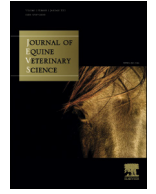




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Original Research

Physical Parameters and Risk Factors Associated with the Elimination of Arabian and Crossed Arabian Endurance Horses during a 120-km Endurance Race



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ABSTRACT

Endurance racing is one long-distance event among the equine sporting activities associated with severe injuries and metabolic derangements that impede the health status of horses participating in the event. Therefore, this study evaluated the physical parameters and risk factors associated with the elimination of Arabian and crossed Arabian endurance horses during a 120-km race. Fifty-three Arabian and crossed Arabian endurance horses aged 6 to 15 years old participated in an endurance race of 120 km. All the horses were examined and found fit according to Fédération Équestre Internationale (FEI) regulations. After the endurance race 14 Arabian endurance horses completed the race successfully while 31 Arabian and crossed Arabian were eliminated. Their speed and heart rates were significantly higher ($P < .0001$). There were significant differences in skin recoil ($P < .0395$), color of mucous membrane ($P < .0189$), intestinal motility ($P < .0124$), and capillary refill time ($P < .0082$). There also were significant differences in age ($P < .0018$), breed ($P < .0119$), and equine establishments ($P < .0205$) among the eliminated horses and the Arabian and crossed Arabian endurance horses that successfully completed the race. In conclusion, the physical parameters and risk factors were significantly associated with the elimination of Arabian and crossed Arabian endurance horses. Therefore, close monitoring of the physical parameters and risk factors are essential in order to improve the performance of Arabian and crossed Arabian horses, and further studies are required on other associated parameters.

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1. Introduction

The endurance event is a long-distance sporting event among equine sporting events that require tremendous energy and effort within distances ranging between 40 and 240 km in a 24-hour period [1–8]. Elimination rates from

endurance competitions range from 10% to 60% depending on the terrain and speed [7–9]. High temperature and humidity could also represent predisposing and risk factors for exhaustion and reduction in running speed during endurance events [2,10].

Endurance horses are eliminated from the race due to either lameness or metabolic disorders. In a recent study by Nagy et al [2] reported an elimination rate of 62.7% for lameness and 24% for metabolic disorder. Furthermore, in a similar study conducted in Malaysia, Lawan et al [11] reported an elimination rate of 17.91% for lameness and

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53.73% for metabolic disorders. Certain breeds were associated with high risk of elimination for lameness and metabolic reasons [2,7]. The distance, duration, and speed of the ride were also associated with both lameness and metabolic eliminations [2]. There was a high correlation between speed and placing in endurance races [12].

Physical parameters indicating the metabolic status of the horse include color of mucous membrane, skin tenting, heart rate, capillary refill time, intestinal sounds, and gait. These parameters are associated with increased risk of elimination for lameness and metabolic disorders [2]. The color of the mucous membrane is suggestive of how efficient the heart pumps the blood to the periphery, the capacity of vessels, and the internal health status, such as heat stroke and synchronous diaphragmatic flutter [13]. A pale colored membrane indicates a reduction of red blood cells or oxygen in the peripheral circulation. This could result from acute or persistent blood loss, dehydration, and toxemia [14]. Dehydration in equids has been appraised by assessment of heart rate, capillary refill time, mucous membrane, and skin tenting [13,15]. The primary abnormality of color of the mucous membrane as a horse dehydrates or reacts to fluid shifts is reddening of the mucous membranes above the tooth root, with an equivalent paling of the other parts of the tissue and is characterized by a dry and sticky texture [14].

Skin tenting is the tendency of the skin to return swiftly to its normal shape after being raised in a fold nipped between the examiner's thumb and forefinger at the point of the shoulder region, whereas skin tenting duration is the holdup in this return [16,17]. Tenting of the skin is the basic sign of dehydration in animals [17,18]. Skin tenting duration varies with age and the pathologic status of the animal [17]. Skin tent duration seems to be influenced by body condition, neck and head location, movement, anatomical position of the nipped skin, and the extent to which the skin is pulled away from its normal outline before the force of the pinch is stopped [17].

Capillary refill time denotes the ability of the horse to pump blood through the small blood vessels in the mucous membranes of the mouth and is the time required for the pinkness to resurface in the mucous membranes of the mouth after finger or thumb pressure is lightly applied to the gum [19]. Capillary refill time is a reliable examination, reflecting the internal health status of the horse [19]. The distraction of blood from visceral to muscle circulation can cause diminished intestinal sounds or even complete ileus. Reduced intestinal sounds in an apparently healthy horse are of less concern than in a horse with absent intestinal sounds accompanied by other metabolic abnormalities. Gait is one of the most significant parameters assessed in endurance events. The ability of an endurance horse to maintain a sound gait is the mainstay of performance [20]. Extreme combinations of physical parameters are a sure sign that the horse is in trouble and is a candidate for elimination from an endurance race. The preeminent known abnormalities in endurance horses at risk for developing metabolic problems are persistently elevated heart rates, synchronous diaphragmatic flutter, dehydration, excessive heat production, fluid and electrolytes shifting, and subclinical conditions subsequently leading to

elimination from the race [9,21–23]. However, recognition and management of these problems may enhance the athletic ability of these horses [24].

Numerous management and training practices in equine establishments are centered on the riding of horses [25,26] because the way in which a horse is ridden could cause persistent stress to the animal. Active older horses have the ability to continue to perform in athletic events for many reasons including genetics, improved health care, and greatly enhanced nutritional management [27]. Unfortunately, many horse owners and riders continue to train their older horses by using exercise training protocols that, although appropriate for younger or middle-aged horse, may not be suitable for the older equine athlete [27]. Most breeds have been tested and used in endurance races, but the most competitive are Arabian and Arabian cross horses [12].

A preliminary examination by a veterinarian determined the physical parameters that were used to distinguish horses that were fit from those that were eliminated from racing [19,28]. Few studies elaborate on the effects of physical parameters, terrain, and weather conditions [9,29]. Elimination of Arabian and crossed Arabian horses from endurance racing is determined by alterations in physical parameters and risk factors. There are limited data on physical parameters and risk factors associated with the elimination of Arabian and crossed Arabian endurance horses during a 120-km endurance race. Therefore, this study was conducted to investigate the physical parameters and risk factors associated with the elimination of Arabian and crossed Arabian endurance horses during a 120-km race.

2. Material and Methods

Fifty-three Arabian and crossed Arabian horses participated in an endurance competition of 120 km in Terengganu Sultan Mizan cup FEI Concours Endurance Internationale (CEI) between October 19 and 21, 2012, at the International Endurance Park Lembah Bidong, Malaysia, and these horses were used for the study. Thirty-one Arabian and crossed Arabian horses were eliminated from the race, and 14 completed the race successfully. Eight horses were retired from the race; among the 31 eliminated endurance horses, 14 were selected randomly from establishments A, B, and C to represent this category. The ages and body weights of the horses ranged between 6 and 15 years and 350 and 450 kg. The body weights of the horses were estimated by using a weighing type method. The age groups of the Arabian and crossed Arabian endurance horses were classified as 6 to 10 and 11 to 15 years, with 14 horses in each age category. Veterinary inspection was conducted after each loop of the races in all competing horses, and physical parameters were recorded using the ride card. The race was conducted in accordance with FEI regulations, and some FEI officials were present to monitor the competition and to see to the welfare of horses and riders.

The physical parameters appraised were the heart rate, which was analyzed as a continuous variable and given as means \pm SEM; categorical variables were the color of mucous membrane (where NL = normal; MC = mildly

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