



Investigating factors affecting the body temperature of dogs competing in cross country (canicross) races in the UK



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ABSTRACT

Increasing numbers of people are running with their dogs, particularly in harness through the sport canicross. Whilst canicross races are typically held in the winter months, some human centred events are encouraging running with dogs in summer months, potentially putting dogs at risk of heat related injuries, including heatstroke. The aim of this project was to investigate the effects of ambient conditions and running speed on post-race temperature of canicross dogs in the UK, and investigate the potential risk of heatstroke to canicross racing dogs. The effects of canine characteristics (e.g. gender, coat colour) were explored in order to identify factors that could increase the risk of exercise-induced hyperthermia (defined as body temperature exceeding the upper normal limit of 38.8 °C). 108 dogs were recruited from 10 race days, where ambient conditions ranged from – 5 to 11 °C measured as universal thermal comfort index (UTCI). 281 post race tympanic membrane temperatures were recorded, ranging from 37.0–42.5 °C. There was a weak correlation between speed and post-race temperature ($r = 0.269$, $P < 0.001$). Whilst no correlation between any single environmental factor or UTCI and post-race temperature was found, the proportion of dogs developing exercise-induced hyperthermia during the race increased with UTCI ($r = 0.688$, $P = 0.028$). Male dogs ($\chi(1) = 18.286$, $P < 0.001$), and dark coated dogs ($\chi(2) = 8.234$, $P = 0.014$), were significantly more likely to finish the race with a temperature exceeding 40.6 °C. Prolonged elevation of body temperature above this temperature is likely to cause heatstroke. At every race dogs exceeded this critical temperature, with 10.7% ($n = 30$) of the overall study population exceeding this temperature throughout the study period. The results suggest male dogs, dark coloured dogs, and increased speed of running all increase the risk of heatstroke in racing canicross dogs. Further research is required to investigate the impact of environmental conditions on post-race cooling, to better understand safe running conditions for dogs.

1. Introduction

The sport canicross involves competitors completing a cross country style race either running, cycling or scootering, whilst harnessed to dogs (see Fig. 1). The dogs normally run ahead, taking up the slack in the bungee line and providing some assistance to the runner. Canicross is an effective means of exercising both runner and dog over relatively short ‘sprint’ distances of approximately 5 km (although longer competitive distances are run). Now formally recognised by The Kennel Club, the sport has been run competitively in the UK since 2000, with increasing numbers of competitors taking part in races around the country (The Kennel Club, 2017). As race results are ultimately linked to both human and dog speed, the sport can promote increased physical activity, encouraging people to exercise with their dog to improve their race times, competitive performance, health and fitness in both species.

There have been several studies exploring ways of encouraging dog owners to spend more time walking and exercising with their dogs (Rhodes et al., 2012; Schneider et al., 2014; Westgarth et al., 2014, 2015), however studies exploring the impact of this advice (both positive and negative) on the dog are lacking. Encouraging owners to increase their activity levels through dog walking or running, could place the dog at risk of conditions such as heatstroke, as unfit dogs show significantly reduced exercise endurance and increased rate of temperature rise (Nazar et al., 1992) compared to healthy dogs. As heatstroke is a potentially fatal condition, and has been reported following just six minutes of exercise in hot ambient conditions (Bruchim et al., 2006), advising owners to start exercising with their unfit dog in spring or summer months could prove extremely dangerous for the dog. At present advice regarding safe ambient temperature thresholds for exercising with dogs is lacking.

Abbreviations: TMT, tympanic membrane temperature; UTCI, universal thermal comfort index

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Fig. 1. One dog canicross competitor on the left, one dog bikejor competitor on the right.

Heatstroke is defined as a systemic inflammatory response leading to multi organ dysfunction and brain damage, associated with hyperthermia (Bouchama and Knochel, 2002), in dogs heatstroke is typically associated with rectal temperatures exceeding 41 °C (Flournoy et al., 2003). One veterinary hospital has reported an increase in the number of dogs presenting with exertional heatstroke (caused by exercise) compared to environmental heatstroke (typically following vehicle confinement), with 73% of recent cases being categorised as exertional heatstroke (Bruchim et al., 2017), compared to 58% of cases previously reported (Aroch et al., 2009). The increase in popularity of amateur canine sports participation in the UK, combined with increasing episodes of warm weather during traditionally colder months in autumn and early spring (WMO, 2017), could potentially increase the risk of canine exertional heatstroke occurring (Hall and Carter, 2016).

Traditionally canicross races are run during the autumn-spring, to avoid warm weather for both the runners' and the dogs' benefit. Dogs are more likely to develop heatstroke following prolonged exercise in warm conditions, as they can only sweat through their paw pads, relying mainly on convection and radiation of heat, then panting to allow evaporative heat loss for thermoregulation (Johnson et al., 2006). As ambient temperature increases, heat loss through convection and radiation is limited (Johnson et al., 2006). When competing at canicross events owners are reminded to monitor their own dogs for signs of overheating, and many canicross clubs have their own informal rules on safe competition conditions. Guidelines on suitable working temperatures are limited, and are reliant on personal experience and anecdote. One such recommendation used by canicross groups and on-line discussion forums is “do not run your dog if ambient temperature (°C) x humidity (%) > 1000”, where multiplying the ambient temperature by the relative humidity is used to determine if it is safe to run with your dog (Cani-Sports Edinburgh, ND; Highland Canicrossers, ND). Studies investigating the validity of this guideline are lacking, and to date, there have been no studies investigating body temperature in pet dogs competing in canicross races. Whilst the effect of exercise on body temperature has been investigated in both long distance sled racing dogs (Phillips et al., 1981), and in greyhounds competing in shorter sprint races under 1 km (McNicholl et al., 2016) there has been no research investigating the temperature of pet dogs racing over middle distances such a canicross race (around 3–5 km),

To develop more robust guidelines for safe environmental conditions for canine sports, additional investigation into the effect of ambient conditions on canine athlete body temperature is needed. Physical exercise can exceed thermoregulatory mechanisms, potentially impacting animal health and performance (Piccione et al., 2012; Robbins et al., 2017). Monitoring body temperature is therefore important to

monitor the health, physiological status and welfare of exercising, competing or working animals (Rizzo et al., 2017). As temperature, humidity and wind speed all influence body temperature, it is important to consider the thermal impact of the combined effect of all three, when investigating environmental impact on body temperature. Universal thermal comfort index (UTCI) incorporates all of these factors to calculate a “feels like” temperature that reflects the ambient conditions as a whole (Jendritzky et al., 2012). This allows individual environmental conditions to be measured in the field, then combined using the UTCI calculation to provide an ambient temperature that reflects the overall impact of the conditions present.

Aural thermometers measuring tympanic membrane temperature (TMT) have been investigated in comparison with rectal thermometers, and have been found to be an effective alternative for monitoring temperature in dogs pre- and post-exercise (Hall and Carter, 2017a; Robbins et al., 2017; Zanghi, 2016). As aural thermometers are faster and often better tolerated than rectal thermometers (Gomart et al., 2014; Lamb and McBrearty, 2013) they offer an ideal means of monitoring immediate post-race body temperature in the canine athlete under field conditions. Aural thermometers under-report body temperature when compared to rectal temperature in dogs, by around 0.4 °C when measured with an animal specific device (Gomart et al., 2014; Hall and Carter, 2017a; Zanghi, 2016), and by around 1.3 °C using a human aural thermometer (Piccione et al., 2011). It is therefore important to use an animal specific thermometer and an appropriate reference range when interpreting ear temperature readings (Hall and Carter, 2017b).

The aims of the study were to investigate the effects of varying ambient conditions on the tympanic membrane temperature (TMT) of privately owned pet dogs competing in middle distance canicross races, and the incidence of post-race temperatures associated with heatstroke. In addition, the effects of race speed, gender and coat colour on post-race temperature were also explored to identify canine characteristics that could increase the risk of exercise-induced hyperthermia.

2. Methods

This study was approved by Nottingham Trent University's School of Animal, Rural and Environmental Sciences ethics committee.

2.1. The race courses

Canicross runners, scooter and bikejor competitors competed with their dogs over a course 3.8–4.5 km in length over two consecutive days (the course was identical on both days). All dogs had previously competed in canicross races and were at least one year of age for canicross,

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