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Elevated Heat Stroke Risk in Older Adults Indirectly Caused by COVID-19 Restrictions

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Abstract: Emergency transport data from Tottori Prefecture, Japan were used to evaluate the indirect impact of coronavirus disease 2019 (COVID-19) restrictions on heat stroke. There were 426 cases of emergency transport owing to heat stroke in summer 2020 compared with 1,465 cases combined for the summers of 2017–2019. The mean age of cases in 2020 was 66.2 years—significantly higher than in previous years (57.4–60.0 years). In 2020, 47.7% of cases were older than 75 (previously, 35.6%–44.2%), and 36.9% were transported from their residence, (previously, 26.6%–29.3%). Thus, COVID-19 measures, such as "stay at home" requests, may have increased the risk of heat stroke in older adults.

Keywords: COVID-19; heat stroke; elderly; stay-at-home

1. Introduction

The coronavirus disease 2019 (COVID-19) pandemic has resulted in over 80 million known infections and 1.7 million deaths as of December 2020 [1] and has had a tremendous impact on the world's economy in a relatively short period of time. Until vaccines or therapeutic medications for COVID-19 become available, many countries and regions are forced to adopt physical distancing measures, such as self-quarantine, lockdowns, and/or stay at home orders/requests to prevent the spread of the disease. However, measures that restrict people's activities may cause unintended health problems owing to a reduction in exercise, as well as mental health problems because of a lack of social contact.

The incidence of heat stroke is a growing health problem that is increasing with global warming. In Japan, older adults account for a high proportion of heat stroke patients, and most of these cases arise in the home [2]. In early summer 2020, concerns were raised that a request to not go outside and the wearing of face masks to prevent transmission might increase the incidence of heat stroke; however, this relationship has not been investigated. In this study, we analyzed emergency transport data from Tottori Prefecture, where the number of COVID-19 cases has been low, to evaluate the indirect effect of COVID-19 measures on the incidence of heat stroke.

2. Materials and Methods

This study was conducted with data from Tottori Prefecture, which is located in western Japan and has the smallest population (555,663 in October 2019) of all 47 prefectures in the country. The daily number of new COVID-19 cases and the date on which the COVID-19 Tottori Alert (the warning system of Tottori Prefecture) was issued were obtained from the COVID-19 website of Tottori Prefecture.

The number of daily ambulance transports for heat stroke was obtained from the Department of Health and Welfare of Tottori Prefecture, which identified a total of 426 of

these cases from April to October 2020. A total of 1,465 heat stroke cases from April to October for the years 2017 to 2019 combined were selected as the control group. The following parameters were compared between the control cases and the 2020 heat stroke cases: mean age, age structure, and the circumstances of the heat stroke: at home, at work (excluding farm work), during exercise (indoors and outdoors), outside (excluding work), farm work, while watching an outdoor event, during tourist activities, or other circumstances. The patient's medical condition and diagnosis were determined by the emergency room physician based on the International Classification of Diseases 10th revision (T67: Effects of heat and light) when the patient arrived at the hospital.

The Japan Meteorological Agency provided air temperature data for Tottori City, the capital of Tottori Prefecture.

Descriptive statistics, one-way analysis of variance, and the $\chi 2$ test were used in the analysis, and the significance level was set at 5%. The analyses were conducted in SPSS version 24.0 (IBM-SPSS, Armonk, NY, USA).

The study was approved by the Tottori University Ethics Committee (No. 180626-069).

3. Results

The first COVID-19 case in Tottori Prefecture was reported on April 10, 2020, and a total of 38 cases were reported by the end of October 2020. As of the end of October 2020, Tottori Prefecture ranked 46th in Japan for the number of COVID-19 cases (the 45th-ranking prefecture had 68.35 cases per million people). In response to the growing number of COVID-19 cases, the Japanese government declared a state of emergency on April 16, 2020, which was lifted on May 14, 2020. Although the Japanese government requested people to quarantine themselves, this was a voluntary measure. Tottori Prefecture issued COVID-19 Tottori Alerts in response to the outbreak of cases in the prefecture, but these were requests to residents and were not enforceable. A COVID-19 Tottori Alert was issued on the following dates: "Advisory", July 2–14, 2020 (Eastern District); July 12–25 (Western District); July 25–28 (Eastern District); August 21–September 2 (Western District); September 22–October 2 (Western District), and "Warning", July 29 (Eastern District); July 30–August 20 (Prefecture-wide); September 12–22 (Prefecture-wide). Figure 1 shows the daily number of new cases of COVID-19 and the issuance of local government alerts in Tottori Prefecture.

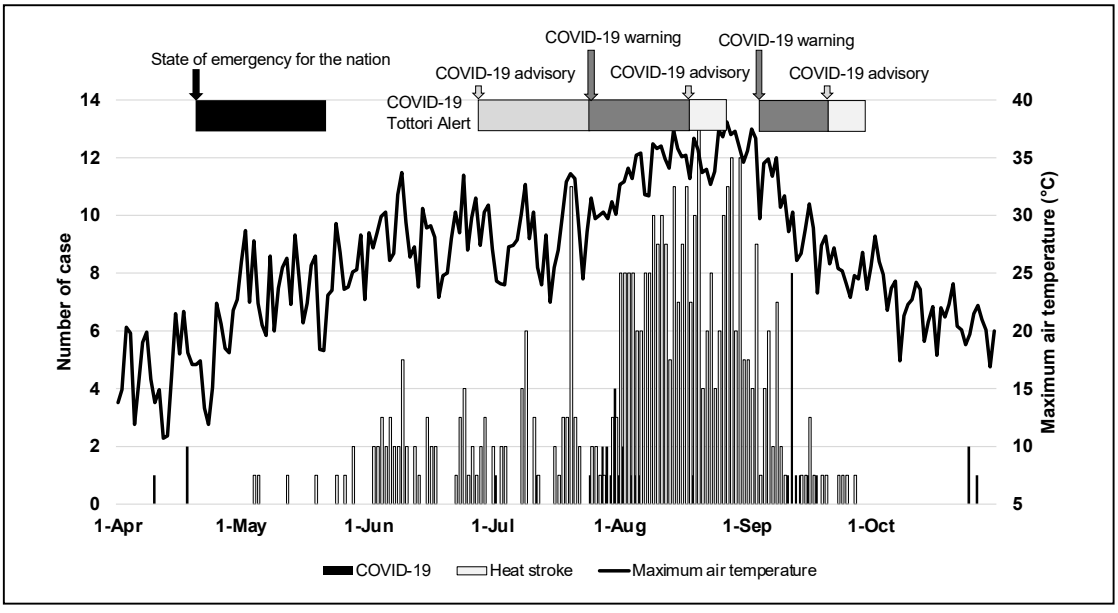

Figure 1. Daily COVID-19 cases and emergency transport of heat stroke patients in Tottori Prefecture, the maximum temperature in Tottori City, and government-issued COVID-19 alerts.

The average minimum and maximum temperatures in Tottori City from April to October for the years 2017 to 2019 are shown in Table 1. In 2020, the average July temperature was lower than in previous years, and the average August temperature was higher than usual and was the highest ever recorded in Tottori City.

Table 1. The average minimum/maximum temperatures (°C) in Tottori City from April to October, 2017 to 2020 and the annual average of 1981–2010.

	April	May	June	July	August	September	October
2017	8.7/20.1	13.5/25.4	16.1/27.0	24.2/32.8	23.5/32.6	17.7/27.2	13.9/21.7
2018	9.5/21.0	13.6/24.4	17.9/27.0	24.0/33.2	24.1/34.4	19.3/26.5	12.9/22.6
2019	7.1/17.8	12.7/26.1	17.8/27.0	22.6/30.3	24.2/33.5	20.6/29.7	14.8/22.9
2020	6.4/17/1	14.0/24.1	18.7/28.5	21.7/28.4	25.0/35.0	20.2/29.0	12.7/21.8
Annual average	7.5/18.7	12.5/23.3	17.6/26.6	22.1/30.4	22.9/32.2	18.7/27.4	12.3/22.0

The mean age (± standard deviation) of heat stroke-related emergency transport patients from 2017–2020 was 60.0 ± 27.9, 57.4 ± 27.9, 57.6 ± 26.9, and 66.2 ± 24.0 years, respectively. The mean age in 2020 was significantly higher than in previous years (Table 2). In 2020, the percentage of those under 18 was 8.0%, which was lower than in previous years (14.9%–18.0%), and the percentage of those over 75 was 47.7%, which was higher than in previous years (35.6%–44.2%). Regarding the circumstances of heat stroke, in 2020, 36.9% of all incidents occurred in the person's residence, which was higher than in previous years (26.6%–29.3%), and 11.3% were associated with exercise, which was lower than in previous years (18.2%–20.4%) (Table 3).

According to information from the Fire Department, there were no cases of heat stroke transport associated with mask-wearing.

Table 2. Mean age (years) and standard deviation of heat stroke transport cases, April to October, 2017–2020.

	2017	2018	2019	2020
Mean age	60.03 ± 27.92	57.38 ± 27.92	57.6 ± 26.9	66.2 ± 24.0
	p = 0.597			
	p = 0.779			
		p = 0.004		
		p = 1.000		
			p < 0.001	
				p < 0.001

Table 3. Heat stroke transport cases by age group (years) and transport circumstances, April–October, 2017–2020.

	2017	2018	2019	2020	p value
Age group					< 0.001
<18	72 (17.8%)	107 (18.0%)	69 (14.8%)	34 (8.0%)	
18≤, <65	87 (21.5%)	174 (29.3%)	145 (31.1%)	115 (27.0%)	
65≤, <75	67 (16.5%)	86 (14.5%)	86 (18.5%)	74 (17.4%)	
75≤	179 (44.2%)	227 (38.2%)	166 (35.6%)	203 (47.7%)	
Total	405 (100%)	594 (100%)	466 (100%)	426 (100%)	
Circumstance					< 0.001

Home	116 (28.6%)	174 (29.3%)	124 (26.6%)	157 (36.9%)
Work	66 (16.3%)	138 (23.2%)	92 (19.7%)	71 (16.7%)
Exercise	78 (19.3%)	121 (20.4%)	85 (18.2%)	48 (11.3%)
Outing	81 (20.0%)	81 (13.6%)	84 (18.0%)	70 (16.4%)
Farm work	52 (12.8%)	48 (8.1%)	52 (11.2%)	73 (17.1%)
Spectating	3 (0.7%)	18 (3.0%)	8 (1.7%)	0 (0.0%)
Tourism	9 (2.2%)	14 (2.4%)	19 (4.1%)	7 (1.6%)
Others	0 (0.0%)	0 (0.0%)	2 (0.4%)	0 (0.0%)
Total	405 (100%)	594 (100%)	466 (100%)	426 (100%)

4. Discussion

The proportion of elderly people among all heat stroke patients has been high in Tottori Prefecture [3]. The current study found that this trend was amplified in 2020. In addition, the frequency of heat stroke cases arising in residences was higher than in previous years. The typical circumstance of a heat stroke incident in Japan is an elderly person suffering from heat stroke at home. This trend became more obvious in 2020, presumably owing to the indirect effect of the COVID-19 voluntary restrictions. Compared with Europe and the United States, Japan has had far fewer cases of COVID-19 and lower mortality related to this disease; furthermore, the government could not legally require lockdown measures. Nevertheless, the government's declaration of a state of emergency and local government requests for infection control measures led many citizens to limit their activities [4]. Although Tottori Prefecture had very few COVID-19 cases, this pandemic may have indirectly altered the pattern of heat stroke incidence.

An increasing number of studies have investigated the physical and mental effects of voluntary isolation during the COVID-19 pandemic [5–7]. In Japan, physical activity among the elderly has reportedly decreased [8]. A decline in physical activity among this population may lead to frailty and cognitive decline; however, it is not clear whether older people are more susceptible to heat stroke. Nevertheless, given the pattern in Japan of elderly people suffering heat stroke at home, it can be inferred that not going outside in the summer has had a negative impact on people's health in hot environments.

In contrast, the proportion of heat stroke transport cases under the age of 18 in 2020 was lower than in previous years. There were also lower numbers of heat stroke cases associated with exercise. This may have been because most sporting events for school children, which are primarily held in the summer, were canceled in 2020 to prevent the spread of the infection. Because most heat stroke cases in young people are related to exertion, strenuous exercise in a hot environment can be a problem in Japan. This point was made clear by the COVID-19 pandemic, but it is hoped that it will provide an opportunity to reassess the future of sports under extreme heat conditions [9].

There have been concerns about the impact of face masks on heat stroke before the summer of 2020. However, according to the information obtained from Tottori Prefecture, there were no reports of heat stroke caused by face masks during the investigated time period. Considering the increased percentage of heat stroke incidents occurring at home, the impact of face masks on heat stroke is considered to be limited.

There are several limitations to this study. Because it included only 4 years of data, it is difficult to say definitively whether 2020 was an aberration. Thus, it is necessary to monitor the incidence of heat stroke going forward. Another limitation is that there is no accurate data on how many people restricted themselves from leaving the residence during the government's request for self-quarantine. Once accurate figures become available, we will be able to assess the risks and benefits of voluntary quarantine aiming to limit the spread of infection.

5. Conclusion

COVID-19 control measures, such as stay at home requests and the cancellation of events, may have contributed to slowing the transmission of the disease. However, restricting outings may further increase heat stroke risk for those who are typically more susceptible to heat stroke that occurs at home.

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Conflicts of Interest: The authors declare no conflict of interest.

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