

## SHORT REPORTS

# Emergency Preparedness for Sudden Cardiac Death and Exertional Heat Stroke during Road Races in China

Yang Zhang<sup>1</sup>, Douglas J. Casa<sup>2</sup>, Phillip A. Bishop<sup>3</sup>

<sup>1</sup>Independent researcher, P.R. China, <sup>2</sup>University of Connecticut, Korey Stringer Institute, Department of Kinesiology, USA, <sup>3</sup>The University of Alabama, Department of Kinesiology, USA (retired)

## Abstract

This short report discusses two deaths that occurred on October 20th 2019 during half-marathons in People's Republic of China. The two fatal events were reported to be the consequence of sudden cardiac death. In September 2019, the State Council of China called for nationwide mass sports participation, which raised urgent operational challenges for event organizers and the sports medicine community in China. This report examined emergency preparedness experiences of road races from the United States, in the hope that the Chinese medicine community could continue to improve their ability to respond, and ultimately, to uphold safe sports participation in China.

**Keywords:** *Marathon, Race Medicine, Cardiac Arrest, Cold Water Immersion*

## Introduction

Sudden cardiac death (SCD) during road races is unusual phenomenon in the United States. Among 10.9 million registered marathon and half-marathon race participants from January 2000 to May 2010, the overall incidence rate of SCD was 0.39 per 100,000 runners (Kim et al., 2012). This incidence rate was further reduced during half-marathons (0.25 per 100,000 runners) than during marathons (0.63 per 100,000 runners) (Kim et al., 2012).

In contrast, the occurrence of SCD during half-marathons seems materially high in China. On October 20th 2019, four runners simultaneously collapsed within 100 meters from the finish line of the Jing Zhou Half-Marathon (Ma & Yu, 2019). Within one minute of the incidence, paramedics attempted to resuscitate the 50-yr-old male using automated external defibrillators. The runner showed no pulse and was pronounced dead while being transported to the hospital. On the same day, one male runner collapsed unconsciously at nearly 20.5 km of the Long

Kou Half-Marathon (Ma & Yu, 2019). The runner never recovered consciousness even after three defibrillations and cardiopulmonary resuscitation. According to the incidence report (Ma & Yu, 2019), this runner showed early signs of cardiac arrest and a volunteer medical staff had suggested he stop running, but the runner continued. Had the runner understood the symptoms and the danger of SCD, or had the race organizer had legal authority to withdraw any runner from the race without legal liability, this runner might have survived.

## Methods

In September 2019, China's State Council unveiled a document entitled "Opinions on Promoting Mass Sports, Sports Consumption and High-Quality Development of Sports Industry" (State Council, 2019) for promotion of market-based actions to enrich mass sports events. This however raises urgent operational challenges for event organizers and the sports medicine community in China.

Correspondence:

**Montenegro  
Sport**

Y. Zhang  
Independent researcher, Jiaxing, Zhejiang Province, 314000, P.R. China  
E-mail: dr.zhang.yang@qq.com

## Results and Discussion

First, any successful mass sports event is not possible without organizers' efforts to implement and sustain emergency preparedness programs. In the United States, emergency managers of long-distance events have been continuously refining protocols for emergency events which has resulted in safer sports competition. For example, in the Twin Cities and Marine Corps marathons, the incidence rate of SCD decreased from 1.8 per 100,000 runners during 1976–1994 to 0.45 per 100,000 runners during 1995–2004 (Roberts & Maron, 2005).

Although China has successfully organized a number of international marathons, both national and regional organizers should keep pace with best practices in the face of the rapid growth of marathon events in China. Recent collaboration between the World Athletics and the International Institute of Race Medicine (World Athletics, 2019) offers medical training sessions worldwide for road race medical directors and other healthcare professionals. National administrators and medical leaders of road races in China could learn the latest medical science and trainings from these leading organizations and improve the emergency preparedness capabilities. Local organizers should assemble medical command teams of cardiovascular specialists, emergency physicians, and sports scientists and work with area police departments and hospitals to ensure that resources are in place to handle all anticipated medical needs.

Second, despite a lack of evidence that pre-participation screening of cardiovascular risk factors improves exercise safety, proper education of marathon participants and organizers about individual medical history and symptoms of cardiovascular disease is still warranted, especially for those 1st time participants who are unaccustomed to extended vigorous exercise. One of the important medical lessons from the sports medicine community in the United States has been that most American people (i.e., 95.5% of women and 93.5% of men) aged  $\geq 40$  years would be advised to consult a physician before engaging in any form of exercise (Whitfield, Pettee Gabriel, Rahbar, & Kohl, 2014).

The aforementioned tragic events highlight the importance of risk stratification and education among the general Chinese population who now enjoy increased access to marathon participation. The sports medicine community in China could adopt the knowledge recommended by the American College of Sports Medicine (Riebe, Ehrman, Liguori, & Magal, 2017) when identifying risks of exercise participation. Education could be improved using mandatory pre-race training during registration, printed medical information at race sites, and planning training for volunteers.

Third, it is important to recognize that incidences of life-threatening events in the marathon also include non-cardiac clinical origins, including hyponatremia and hyperthermia. In the Boston Marathon, hyponatremia occurs in a substantial fraction of non-elite runners (i.e., racing time of  $>4:00$  hours) (Almond et al., 2005) and proper practice (Noakes et al., 2005) may avert preventable deaths in susceptible runners (e.g., females) (Almond et al., 2005).

Likewise, exertional heat stroke (EHS) pose a threat to the life of competitors in endurance sports performed in mild to hot environments. Fatal events as a result of EHS could be 10 times higher than those of cardiac origins (Yankelson et al., 2014). In 2019, there have been numerous reports of heat illness injury during long-distance events in China (Sina Sports, 2019). On June 6th 2019, one 27-yr-old male runner resumed running following heat exhaustion, eventually collapsed again just 500 meters from the finished line and died after two days of intensive hospital care (Sohu, 2019). The final diagnosis was EHS progressing to multiorgan failure and muscle necrosis. Policymakers in the United States have recognized the risks of EHS and designed education-

al materials (Casa et al., 2015), which could also be used by the sports medicine community in China to improve EHS diagnosis and injury prevention. Meanwhile, marathon organizers in China should follow validated clinical procedures (Belval et al., 2018), and most importantly, institute the principle of “cool first (i.e., use cold water immersion to reduce the rectal temperature below 38.6°C as quickly as possible), transport second (i.e., then transport the patient to the emergency department)”, to improve survival rate of EHS (Demartini et al., 2015).

Until detailed guidelines for pre-participation screening, along with a very carefully coordinated emergency management protocol and repeated training protocols are implemented, we remain cautious about mass marathon participation in China.

## Acknowledgements

There are no acknowledgements.

## Conflict of Interest

The authors declare that there are no conflicts of interest.

**Received:** 19 January 2020 | **Accepted:** 12 February 2020 | **Published:** 14 April 2020

## References

- Almond, C.S., Shin, A.Y., Fortescue, E.B., Mannix, R.C., Wypij, D., Binstadt, B.A., Duncan, C.N., Olson, D.P., Salerno, A.E., Newburger, J.W., & Greens, D.S. (2005). Hyponatremia among runners in the Boston Marathon. *The New England Journal of Medicine*, 352(15), 1550-1556.
- Belval, L.N., Casa, D.J., Adams, W.M., Chiampas, G.T., Holschen, J.C., Hosokawa, Y., Jardine, J., Kane, S.F., Labotz, M., Lemieux, R.S., McClaine, K.B., Nye, N.S., O'Connor, F.G., Prine, B., Raukar N.P., Smith, M.S., & Stearns, R. L. (2018). Consensus Statement- Prehospital Care of Exertional Heat Stroke. *Prehospital Emergency Care*, 22(3), 392-397.
- Casa, D.J., DeMartini, J.K., Bergeron, M.F., Csillan, D., Eichner, E.R., Lopez, R.M., Ferrara, M.S., Miller, K.C., O'Connor, F., Sawka, M.N., & Yeargin, S.W. (2015). National Athletic Trainers' Association Position Statement: Exertional Heat Illnesses. *Journal of Athletic Training*, 50(9), 986-1000.
- Demartini, J.K., Casa, D.J., Stearns, R., Belval, L., Crago, A., Davis, R., & Jardine, J. (2015). Effectiveness of cold water immersion in the treatment of exertional heat stroke at the Falmouth Road Race. *Medicine and Science in Sports and Exercise*, 47(2), 240-245.
- Kim, J.H., Malhotra, R., Chiampas, G., d'Hemecourt, P., Troyanos, C., Cianca, J., Smith, R.N., Wang, T.J., Roberts, W.O., Thompson, P.D., & Baggish, A.L. for the Race Associated Cardiac Arrest Event Registry Study Group. (2012). Cardiac arrest during long-distance running races. *The New England Journal of Medicine*, 366(2), 130-140.
- Ma, Z.Y., & Yu, Z.X. (2019). Two marathon runners died in one day, they fell to the end of the sprint. Retrieved from [https://www.thepaper.cn/newsDetail\\_forward\\_4669744](https://www.thepaper.cn/newsDetail_forward_4669744)
- Noakes, T.D., Sharwood, K., Speedy, D., Hew, T., Reid, S., Dugas, J., Wharam, A.P., & Weschler, L. (2005). Three independent biological mechanisms cause exercise-associated hyponatremia: evidence from 2,135 weighed competitive athletic performances. *Proceedings of the National Academy of Sciences of the United States of America*, 102(51), 18550-18555.
- Riebe, D., Ehrman, J.K., Liguori, G., & Magal, M. (2017). Chapter 2. Exercise preparticipation health screening. In *ACSM's Guidelines for Exercise Testing and Prescription* (23–31). Philadelphia (PA): Lippincott Williams & Wilkins.
- Roberts, W.O., & Maron, B.J. (2005). Evidence for decreasing occurrence of sudden cardiac death associated with the marathon. *Journal of the American College of Cardiology*, 46(7), 1373-1374.
- Sina Sports. (2019). Guangzhou Happy Running Witnessed Mass Heatstroke. Retrieved from <http://sports.sina.com.cn/run/2019-05-19/doc-ihvhiqax9762083.shtml>
- Sohu. (2019). One man ran twice in heat stroke and eventually died! Retrieved from [http://www.sohu.com/a/322367124\\_658595](http://www.sohu.com/a/322367124_658595)
- State Council. (2019). Opinions on Promoting Mass Sports, Sports Consumption and High Quality Development of Sports Industry. Retrieved from [http://www.gov.cn/zhengce/content/2019-09/17/content\\_5430555.htm](http://www.gov.cn/zhengce/content/2019-09/17/content_5430555.htm)
- Whitfield, G.P., Pettee Gabriel, K.K., Rahbar, M.H., & Kohl, H.W. (2014). Application of the American Heart Association/American College of Sports Medicine Adult Preparticipation Screening Checklist to a nationally representative sample of US adults aged  $\geq 40$  years from

- the National Health and Nutrition Examination Survey 2001 to 2004. *Circulation*, 129(10), 1113-1120.
- World Athletics. (2019). IAAF and IIRM announce partnership to enhance safety at road races. Retrieved from <https://www.worldathletics.org/news/press-release/iaaf-iirm-partnership-road-race-safety>
- Yankelson, L., Sadeh, B., Gershovitz, L., Werthein, J., Heller, K., Halpern, P., Halkin, A., Adler, A., Steinvil, A., & Viskin, S. (2014). Life-threatening events during endurance sports: is heat stroke more prevalent than arrhythmic death? *Journal of the American College of Cardiology*, 64(5), 463-469.