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Navigating implementation barriers: a holistic approach to improving exertional heat stroke management

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ABSTRACT

Objectives To assess the shift in medical volunteers' perception and practice surrounding exertional heat stroke (EHS) prehospital management after the Tokyo 2020 Olympic Games.

Methods An online survey was sent to medical volunteers assigned to work at high EHS risk events during the Tokyo 2020 Olympic Games. Surveys were sent at the time of initial training, immediately after the Games, and one year after the Games. The survey investigated medical volunteers' perceptions and practices regarding the assessment of rectal temperature and the use of whole-body cold water immersion (CWI) as prehospital management of EHS. In addition, an open-ended question was prepared to examine barriers and facilitators of their chosen perception and/or behaviour.

Results The lack of knowledge about rectal temperature assessment improved over time, but the actual implementation did not. Meanwhile, increased utilisation of CWI was observed 1 year after the Games. The lack of equipment, apprehension towards rectal temperature assessment, the perception of difficulty getting patient consent, concerns for hypothermic overshoot and the number of required medical providers were raised as barriers to implementation.

Conclusion Some improvements were observed in perception and practice; however, further organisational and financial support is warranted for a broader skill transfer and implementation.

WHAT IS ALREADY KNOWN ON THIS TOPIC

⇒ Before the Tokyo 2020 Olympic Games, local medical providers in Japan were unfamiliar with (1) the assessment of rectal temperature in the prehospital setting and (2) the use of whole-body cold water immersion before transferring the collapsed athlete to the hospital.

WHAT THIS REPORT ADDS

⇒ Large-scale summer sporting events provide great opportunities for medical providers to learn and acquire skills to implement gold-standard methods of diagnosing and treating exertional heat stroke (EHS) patients in a prehospital setting.

HOW THIS STUDY MIGHT AFFECT RESEARCH, PRACTICE OR POLICY

⇒ Online and hands-on experience may sufficiently improve medical providers' knowledge and skills required in the prehospital management of EHS; however, organisational support and funding are essential in the continued implementation of good practice.

INTRODUCTION

One of the challenges the Tokyo 2020 Olympic Games faced outside of the COVID-19 pandemic was the extreme heat. Therefore, optimising the prehospital management of exertional heat stroke (EHS) was placed as one of the utmost tasks by the medical committee of the local organising committee and the International Olympic Committee.[1] In particular, the 'cool first, transport second' methodology[2] to diagnose and treat patients with EHS in the prehospital setting, which has become the standard of care in endurance events,[3 4] was not a common practice in Japan.[5] Specifically, local medical providers were not familiar with (1) the assessment of rectal temperature in the prehospital setting and (2) the use of whole-body cold water immersion (CWI) before transferring the collapsed athlete to the hospital. It was a common belief (ie, misconception) that whole-body CWI would induce shock and is contraindicated for EHS.[6] Therefore, it was critical that medical providers not only understood the life-saving procedures but were competent in executing the procedures that were introduced to them because of the Tokyo 2020. For that reason, medical providers assigned to work at high-risk events for EHS (eg, athletics, cycling [road, mountain and BMX], beach volleyball, marathon swimming, boat, tennis, triathlon, rugby, field hockey and soccer) had online and on-site training opportunities to learn and practice prehospital management of EHS.

This study aimed to assess the shift in medical volunteers' perception and practice surrounding EHS prehospital management via an online survey to examine the impact of the training and experience at the Games. We

Table 1 Categorisation of medical volunteers' responses

Statement for section 1	Statement for section 2	Stage classification
► I do not know that rectal temperature assessment is used to diagnose EHS in a prehospital setting	► I do not know that CWI is used to treat EHS in a prehospital setting	Unaware (stage 1)
► I know that rectal temperature assessment is used to diagnose EHS in a prehospital setting, but I have not considered doing it	► I know that CWI is used for treating EHS in a prehospital setting, but I have not considered doing it	Unengaged (stage 2)
► I have considered the use of rectal temperature assessment to diagnose EHS in a prehospital setting, but I am undecided about acting	► I have considered the use of CWI to treat EHS in a prehospital setting, but I am undecided about acting	Undecided (stage 3)
► I have considered the use of rectal temperature assessment to diagnose EHS in a prehospital setting but decided not to	► I have considered the use of CWI to treat EHS in a prehospital setting but decided not to	Decided not to act (stage 4)
► I have plans to use rectal temperature assessment to diagnose EHS in a prehospital setting in the future	► I have plans to use CWI to treat patients in a prehospital setting in the future	Decided to act (stage 5)
► I use rectal temperature assessment to diagnose EHS in a prehospital setting some of the time	► I use CWI to treat EHS in a prehospital setting some of the time	Acting (stage 6)
► I use rectal temperature assessment to diagnose EHS in a prehospital setting all the time	► I use CWI to treat EHS in a prehospital setting all the time	Maintaining (stage 7)

CWI, cold water immersion; EHS, exertional heat stroke.

hypothesised that the Games positively changed medical providers' perceptions and practices surrounding EHS prehospital management.

METHODS

An online survey was sent to medical volunteers (physicians, nurses, physical therapists, judo therapists, and acupuncture and moxibustion therapists) of the high-risk events at the time of initial training (22 June 2021–30 August 2021) immediately after the Games (post, 17 August 2021–8 September 2021), and 1 year after the Games (post-1, 28 September 2022–10 October 2022). The survey consisted of two sections. The first section investigated medical volunteers' perceptions and practices regarding assessing rectal temperature as part of the prehospital diagnosis of EHS. The second section investigated medical volunteers' perceptions and practices regarding whole-body CWI as a prehospital treatment method for EHS. Medical volunteers' responses were categorised into one of the seven categories that followed the precaution-adoption process model (table 1). Medical volunteers were also provided with an optional open-ended question to describe why they chose their answer to explain the reasons for their perception and practice. Descriptive statistics are reported in proportions. The study was approved by the Office of Research Ethics at Waseda University (#2020_220). Participants provided

Table 2 Number of medical volunteers who completed the survey

	Pre	Post	Post-1	Completed surveys at all three time points and attended both online and on-site training
Section 1: assessment of rectal temperature	243	63	52	34
Section 2: Use of cold water immersion	282	79	53	42

Pre: before Tokyo 2020 Olympic Games. Post: immediately post-Tokyo 2020 Olympic Games. Post-1: 1 year post-Tokyo 2020 Olympic Games.

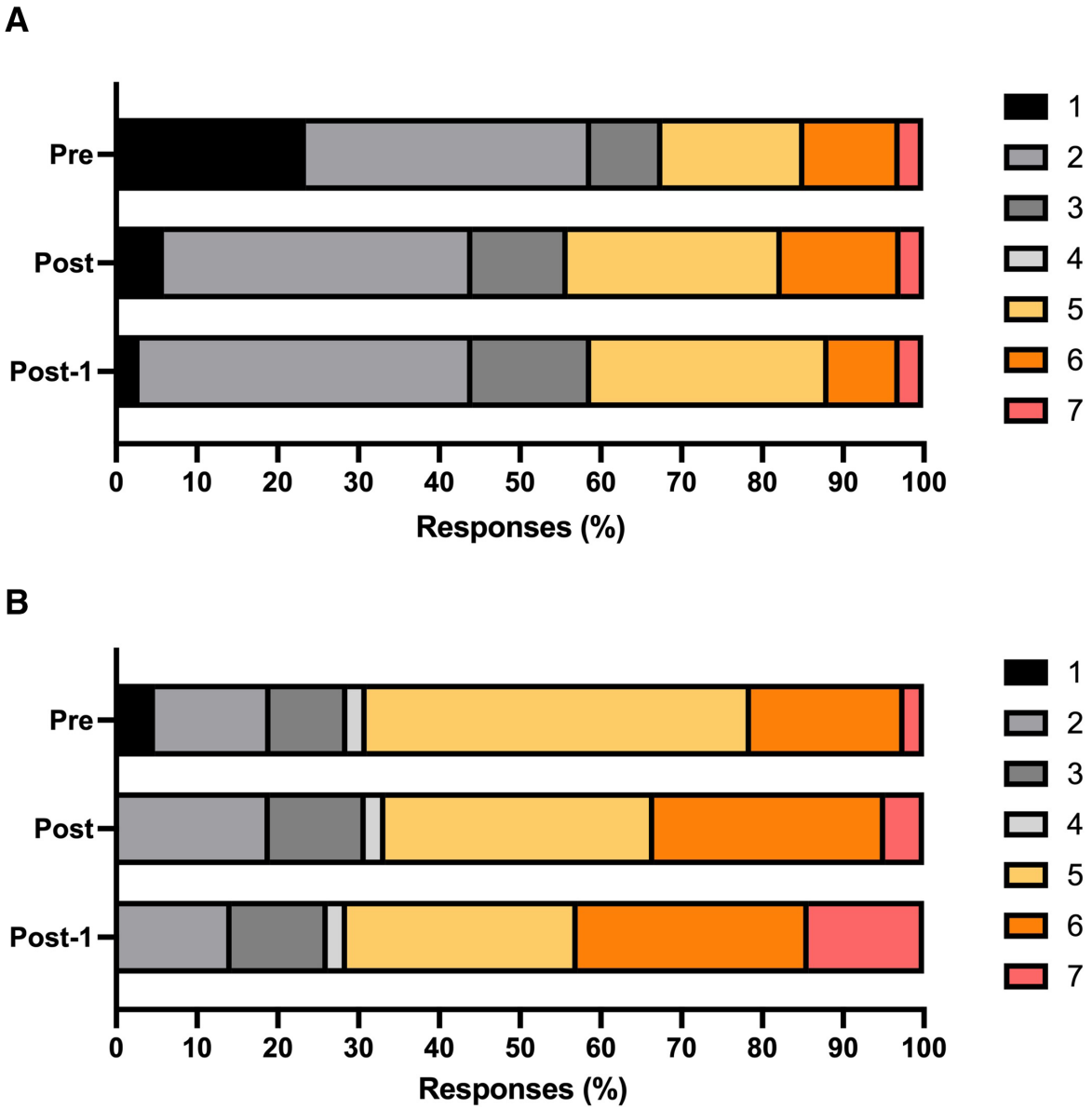

Figure 1 Shift in medical volunteer's perception and practice surrounding (A) the use of rectal temperature assessment to diagnose exertional heat stroke and (B) the use of cold water immersion to treat exertional heat stroke in the prehospital setting before Tokyo 2020 Olympic Games (pre), immediately post-Tokyo 2020 Olympic Games (post), 1 year post-Tokyo 2020 Olympic Games (post-1). Response categories: 1, unaware; 2, unengaged; 3, undecided; 4, decided not to act; 5, decided to act; 6, acting; and 7, maintaining.

consent to be part of the study by completing the online survey.

RESULTS

The number of medical volunteers who completed the survey for sections 1 and 2 and their responses are summarised in table 2 and figure 1. Among the medical volunteers who completed the survey at all three points, 23.5% answered that they did not know the use of rectal temperature assessment for the prehospital diagnosis of EHS in the presurvey (stage 1). This value was reduced (ie, improved) to 5.9% and 2.9%, respectively, at post and post-1. However, the proportions of medical volunteers who reported that they sometimes or always assessed rectal temperature for the diagnosis of EHS did not improve (sum of stage 6 and stage 7: pre, 14.7%; post, 17.6%; post-1, 11.7%). The top reasons for the lack of implementation reported by those in stages 3–6 were (1) the lack of equipment, (2) the perception that rectal temperature assessment is uncommon and (3) the perception that it would be difficult to get consent from the patient.

On the contrary, 95.2% of medical volunteers knew about CWI as a treatment method of EHS (sum of stages 2–7), but the proportion of medical volunteers who reported sometimes or always using CWI for patients with EHS was limited to 21.4% at pre (sum of stages 6 and 7). This value was improved further at post (33.4%)

Table 3 Examples of shifts in medical volunteers' knowledge and practice

	Self-reported stages and reasons		
Stage shift pattern	Pre	Post	Post-1
Physician 1 Stages: 3-6-6	I am undecided about the use of CWI because it is challenging to prepare and maintain large amounts of ice, and there is a risk of hypothermia when you cannot measure internal body temperature	I use CWI to treat EHS in a prehospital setting when there is equipment available	I use CWI to treat EHS in a prehospital setting when extreme heat is forecasted
Nurse 1 Stages: 5-6-7	I have plans to use CWI in events that I organise, but I foresee the preparation of equipment, securing the heat deck space and budget will become barriers to implementation	I sometimes use CWI to treat EHS in a prehospital setting because I learnt about its effectiveness at the training session	I use CWI to treat EHS in a prehospital setting all the time because it was the method used in the Tokyo 2020 Olympic Games, and it is the most effective EHS treatment method
Physician 2 Stages: 5-6-7	I have plans to use CWI but have not had the experience	I sometimes use CWI to treat EHS in a prehospital setting because not all events can prepare enough physicians and budget	I use CWI to treat EHS in a prehospital setting all the time because EHS is becoming more frequent
Physical therapist 1 Stages: 5-5-6	I have plans to use CWI because it is the most effective method to lower internal body temperature	I plan to use CWI, but I have not acted on it because of the lack of equipment and the lack of the chance to assess T_{REC}	I sometimes use CWI to treat EHS in a prehospital setting because I learnt its method during the Tokyo 2020 Olympic Games
Nurse 3 Stages: 3-5-3	I am undecided about using the T_{REC} assessment because of the lack of a device	I have plans to use the T_{REC} assessment, but it seems difficult to get everyone's buy-in	I am undecided about using the T_{REC} assessment because of the lack of a device
Physician 3 Stages: 3-5-3	I am undecided about using the T_{REC} assessment because of the perceived difficulty in obtaining athletes' consent	I have plans to use the T_{REC} assessment, but it will require all stakeholders to understand the importance of it. Preparation of equipment should not be an issue	I am undecided about the use of T_{REC} assessment because of the cost. Rental service of equipment should facilitate the implementation
Physical therapist 2 Stages: 5-3-5	I have plans to use the T_{REC} assessment, but I have not acted on it because of the lack of equipment and knowledge about the procedures	I am undecided about using the T_{REC} assessment because current regulations do not allow my profession to monitor the rectal temperature	I have plans to use the T_{REC} assessment, but I have not acted on it because of the lack of equipment and the setup
Physical therapist 3 Stages: 5-3-5	I have plans to use the T_{REC} assessment because it is the validated method	I am undecided about using T_{REC} assessment because it cannot be measured without physicians or nurses	I have plans to use T_{REC} assessment, but I have not acted on it because of the lack of equipment

Pre: before Tokyo 2020 Olympic Games. Post: immediately post-Tokyo 2020 Olympic Games. Post-1: 1 year post Olympic Games.
CWI, cold water immersion; EHS, exertional heat stroke; T_{REC}, rectal temperature.

and post-1 (42.9%). Among those who do not always use CWI (sum of stages 3–6), the top reasons for the lack of implementation were (1) difficulty preparing the tub and an ample amount of ice for CWI, (2) concerns for hypothermic overshoot and (3) difficulty preparing enough number of medical providers and equipment to perform CWI.

Examples of shifts in medical providers' knowledge and practice regarding rectal temperature assessment for EHS diagnosis and CWI for EHS treatment are summarised in table 3. While the timing and magnitude of change in stages were variable across medical providers, medical providers overcame the barriers mentioned above through their experience at the Games.

DISCUSSION

Mass participation and international sporting events are sometimes described as 'planned mass casualties' because medical providers are expected to prepare for injuries and illnesses that are bound to happen, given

the number of people and type of activities involved in these events.[7] These events often allow medical providers to execute medical provisions that may not be readily feasible in small, local events. The financial and human resources usually available in these large-scale events enable medical providers to practice the best available services. For that reason, large-scale events can be a great opportunity for many medical volunteers to engage in new techniques and practice skills that are otherwise difficult.

For medical providers in Japan, the Tokyo 2020 Olympic Games became a novel opportunity to learn and practice the standard of care for prehospital management of EHS. Our longitudinal study revealed that training and experiences during the Tokyo 2020 Olympic Games had brought positive changes in the knowledge, awareness and actions of medical staff regarding the prehospital management of EHS to an extent. Additionally, barriers that must be overcome to promote ideal prehospital management have become apparent. For example, participants commonly raised the lack of equipment and resources as a major barrier, such that if the equipment and resources were readily available, they would consider rectal temperature assessment and CWI for EHS treatment (table 3). Similar barriers were reported among athletic trainers working in US high school athletics,[8] with a particular apprehension towards using rectal thermometers because of the resistance from parents, legal guardians or coaches. Indeed, medical providers in our study (table 3, nurse 3 and physician 3) also raised a lack of understanding from stakeholders as their perceived barriers in the survey conducted immediately after the Tokyo 2020 Olympic Games. We also observed that despite the successful knowledge transfer after the Games, we did not see the implementation of rectal temperature assessment 1 year after the Games due to the lack of equipment (ie, rectal thermometers) (table 3, nurse 3, physician 3 and physical therapists 2 and 3). Therefore, overcoming medical providers' lack of knowledge and preparing the appropriate equipment must be addressed simultaneously to successfully overcome the barriers to promoting rectal temperature assessment for EHS diagnosis.

In conclusion, these results offer insight into the influence created by opportunities at international sporting events for medical providers to acquire new skills regarding EHS prehospital management. To apply and transfer the acquired knowledge and skills to other sporting events and competition levels, there is a need for continued education to increase the number of stakeholders who support EHS prehospital management. Organisational and financial support is also critical to establishing an ideal prehospital medical system to treat EHS.

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Competing interests None declared.

Patient consent for publication Not applicable.

Ethics approval This study involves human participants and was approved by the Office of Research Ethics at Waseda University (#2020_220). Participants gave informed consent to participate in the study before taking part.

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