

Epidemiology of Heat Illness

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Abstract

With the effects of global warming as well as problems such as power supply shortages related to the nuclear power accident caused by the Great East Japan Earthquake of 2011, it is feared that heat illness patients will increase. In past reports there is a large fluctuation in annual mortality due to heat illness, with climatic conditions, which are an environmental factor, having an impact. A review of the results of surveys conducted by the Heatstroke Surveillance Committee of the Japanese Association for Acute Medicine revealed that out of the past several years 2010 had the highest number of heat illness patients transported by emergency medical services, the highest severity, and most fatalities. According to the survey results, in males cases appeared on the average from young to old age whereas in females there were two peaks—one in the young and one in the elderly. Further, the younger the age, the more cases were mild whereas the elderly developed non-exertional heat illness in ordinary life circumstances and had a high rate of severe cases. It is possible that harsh summers could occur frequently in future. In addition to awareness-building activities to prevent heat illness, it is important to establish effective safety nets in communities to prevent occurrence and increasing severity in the elderly.

Key words Heat illness, Epidemiology, Mortality, Severity

Introduction

Heat illness is a general term for clinical conditions that arise from the body's maladjustment to environmental heat. The frequency of heat illness is increasing, due in part to the effects of recent global warming and the urban heat island phenomenon. According to *the Vital Statistics in Japan* published by the Ministry of Health, Labour and Welfare of Japan,¹ mortality due to heat illness in 2010 was 1,731 deaths, which is a marked increase compared to the past. There were fears that the incidence would increase further in 2011 with the power supply shortages resulting from the nuclear power accident caused by the Great East Japan Earthquake of 2011. Although it is a rough number, mortality due to heat illness for June to September 2011 was 901 deaths. While this was less than the 1,684 deaths

during the same period in 2010, it was still the second highest mortality, following 2010, during the five-year period since 2007 (**Fig. 1**).

This paper comments on the epidemiology of heat illness based on heat illness surveys [Heatstroke STUDY-2006 (HsS2006), Heatstroke STUDY-2008 (HsS2008), and Heatstroke STUDY-2010 (HsS2010)] conducted by the Heatstroke Surveillance Committee of the Japanese Association for Acute Medicine (JAAM) beginning in 2006 in addition to past reports.

Overview of the Heatstroke Surveillance Committee's Surveys

The Heatstroke Surveillance Committee conducted surveys of heat illness patients who were seen and received treatment at emergency and critical care centers nationwide, accredited

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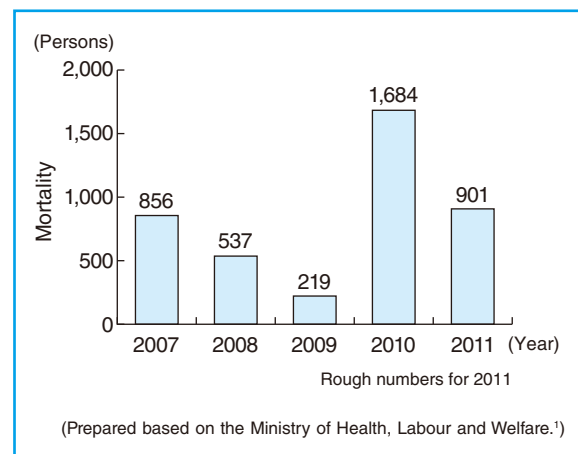


Fig. 1 Mortality due to heat illness from June to September

Table 1 Overview of the Heatstroke STUDY

| | Heatstroke STUDY-2006 | Heatstroke STUDY-2008 | Heatstroke STUDY-2010 |
|--------------------------|-----------------------|-----------------------|-----------------------|
| Participating facilities | 66 | 82 | 94 |
| Cases | 528 | 913 | 1,780 |
| Cases/facility | 8.0 | 11.1 | 18.9 |
| Males:females (unknown) | 413:113 (2) | 670:236 (7) | 1,253:511 (16) |
| Males/females | 3.7 | 2.8 | 2.5 |
| Average age (years) | 41.5 | 44.6 | 49.5 |
| Mortality | 13 (2.5%) | 15 (1.6%) | 63 (3.5%) |

(Extracted from Miyake Y, et al²; Miyake Y, et al³; Miyake Y, et al.⁴)

training institutions for senior fellowship of the JAAM, and emergency departments of university hospitals. The surveys covered the three months of June to August 2006 and the four months of June to September 2008 and June to September 2010. The results of each survey were reported in the HsS2006,² HsS2008,³ and HsS2010,⁴ respectively.

The number of participating medical institutions and recorded cases were: 66 facilities and 528 cases in the HsS2006; 82 facilities and 913 cases in the HsS2008; and 94 facilities and 1,780 cases in the HsS2010. The respective gender and average age of patients were: 413:113 male:female (2 unknown), 41.5 years old; 670:236 (7), 44.6 years old; and 1,253:511 (16), 49.5 years old. (Table 1). Although a simple comparison

cannot be made since the survey period was shorter for HsS2006, on comparison even with HsS2008, in HsS2010 the number of cases per facility increased, the gender ratio decreased, and the average age increased.

Changes in Mortality Due to Heat Illness

Mortality due to heat illness during the 40 years from 1970 to 2009 was 7,502 cases, of which 4,497 were male and 3,005 were female.⁵ Up until 1994 the annual average was 88 cases. Since 1995 it has been 353 cases, and it has been pointed out that the ICD-10 had an effect, since it came into use starting in 1995. After the change to ICD-10, it is needed to write the primary disease on death certificates. Therefore, it is conjectured that condi-

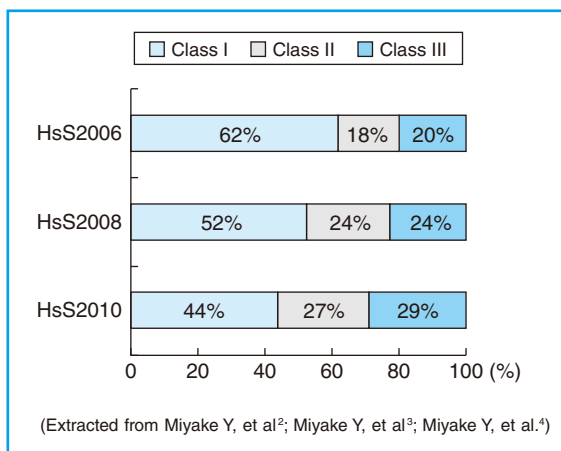


Fig. 2 Severity on arrival at hospital

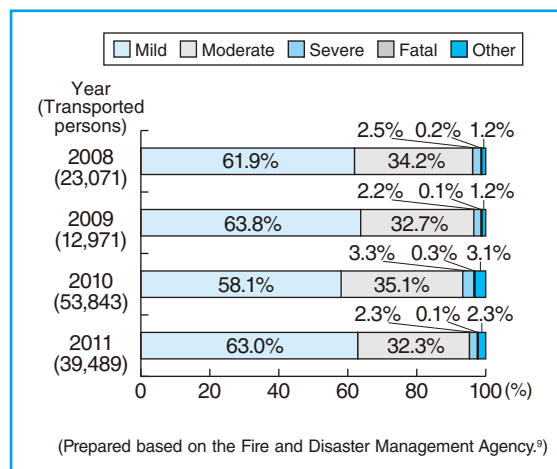


Fig. 3 Emergency medical transport of persons with heat illness

tions such as heart failure for deaths under a hot environment used to be given on death certificates, but, as a result of giving a more accurate diagnosis, heat illness started to be written down on the certificates.⁶

The annual average mortality due to heat illness has increased further to 839 cases in the past five years.¹ However, mortality in 2009 was 219 cases; there is a big fluctuation in annual mortality due to heat illness (Fig. 1). Significant correlations have been reported between mortality due to heat illness and the number of days on which the temperature exceeds 30°C and the number of nights in which the temperature does not fall below 25°C,⁵ and also between the yearly high temperature and the death rate and age-adjusted death rate.⁶ Changes in mortality over the past five years match changes in the deviation in seasonal average temperature for summer,⁷ and the climatic conditions, which are an environmental factor, are a major factor in death due to heat illness.

Changes in Heat Illness Severity

HsS2006, HsS2008, and HsS2010 assess severity using the new classifications for heat illness advocated by the Japanese Congress on Neurological Emergencies, which is categorized as Class I (mild), Class II (moderate), and Class III (severe).⁸ The breakdown of severity on arrival at hospital was 62% for Class I, 18% for

Class II, and 20% for Class III in the HsS2006; 52%, 24%, and 24% in the HsS2008, and 44%, 27%, and 29% in the HsS2010 (Fig. 2). There were 13 fatal cases (2.5%) in the HsS2006, 15 fatal cases (1.6%) in the HsS2008, and 63 fatal cases (3.5%) in the HsS2010 (Table 1). In the results for HsS2010, the frequency of severe cases and mortality also rose in addition to the previously mentioned increase in the number of cases of heat illness.

The number of persons with heat illness who were transported by emergency medical services from July to September and the severity on first diagnosis in the medical institution to which the patient was transported have been reported by the Fire and Disaster Management Agency of Japan since 2008 (Fig. 3).⁹ The change in the number of persons with heat illness matches the change in mortality due to heat illness (Fig. 1). In 2010, as many as 53,843 heat illness patients were transported by emergency medical services. Frequencies by level of severity were, in the order mild, moderate, severe, fatal, and other: 61.9%, 34.2%, 2.5%, 0.2%, and 1.2% in 2008; 63.8%, 32.7%, 2.2%, 0.1%, and 1.2% in 2009; and 63.0%, 32.3%, 2.3%, 0.1%, and 2.3% in 2011. There was no major fluctuation during those three years. In 2010, however, the frequency slanted toward severe cases: 58.1%, 35.1%, 3.3%, 0.3%, and 3.1%. This trend matches the results of the HsS2010 and shows just how harsh the summer of 2010 was.

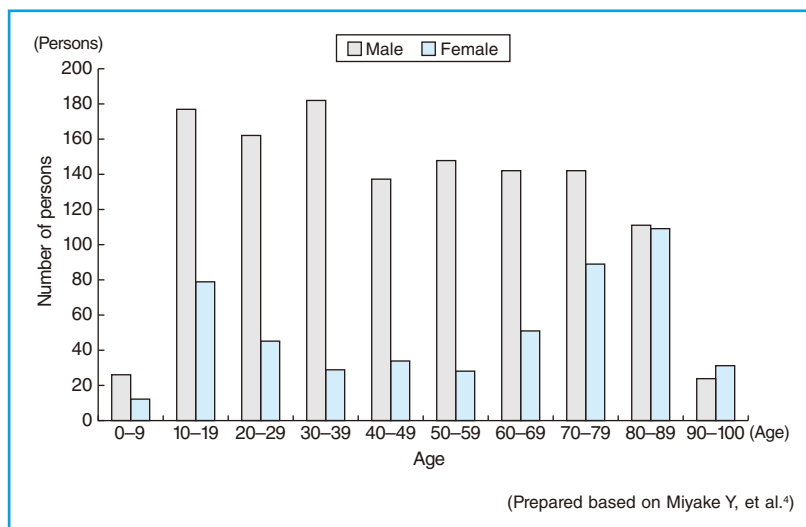


Fig. 4 Incidence of heat illness by gender and age

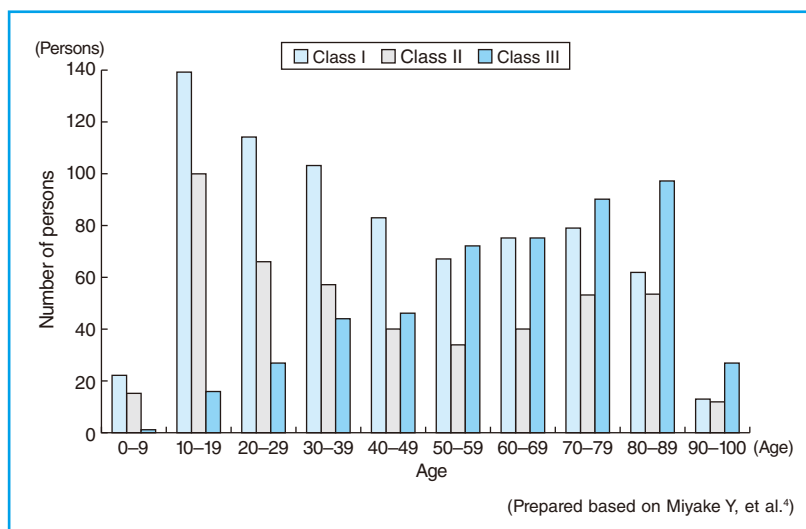


Fig. 5 Heat illness severity by age

Heat Illness Gender Differences by Age

The number of heat illness cases by gender and age in the HsS2010 were nearly the same as the results for HsS2006 and HsS2008.^{2,3} In males cases appeared on the average from young to old age whereas in females there were two peaks—one in the young and one in the elderly (**Fig. 4**). Young females develop heat illness in connection to sports while in old age they develop non-exertional heat illness in ordinary life circum-

stances. A gender reversal was seen in elderly people above their 80s, but this is due to the effects of sex ratio in the elderly.

Heat Illness Severity by Age

Severity by age in the HsS2010 was also nearly the same as the results for HsS2006 and HsS2008.^{2,3} The younger the age, the more cases of Class I while the rate of Class III increases with age (**Fig. 5**).

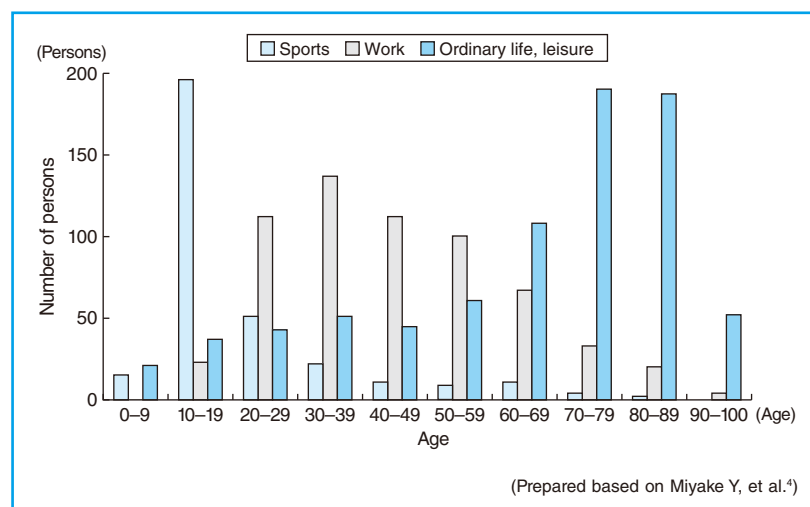


Fig. 6 Incidence of heat illness by age and activity

Number of Heat Illness Cases by Age and Type of Activity

The number of heat illness cases by age and type of activity in the HsS2010 was the same as the results for HsS2008.³ Prevalence was higher during sports for young people and higher during work for middle and late middle age (Fig. 6). Among the elderly, prevalence was high during ordinary life, necessitating caution, including active prevention.

Conclusion

The trend toward higher temperatures due to

global warming is continuing, and so it is possible that harsh summers like in 2010 could occur frequently. If so, not only would the incidence of heat illness increase, but so too would severe cases of heat illness and mortality due to heat illness. Care must be taken especially for the elderly, since they develop heat illness even under the conditions of ordinary life and tend to develop severe cases. In order to prevent heat illness, in addition to awareness-building activities, safety nets have to be established in communities, such as intervention for the elderly by local society and socialization among community residents, and it is important for these to function effectively.

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