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Physical performance and environmental conditions: 2014 World Soccer Cup and 2016 Summer Olympics in Brazil

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This editorial is for the special issue "Temperature sciences in Brazil" of the journal *Temperature*. It focuses on the physical performance and environmental conditions during the 2014 World Cup and the coming 2016 Summer Olympics. It emphasizes that a hot and humid environment imposes a great challenge to the human thermoregulation system, can lead to performance decrements, and increases the risk of developing hyperthermia. Adequate hydration, acclimatization, and body cooling strategies are effective interventions to minimize the risks associated with exercise in the heat.

It is well known that performance capacity may be altered in hot environments.[1,2,3] Many factors, such as thermoregulatory, cardiovascular, and metabolic stress, may contribute for the reduction in physical performance capacity during exercise in the heat due to increases in core temperature, heart rate, rate of perceived exertion,[1] and metabolic rate,[4] as well as dehydration,[5] blood flow redistribution, and adjustments in the central nervous system and the motor command drive.[6] There is also an elevated risk for hyperthermia during prolonged exercise in the heat.[7,8] Therefore, sport activities performed in warm environments often require special attention of the coaching staff and athletes.

Brazil hosted the Soccer World Cup in June and July of 2014 and will host both the Summer Olympic and Paralympic Games in August and September of 2016, respectively. June, July, and August are actually winter months in Brazil, but the temperatures in some Brazilian cities may be quite high during these months. Some games of the 2014 World Cup were played in very warm environments, especially the games in Manaus, which is located close to the Equator in the heart of the Amazon jungle, and has high ambient temperature (29°C, mean for July) and relative humidity (65%, mean for July). Similar conditions were experiences during the games played in Fortaleza (30°C, mean temperature in July, and 55%, mean relative humidity for July) and in Cuiabá (31°C and 44%, respectively). This is in great contrast to the games played in Porto Alegre (18°C and 75%), which is located near the South Pole, ~4,000 km South of Manaus. The game Italy vs. England was played in Manaus City at 32°C, and the game Germany vs. Ghana was played in Cuiabá City at 31°C; both are considered high temperatures. The athletes of the top teams were acclimated by playing at the high temperatures of the European summer, which are close to winter temperatures in many Brazilian cities. Moreover, the main contestants came to Brazil a couple of weeks before the games, to allow their players to acclimatize to the Brazilian conditions, and the environmental temperature was not expected to play an important role in the games. That was the conclusion of Nassis et al.[9] who reported that the different environmental conditions did not affect negatively the athletes' performance. Furthermore, there were no major complaints of any of the participating teams about the temperatures during their games.

The World Cup games were played in Rio de Janeiro, São Paulo, Belo Horizonte, Brasília, Fortaleza, Porto Alegre, Goiânia, Cuiabá, Curitiba, Manaus, Recife, and Natal, while the Olympic Games' events will take place in Rio de Janeiro, with the exception of the men's and women's Soccer tournaments, which will use some of the same stadiums used in the World Cup (São Paulo, Belo Horizonte, Brasília, Manaus, and Salvador). The mean temperature in August in Rio de Janeiro is 22°C (range 19 – 28 °C) and the relative humidity is 69% (mean data from last three years).[10] According to the weather forecast, the temperatures in Rio de Janeiro are not going to be very high during the Olympics, but soccer games will be played in warmer cities, such as Manaus. For games played in these cities, especially during the afternoon hours, the coaching staff should be prepared to intervene to help the athletes to reduce the risks of developing hyperthermia and dehydration.

Among the suggested strategies to be used in order to minimize thermal stress and physiological risks of heat exhaustion or other heat-related illnesses, heat acclimatization is the most important intervention.[9] Heat acclimatization can be achieved after 6 – 10 days of training in the heat, with a targeted minimal deep body temperature of 38.5°C for at least 30 minutes in each training session. The acclimatization to a warm environment is the result of physiological adaptations that improve the thermoregulatory function and decrease cardiovascular effort due to thermal stress. Some adaptations are well known, such as an increase in the plasma volume and cutaneous blood flow, a higher sweating rate, improved

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thermoregulatory efficiency, and decreased heart rate and internal temperature, as well as reduced salt loss.[11,12,13] Therefore, athletes who are coming for the 2016 Olympics in Rio from temperate or cold countries should include a period of training in a warmer environment, at least for a couple of weeks before the beginning of the games. Coming to Brazil prior to the Olympic Games and spending a few weeks training under the local environmental conditions appears to be the strategy of choice for many teams. Another strategy is to assure that athletes are well hydrated at all times, and enough fluid should be provided before, during, and after the games. It is also desirable to use ice or ice cold water to lower the skin temperature thereby cooling the body.[8] A cold shower, use of cooling vests, or simply wrapping the body with towels soaked in icy water can be used before each game and also at half-time breaks.

Importantly, environmental factors affect differently athletes competing in different sports. Because athletes competing in outdoor sports (e.g., soccer players, cyclists, marathon runners, and triathletes) are exposed to the sun and will absorb a great amount of radiant heat, they are subjected to a higher environmental stress than those athletes who compete in indoor sports. And while high ambient temperatures are likely to decrease performance capacity of athletes in long-lasting events, athletes competing in events with very short duration may benefit from the heat.[14,15]

In conclusion, even though the temperature in Rio de Janeiro may not be very high during the upcoming Olympics, it is advisable that soccer athletes who will compete in northern cities (like Manaus and Salvador) are allowed to acclimatize to higher temperatures for 2 to 3 weeks before the games. Many teams gained experience dealing with this issue during the 2014 World Cup.

Disclosure of Potential Conflict of Interest

No potential conflicts of interest were disclosed.

References

1. Marino FE, et al. Eur J Physiol 2001; 86:71-8; http://dx.doi.org/10.1007/s004210100506
2. Marino FE, et al. J Thermal Biol 2004; 29(1):21-9; http://dx.doi.org/10.1016/j.jtherbio.2003.08.008
3. Peiffer J, et al. Int J Sports Physiol Performance 2011; 6:208-20.
4. Parkin JM, et al. J Applied Physiol 1999; 86:902-8.
5. González-Alonso J, et al. J Physiol 2008; 586(1):45-53.
6. Nybo L. J Applied Physiol 2008; 104:871-8.
7. Wendt D, et al. Sports Med 2007; 37(8):669-82; PMID:17645370; http://dx.doi.org/10.2165/00007256-200737080-00002
8. Racinais S, et al. Br J Sports Med 2015; 25(suppl1):6-19.
9. Nassis GP, et al. Br J Sports Med 2015; 49(9):609-13; PMID:25690408; http://dx.doi.org/10.1136/bjsports-2014-094449
10. INMET - Instituto Nacional de Meteorologia. Http://www.inmet.gov.br/portal/index.php?R=bdmep/bdmep
11. Patterson MJ, et al. J Physiol 2004; 559:327-34; PMID:15218070; http://dx.doi.org/10.1113/jphysiol.2004.063289
12. Machado-Moreira CA, et al. J Therm Biol 2005; 30:437-42; http://dx.doi.org/10.1016/j.jtherbio.2005.05.002
13. Magalhães FC, et al. J Physiol Anthropol 2010; 29 (1):1-12; http://dx.doi.org/10.2114/jpa2.29.1
14. Girard O, et al. Scand J Med Sci Sports 2015; 25 (suppl 1):79-89
15. Lacerda AC, et al. Eur J Appl Physiol 2007; 99 (n.1):87-93