

Clinical insights: Preparing for the Tokyo Olympics—Ensuring health and welfare of equine athletes in the face of heat and humidity

“Those who cannot remember the past are condemned to repeat it”—George Santayana, 1905.

The Olympic equestrian disciplines of Eventing, Jumping and Dressage made their Olympic debut in Paris 1900 but were absent in 1904 and 1908 before returning in 1912. Equestrian has been a permanent feature of every Olympic Games since. A variety of complex and often controversial factors contribute to the selection of future Olympic Games host cities. Unfortunately, climatic challenges and suitability to successfully host Equestrian events appears to rarely rate a mention.

The COVID-19-delayed Tokyo Olympics are scheduled for 23 July to 8 August of this year, placing them in the middle of the heat and humidity of the Japanese Summer. Tokyo regularly experiences temperatures in excess of 41°C (105°F) with human hospitalisations due to heat stroke numbering in the many thousands and deaths frequently 100+ in the months of July and August. The equestrian events of the Tokyo Games will be a challenge for all involved to ensure the health and safety of equine athletes.

Tokyo certainly is not the first time that extreme heat and humidity has challenged the viability of Equestrian events at the Olympic Games, and it won't be the last. In the face of global climate change and future Olympics, host cities including Paris 2024 and Los Angeles 2028 both of which regularly experience hazardous heatwaves each summer, managing equine athletes in hot and humid conditions will be something veterinarians will be challenged with for many years to come. It is vital that we learn from the past to ensure the welfare of equine athletes in the future.

The aim of this editorial is to highlight the ground-breaking research which followed the 1992 Barcelona Olympics. The accompanying Special Collection ensures that the articles published in EVJ which have contributed to knowledge in this area are readily accessible. This work revolutionised our understanding of managing equine athletes in hot and humid conditions and allowed the successful running of the 1996 Atlanta Olympics. In the lead up to the 2008 Beijing Olympics, another concerted effort by veterinary researchers again advanced our understanding, and it is on the back of this work that recent literature of equine heat stress and optimisation of cooling methods has been established.

It was the 1992 Barcelona Olympic Games that brought the challenges of managing equine athletes in hot climates to the fore of the minds of the International Olympic Committee (IOC), the Federation Equestre Internationale (FEI), and veterinarians alike. Live TV

coverage of distressed horses during the cross-country phase drew sharp focus and concern. Veterinarians working on cross-country that day reported many horses finishing with rectal temperatures of at least 42°C, which was the highest reading capacity of thermometers available at the time.¹

A commonly held belief at the time of the 1992 Games was that it is beneficial for horses to avoid training in the heat of the day so as to avoid getting too hot. A lack of understanding of acclimatisation combined with inadequate post-exercise cooling techniques and a competition schedule that did not consider climatic factors thoroughly enough are thought to have been major contributors to the events that transpired on cross-country day. Following the 1992 Games, and in advance of the predicted extreme climatic conditions of the 1996 Atlanta Olympic Games, an initiative launched by the FEI led to a huge amount of scientific progress in the veterinary understanding of the effects of exercising horses in hot and humid conditions, optimal methods of cooling horses and equine athlete acclimatisation. Prior to this initiative, the knowledge in this field was very limited, with only about 20 articles published between 1960 and 1992. More than 20 articles were published in just 3 years from 1993 to 1996, and this foundational work led to better understanding of the field, improved welfare and performance of equine athletes and great advances in more recent times.

The concerted effort made during this time led to the establishment of appropriate methods for monitoring and cooling down horses post exercise, recognition of tired horses, identification and management of horses affected by heat stress, modification of competition schedule and length of cross country course when faced with challenging climate and best practice protocols for heat acclimatisation of equine athletes; all of which are now widely accepted and common place but at the time lacked scientific evidence to challenge established dogma.

Research was focused around the cross-country phase of eventing as it is the most physically demanding aspect of all the Olympic equestrian disciplines. Field studies at Burghley Horse Trials in England² and several locations in the USA, including a test-event held at the site of the 1996 Atlanta Games,^{3,4} provided valuable baseline data on horses immediately post cross country, demonstrating that rectal temperatures and respiratory rates of horses competing in hot and humid conditions were significantly higher than those competing in cool conditions.

Studies utilising treadmills and standardised exercises testing were able to thoroughly investigate the clinical and physiological effects of exercise in both cool and hot/humid climates. These studies demonstrated exercising in hot/humid environments not only increased clinical parameters such as heart rate and respiratory rate, and biochemical markers such as lactate, but one also showed reduced performance markers as shorter mean run times to fatigue.⁵

Weight loss and sweating rate in cool conditions compared to hot/humid conditions were investigated in several studies by different authors. One such study⁶ clearly demonstrated increased sweating rate and increased weight loss in horses exercising in hot/humid conditions compared to the cool. These findings led to the recommendation at the 1996 Atlanta Olympics for horses to be weighed twice daily with forced rehydration via either nasogastric tube or intravenous perfusion instituted when horses approached 5% total progressive body weight loss. This recommendation has stood the test of time and weighing of event horses is commonplace and is the basis of the frequent, almost routine practice of intravenous rehydration of horses following cross country in long format modern Eventing.

The lack of knowledge regarding heat acclimatisation was a contributing factor in the difficulties encountered at the 1992 Games and was a key focus of research leading into the Atlanta Games. All studies on this topic showed a significant benefit of heat acclimatisation across numerous parameters. Studies prior to 1996 indicated daily exposure for 3 weeks to heat and humidity resulted in physiological adaptations and heat tolerance. This led to the requirement that horses competing at the 1996 Games arrive on site in Atlanta 3 weeks prior to the competition. Subsequent to this, more recent work into acclimatisation has demonstrated that a 15-day period of training in hot humid conditions is adequate to achieve acclimatisation.⁷ As years have progressed, the demands of modern equestrian sport have changed. The elimination of roads and tracks within eventing has reduced the physical demand of the horse, but with an increased frequency of competitions along with higher financial risk-reward demand, pressure on horses has increased in other ways. Horse arrivals prior to the Olympics are now scheduled approximately 7 days prior to competition. Active acclimatisation strategies are instituted for several weeks at home prior to departure. These strategies include training during the hottest part of the day and exercising on treadmills in heated rooms. Comprehensive veterinary advice regarding heat management and acclimatisation is communicated to national equestrian federations well in advance of the games via the FEI.⁸

Many misconceptions regarding the most appropriate way to cool down horses after exercise were prevalent and persistent prior to the 1992 Games. Understanding the importance of this, numerous research projects leading into the 1996 Games clearly showed aggressively cooling with water reduced rectal temperature, heart rate, pulmonary artery temperature and gluteal temperature with no adverse effect on muscle derived enzyme.⁹ Based on this research, cooling techniques such as misting tents and access to high volumes of cool water at the end of cross country were put in place

and deemed successful in a veterinary review of the 1996 Games.¹⁰ Despite the adverse condition present on cross country day at Atlanta, all rectal temperatures were recorded to be <40.5°C and only 2 of the 99 horses were seen to be showing excessive fatigue. Study in this topic has been on-going with the most recent work being from a Japanese research team¹¹ who compared 5 different techniques to cool down horses. Using horses exercising on a treadmill in a hot/humid environment, it was shown that continuous application of large volumes of tap water to a stationary horse was the most effective method of reducing core temperature post exercise when compared to walking with no additional cooling, walking with a fan being applied or walking with intermittent application of cold water with or without scraping.

The Web Bulb Globe Thermometer (WBGT) quantifies the heat load experienced by horses (and riders) by measuring ambient temperature, relative humidity, wind strength and intensity of solar radiation. The higher the WBGT reading, the higher the total heat load experienced by the horse. Validation studies of the WBGT were conducted at numerous Horse Trails throughout the northern hemisphere¹² and were used to establish FEI heat management guidelines such as "WBGT readings above 33 indicate climatic conditions may not be compatible with safe competition. Further veterinary advice is required before proceeding"¹³ The WBGT is now a well-established objective tool to help event organisers and veterinarians alike best schedule equestrian competitions in challenging climates. It was vital to the success of the 1996 Games, and integral to the success of subsequent games such as the equestrian events of the 2008 Beijing Olympics held in Hong Kong. Early morning starts for cross country and better cooling facilities are now standard wherever hot and humid climate challenges are present. Recommendations regarding active acclimatisation strategies have been perfected and a highly effective system for rapid cooling systems utilising shade tents, misting fans and large volumes of readily available cold water established.¹⁴

The protocols, guidelines, techniques and technologies established at the 2008 Games are now used widely and provide the base for veterinary management of all subsequent Olympics. It is within the literature from the 2008 Games that we see the closest parallels and most important lessons to be heeded in the lead up to Tokyo. The work done leading into the 2008 Games has been replicated and expanded on leading into Tokyo with a similar method of pre-Olympic climatic modelling in order to provide specific veterinary heat management plans and protocols.¹⁵ For those veterinarians who were present at the Games in Hong Kong, Tokyo is anticipated to be similar.

Prevention is always better than cure, but when presented with a horse experiencing heat stress, it is essential that rapid recognition, treatment and management are instituted. A review article from Australia (a country that routinely manages racing and equestrian events in heat of 30+ WBGT) provides an excellent summary regarding pathogenesis, pathophysiology, identification and treatment of exertional heat related illness.¹⁶ With specific reference to Japan a study of flat racehorses has shown that WBGT >28, races longer

than 1600 m, horses aged over 5 years old and being a Gelding were all increased risk factors for exertional heat illness.¹⁷ A study into the prevalence of post-race exertional heat illness on Japanese racetracks showed a prevalence in summer months of 0.086% (1 in every 1165 starters) with a noticeable year on year increase in case numbers associated with increasing average summer temperatures in Japan.¹⁸

The challenging climatic conditions of the delayed 2020 Tokyo Olympic Games are fast upon us. We must consider history and, as veterinarians involved in the management of athletic horses competing in hot and humid climates, must understand the core research that forms the base of our current understanding and ensure we heed the lessons learnt by our predecessors. This is vital to ensure the safe and successful completion of the equestrian events of the 32nd Olympiad in Tokyo.

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