57. EAAP Annual Meeting, Antalya, Turkey

Session H11.7

Investigations on the activity of trotters and the relationship to growth

L. Voswinkel, K.-H. Tölle, C. Henze, K. Blobel and J. Krieter

Christian-Albrechts-Universität Kiel
Faculty of Agricultural and Nutritional Science
Institute of Animal Breeding and Husbandry
Olshausenstraße 40, 24098 Kiel
Germany
*email: lvoswinkel@tierzucht.uni-kiel.de

Summary

The aim of this study was to determine factors affecting the activity of juvenile horses on pasture during rearing. Furthermore the influence of the activity on growth parameters and on basis endurance was analysed. Data of 30 horses of one stud were available. After weaning two foals were first housed in single boxes (pair) with daily exercise for 4 to 5 weeks. Afterwards all weanlings were separated by sex and kept in group housing with directly access pasture. Pedometers and videotaping were used to measure the activity. Climatic data were taken each test day. To determine the individual development growth parameters were recorded. For analysing the endurance, heart rate measurements and lactate values were used. During the investigation period the individual activity of each horse remained constant compared to the average of the herd. Pairs of foals showed a more similar activity pattern ($p<0.001$). Positive phenotypic correlation was found between activity and diameter of superficial digital flexortendon ($r_p=0.24$) and deep digital flexortendon ($r_p=0.27$). A negative correlation was estimated between the activity of the animals and their lactate value ($r_{animal} = -0.40$). Foals with low activity during rearing tended to higher lactate values at the beginning of the training.

Keywords: horse, activity, growth, endurance

Introduction

Endurance is the basis to practice any other physical abilities (Lindner, 1997). Therefore training of endurance is important to avoid damages and injuries caused by overwork, irrespective of the discipline (Schäfer, 2000).
The organism of the horse is strongly affected by specialisation to a run and escape animal. Under close to nature conditions, horses move about 16 hours per day (Kolter & Meyer, 1986; Kiley-Worthington, 1990).

Material and methods

Data of 30 trotters, born between 08.02.2004 and 06.06.2004, were available. Data recording occurred in the period from November 2004 to June 2006. At the beginning of the training data acquisition (April, 2006) 18 animals were available. To assure that all animals have grown up on nearly same environmental conditions, the investigation was carried out on one stud. After weaning two foals were first housed together in single boxes with daily exercise for 4 to 5 weeks. Afterwards all weanlings were kept seperated by sex together in a group housing system with directly access to pasture. After an adaptation-phase of four weeks measurements of activity started by using pedometers. To analyse different movement types digital cameras recorded the action of foals during every investigation day (n = 112). For intervals of ten weeks, the development in height at withers, cannon bone diameter and circumference, length of foreleg, weight, and diameter of flexortendons were recorded. To examine the individual bone development, X-rays of the epiphysis of the distal radius were taken at the time of weaning and at the beginning of the training in May, 2006. The different stages of epiphyseal closure were divided in 5 classes (table 1).

Table 1. Classes of the grade of epiphyseal closure

Class	Explanation
I	no periostal reaction in the distal radius – epiphyseal plate completely open
II	low periostal reaction/structural compressions in the distal radius – epiphyseal plate completely open
III	zones of compression in the distal radius – narrowing of the epiphyseal plate recognizably
IV	high reactions in the distal radius/high bone compression – beginning of epiphyseal closure recognizably
V	completed epiphyseal closure

During the training unities (8km per unity) the heart rate, the speed and the distance were recorded by a combined heart rate/Global Positioning System (GPS) system (Garmin GPS Forerunner 301). Five minutes after the load a blood sample was taken from vena jugularis externa. The lactate value was determined by a quick test (Accurend® Lactate). Climatic data of each test day were available by a weather station.
Table 2 shows an overview about averages, standard deviation as well as minimum and maximum of chosen parameters.

Table 2. Chosen parameters with their average (Mean), standard deviation (Std), minimum (Min) and maximum (Max)

Parameter	Mean	Std	Min	Max
Activity per hour (act/h)	65.2	16.6	36.5	129.9
Superficial digital flexortendon (cm)	2.0	0.2	1.7	2.4
Deep digital flexortendon (cm)	1.4	0.2	1.0	1.9
Grade of epiphyseal closure	3.0	1.1	2.0	5.0
Pace (km/h)	24.0	6.7	2.0	45.0
Heart rate (bpm)	108.0	36.0	35.0	239.0
Lactate value (mmol/l)	2.2	0.6	1.4	3.7

The statistical analysis was performed with the software package SAS (SAS, 2005). The influence on the activity was estimated by using a mixed linear model with fixed effects temperature (≤ 2,5°C, > 2,5°C to ≤ 5°C, > 5°C), rain (0 ml, > 0 ml), wind speed (< 3 m/s, ≥ 3 m/s) and their interactions. The activity was the repeated performance of each animal. By this reason the animal as well as the test day were taken into consideration as random effects. On account of the weaning method with two foals per single box, the random effect of the pair also was considered. To estimate the influence on growth parameters, the fixed effect sex and the random effects animal and test day were included in model. On each day of growth measurement, the horses were in different stages of age, so the age within the test day was regarded as covariable. For determination of the influence on performance, endurance parameters were corrected by fixed effects birth season (early = February/March, late = April/May) sex, distance (km) and random effect animal. Phenotypic correlations between activity and growth were estimated by residuals. The relationship between activity and endurance parameters was determined by animal effects.

Results

The investigation show a significant influence of the temperature and the wind speed on the activity. Higher temperature increases activity, while a stronger wind speed decreases activity (table 3). For interpretation of these results it has to be considered, that most of the data were collected during the winter period and therefore very high temperatures did not appear.

Table 3. Least –Square-Means (LSM) and their standard errors(SE) and significance level(Pr > F) of the parameter activity per hour (act/h)for the effects temperature and wind speed

Parameter	Class	LSM (act/h)	SE	Pr > F
	≤2.5	56.67	3.92	
Temperature (°C)	>2.5 to ≤5	59.24	3.96	<0.0001
	>5	71.80	3.47	
Wind speed (m/s)	<3	64.13	3.33	<0.0001
	≥3	61.01	3.74	

In spite of nearly same environmental conditions the horses showed differences in height of activity (table 2). The repeatability was very high (74.9%) and marks a constant movement pattern of the individual animal. The random effect weaning pair had a big influence on activity, so that the height of activity adapts in each case to both animals of a pair.
The physiological age of epiphyseal closure in the distal radius is 24 to 30 month (Huskamp et al., 1996). At the beginning of training, the horses were in an age of 22 to 27 month. The evaluation of the radiographs showed a distribution of the horses on the different grades of epiphyseal closure. 17% of the horses were in class III, 39% in class IV and 44% of the animals had completed bone growth in the distal radius (class V). Estimates of activity in the different stages of growth plate closure showed that horses with an lower activity during rearing were more often in class III at the beginning of training and horses with higher activities tended to a completed epiphyseal closure in the distal radius (table 4).

Table 4. Mean Estimates of activity (act/h) in the different stages of epiphyseal closure

Class		act/h
III	epiphyseal plate open	54.5
IV	beginning of epiphyseal closure	57.6
V	total epiphyseal closure	70.8

In addition to the relationship between activity and bone growth the influence on tendon growth was analysed. Positive phenotypic correlations were found between activity and diameter of superficial digital flexortendons ($r_p = 0.27$) as well as diameter of deep digital flexortendons ($r_p = 0.24$).
Hardly any relationship could be determined between the activity during rearing and the heart rate at the beginning of training ($r_{animal} = 0.09$). A negative correlation was estimated between activity and lactate value ($r_{animal} = -0.40$), so that animals with low activities during rearing tended to higher lactate values at the beginning of training.

Conclusion

The distribution on the classes of epiphyseal closure shows a strong variation concerning the individual development, which has to be considered in start date of training. An expected low heart rate of horses with high activities during rearing could not be confirmed. The strong dependence of heart rate to mental stress was possibly the reason for this result. More resistant against psychical factors is the lactate value. Negative relationships between activity and lactate value let recognise that horses with higher activity start in the training with better basis endurance. These first results show the importance of activity during rearing.

References

Huskamp, B., K. Dämmrich, J. Erbslöh und L.B. Jeffcott (1996): Skelettreife und Trainingsbeginn bei Vollblutpferden unter besonderer Berücksichtigung des Tierschutzgesetzes.
Hrsg.: Direktorium für Vollblutzucht und Rennen wak Verlag und Kunstberatung, München
Kiley-Worthington, M. (1990): The behavior of horses in relation to management and training – towards ethologically sound environments. Journal of Equine Veterinary Science. 10: 1. 62-71
Kolter, L. und H. Meyer (1986): In: Unterlagensammlung Pferdehaltung; 1. Ernährung und Haltung. Deutsche Reiterliche Vereinigung (Hrsg.); FN Verlag, Warendorf
Lindner, A. (1997): Laktat und Leistung; Verlag Dr. A. Lindner
SAS (2005): SAS/STAT Users Guide, Version 8.2
Schäfer, B. (2000): Reaktionen physiologischer Leistungskriterien auf zusätzliches Ausdauertraining während der reiterlichen Ausbildung von Sportpferden, Dissertation Göttingen, FN-Verlag, Warendorf