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History of horse whims, teamboats, treadwheels, and equine treadmills

HOWARD H. ERICKSON
Dept of Anatomy and Physiology, College of Veterinary Medicine, Kansas State University, USA.

Horse-whim mechanisms were first used to turn rotary mills in Greece in 300 B.C.. Roman engineers developed the capstan machinery to propel boats with paddle wheels such as the Liburna around 370 A.D.. About 1680, Rupert, prince palatine of the Rhine and cousin of England’s King Charles II, designed and built the first horseboat using a horse-whim mechanism, powered by horses and capable of towing the largest ships in the Royal Navy. In the 1800s, people in America called the vessels “teamboats,” because of their close relationship to steamboats. By 1819, 8-12 horse-propelled boats churned between Manhattan and points across the Hudson and East Rivers. Although teamboats were cheaper than steamboats, they had disadvantages: the circular walkways took up a lot of deck space and the horses had to walk in small circles. In 1819, Landgon invented the treadwheel-propelled horseboat which placed the rotating turntable below the boat’s deck; horses stood on top of the turntable through large slots in the deck and drove the wheel backward by walking in place. This design eased the burden on the horses, freed up valuable deck space, and allowed the ferry to be built on one hull. Horseboats with horizontal treadwheels were cheap and reliable and became the common type of horseboat in many locations in New England and the Mid-Atlantic until the 1850s. In the 1830s, horse-powered inclined treadmills were developed and were used with various attachments to saw wood, churn butter, pump water, and thresh grain. Treadmills revolutionized the design of horse ferries or teamboats. In 1890, Zuntz and Lehmann reported on the chemistry of respiration in the horse at rest and during exercise using a revolving platform. In the 1930s, Brody used a treadmill to study energy metabolism of the horse and in the early 1960s Persson was the first to use a high-speed treadmill to study the physiology of exercise in the horse.
Effect of conditioning horses 1, 2, 3 x a week with 2 intervals of 100 m at near maximal speed on biochemical variables in the blood

ARNO LINDNER*, RAUL SIGNORINI†, LUCIANA BRERO†, EDUARDO ARN‡, RUBEN MANCINI† AND ALEJANDRO ENRIQUE†
* Arbeitsgruppe Pferd, Essen, Germany, † Facultad de Veterinaria, Universidad del Litoral, Esperanza, Argentine, ‡ Liceo Militar General Belgrano, Ejército Argentino, Santa Fé, Argentine.

Introduction

Intensive and short intervals are used to condition horses for racing. No literature on the effect of this type of exercise was found. This study examines the effect of conditioning horses 1, 2 or 3 x a wk with exercise at near maximal speed over 2 gallops of 100 m on blood [LA], and plasma [NH3] and [urea].

Material and methods

Fourteen 4-5-yr-old THB were conditioned on a dirt track for a 6 wk period 1 (n = 5), 2 (n = 5) or 3 (n = 4) x wk with 2 gallops at near maximal speed over 100 m. Before, during (every 2 wk) and after the conditioning period blood was drawn at 0, 2 and 4 min after each gallop to measure blood [LA] and to determine the maximal [LA] post-exercise [LAmax]. Plasma [NH3] was also measured and the maximal [NH3] post-exercise [NH3max] was determined.

Results

Conditioning did not have an effect on [LAmax] and [LA] immediately after ([LA0] in the 1st gallop of exercise (P > 0.05), but [LA0] after the 2nd gallop was lower after conditioning (7.6 ± 2.4 vs. 6.7 ± 1.3 mmol/L; P < 0.05). [NH3max] after the 1st and 2nd gallop decreased due to conditioning (186 ± 88 vs. 119 ± 40 µmol and 272 ± 164 vs. 166 ± 73 µmol for the 1st and 2nd gallop resp. at the beginning vs end of conditioning; P < 0.05), but not on the [NH3] immediately after exercise (P > 0.05). None of the variables measured differed significantly between conditioning protocols.

Conclusion

Conditioning horses with two gallops over 100 m at near maximal speed had a significant effect on energy metabolism. Frequency of exercise did not matter.
Thoroughbred racehorse training using objective indices of speed and work rate

J.R.J. NAYLOR*, L.A. KIDSON*, S.H. FRANKLIN* AND JOEL JIM†
* Cleeve Stables, Elston, Wiltshire, UK.
† Equine Sports Medicine Centre, Department of Anatomy, University of Bristol, Langford, Bristol, UK.

Introduction

Most racehorses are trained empirically. While the quality and quantity of exercise in training profoundly influence racing performance, conventional training methods do not utilise objective indices of work. Technological advances may allow work rates to be established objectively and efficacy of training to be assessed more accurately. Aim: to quantify work performed during training using on-board speed monitoring and objective measurement of work effort (heart rate (HR) and plasma lactate concentration (LA)).

Material and methods

The responses of 7 Thoroughbred racehorses were evaluated during interval training on turf and wood-chip all-weather tracks for 20 weeks. Running speeds were set and speed and distance measured using a global positioning system (GPS) worn by the rider. HR was measured throughout exercise and jugular vein LA was measured after each interval.

Results

The horses were exercised in intervals over total distances of 1.5-3.5 miles. Speeds ranged from 18-36 miles/h, peak HR from 200-227 beats/min and peak LA from 14.3-31.7 mmol/L. Intra-horse repeatability in peak HR, V200 and Vla4 was high, with coefficients of variation from 0.36-12.77%. V200 and Vla4 tended to be higher on wood-chip than on grass.

Conclusion

In commercial racehorse training, running speed can be established and measured using GPS and simultaneously, work rate can be quantified accurately using HR and LA measurements. These methods will have numerous applications including comparing work rates during training vs competition, assessing the suitability of training regimes in different locations/terrains and using different surfaces, and measuring progress of training in individual horses.
The workload of horses during jumping

M.M. SLOET VAN OLDRUITENBORGH-OOSTERBAAN, A.J. SPIERENBURG AND E.T.W. VAN DEN BROEK
Department of Equine Sciences, Faculty of Veterinary Medicine, Utrecht University, The Netherlands.

Introduction
The aim of this study was to compare the workload of horses during jumping a course of fences with that of cantering the same course without fences at the same average speed. The workload variables included heart rate, packed cell volume, venous pH and pCO2, and blood lactate, potassium and glucose concentrations.

Material and methods
Six healthy riding-school horses performed test I (a course of approximately 700 m with 12 jumps at an average speed of approximately 350 m/min) and test II (same course at the same speed, but without the rails) in an at random order with at least 4 hours in between the two tests. The horses were equipped with a heart rate meter (Polar Electro®). Blood samples were taken from the jugular vein at rest, after a warming-up, immediately after the canter (peak), and after recovery. All samples were immediately analysed. All results (mean ± standard deviation) were subjected to a Student-t test (P < 0.05).

Results
The mean heart rates (beats/min) at peak exercise (189 ± 15 and 160 ± 22 resp.) and the mean heart rates after recovery (80 ± 7 and 69 ± 6 resp.) were significantly higher in test I compared to test II. Peak blood lactate concentrations (mmol/L) were also significantly higher in test I (4.2 ± 2.8) compared to test II (1.0 ± 0.6). The mean pH after peak exercise was significantly lower in test I (7.39 ± 0.04) compared to test II (7.44 ± 0.03). The packed cell volume concentrations (L/L) at recovery were significantly higher in test I (0.39 ± 0.02) compared to test II (0.36 ± 0.02). No other statistically significant differences were found.

Conclusion
This study indicates that jumping fences, even at a low level competition, provokes a significant anaerobic workload compared to cantering the same distance and speed without fences.
Heart rates of horses competing at three levels of competitive dressage

RICHARD GEERING*, DEBORAH FIELDING, LYNNE CLARKE, THEA CUFF† AND DAVID MARLIN†
*Imperial College, London, UK,
†Animal Health Trust, Newmarket, Suffolk, UK.

Introduction

Despite Dressage being a major international equestrian discipline, a search of the literature reveals a paucity of information, especially with regards to its metabolic demand and physiological stress. The aim of the present study was to determine the pattern of heart rate (HR) changes in Dressage, whether the average HR increases with test difficulty and which movements produced the highest HR.

Material and methods

Eighteen horses in affiliated British Dressage competitions at 3 levels at the same venue were studied: Elementary (E), Medium (M) and Prix St George (PSG). HR during competition were recorded and the HR was synchronised with a video camera with a time display facility. The entire dressage test was recorded and the marks awarded obtained. An average HR was calculated for each movement corresponding to the times obtained from the video recordings.

Results

Mean HR during PSG (112 ± 12 bpm) was significantly higher than during E (103 ± 14 bpm; \( P = 0.0019 \)) but neither were different from M (105 ± 11 bpm). The pattern of HR changes were similar for all three levels, although there was less variation between horses performing at PSG. The movements resulting in the highest mean HR were 10m circle in collected canter (122 ± 4 b.p.m.), transition from collected trot to collected canter (121 ± 8 b.p.m.) and transition from extended canter to collected canter followed by a flying change (127 ± 5 b.p.m.) for E, M and PSG, respectively.

Conclusion

As far as we are aware, this is the first detailed report of the HR of horses performing competitive dressage. We have demonstrated that reliable HR measurements can be obtained from horses during dressage competition and that whilst there is a similar pattern of HR changes over time, the higher level of PSG is associated with higher mean HR.
Early criteria for the selection of jumping horses

BERTRAND LANGLOIS, CHRISTINE BLOUIN AND ERIC BARREY
INRA-CRJ-SGQA, Jouy-en-Josas, France.
INRA, LEPHE, Génopole Evry, France

Introduction

The aim of this study was to evaluate whether early measurements of morphology and gaits can be used to predict jumping performance.

Material and methods

Several hundred 3-year-old French saddle horses participating in breeding events from 1998 to 2000 were tested for morphology and gaits. Their performance records in jumping were collected since 2003. The Equimétrix gait analysis system provided 74 variables (10 for walking, 10 for trotting, 18 for free jumping and 36 for conformation), collected in 433 horses for conformation, 255 for walking, 261 for trotting and 339 for free jumping. We report here only a discriminant analysis of 125 horses measured for the 74 variables. Three categories were made according to the jumping competition results: (a) those horses having no earnings (b) those belonging to the 50% lower earnings and (c) those having 50% higher earnings.

Results

The three categories could be discriminated with less than 3% of mistakes when using all the information on the 74 variables. The first axis allowed isolating the (c) horses and the second axis allowed separating (a) and (b) horses. However, this result must not be over-weighted. The same analysis, on a stepwise mode, when introducing only significant variables led to a mean canonical R² of 0.36 only, instead of 0.94 in the first case. For the 14 significant variables then retained, only five concerned conformation. The other variables concerned gaits (7) and free jumping (3).

Conclusion

For French saddle horses, predicting jumping ability in competition only by a conformation exam is illusory. The accuracy increases by measuring gaits and free jumping. However, even if the current examination could be improved, its accuracy remains low. Therefore, we do not think that it could replace the test of jumping aptitude in competition whose organization has to be preserved when it exists or organized when it does not exist.
Body composition in young Standardbreds in training: relationships to body condition score, physiological and locomotor variables during exercise

C. LELEU AND C. COTREL
Pegase Mayenne, Laval, France.

Introduction

Body composition is an essential factor in athletic performance of human sprinters and long distance runners. However, in athletic horses, many questions remain concerning the relationships between body composition and performance in the different equine activities. This study explores the relationships between body composition, body score, physiological and locomotor variables in a population of young Standardbreds in training.

Material and methods

The population studied was composed of twenty-four 2 year-old Standardbreds. Their body condition was noted on a scale from 0 to 5 and their body weight and height at wither were measured. Percentage of fat (% F), fat mass (FM) and fat free mass (FFM) were also estimated by an ultrasound technique. During a standardized exercise test, velocity, heart rate, respiratory frequency and blood lactate concentration were measured. V4 and V200 (velocity for a blood lactate concentration of 4 mmol/L and velocity of 200 bpm) were calculated. Basic gait variables were measured at four different speeds with an accelerometric device. Analysis of variance and a correlation matrix were calculated to study the relationships between body composition, body score, physiological and gait variables.

Results

Body composition variables: % F and FM were significantly related to body condition score and physiological variables. Body score was found highly correlated to % F (r = 0.64) and FM (r = 0.71). V4 was negatively correlated to % F (r = -0.59) and FM (r = -0.60), P < 0.05. V200 was also negatively related to %F and FM, (r = - 0.39 and r = - 0.37, respectively, P < 0.1). No relationships were found between body composition and gait characteristics.

Conclusion

The results show that body composition in race horses is closely related to indirect measurements of aerobic capacity and thus to athletic performance in middle distance running horses.
Effect of conditioning horses with exercises at v10

FEDERICO BOFFI*, ARNO LINDNER*, RAMÓN LOPEZ†, ROQUE MIRANDA† AND EDUARDO DESMARÁS†
* Arbeitsgruppe Pferd, Essen, Germany,
† Centro de Fisiología y Fisiopatología del Equino Deportivo, Facultad de Ciencias Veterinarias, Universidad Nacional de La Plata, Buenos Aires, Argentina.

Introduction

The effect of exercises for which the speed is derived from the blood lactate-running speed (blrs) relation on performance parameters of horses has been published, but until now only speeds inducing SET blood lactate concentrations up to 4 mmol/L have been examined (v4). This study examined the effect of exercising horses at their v10 on v4.

Material and methods

Eleven Aas and THBs were conditioned during 6 wk on a treadmill. A SET was performed at the beginning on each horse to determine its blrs relation and repeated every 2 wk. From the blrs curve, the horse’s speed at which [LA] reached 10 (v10) and 4 mmol/L (v4) was calculated. Each horse was then conditioned for the next 2 wk at its individual v10 for 2 x 5 min with a 5 min rest in between. Six horses were exercised 3 x wk and 5 horses 2 x wk. Exercise speed was individually adapted to the new v10 every 2 wk.

Results

In horses exercised 3 x wk v4 decreased after the first 2 wk (from 6.23 ± 0.41 m/s to 5.95 ± 0.33 m/s, mean ± SD; P < 0.05), increased in the following 2 wk (to 6.33 ± 0.58 m/s; P < 0.01), and stayed constant thereafter (6.34 ± 0.53 m/s; P > 0.05). In horses exercised 2 x wk v4 increased steadily (from 5.54 ± 0.47 m/s to 6.3 ± 0.55 m/s; P < 0.05).

Conclusion

Exercising horses 2 x wk for 2 x 5 min at their v10 improved their v4 while exercising them 3 x wk did not. This study shows the importance of considering the frequency of exercise also when searching for better conditioning programs.
Optimal active recovery intensity in Standardbreds after submaximal work

S. DAHL, C. COTREL AND C. LELEU
Pegase Mayenne, Laval, France.

Introduction

A retrospective study concerning spontaneous active recovery intensity after a submaximal exercise in trotters showed that the mean intensity demanded by trainers corresponds to 50-55 % max HR (maximal heart rate). However, in human athletes, optimal active recovery intensity was found to be 60-75 % of max HR. Is the spontaneous recovery optimal after a submaximal exercise in trotters? The aim of this study was to compare different recovery intensities and define the most efficient one.

Material and methods

Thirty-seven trotters performed a standardized exercise test on the track. The horses were randomly divided into 4 groups of recovery: passive recovery (n = 10), 10 mn walk recovery (n = 10, speed = 6 km/h), 10 mn slow trot recovery (n = 9, speed = 15 km/h) and 10 mn fast trot recovery (n = 8, speed = 25 km/h). Before, during and one hour after exercise, speed, heart rate, and blood lactate concentration were measured as well as respiratory frequency and body temperature. CK were measured 1, 3 and 5 hours after exercise. An analysis of variance was calculated to compare recovery variables in the four groups.

Results

Most physiological variables were influenced by the intensity of recovery. Walk, slow trot and fast trot recovery corresponded respectively to 45–50 %, 55-60% and 65-70 % of max HR. Heart rate, respiratory frequency, body temperature and lactate concentration were significantly lower with increasing intensity of recovery. CK kinetic was not influenced by the type of recovery.

Conclusion

The most efficient intensity of recovery was the 10 mn fast trot recovery (65-70 % max HR) since this type of recovery maintains a high muscle perfusion and thus a better lactate clearance. Considering the usual habits of trainers or drivers, recovery intensity after trot races should be increased in intensity to optimize its efficiency.
Use of a global positioning and heart rate monitoring system to assess training load in a group of thoroughbred racehorses

JANENE K. KINGSTON, GEORGETTE SOPPET, CHRIS W. ROGERS AND ELWYN C. FIRTH
Institute of Veterinary, Animal and Biomedical Sciences, Massey University, Palmerston North, New Zealand.

Introduction

Training is an important variable for determining athletic success. Nonetheless, there has been minimal scientific evaluation of racehorse-training programmes. Training of racehorses focuses on running the horses at certain speeds by using a combination of a stopwatch and rider’s “feel” for a horse’s work intensity. Consequently, actual work intensity for individual horses is not clearly defined.

The aims of the present study were 1) to utilise a combined global positioning system (GPS) and heart rate monitor system to quantify training intensity and physiological responses of a group of racehorses undergoing training and racing; and 2) to compare the workload measured by the GPS to that timed and recorded daily by a racehorse trainer.

Material and methods

Nineteen 3-year-old racehorses were followed through a traditional training and racing programme over a 4 month period. Daily GPS and heart rate data together with the trainer’s timing and distance data were collected while the horses were trained. Data were analysed using an ANOVA for repeated measures.

Results

The combined GPS/heart rate monitoring system detected different heart rate responses in individual horses subjected to the same training workouts. The average speeds detected with the GPS system were in agreement with average speeds timed by the trainer. However, the peak speeds reached during training were significantly greater ($P < 0.05$) than those estimated with stopwatch timing, particularly during gallop sessions. The horses showed a greater tendency towards acceleration versus steady state speeds during their workouts as training progressed.

Conclusion

The results from this study show that a GPS/heart rate monitor system provides a reliable measure of daily workload in horses during training. This technology provides a detailed picture of horses’ training sessions and has the potential to provide greater insight into the types of training that may predispose horses to injury.
Heart rate responses during acclimation of horses to water treadmill exercise

K.J. NANKERVIS AND R.J. WILLIAMS
Equine Veterinary and Therapy Centre, Hartpury College, UK.

Introduction

The use of water treadmill exercise in horses has become increasingly popular in recent years, with a number of studies referring to its use (Tokuriki et al. 1999, Voss et al. 2002). No information exists regarding the time taken to acclimate to water treadmill exercise although such information does exist for acclimation to high-speed treadmill exercise for both physiological and biomechanical parameters (King et al. 1995; Buchner et al. 1994). The aim of this study was to determine the heart rate responses during acclimation with and without sedation on first time exposure.

Material and methods

Twelve horses (mean age 9 ± 3.2 years) were randomly assigned to Group A (sedated) and Group B (non-sedated). Group A was given an appropriate i.v. dose of Romifidine according to bodyweight within 10-15 minutes of the start of the first acclimating run. All horses were exercised on a water treadmill at the walk for 15 minutes once a day for 4 days. Acclimation was determined by the time taken to reach a threshold heart rate value according to the method used by Buchner et al. 1994.

Results

Horses in Group A and B reached threshold heart rate values by the 6th minute of the fourth run, and the 6th minute of the third run respectively. A significant difference (15 minutes) was found (Mann-Whitney U Test, P = 0.034) between Groups A and B in the time taken to reach threshold heart rate values.

Conclusion

Acclimation to water treadmill exercise in non-sedated horses requires a minimum of 2 x 15 minute acclimating runs. Sedation can be used to minimise the risk of injury during the first run, extending the time taken to reach the threshold by the equivalent of the total sedated run time.
Measurements of fitness in Thoroughbred racehorses using field studies of
heart rate and velocity

A.D. VERMEULEN* AND D.L. EVANS†
* Nature Vet, PO Box 147, Glenorie, Australia,
† Faculty of Veterinary Science, University of Sydney, Australia.

Introduction

The aim of this study was to investigate measurements of fitness in the field without using multiple, standardised steps of increasing velocity in the exercise test. The reliability of measurements of fitness in a commercial Thoroughbred training establishment was investigated, and the effect of commercial exercise training was investigated.

Material and methods.

Twelve healthy 3 to 5-year-old Thoroughbreds were used in the study of reliability, and twelve 2-year-old Thoroughbreds were used in the investigation of the effect of training. Five second averages of velocity and heart rate (HR) were recorded during a typical fast exercise training session, using a global positioning system (GPS) and Polar HR monitor. A standardised exercise test protocol was not used. Regression analyses using trot and gallop data were used to calculate velocities at HR of 200 bpm (V200), and at maximal HR (VHRmax). Data were collected on consecutive ‘fast’ day training sessions to assess the reliability of measurements. The effect of training was investigated with fitness tests in weeks 2 and 6 of ‘fast’ training. Absolute and relative differences were calculated to evaluate reliability, and paired t tests were used to detect an effect of training.

Results

VHRmax, V200 and HRmax were reliable measurements of fitness, with mean differences of 2 % or less. Reliability of VHRmax was not dependent on the VHRmax value. VHRmax and V200 increased significantly with training (P < 0.01), but there was no effect of training on HRmax. There were no significant changes in the slope or intercept of the regression equations after training.

Conclusion

Velocity and HR measurements during field gallop exercise provided reliable measurements of fitness that can be used to monitor adaptations to training without reliance on a multiple step, standardised exercise test protocol.
Heart rate analysis in Standardbreds during early overtraining

E. SMIET*, E. DE GRAAF-ROELFSEMA*, E. VAN BREDAM†, I.D. WIJNBERG*, H.A. KEIZER† AND J.H. VAN DER KOLK*

* Department of Equine Sciences, Medicine Section, Faculty of Veterinary Medicine, Utrecht University, Utrecht, The Netherlands,
† Department of Movement Sciences, Faculty of Health Sciences, Maastricht University, Maastricht, The Netherlands.

Introduction

Twelve Standardbred geldings aged around 1.5 years were selected for a longitudinal study of experimentally induced overtraining to assess possible differences in heart rate (HR).

Material and methods

Training was divided into four phases: 1) acclimatisation to exercise on the treadmill for 4 weeks; 2) training period for 18 weeks with alternating both endurance (~ 60% HRmax) and intensity training (~ 80% HRmax); 3) increased training volume and intensity for 6 weeks, and 4) detraining for 4 weeks (~60% HRmax). In phase 3, the horses were randomly divided into 2 groups: control and overtraining. Training of control horses always consisted of exercise 4 days/week, whereas the overtrained horses were exercised 6 days/week during the first three weeks of phase 3, and 7 days/week with increasing volume and intensity during the last three weeks. At the end of each phase, a standardised exercise test (SET) was performed at ~ 80% HRmax (equivalent to 8-8.5 m/s and 1-2.5% incline) for 20 minutes. HR was monitored using a Polar S610i during SET and analysed using approximate entropy (ApEn) statistics and linear regression analysis. The differences between groups were calculated employing the Huynh-Feldt test for repeated measures analysis. P values < 0.05 were considered significant.

Results

Complete data were obtained from six horses yet. Over-trained horses were unable to finish the third standardised exercise test with normal handling in contrast with the control horses. Mean HR during SET 3 was significantly (P = 0.002) lower in over-trained horses compared with controls (194 ± 4.4 (sd) versus 181 ± 4.8 beats/min, respectively). Over-trained horses also showed decreased rectal temperatures post exercise. Both fast and slow recovery patterns assessed by linear regression, were non-significantly different between the control and over-trained groups following SET 3.

Conclusion

Our preliminary results suggest early over-training to be parasympathetic in Standardbreds.
Correlation of race earnings with velocity at maximal heart rate during a field exercise test in Thoroughbred racehorses

H.L. GRAMKOW AND D.L. EVANS
Faculty of Veterinary Science, University of Sydney, Australia.

Introduction
The running ability of Thoroughbred racehorses is correlated with maximal oxygen uptake, and the velocity at maximal oxygen uptake is highly correlated with the velocity at maximal heart rate (VHRmax). The aim of this study was to investigate the relationship between VHRmax and racing performance, expressed as “peak dollars earned per race start”.

Material and methods
Heart rate (HR) and velocity were recorded in 25 Thoroughbred racehorses during trotting and subsequent fast gallops in the field at velocities of 15-16 m.s⁻¹. Velocity was recorded by an “on board” global positioning system (GPS). Maximal HR (HRmax) and maximal velocity (Vmax) were identified, and a linear regression of HR on velocity for trotting and galloping data was constructed to derive VHRmax. The horses following the training program designed by one trainer, had at least 6 race starts and were clinically sound at the time of testing. Race earnings were expressed as the peak dollars per start in the horse’s racing career. Data were normalized using the results for the square root of “peak dollars earned per race start” and the significance of associations between variables was determined by correlation coefficient and least squares analyses.

Results
Horses with higher VHRmax earned significantly more dollars per race start \( r = 0.41, P < 0.05 \), and horses with VHRmax less than 14.5 ms⁻¹ did not earn more than A$ 2,500 per race. There were no correlations between race earnings and either HRmax or Vmax.

Conclusion
Field studies of the relationship between HR and velocity with a GPS enable the identification of horses with limited earnings potential.

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A comparison of the physiological responses to simulated race tests on track and treadmill in Standardbred trotters

K NOSTELL, P. FUNKQUIST, G. NYMAN, B. ESSÉN-GUSTAVSSON, M. CONNYSSON, S. MUHONEN AND A. JANSSON
Swedish University of Agricultural Sciences, SLU, Dept. of Clinical Sciences, Sweden.

Introduction

Few studies have been performed to compare the physiological response to treadmill and track exercise in Standardbred race horses. The aim of the present study was to evaluate if a simulated race performed on a treadmill approximates to a simulated race performed on a track.

Material and methods

Five Standardbred trotters in racing condition, age 7-10 years, performed standardised simulated race tests on an inclined treadmill (TM) and on a field track (FT). The FT test included a 500 m finish at maximal speed. All horses were fed a controlled diet. Haemoglobin (Hb), packed cell volume (PCV), pH and glucose in venous blood, plasma lactate, heart rate and respiratory rate were measured before and immediately after exercise and at 15, 30 and 60 min of recovery.

Results

Maximal heart rate did not differ between the tests (FT; 214 ± 8 vs. TM; 219 ± 10 beats/min) but plasma lactate concentration was higher (22 ± 5 mmol/L vs. 18 ± 5 mmol/L) and blood pH lower (7.24 ± 0.07 vs. 7.30 ± 0.06) at the end of exercise in the FT compared to the TM. During the recovery period, the decrease in plasma lactate was slower after the FT compared to the TM and plasma lactate was still elevated 1 hour after the FT compared to pre-race concentrations. Blood pH was lower until 15 min after the FT compared to the TM. No differences were observed in respiratory rate, Hb, PCV and glucose between the tests.

Conclusion

The physiological response to the treadmill test, assessed from heart rate, Hb and PCV, mimics the response observed in the test performed on the track, but the differences observed in plasma lactate and blood pH indicates that the workloads are not completely comparable.
The measurement of work load in a population of Thoroughbred foals

Massey Equine, Institute of Veterinary, Animal and Biomedical Sciences, Massey University, Private Bag 11 222, Palmerston North New Zealand.

Introduction

The measurement of workload in a population of Thoroughbred foals Musculoskeletal tissue responds to training stimulus, but quantifying the exercise stimulus has always been difficult. The comparison of workload and tissue response between studies has thus remained extremely limited. The product of velocity and distance covered at that velocity (range) has been suggested as a first attempt to derive a cumulative workload index (CWI).

Material and methods

The data consisted of 80 weeks of training records for seventeen thoroughbred horses. The training programme consisted of 2 laps of a 515m track. Base velocity averaged 5.36 ± 0.89 m/s in phase A, 7.52 ± 1.75 m/s in phase B and 9.62 ± 0.71 m/s in phase C. Average sprint velocity was 12.52 ± 3.39 m/s in phase C. There were significant differences in the daily CWI between the phases (P < 0.05). The increase in mean base velocity between phases A and B was in the order of 40% and the increase in daily CWI was 6% (5516 ± 917 vs. 7748 ± 1804). Phase C mean base velocity was 27.9% greater than in Phase B, and the total daily CWI increased by 81.9% (10320 ±755) primarily due to the introduction of the 240m sprint exercise. Between-horse comparison of CWI of individual horses showed 0.6% variation in CWI in phase A, 23.3% in phase B, and 7.9% in phase C base and phase C sprint 27.1% variation.

Conclusion

The CWI provides a method to quantify the workload of horses and compare training load between horses, sessions, days, weeks, or phases of a competition/racing programme. It also allows at least some quantifiable comparison between different studies.
Racing speeds of quarter horses, Thoroughbreds and Arabians while the quarter

B.D. NIELSEN, K.K. TURNER, B. VENTURA, A.D. WOODWARD AND C.I. O’CONNOR.
Michigan State University, Michigan, USA.

Introduction

Horse is recognized as the fastest breed of horse, direct comparisons from race times with other breeds can be misleading. Quarter Horse races begin when the starting gates open. Thoroughbred and Arabian races begin a short distance from the gates after the horses have started running. This study compared the speeds of these breeds as they accelerate from the starting gates and also during the middle and end of the races.

Material and methods

Video tapes of races were obtained from a local track. The various race segments were viewed and timed by 5 individuals. The fastest and slowest times were removed and the 3 remaining times averaged. The times were recorded at each point for the horse that won the race and the leader at that portion of the race.

Results

Quarter Horses averaged faster speeds than Thoroughbreds ($P < 0.0001$) even when Thoroughbreds were raced at a distance (402 m) similar to Quarter Horse races. Both breeds were substantially faster than Arabians ($P < 0.0001$). Quarter Horses accelerated the fastest from the gates and Arabians the slowest ($P < 0.0001$). Quarter Horses racing 320 m and Thoroughbreds racing 402 m reached peak speeds in the final 100 m with Quarter Horses averaging 21.5 ± 0.5 m/sec and Thoroughbreds 19.9 ± 1.1 m/sec. Arabians racing 1,006 m were the fastest during the middle of the race (15.1 ± 0.1 m/sec) and slowed by the end of the race ($P < 0.0001$).

Conclusion

Despite similar race times reported for 402 m, Quarter Horses averaged faster speeds than Thoroughbreds when timed from a standing start. In short races, both breeds accelerate throughout the race. Arabians, despite being known for endurance, had slowed by the end of the race, suggesting that a slower, more consistent, pace throughout the race may be more efficient and result in a faster overall race time.
A comparison of cross-country recovery rates at CCI 2* with and without steeplechase competitions.

E.R. SINGER*, J.K. MURRAY† AND J.M. SENIOR* *
* University of Liverpool, UK,
† University of Bristol, UK.

Introduction

The study was performed to investigate anecdotal reports that horses completing the cross-country phase of short format (without steeplechase) three-day events tired more quickly compared with horses completing the cross-country phase of long format (with steeplechase) three-day events. The aim of the study was to compare the physiological and haematological parameters of horses that had completed the cross-country phase of CCI 2* short format (SF) and long format (LF) competitions.

Material and methods

Physiological and haematological parameters were compared between 53 horses that had completed the cross-country phase of a LF (phases A, B, C and D) and 56 horses that had completed a SF (phase D only) CCI 2* competition. Phase D (the cross-country course) was identical for both competitions. Training schedules, age and previous competition experience were not significantly different between horses competing in the SF and LF competitions.

Results

On completion of phase D, SF horses had significantly higher ($P < 0.001$) packed cell volume (64%) and significantly lower ($P = 0.001$) ionised calcium concentrations (1.40 mmol/L) when compared with LF horses (59% and 1.45 mmol/L, respectively). LF horses had significantly higher heart rates than SF horses 10 minutes prior to starting phase D ($P < 0.001$) and immediately after completing phase D ($P = 0.04$); however, no other significant differences were found between the two groups of horses ($P > 0.05$).

Conclusion

The results of this study provide only weak evidence to support the hypothesis that the workload for the horse in a SF CCI 2* competition is significantly different when compared to the LF CCI 2* competition. Further research is required to determine if these findings are consistent at CCI 3* and CCI 4* level competitions.
Standardised structural behavioural observations: a tool to predict early overtraining?

M.C. VANDIERENDONCK*,†, A. MAASKANT†, E. DE GRAAF-ROELFSEMA†, E. VAN BREDAB‡, I.D. WIJNBERG†, H.A. KEIZER† AND J.H. VAN DER KOLK†

* Ethology and Welfare, Veterinary Faculty, University of Utrecht; The Netherlands,
† Equine Sciences Veterinary Faculty, University of Utrecht; The Netherlands,
‡ Institute of Sport Physiology, University of Maastricht, The Netherlands.

Material and methods

Twelve Standardbred geldings (1.5 yr) were selected for a longitudinal study of experimentally induced early overtraining. Training was divided into 4 phases: phase 1) acclimatisation to treadmill exercise (4 weeks (wks)); phase 2) training for 18 wks using a structured training program. Phase 3) 6 wks of increased training to induce overtraining and phase 4) detraining for 4 wks. In the overtraining phase, horses were randomly divided to a control or overtraining group. Control horses (CH) exercised 4 days/week (d/w), whereas the overtraining horses (OH) exercised 6 d/w (1st 3 wks) and 7 d/w with increased exercise load (last 3 wks). At the end of each phase, a standardised exercise test (SET) was performed. During phase 2/3/4, 3 types of observations were performed: I) standardised observations during training; II) 6-hour time budget in home stable; III) Novel-Horse-Test to detect possible behavioural changes in a challenging situation (NHT). Each test was repeated at least 5 times/phase. Tests I&II were performed with simultaneous heart-rate-variability (HRV) measurements. Statistics used: paired t-test. Results presented as mean±SD.

Results

Data were obtained from six horses. All 3 OH were unable to finish the 3rd SET in contrast with the CH. The OH horses also showed weight loss compared with the CH. Some parameters discriminated between both groups. F.i. snorting frequency: during NHT OH showed a significant \((P < 0.01)\) increase \((17.3 \pm 1.1 /5\text{min})\) compared to the CH \((2.7 \pm 2.5 /5\text{min})\). All OH had shorter contact duration \((28 \pm 24 \text{sec})\) during the NHT compared to the CH \((46 \pm 15 \text{sec})\) \((P < 0.08)\). Several HRV measures discriminated between OH and CH.

Conclusion

Standardised structural behavioural testing seems a promising (additional) tool to detect early overtraining.