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報告｜Report

Exercise Medicine
Athletic Performance in Heat and Humidity during Summer Olympic Games

運動医学
夏季オリンピック期間中の高温多湿の環境下での運動能力

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[Abstract]

This summer, athletes will meet to participate in one of the biggest sporting events in the world. Throughout the course of the games, heat and humidity could affect athletes' exercise capacity and performance outcomes. Acclimatization, prearranged cooling, regular hydration and recovery would be the necessary strategies for improving athletic performance.

［抄録］

今年の夏、アスリートは世界最大のスポーツイベントの一つに参加するために集まる。ゲーム期間を通し、蒸し暑さはアスリートの運動能力と競技パフォーマンスの成果に影響を及ぼす可能性がある。順応、冷房計画、規則正しい水分補給と回復が、競技パフォーマンスをよりよいものにするためには必要不可欠な戦略である。

Keywords:

順応 (Acclimatization) / 暑さ(Heat) / 湿気 (Humidity)/ 水分補給 (Hydration)

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1. Introduction

This year Tokyo will once again host the summer Olympics after hosting the games in 1964 as the first Asian host city. Temperatures in the Kanto area of Japan can reach up to 39.5°C and this could cause exertional heat illness (EHI) amongst athletes. There would be a concern about this as studies in exercise and sports performance have reported that cardiac disease and heat stroke are the highest causes of death[1)]. The athletic performance (AP) during training and games could also be affected by heat stress. Although, warming up would enhance the athletes' performance, but an increase in the body's core temperature during prolonged exposure to the heat and humidity (HH) will limit AP by burdening the circulatory system[2)]. Prolonged AP could lead to heat-related illness, (i.e. hyperthermia) as the body's mechanisms of homeostatic temperature regulation are overpowered[2)].

Athletes' exercise capacity in the heat would depend on their thermoregulatory responses through sweating and the cardiovascular consequences, therefore acclimatization in the new surroundings would be necessary[3)]. According to Périard[4)] and his colleagues, a clinical sign of heat acclimatization would be a decrease in heart rate for a given exercise intensity. Studies have shown that the first week of sports and exercise performance in HH is the period of the highest risk for EHI and acclimatization would require one to two weeks[5)].

2. Limiting factor of exercise in heat and humidity

During AP, heat is generated with increased metabolism and muscle contractions, and this results in increased core body temperature (ICBT). Heat dissipation (HD) occurs during ICBT through various thermoregulatory responses. HD can take place as the sensible heat loss (SHL) into the surrounding tissues and environment or as insensible heat loss (IHL) by sweat evaporation (SE) and thus overheating is prevented[6)]. Environmental conditions can affect HD during AP, such as when the temperature gradient between the environment and skin is high in cool conditions with the resulting increased SHL. As the environmental temperature increases SHL is reduced. IHL usually follows when the environmental temperature and skin temperature are equal. In high humidity conditions, when the air is saturated with water, the rate of SE is reduced and thus reducing heat loss[6)].

3. Association between fluid loss and body mass

Studies have shown that hydration is a key factor in AP and hypohydration of >1-2% body mass deficit can have an unfavourable effect on the AP[7)]. Further studies have shown that many athletes often experience hypohydration before AP[8)]. Hydration can vary and depends on the ability to drink during AP, and the type of sport and environment. Long-distance runners would find it difficult to drink regularly as compared to tennis players. Part of the hydration strategy would be to optimise hydration before, during and after the AP. Hypohydration can be calculated by weight loss before and after the AP. It would also be necessary for athletes to avoid consumption of alcohol and caffeine as these can enhance fluid loss[9)].

4. Body temperature regulation in an athlete during the Paralympics

Throughout the performance in extreme HH, the Paralympic athlete is exposed to heat injury because of the reduction in cooling mechanisms[10]. Therefore, discussions on cooling and precooling strategies as shown in the diagram below, would improve the functional capacity (FC) and physical capacity (PC)[11, 12]. FC can be improved by precooling with ice drinks or ice baths, placing ice packs on the axillae and neck and using misting fans[11, 12]. At the lower level of spinal injury there might be inadequate sweating during Tokyo games and athletes will need to acclimatise and hydrate accordingly[12]. There could also be FC consequences of the athlete's impairment on their PC if the interface between the athlete and the wheelchair is not taken into consideration[12].

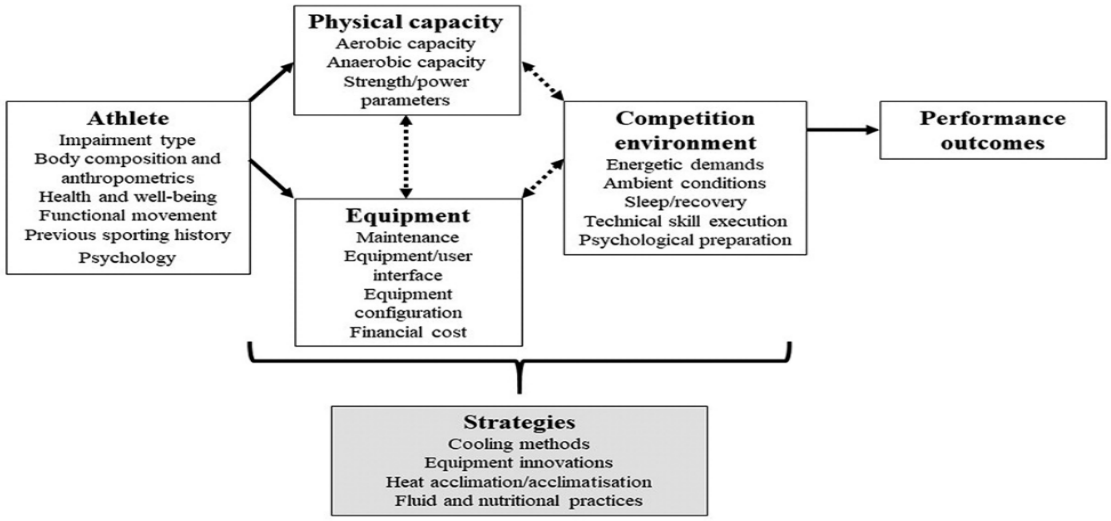

Diagram on enhancing wheelchair court sport performance (Paulson and Goosey-Tolfrey, 2017)

5. Conclusion

In an unacclimated environment, limitation of athletic performance can occur in prolonged exposure to high temperatures and humidity. A hydration plan and cooling strategies would be necessary to keep the athletes hydrated. Special consideration is needed for the cooling of the athletes with spinal injuries.

References

1. Stearns RL, Casa DJ, O'Connor F et al (2017) Exertional heat stroke. In: Casa DJ, Stearns RL, eds. Preventing sudden death in sport and physical activity. 2nd ed. Burlington: Jones & Bartlett Learning: pp71–96.

2. Racinais S, Cocking S, Périard JD (2017) Sports and environmental temperature: from warming-up to heating-up. Temperature (Austin); 4(3): pp227–57.

3. Karlsen A, Nybo L, Norgaard SJ et al (2015) Time course of natural heat acclimatization in well-trained cyclists during a 2-week training camp in the heat. Scand J Med Sci Sports; 25 Suppl 1: pp240–249.

4. Périard JD, Racinais S, Sawka MN (2015) Adaptations and mechanisms of human heat acclimation: applications for competitive athletes and sports. Scand J Med Sci Sports; 25: pp20–38.

5. Casa DJ, Csillan D (2009) Inter-Association Task Force for Preseason Secondary School Athletics Participants, et al. Preseason heat-acclimatization guidelines for secondary school athletics. J Athl Train; 44: p332.

6. No, M. and H.-B. Kwak (2016). Effects of environmental temperature on physiological responses during submaximal and maximal exercises in soccer players. Integrative Medicine Research 5(3): pp216-222

7. Arnaoutis, G., Kavouras, S.A., Angelopoulou, A. et al. (2015) Fluid balance during training in elite young athletes of different sports, J Strength Cond Res*.,* 29(12): pp3447-3452.

8. Nuccio, R.P., Barnes, K.A., Carter, J.M. et al. (2017) Fluid Balance in Team Sport Athletes and the Effect of Hypohydration on Cognitive, Technical, and Physical Performance, Sports Med*.,* 47(10): pp1951–1982.

9. Belval, L.N., Hosokawa, Y., Casa, D.J. et al. (2019) Practical Hydration Solutions for Sports, Nutrients, 11(7): p550.

10. Price, M. J., Trbovich, M. (2018) Thermoregulation following spinal cord injury. Handb Clin Neurol 157: pp799-820.

11. Webborn N, Price MJ, Castle PC et al (2005) Effects of two cooling strategies on thermoregulatory responses of tetraplegic athletes during repeated intermittent exercise in the heat. J Appl Physiol (1985); 98(6): pp2101–2107.

12. Paulson T, Goosey-Tolfrey V (2017) Current perspectives on profiling and enhancing wheelchair court sport performance. Int J Sports Physiol Perform;12(3): pp275–286.