2013Information System for Heat Disorders in Japan.

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Abstract

Recently Japan experienced hotter summer than usual, and according to the prompt reports of heat disorder patients taken to hospitals by ambulance cars (the Fire and Disaster Management Agency [FDMA]) the number of patients was 58,729 from June to September in 2013 and exceeded the previous record (56,119: June to September in 2010). The Ministry of Environment (MOE) started the information system to reduce risks for heat disorders in 2005 and developed the system year by year. In Japan to inform people of risks for heat disorders, we commonly use WBGT (Wet-Bulb Globe Temperature). For 2013 summer, the MOE renewals heat information system, and we provide 3 hourly WBGT forecasts for 3 days and inform of 1 hourly observed and estimated WBGT for almost 850 towns (special resolution is around 23km). Additionally we provide WBGT forecasts for local governments and companies by http or ftp and for individuals by mobile phone short mails. Such educational activities encourage people' understandings for heat disorders and contribute reduction of severe symptom patients during heat spell condition.

Introduction

Heat disorder patients increase with global warming, urbanization, etc, and heat spells bring health damage especially for elderly people. In 2013, Japan experienced hot summer again, and according to the FDMA report, the total number of patients taken to hospitals by ambulance cars from June to September was exceeded to 58,729(1), (the FDMA record from 2010). About the ratio of patients separated by age, elderly patients (older than 65 years) were the most common category 47.4 percent. In 2013 hot summer, as observed in 2010 hot summer, during the 1st. heat spell, (1) patients taken to hospitals by ambulance cars were greater than later heat spell, (2) severe symptom patients became bigger and (3) elderly patients (older than 65 years) increased(2).

There are several indexes related to heat disorders, however, WBGT (Wet Bulb Globe Temperature, Yaglou, 1957) (3), adopted as ISO 7243, is commonly used in Japan. WBGT is calculated from T_w (wet bulb temperature), T_g (globe temperature) and T_a (dry bulb temperature) as follows.

$$WBGT = 0.7 \times T_w + 0.2 \times T_g + 0.1 \times T_a \qquad (1)$$

Information system regarding heat disorder

MOE manages 'Heat Stroke Information web site' from 2005 and in 2013 season MOE provides the information May (1month earlier to previous season) to September. Until 2012, observed WBGT at 6 cities (Tokyo, Niigata, Nagoya, Osaka, Hiroshima and Fukuoka) and estimated WBGT at 147 cities are updated 1 hourly, and 3 hourly WBGT forecast for 150 cities beyond the day after tomorrow was provided. In 2013 season, the number of forecasts and

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observation/estimation points was expanded to 841 and it's special resolution became 23km. WBGT forecast is updated with 6 hourly by NWP forecast (JMA-GSM) and corrected with observed/estimated WBGT 1 hourly.

WBGT is calculated with equation (1), however, most of observatories does not observe T_g (globe temperature). At such observatories, we estimate WBGT from temperature, relative humidity, sun radiation and wind speed with equation (2). This equation was obtained from observed data at 6 cities (Tokyo, Niigata, Nagoya, Osaka, Hiroshima and Fukuoka) during 2007, 2008, 2009 season. And when sun radiation is not observed, we calculated sun radiation (S_0) in clear sky condition, and with using sun duration in 10 minutes (SD) estimated sun radiation (S_1) with equation (3). Additionally when relative humidity is not observed, we estimated it from objective analysis data (JMA-MSM data and observed relative humidity at 150 observatories). At JMA observatories, relative humidity is observed under forced draft condition (5m/s) by fan, however, ISO instructed relative humidity for WBGT should be observed under natural ventilation. The average bias of WBGT under natural ventilation to WBGT under forced draft condition, estimated for Nagoya in 2008 by heat budget equations, is +0.54 (0.22 to 2.55) degree in Celsius and standard deviation of bias is 0.18 degree in Celsius. The bias becomes bigger under weak wind and lower temperature condition.[4]

$$WBGT = 0.735 \times T_a + 0.0374 \times RH + 0.00292 \times T_a \times RH + 7.619 \times SR - 4.557 \times SR^2 - 0.0572 \times WS - 4.064 \quad (2)$$

Here, T_a is temperature (deg. in Celsius), RH is relative humidity (%), SR is sun radiation (kW/m^2), WS is wind speed (m/s).

$$S_1 = S_0 \text{ / } c \quad (\text{when SD} = 0)$$
$$S_0 \text{ / } \{1 + a \times \exp(-c \times \text{sun})\} \quad (\text{when SD} = 1 \text{ to } 10 \text{ (min.)}) \quad (3)$$

Here, coefficient a, b and c are calculated from 2011 observation data at the nearest observatory where sun radiation is observed. For example a= 1.3, b=0.19 and c=4.0 at Tokyo.

Table 1. WBGT warning categories and remark
(Japan Amateur Sports Association, 1994)

WBGT threshold (degrees C)		
31	danger	Stop exercises in principle
28	alert	Stop severe exercises
25	advisory	Take rests frequently
21	caution	Frequent hydration
	almost safe	Risk is relatively lower

WBGT observation and forecast data is displayed with 5 colored categories separated by WBGT threshold (Japan Amateur Sports Association, 1994)[5] shown in Table 1. 'Pink' (WBGT is greater than 28 degree) warns the heat condition is in alert level (patients taken to hospitals will be increasing). And 'Red' (WBGT is greater than 31 degree) warns the heat condition is in danger (patients taken to hospitals might exceed to 1,000 in a day or several fatalities might be recorded). In the web site or in the MOE guidebook[6], directions how to reduce heat risks or how to protect health condition are mentioned. The system provides actual WBGT and WBGT forecast

to 1,366 local governments, related organizations, private companies and so on by ftp/http protocol. Local governments, received WBGT information, distribute the information to staff who responsible for schools, hospitals, care managements, sports and so on. Additionally from 2013 the system starts SMS information service to subscribed personal users (around 15,000).

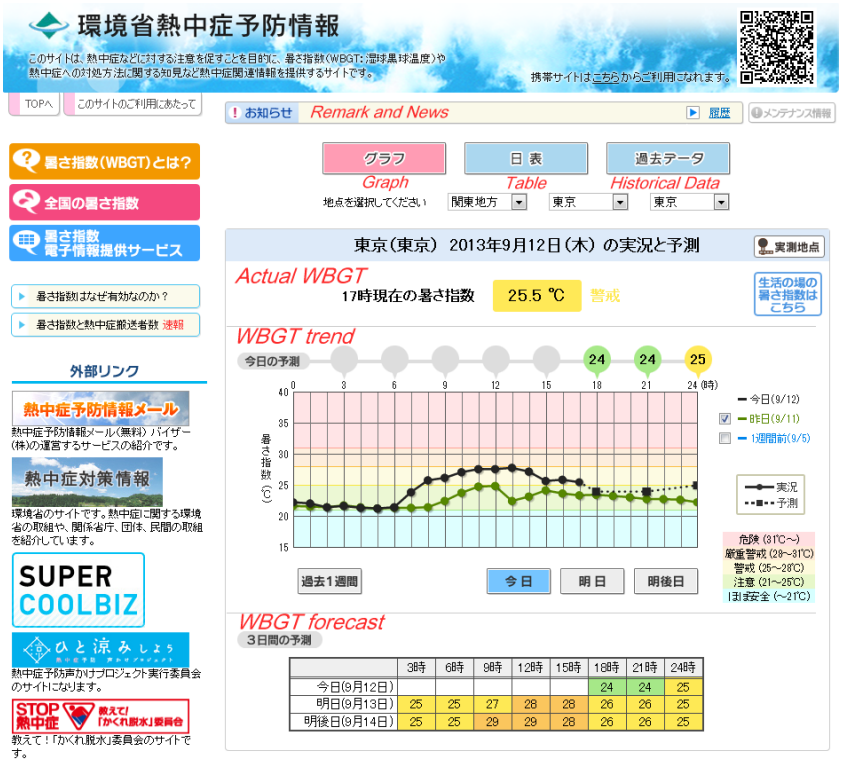

Fig. 1 WBGT web site (Ministry of Environment and National Institute for Environmental Studies) http://www.wbgt.env.go.jp/

WBGT information site is well known in Japan, and the hit for WBGT information is steady increasing year by year. In 2013 summer season (May to September), the total access for the top page of the WBGT information site was exceeded to 10.4 million hits (7.7 million hits in 2012).

Seminars for local governments' staffs

The Ministry of Environment (MOE) issued 'A guide book for preventing heat disorders'[(6)] from 2005, and provided leaflets or a post card to warn heat disorder risks especially for elderly people. In 2013 MOE held seminars for nurses, care managers and local government staffs at 14 big cities from May and June. The seminar is consisted of 3 sessions shown below.
http://www.env.go.jp/chemi/heat_stroke/seminar2013/index.html

Session 1: Heat disorder mechanism, expedient treatment and medical treatment

Session 2: Heat disorder in daily life

Session 3: Guideline for heat disorders and examples of local government approaches

The presentation files used on seminars are published as a handout and opened for the public usage through the Internet.

Effects of educational activities and information

MOE has been implementing several projects from 2005, and other ministries/agencies (ex. The Health, Labour and Welfare Ministry, the FDMA and etc) also have promoted educational activities. We evaluated the effects of such educational activities and information with comparison of patients in FDMA reports. We compared the 2013 first heal spell, from 7th to 14th of July, and the 2010 first heat spell continued from 20th to 26th of July. During the first spell in

2010, average of maximum WBGT at 6 cities (Tokyo, Niigata, Nagoya, Osaka, Hiroshima and Fukuoka) was 30.0 degree in Celsius and average of maximum WBGT in 2013 was almost same as 29.8 degree in Celsius. And the statistical values of patients during the first heat spell in 2010 and 2013 are shown in Table 2.

Table 2. Statistical values during the first heat spell in 2010 and 2013.

	2013 7th to 14th of July	2010 20th to 26th of July	
WBGT(degree in Celsius)	29.8	30.0	
Total patients	10,913	10,303	
Fatalities	16	76	P<0.01
Severe symptom patients	409 (3.7%)	624 (5.9%)	P<0.01
Severe/Moderate symptom patients	4,263 (38.6%)	4,631 (44.8%)	P<0.01

The number of heat disorder patients has a proportionate relationship with exponential of maximum WBGT, and we revised 2013 patients with using regression equation. The 2013 patients at WBGT 30.0 degree in Celsius increased 13 or 20 percent (estimated by 2010 and 2013 equation) compare to 2010. However, the fatalities decreased in 21% and the number of severe symptom decreased in 38%. We suppose that public awareness for heat disorders and various educational activities effect “Patients increase and reduction of severe patients”.

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