislocations, and fractures”, “seizures, epilepsy, and syncope”, and “cuts, bruises, lacerations, trauma, amputations, and burns” accounted for 61.6% of all ambulance dispatches. Our findings on heat stroke, a condition that should be possible to effectively

control through prevention and public awareness, indicate that it is necessary to prevent heat stroke during high school club activities.

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CONFLICT OF INTEREST

NONE.

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