Original Paper

Impact of training load on the heart rate of horses

Eva Mlyneková[1*], Marko Halo[1], Miroslav Maršálek[2], Lucie Starostová[3]
[1]*Slovak university of agriculture in Nitra, Slovak Republic*
[2]*University of South Bohemia in České Budějovice, Czech Republic*
[3]*Czech university of Life Sciences in Prague, Czech Republic*

Article Details: Received: 2016-02-18 | Accepted: 2016-03-04 | Available online: 2016-12-22

http://dx.doi.org/10.15414/afz.2016.19.04.167-170

The aim of the experiment was to analyze the effect of training load on the heart rate of horses in a simulated load by the loading regulator for horse motion Horse Gym 2000. In the experiment 8 Slovak Warmblood horses (3 mares, 4 geldings, 1 stallion) aged 6–10 years were observed. The experiment was divided into two parts, each part lasted three weeks. The speed of the tested horses was 4.9 km h^{-1} in the first part of experiment, in the second part the speed was 5.2 km h^{-1} with a gradual uphill up to 7%. Tested horses achieved during the experiment an average heart rate level below 70 beats per minute, which is a light load. The maximum values of heart rate were recorded from 120 to 147 beats min^{-1}. Differences between tested horses in the values of heart rate were not statistically significant (P >0.05). After three weeks was recorded in the values of average and maximum heart rate onset of bradycardia, which documented the adaptation of body to the specified load.

Keywords: heart rate, horse, load, training

1 Introduction

The horses compared to other mammals have higher maximum oxygen consumption in relation to the body weight. One contraction from the heart of trained horse print over 1 liter of blood. The maximum values of blood flow during the load are at the level of 300 l min^{-1}.

The heart rate of horses at rest depends mainly on the degree of relaxation and health. The heart rate of horses in rest is normally within the range of 25–40 beats per min. The sudden excitement, fear and expected training can quickly increase the heart rate to above 100 beats per min (Evans, 2007; Hamlin et al., 1972). As reported by Littlejohn (1987), Marr and Burton (2010) achieving of resting heart rate values is lower in trained horses than untrained horses. However, generally by Poole and Erickson (2004), Burton (2010) applies that the rest heart rate is not reduced after training in the horse as well as in human athletes. The use of heart rate to monitor condition is limited to measuring during exercise or after exercise. The heart rate is increasing rapidly at the beginning of the exercise and reaches a steady state in 2–3 minutes (Evans, 2007; Marr and Burton, 2010). Based on studies Poole and Erickson (2004), Young (2004) reported that this increase was associated with increased sympathetic activity of the nervous system and the release of adrenaline. Steady state by Engelhardt (1977) and Young (2004) remains constant during the submaximal workloads. At the beginning of the load may occur exceeding of the heart rate above the level that is steady in the submaximal load (Persson, 1967; Persson and Lydin, 1973). The average time needed to achieve the maximum heart rate in the training of Thoroughbred was 22 seconds (Krzywanek et al., 1970; Young, 2004). The trotting did not achieve the maximum heart rate at a speed from 12 to 12.5 meters per second (m/s) neither after riding 700 m (Courouce et al., 2002; Lindholm and Saltin, 1974). The kinetics of the heart rate at the beginning of training without the previous warming depends on intensity of training (Evans 2007; Poole and Erickson, 2004).

The heart rate is a fairly reliable indicator of training intensity and it is possible to manage the training effectively according to it (Leino et al., 2010). For the load in light intensity according to Schmidt et al. (2010) is characterized by heart rate lower than 100 beats min^{-1} (55–70% SFmax), moderate intensity of load corresponds to the pulse frequency at the level of 100 to 124 beats min^{-1} (70–80% SFmax), higher intensity of load is usually characterized by the heart rate in range of 124 to 150 beats min^{-1} and frequency above 150 beats min^{-1} is high intensity of load. Dobšák et al. (2009) stateed that the value of the pulse rate, can vary in the range 50–150% of average values, depending on the way of performing the movement.

***Corresponding Author:** Eva Mlyneková, Slovak University of Agriculture in Nitra, Department of Animal Husbandry, Tr. Andreja Hlinku 2, 94976 Nitra, Slovak Republic. e-mail: eva.mlynekova@gmail.com

The aim of this study was to analyse the effect of training load on the horses heart rate in simulated load by the loading regulator for horse motion.

2 Material and methods

In the experiment 8 Slovak Warmblood horses (3 mares, 4 geldings, 1 stallion) aged 6–10 years were observed. All horses were housed in the box stable and used in light work 1 hour per day. Body weight of tested horses was 550 ± 20 kg. They were fed three times a day (oats 3.5 kg per horse hay 10 kg per horse) during the monitored period. The load experiment was conducted by the loading regulator for horse motion Horse Gym 2000 controlled with the computer unit. Load regulator for horse motion is equipped with an entrance and exit ramp. The strip is made of non-slipe rubber. Load regulator is controlled by a computer unit through which you can select up to 99 separate programs. Time interval from 1 minute to 24 hours, speed in kilometers per hour and smooth lifting and lowering of the strip (0–7%) can be selected per each program.

The average and maximum heart rate of all the tested horses during the load experiment with Polar Equine FT 40 was measured, which includes a flexible strap attached to the chest of tested horse. Sensing electrodes perfectly copied all shapes of horse chest and that is secured absolutely flawless transmission of heart rate to the receiver.

The load of tested horses lasted six weeks, all horses were loaded each day during the experiment (6 weaks, 336 heart rate measurements at the loads). Average heart rate and maximal heart rate were recorded every day during whole experiment. The experiment was divided into two parts, each part lasted three weeks.

In the first part was the load of tested horses as follows:

- 1st week – 20 minutes walk, uphill 0%, speed 4.9 km h^{-1}
- 2nd week – 30 minutes walk, uphill 0%, speed 4.9 km h^{-1}
- 3rd week – 20 minutes walk, uphill 0%, speed 4.9 km h^{-1}
  15 minutes walk, uphill 3%, speed 4.9 km h^{-1}

In the second part was the load of tested horses as follows:

- 4th week – 20 minutes walk, uphill 0%, speed 5.2 km h^{-1}
  15 minutes walk, uphill 3%, speed 5.2 km h^{-1}
- 5th week – 20 minutes walk, uphill 0%, speed 5.2 km h^{-1}
  10 minutes walk, uphill 3%, speed 5.2 km h^{-1}
  10 minutes walk, uphill 4%, speed 5.2 km h^{-1}
  5 minutes walk, uphill 6%, speed 5.2 km h^{-1}
- 6th week – 20 minutes walk uphill 0%, speed 5.2 km h^{-1}
  10 minutes walk, uphill 4%, speed 5.2 km h^{-1}
  10 minutes walk, uphill 6%, speed 5.2 km h^{-1}
  5 minutes walk, uphill 7%, speed 5.2 km h^{-1}

The obtained data were statistically evaluated by the software SPSS 11. Comparison of substantiating differences first and second part of the load was performed by ANOVA.

3 Results and discussion

The importance of recording the heart rate during training, or the competition based on the knowledge that there is a direct relationship between heart rate and the achieved performance of horse. In general, the higher is pulse rate, the higher is the physical or mental load.

The Figure 1 shows the average heart rate of tested horses. Physiological values of horse heart rate in walk lie in the range 60 to 90 beats per minute, which is according to Dobšák (2009) on the low loads level or generally characterized as a light load. The measured values did

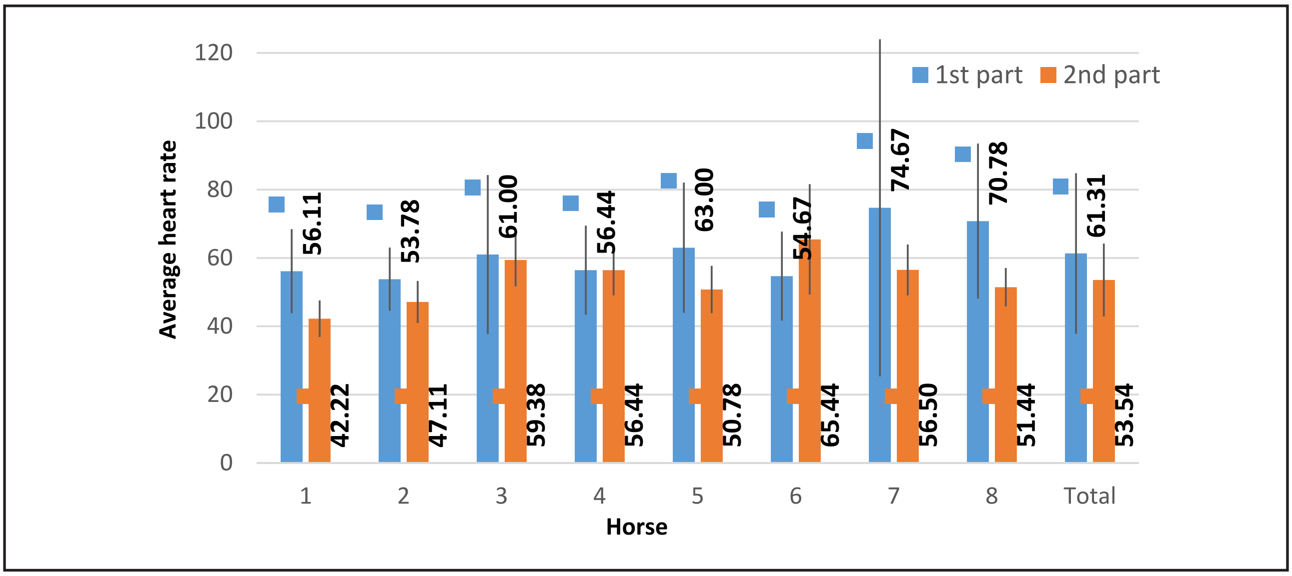

Figure 1 Average heart rate of horses during experiment

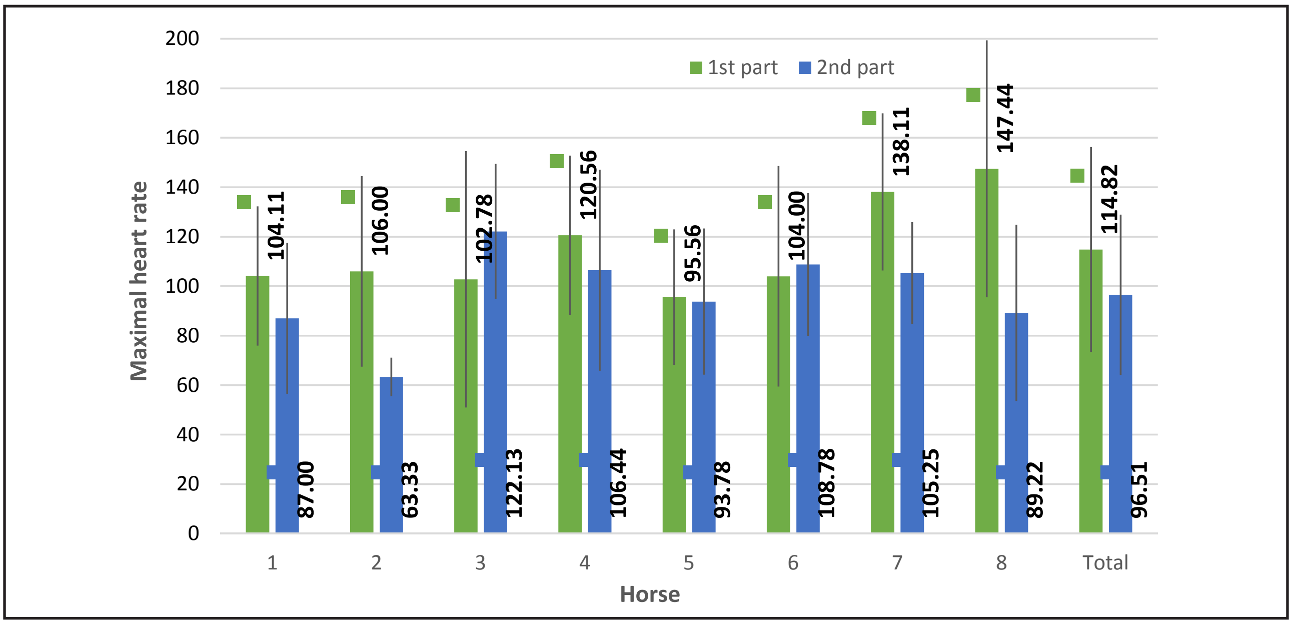

Figure 2 Maximal heart rate of horses during experiment

not exceed this range in any of the monitored subjects. Only one monitored stallions and one mare achieved average values just above the level 70 beats per minute. But neither these values are not above the physiological level, which is characterized as a light load, which is in compliance with the findings of Freeman et al. (2006).

The results of the second part of the experiment show that the tested horses achieved an average heart rate lower than in the first part of the experiment, despite the higher load through the speed and increase percentage. Differences between first and second part of experiment in the parameter average heart rate were not statistically significant (*P* >0.05). The achieved values declare the beginning of adaptation of the organism to a potential load after three weeks, which is comparable to Cross et al. (2008), Voss et al. (2002). A similar conclusion was reached by Mohr et al. (2000) during the training of a submaximal movement load where a lower heart rate was recorded. Heart rate during a submaximal movement load may therefore provide a means for monitoring the adaptation of cardiovascular system to the training. Bradycardia is recorded up after 5 weeks of periodic training. The decrease of heart rate during a submaximal load of periodic training is often only 10 to 20 beats/min (Perini and Veicteinas, 2003). Tested horses achieved bradycardia after three weeks, when the decrease of heartbeats was 7 beats per min. This rapid onset of bradycardia may be explained by a good condition of tested horses and systematic training, which is essential for achieving any success.

The maximum values of heart rate (Figure 2) of all tested horses were about twice higher compared to the average heart rate. Differences of maximum heart rate values were not statistically significant (*P* >0.05) between first and second part of experiment. Measured maximum heart rate is by the authors Hanák and Olehla (2010) described as medium load level. As in the evaluation of the average heart rate, also the value of the maximum heart rate at the same horses were more pronounced heart rate values than at the other monitored subjects, which is according to the authors Dobšák (2009), Marr and Burton (2010) upper-middle load level.

Table 1 Horse heart rate statistic analyses during experiment

		Sum of Squares	df	Mean Square	F	Sig.
Average heart rate	Between parts of exp.	233.631	1	233.631	4.104	0.062
	Within parts of exp.	796.950	14	56.925		
	Total	1030.581	15			
Maximal heart rate	Between parts of exp.	1271.457	1	1271.457	3.790	0.072
	Within parts of exp.	4696.941	14	335.496		
	Total	5968.398	15			

- *P* >0.05, + *P* ≤0.05, ++ *P* ≤0.01, +++ *P* ≤0.001

The values of maximum heart rate also confirmed the fact that the adaptation of organism to the training load becomes after three weeks of systematic work. It also confirmed that the systematic training of horses decreases heart rate in a few weeks after the start of training load. In our experiment, we recorded the decrease by 17 beats min^{-1} in average maximal heart rate of tested horses.

4 Conclusions

The training process significantly affects the internal environment for the horse. The results of our experiment show that the analysis of heart rate did not recorded statistically significant differences (P >0.05) between tested horses. Acquired values confirm that tested load did not caused any physiological changes and its length and load level were well chosen for achieving a higher level of tested horses training. Simultaneously from the course of the observed values of average and maximum heart rate can be concluded that the onset of adaptation of the organism to the training load starts after three weeks of systematic training.

Acknowledgements

This work was financially supported by VEGA 1/0724/16.

References

COUROUCE, A., CHRETIEN, M. AND VALETTE, J. P. (2002) Physiological variables measured under field conditions according to age and state of training in French Trotters. *Equine Veterinary Journal*, vol. 34, pp. 91–97.

CROSS, N. et al. (2008) Effects of lighting conditions on the welfare of horses being loaded for training. *Journal of Veterinary Behavior*, vol. 3, pp. 20–24.

DOBŠÁK, P. (2009) *Clinical physiology of physical load.* Brno: Masaryk university, pp. 47–53.

ENGELHARDT, W. V. (1977) Cardiovascular effect of exercise and training of horses. *Adv. Vet. Sci. Comp. Med.*, vol. 21, pp. 173–205.

EVANS, D. L. (2007) Physiology of equine performance and associated tests of function. *Equine Veterinary Journal*, vol. 33, p. 543.

FREEMAN, J. V. et al. (2006) Autonomic nervous system interaction with the cardiovascular system during exercise. *Progress in Cardiovascular Diseases*, vol. 48, pp. 342–362. doi: http://dx.doi.org/10.1016/j.pcad.2005.11.003

HANÁK, J. and OLEHLA, Č. (2010) Clinical physiology of horses and their training. *University of Veterinary and Pharmaceutical Science,* Brno, pp. 130–136.

KRZYWANEK, H. et al. (1970) The heart rates of Thoroughbred horses during a race. *Equine Veterinary Journal*, vol. 2, pp. 115–117.

LEINO, J. et al. (2010) Exercise-test-related heart rate variability and mortality: The Finnish cardiovascular study. *International Journal of Cardiology*, vol. 144, pp. 154–155. doi: http://dx.doi.org/10.1016/j.ijcard.2008.12.123

LINDHOLM, A. and SALTIN, B. (1974) The physiological and biochemical response of standardbred horses to exercise of varying speed and duration. *Acta Veterinaria Scandinavica*, vol. 15, pp. 310–324.

LITTLEJOHN, A. (1987) Exercise-related cardiovascular problems. In: Robinson, N. E. (ed.) *Current therapy in equine medicine 2*. Philadelphia: WB Saunders Co., p. 176.

MARR, C. M. and BURTON, M. (2010) *Cardiology of the horse.* 2nd ed. London: Elsevier. p. 84

MOHR, E., WITTE, E. and VOSS, B. (2000) Heart rate variability as stress indicator. *Archive Tierzucht.*, Sonderheft, Dummerstorf, vol. 43, pp. 171–176.

PERINI, R. and VEICTEINAS, A. (2003) Heart rate variability and autonomic activity at rest and during exercise in various physiological conditions. Eur. *Journal Application Physiology*, vol. 90, pp. 317–325. doi: http://dx.doi.org/10.1007/s00421-003-0953-9

PERSSON, S. G. B. (1967) On blood volume and working capacity in horses. *Acta Veterinaria Scandinavica*, vol. 19 (Suppl.), pp. 101–121.

PERSSON, S. G. B. and LYDIN, G. (1973) Circulatory effects of splenectomy in the horse, III Effect on pulse-work relationship. *Journal of Veterinary Medicine* [A], vol. 20, pp. 521–530.

POOPLE, D. C. and Erickson, H. H. (2004) Heart and vessels function during exercise and response to training. In: Hinchcliff, K. W., Kaneps, A. J., and Geor, R. J. (eds.) *Equine sports medicine and surgery.* New York: Saunders, p. 699.

SCHMIDT, A. et al. (2010) Cortisol release, heart rate, and heart rate variability in transport-naive horses during repeated road transport. *Domestic Animal Endocrinology*, vol. 3, pp. 205–213.

VOSS, B., MOHR, E. and KRZYWANEK, H. (2002) Effects of aqua-treadmill exercise on selected blood parameters and on heart-rate variability of horses. *Journal of Veterinary Medicine A, Physiology, Pathology and Clinical Medicine*, vol. 49, no. 3, pp. 137–143.

YOUNG, L. (2004) Diseases of the heart and vessels. In: Hinchcliff, K. W., Kaneps, A. J. and Geor, R. J. (eds.) *Equine sports medicine and surgery*. New York: Saunders, p. 727.