BJSM Online First, published on July 14, 2015 as 10.1136/bjsports-2015-095113

Blood, sweat and tears: training and competing in the heat

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The Consensus Statement by Racinais *et al*[1] on training and competing in the heat provides practical recommendations for athletes, clinicians and event organisers to optimise performance during sporting activities in the heat. The focus is on three different areas: heat acclimatisation, hydration and cooling strategies, with practical recommendations for event organisers.

Heat acclimatisation is the most important intervention available to reduce physiological strain and optimise exercise capacity in hot ambient conditions. Most adaptations develop within the first week of heat acclimatisation, and more slowly in the subsequent 2 weeks.[2] Consequently, athletes benefit from only a few days of acclimatisation, but may require up to 2 weeks for optimal performance. Training sessions should last at least 60 min per day and induce a significant increase in body and skin temperatures, as well as profuse sweating. Ideally, athletes should train in the same environment as the competition venue, as this allows for experiencing the exact nature of the heat stress to be encountered.

The second section focuses on hydration. Naturally, sweat rate increases during exercise in the heat, which can lead to progressive dehydration if fluid losses are not minimised by increasing fluid intake. This progressive dehydration leads to plasma hyperosmolality, which reduces sweat rate, ultimately decreasing evaporative heat loss. In addition, dehydration decreases cardiac filling and challenges blood pressure regulation. Thus, since dehydration exacerbates the rate of heat storage and cardiovascular strain, it is important to start exercising in a euhydrated state. It is recommended that athletes drink ~6 mL of fluid per kg of body mass in the 2–3 h preceding training or competition.

There has been debate regarding the influence of dehydration on impairing aerobic performance under heat stress, as well as regarding the question of whether athletes should be given drinking recommendations or simply drink to thirst.[3 4] The consensus appears to be that fluid consumption depends on the circumstances, including fluid availability and specificity of the event. For example, drinking to thirst is not appropriate in settings where severe dehydration is expected (eg, Ironman triathlon). Athletes competing in such events should limit body mass losses in order to reduce physiological strain and preserve performance. Sodium and carbohydrate losses should also be replenished through a combination of fluids and solid foods. The fluids should contain 0.5–0.7 g/L of sodium, which should be increased to 1.5 g/L in athletes experiencing muscle cramping. After exercise, rehydration can be accomplished by drinking plenty of fluids with meals, preferably within 1 h after exercise.

The third major area of the consensus statement pertains to cooling methods. These can be subdivided into external (eg, cooling vests, cold towels, cold water immersion, fanning) and internal (eg, ice slurries, cold beverages) cooling methods. It was suggested that precooling might play a role in prolonged events, whereas team and racket sport athletes may also benefit from cooling during breaks in play.[5] Of note, precooling was not recommended for sprint and explosive events, as this may lower muscle temperature and impair performance. Fans and cooling vests were considered useful cooling methods, however, it was recommended that further research should be conducted to identify the best cooling methods.

The consensus statement concluded with recommendations for event organisers. The authors acknowledged that it is difficult to establish universal guidelines for when play should be stopped, as the heat strain experienced by athletes depends on many factors (eg, metabolic heat production, clothing acclimatisation state, etc), in addition to the environmental conditions. It was therefore advised that event organisers should implement preventive countermeasures. This includes appropriate scheduling of events based on the weather conditions and patterns, allowing extra breaks or recovery periods, having a medical response protocol in place and having cooling facilities available.[6] Organisers should also pay particular attention to 'at risk' populations, advise participants of the risks associated with participating and consider cancelling events in the case of unexpected or unseasonably hot weather.

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Competing interests None declared.

Provenance and peer review Commissioned; internally peer reviewed.

To cite Pluim BM, Racinais S, Périard JD. *Br J Sports Med* Published Online First: [*please include* Day Month Year] doi:10.1136/bjsports-2015-095113

Accepted 21 June 2015

Linked

► http://dx.doi.org/10.1136/bjsports-2015-094915

Br J Sports Med 2015;**0**:1. doi:10.1136/bjsports-2015-095113

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