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Impact of a 100-km race on the heart rate and speed of endurance horses in Bulgaria

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Abstract

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The main purpose of the study was to determine the changes that occurred in the heart rate and speed of movement of horses competing in endurance races at a distance of 100 km in Bulgaria. Two races were included in the study, which were conducted during the racing seasons of 2022 and 2023. The total number of horses competing in both races was 23 representing different breeds. The pre-race heart rate of successful horses during 2022 race was on average 46±9.38 bpm and post-race 60.66±2.73 bpm and the eliminated horses during that race had a mean heart rate of 74±19.79 post-race. The average speed during the stages varied from 12.82±1.07 km/h to 14.23±0.98 km/h, as the lower speed was observed during the last loop of the competition for successful horses. A similar speed range was observed in the group of eliminated horses. During the 2023 race, successful horses had a pre-ride pulse of 42.44±3.57 bpm and 58.22±2.86 post-race. The speed of movement ranged from 13.60±1.16 km/h to 15.01±0.43 km/h, again the lowest speed was performed during the last stage of the race.

Keywords: horses; endurance; heart rate; speed

Introduction

Horses participating in the International Endurance Competition (CEI 1*-100 km) undergo an individual training program tailored to the specific characteristics of each animal. The individual approach allows strict monitoring of the horse's reactions during the training process and adaptation of the program accordingly. During training, horses are required to overcome loads of varying intensity and volume, but the maximum load occurs during the competition itself. It is assumed that the horses participating in CEI 1* competitions are well prepared and in excellent sports shape; precisely for this reason, if all the optimal conditions are provided during the competition, no striking deviations should be found in the studied indicators. The evaluation of horses in various disciplines of equestrian sport is the last stage of the selection and breeding process in the equestrian industry. Then, the actions of breeders and trainers can be evaluated, good practices can be reinforced, and mistakes and shortcomings can be removed. Monitoring of the physiological parameters of the horses participating in endurance discipline is necessary to avoid possible risky conditions and improve the performance of the horses in the competition (Adamu et al., 2014). Heart rate is the most accessible indicator, according to FEI (International Equestrian Federation) endurance rules it should be no more than 64 bpm within 15 min of crossing the end line of each Loop and within 20 min of crossing the finish line of the final Loop. Horses that fail to achieve a heart rate below 65 bpm within 11 min after first and second loop and within 13 min after third and fourth loop have 70% chance of elimination at the next vet gates (Younes et al., 2015).

The aim of this recent study was to determine the impact of prolonged effort during a 100-km competition race on the

heart rate and performance of endurance horses in Bulgaria.

Material and Methods

Competition venues and animals

The study was conducted during two CEI 1* 100 km races. The competitions were organized in accordance with the rules for endurance competition rides provided by the Bulgarian Equestrian Federation (BEF), fallowing FEI. The courses consisted of grassy, hilly, and agricultural roads. Race "A" was held on the territory of the national stud farm "Kabiyuk" near Shumen, Bulgaria, on 25.06.2022, during the summer period. The altitude of the competition site was 269 m. The average daily temperature on the competition day was 22°C, and the humidity was on average 45%. The number of horses included in the starting list was ten, six of them completed the competition successfully and four failed to qualify. Three of the horses were male and seven were female, aged between 7 and 12 years. Six of the horses were of pure Arabian breed, two were Shagya, one Anglo-Arab and one was of crossbreed. Race "B" was held in Ruse near the Racecourse on 30.09.2023. The altitude differential of the competition site was 200 m. During the competition day, the average daily temperature was 20°C and the humidity was 35% on average. Race "B" had 13 entries, 9 of which were completed successfully and 4 were eliminated. Six of the horses were of pure Arabian breed, four were Shagya, one was Anglo-Arab and two were crossbreeds. The horses competing in race "B" were aged between 6 and 15; four were male and nine were female. During both races, prior to the beginning of competition, food and water were offered to the animals and water was available throughout all stages of the endurance test.

Examination and data collection

The information about the heart rate of the horses was collected from the veterinary cards. A vet completed each veterinary card after each loop of the competition. Pulse was measured using a stethoscope placed on the left side of horse's chest at the elbow level. The pulse was measured for 15 s interval and then multiplied by 4. The average speed over a loop was calculated by dividing the length of the loop by the time taken to complete the loop. The information was provided by BEF for race "A" and accessed through T-Track System for race "B".

Statistical analysis

Statistical data processing was performed using IBM SPSS Statistics, version 26. Means and standard deviations were computed performing a Paired-Samples T-test. Values were considered statistically significant at $p<0.05$.

Results and Discussion

The heart rate during the 100 km test in the horses that successfully finished race "A" increased from 46.00±9.38 bpm before the start to 60.66±2.73 bpm after the finish, and during the individual stages, the horses managed to maintain a heart rate of 61.66 bpm. In the eliminated horses, the heart rate before the start of the competition had an average value of 40.00±11.31 bpm and after the final 74.00±19.79 bpm. The average speed of movement during the various stages in the successfully completed horses was approximately the same as that in the eliminated ones, whereas in the second group a slightly lower speed was established during the first stage of the course, an average of 13.52±1.01 km/h. In the first group, the average movement speed during the first stage was 14.23±0.98 km/h (Table 1).

During race "B", horses that successfully qualified had a pre-race heart rate of 42.44±3.57 bpm, as during the stages they managed to maintain mean values of 58.55±2.40 and 59.88±2.14 bpm. After finishing the final loop, the mean heart rate was 58.22±2.86 bpm. For the horses that failed to finish the competition, the pulse varied between 41.50±7.18 bpm pre-race and 63.00±7.0 bpm after L3, when three of the horses were eliminated. The speed of horses that finished the race successfully was 15.01±0.43 km/h during the first loop of the race and 13.60±1.16 km/h after completion of the final loop of the competition. Horses that failed to qualify in the competition moved with a higher speed during the

Table 1. Mean values of heart rate and speed of endurance horses competing in the 100-km race (Data for race "A")

Parameter	Successfully qualified horses (n = 6)		Eliminated horses (n = 4)	
	Heart rate (bpm)	Speed (km/h)	Heart rate (bpm)	Speed (km/h)
Pre-race (mean ±SD)	46.00±9.38		40.00±11.31	
L1-39.80 km (mean ±SD)	61.66±1.96	14.23±0.98	63.00±1.41	13.52±1.01
L2-39.80 km (mean ±SD)	61.66±2.65	13.78±0.81	62.00±2.82	13.0±1.25
L3-21.90 km (mean ±SD)	60.66±2.73	12.82±1.07	74.00±19.79	12.96±0.70

The stages of the competition are presented as L1, first loop; L2, second loop; L3, final loop with distance length. Total course distance: 101.50 km.

Table 2. Mean values of heart rate and speed of endurance horses competing in the 100-km race (Data for race "B")

Parameter	Successfully qualified horses (n = 9)		Eliminated horses (n = 4)	
	Heart rate (bpm)	Speed (km/h)	Heart rate (bpm)	Speed (km/h)
Pre-race (mean ±SD)	42.44±3.57		41.50±7.18	
L1-38.0 km (mean ±SD)	59.88±1.76	15.01±0.43	60.00±2.58	15.77±1.21
L2-22.0 km (mean ±SD)	58.55±2.40	14.45±0.82	57.50±1.89	15.16±0.75
L3-22.0 km (mean ±SD)	59.88±2.14	13.82±0.43	63.00±7.0	14.78±2.61
L4-22.0 km (mean ±SD)	58.22±2.86	13.60±1.16	NA	NA

The stages of the competition are presented as L1, first loop; L2, second loop; L3, third loop; L4, final loop with distance length. Total course distance: 104 km

stages: after L1, the mean speed was 15.77±1.21 km/h and after L3, it was 14.78±2.61 km/h. The higher heart rate of the horses that failed to complete the race corresponds to the higher speed that the horses maintained during the stages of the competition (Table 2).

Horses competing at distances between 106 and 132 km were reported mean heart rate prerace 36.9±2.1 bpm and after finish 50.2±2.0 bpm (Amory et al., 2010). These values are lower than those obtained in the recent study of horses competing in Bulgaria. At a 160-km race, the mean heart rate value after L2 (66 km) was 60.3±4.4 after L3 (98 km) 59.1±3.6 and after finish 57.7±3.9 for successful horses and 59.1±4.0; 60.6±7.9; 60.7±9.0 respectively for eliminated horses (Schott II et al., 2006). In Malaysia, horses performing at a distance of 80 km were reported to have mean heart rate values of 37±4 bpm pre-ride and 56±7 bpm post-ride for successful horses and 45±6 bpm pre-ride and 78±7 bpm for horses with poor performance (Lawan et al., 2012). Similar results were observed for horses competing in the 100-km race in Bulgaria. Horses competing at a distance ranging from 25 to 100 miles in the US were reported to have a mean heart rate at the pre-ride examination of 43±7 bpm and during the second half of the ride 55±17 bpm (Fielding et al., 2011).

Regarding speed, the mean values obtained in our study were lower than most of the mean winning speeds reported at distances of 100-120 km (Nagy et al., 2010). In different countries, authors report mean speed of 14.1±2.7 and 24.8±27 km/h. In the United Kingdom, the mean speed value for successfully finished 160-km race horses was reported to be 15.2±1.5 km/h with variation between 13.2 and 17.8 km/h (Schott II et al., 2006). In France and Belgium, endurance races with a mean distance of 124.9 km were estimated to have a mean speed of 16.3±1.3 km/h, ranging from 14.6-18.5 km/h (Amory et al., 2010). Again, a higher speed was reported in horses performing at a distance of 120 km compared with the results of the recent study. Successfully completed horses had an average speed throughout the stages of the competition close to 15km/h (14.82±0.73 to 15.66±1.48 km/h), and the heart rate varied from 52±1 bpm to 57±2 bpm (Adamu et al., 2012), which is in fact lower than our result. This clearly indicates that horses performing in endurance races in Bulgaria have a higher heart rate during the 100-km ride, running at an average lower speed.

Conclusions

The heart rate of the successfully qualified horses during race "A" ranged between 46.00±9.38 bpm pre-race and 60.66±2.73 bpm during the last loop. For race "B" horses that completed the race had mean values for pre-ride pulse 42.44±3.57 bpm and after finishing the last loop, the heart rate was 58.22±2.86 bpm. The heart rate of the eliminated horses in both races increased continually during the races. The speed that the failed to qualify horses maintained during the stages of the race was higher than that of the successfully completed horses in race "B".

In conclusion, we can state that heart rate is an easily accessible and reliable parameter that can designate the performance of horses in endurance races.

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