BRINGING THE GAMES TO THE WORLD II – ENVIRONMENTAL CHALLENGES TO ATHLETE HEALTH AND PERFORMANCE IN THE HEAT

A TRACK AND FIELD PERSPECTIVE

– Written by Juan-Manuel Alonso, Qatar

THE PROBLEM

Although many elite sporting events occur in climate-controlled venues, some athletes train and compete in environments that can potentially pose a risk to their health. Athletes competing internationally at events such as the Olympic Games or World Championships may encounter conditions they are not familiar with (or used to competing in) in the host country.

THE HEALTH RISK TO TRACK AND FIELD ATHLETES

Track and field athletes in particular, can be exposed to environmental challenges during competition and/or training. This article looks at the climatic aspects, specifically temperature, with the most common scenarios being extreme hot and humid conditions and, to a lesser extent, low temperatures. Both conditions may pose a considerable challenge to those not accustomed to them, which is a consideration when choosing the host country for an international event. At the same time, both conditions become a challenge even for acclimatised athletes when they are expressed in extremes. This article focuses on heat as an environmental challenge.

In hot and humid climates, the main risk is suffering from exertional heat illness, which can affect athletes during both short, high-intensity and long-duration exercise. In a best case scenario, this may result in having to abort a training session or withdraw from a competition, in a worst case scenario, it may lead to collapse during or soon after activity[1]. On the other hand, although very uncommon, exposure to cold and wet conditions may result in an increasing incidence of hypothermia, as has been observed in exhausted marathon runners[2].

> ***The most important preparation for competing in the heat is to train in the heat***

Table 1

	Risk	WGBT	Recommendation
Black flag	*Extreme*	*> 28°C (82°F)*	*Consider rescheduling or delaying the event until safer conditions prevail; if the event must take place, be on high alert*
Red flag	*High*	*23-28°C (73-82°F)*	*Everyone should be aware of injury potential; individuals at risk should not compete*
Yellow flag	*Moderate*	*18-23°C (65-73°F)*	*Risk increases as event progresses throughout the day*
Green flag	*Low*	*< 18°C (65°F)*	*Risk low but still exists on the basis of risk factors*
White Flag	*Lower risk for hyperthermia but increasing risk for hypothermia*	*< 10°C (50°F)*	

Table 1: Wet bulb globe temperature (WBGT) Index Flag Coding system, risks and recommendations[12,14].

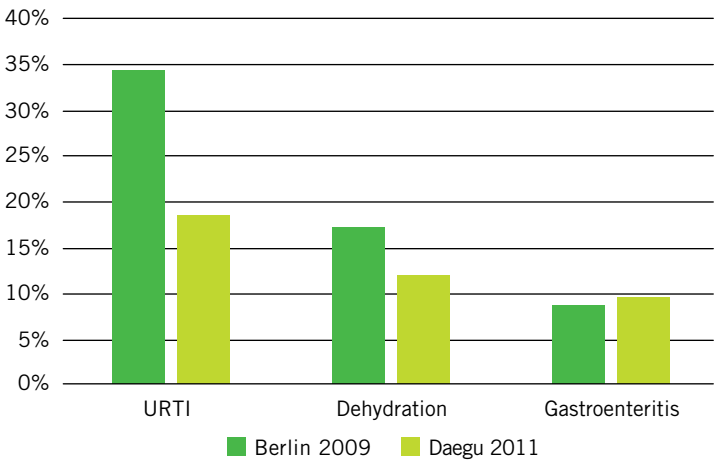

Figure 1: Percentage of illness diagnoses during Berlin 2009 and Daegu 2011 World IAAF Athletic Championhsips.

Environmental and exercise-induced illnesses were the second and third most common conditions among athletes participating in the World Athletics Championships in Berlin, 2009 and Daegu, 2011 (respectively). Among the athletes participating in these championships, those performing in race walking had the highest propensity to incur these kinds of illnesses[3,4].

The illnesses encountered at major sport events can include exercise-associated collapse[5], exercise-associated muscle cramping, heat exhaustion or exertional heat stroke. Whereas certain individuals are more prone to collapse from exhaustion in the heat (i.e. those who are not acclimatised, use certain medications, are dehydrated or have recently been ill), exertional heat stroke can affect ostensibly healthy athletes even when the environment is relatively cool with temperatures below 10°C and over 60% humidity[1,2].

COMPLEX CAUSE-EFFECT RELATIONSHIPS

Although numerous contributing factors to the development of heat illness have been identified, by far the most common causative factor is an individual's degree of exertion relative to their body's ability to dissipate the heat generated by exercise. Each athlete's response to exercise in the heat is different and difficult to predict[6]. Hence, athletes must be very careful when training and competing in athletics, not only in long distance and race walking events, but also during long training sessions and other competitions involving longer exposures to heat. In this regard, field events like jumps or combined events such as decathlon should not be neglected.

Moreover, particular caution should be taken when training for athletics in extreme environmental conditions, where excessive over-commitment and peer competitiveness, (common in individual sports such as track and field), or encouragement from fellow athletes, coaches and leadership, (more common in team sports), may lead individuals to over-extend themselves[6]. The International Association of Athletics Federations (IAAF) is aware of the health risks posed to athletes by environmental factors and has implemented protective measures. The IAAF believes in an unrestrained and co-operative partnership between coaches, athletes and medical staff as a vital approach to ensure the protection of athlete health[6].

PREPARING ATHLETES FOR COMPETITIONS IN THE HEAT

The most important preparation for competing in the heat is to train in the heat, in order to induce heat acclimatisation. Athletes should train for at least 1 week, but ideally 2 weeks under conditions that expose them to a comparable degree of heat stress in terms of temperature and humidity to the target competition. Training should last around 90 minutes daily to increase body core and skin temperatures and stimulate sweating and elevated skin blood flow. If such preparation in a similar environment is not possible, athletes can use indoor training in a heat chamber to induce the desired physiological adaptations. Athletes should start exercising in a euhydrated state and continuously replace fluid losses so that dehydration does not exceed 1 to 2% of pre-exercise body mass during prolonged exercise[7].

The combination of different cooling strategies i.e. mixed-method approaches using both internal and external cooling

strategies both before and during exercise has a significantly larger effect than individual cooling techniques used independently. In sporting practice, this can be achieved by combining simple strategies such as the ingestion of cold water/ice-slurries with wearing cooling vests/iced towels[7].

PREVENTIVE MEASURES

At international competitions hosted in hot and humid climates or during an exceptionally hot period of the year, it is the responsibility of the International Federation to ensure that the relevant precautions are taken to protect athlete health. Preparedness by local organising committees, including comprehensive medical services, is crucial to limit the impact of heat illnesses[8]. In this context, the implementation of regular measurements of the wet bulb globe temperature (WBGT) to assess environmental heat stress in athletics competitions, based on published guidelines for distance running events, assist in preventing exertional heat illness[9]. The WBGT incorporates measures of the four basic elements of the thermal environment: air temperature, mean radiant temperature, absolute humidity and air movement[10]. Using the WBGT index to assess on-site environmental heat stress at regular intervals prior to and during competition is an important starting point. The combination of WBGT monitoring with recommended evidence-based actions such as appropriate scheduling, adequate acclimatisation, proper hydration and high-quality medical coverage can significantly contribute to preventing or minimising the number and severity of exertional heat illness incidents[1,8,9,11].

THE IAAF APPROACH

The on-field assessment of WBGT has been used in World IAAF Athletics Championships since Osaka 2007. To this end, the IAAF employs the flag system based on the WBGT developed by the US Navy, made popular in sports medicine by the American College of Sports Medicine[1] and National Association of Athletic Trainers[12] and currently being used by several sporting federations. Although it has some limitations[7,10,13], the implementation of WBGT measurements in warm-up areas, at the competition track and on courses, as well as appropriate announcement of the readings have been implemented at the Daegu 2011 and Beijing 2015 World Athletics Championships by the local organising committees (see Table 1)[14]. This measure, together with the publication of educational material – both in print and online as part of the competition website – in addition to its promotion among registered athletes and their entourage, could have played a role in the reduction of dehydration incidents during Daegu 2011, compared to Berlin 2009 (Figure 1)[4].

The WBGT is an environmental heat stress index and not a complete representation of the actual heat strain on human beings, as athletes may have different thermoregulatory constraints. It is therefore difficult to establish absolute participation cut-off values across sports for different athletes. Rather, it is recommended to implement preventive countermeasures, among them appropriate scheduling of the competition throughout the calendar year and the most suitable start times in championship timetables. In warm and humid climatic areas, events should also be (re-)scheduled to avoid the hottest hours of the day and minimise the exposure of athletes to solar radiation (e.g. early morning or late evening). Event cancellation might be necessary if serious hazards to athletes' health are anticipated[7]. However, the decision to cancel an event should be based not only on the prevailing ambient conditions, but the amount of heat produced by the athlete, which may be assessed by methods such as ingestible temperature pills. Additionally, a host of other factors, such as the time spent in the heat and the nature of the athletic population at the event (elite and amateur athletes, youth and masters athletes, male and female individuals) should be considered when making the decision to cancel an event. Such a decision would also never be made solely by the medical officials, but in collaboration with technical officials[15].

As mentioned, a suitable medical response protocol for the medical teams of the local organising committee should be in place. The possibility to adapt rules or implement specific arrangements at certain competitions to facilitate larger cooling facilities[7] and an extra supply of drinks

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are further provisions complementing the preventive approach in hot and humid conditions.

Some authors[13,16] have recommended using the Universal Thermal Climate Index as an alternative to WBGT. This method integrates predictive mathematical formulae of human thermal regulation based on activities conducted in wide-ranging outdoor climate conditions characterised by non-moderate ambient temperatures, elevated wind speeds and solar radiation conditions. Until further research and more appropriate tools and guidelines are developed to help ensure the health and safety of athletes in hot environments, the WBGT seems to be an affordable and easy-to-use heat stress measurement index[15] for International Federations and local organising committees.

The role of International Federations

As mandated by the Olympic Movement Medical Code, International Federations have an important responsibility to ensure the health and safety of their athletes. In addition, these federations provide important educational support for National Olympic Committees, associated world sport organisations and the local organising committees at their events, through the provision of factual information on reducing hyperthermic risks for participating athletes, coaches and members of the athlete entourage at all competitive and recreational levels in their respective sports.

The IAAF plays an integral role in promoting and supporting the scientific advancement of knowledge specific to the physiological challenges related to hyperthermia in the elite athlete, and the prevention of exertional heat illness and injury, that is not necessarily limited to athletics[8]. The athletics governing body should consider the adoption of a smarter policy when awarding host cities to avoid hot and humid climates and to ensure appropriate event scheduling to manage the higher risk – for example, planning long-lasting events during the coolest time of the day. The implementation of effective educational programmes to promote adequate acclimatisation, hydration and cooling strategies by athletes is a must. Last but not least, the provision of high-quality medical coverage should be guaranteed at every single major athletics championships. The combination of all these actions will surely contribute to reducing the risk and incidence of heat-related illness in track and field athletes.

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Juan Manuel Alonso M.D., Ph.D.

Former Chair, IAAF Medical Commission

Acting Chief of Sports Medicine

Aspetar Orthopaedic and Sports Medicine Hospital

Qatar

Contact: juan-manuel.alonso@aspetar.com