

Is heart rate variability an effective measure of equine fitness, overtraining, or metabolic derangements?

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Heart rate variability (HRV) is a proven technique in humans to evaluate athletic training, overtraining, and fatigue. Also, HRV has been used in people and farm animals to assess pain, stress, severity of disease, and risk of death. Recently, actively-racing California Thoroughbred racehorses were evaluated using HRV, and their physical well-being were reflected in HRV pattern.

In this pioneering study, the hearts of elite and non-elite Arabian endurance horses, along with Arabians not used for endurance competition will be compared using HRV. Additionally, the hearts will be measured echocardiographically to provide anatomical measurements for comparisons.

In the best spirit of scientific investigation, the study will seek to confirm differences in these three groups that will be similar to what has been seen previously in elite human athletes, non-elite human athletes, and sedentary humans. If these pilot investigations bear fruit, then these non-invasive, relatively brief cardiac examinations may be very useful in selecting competitive and very competitive endurance horses. Potentially even more important, HRV may uniquely useful to identify the overtrained endurance horse before onset of clinical disease and possibility mortality.

The title of the funded research is "Comparison of heart rate variability and echocardiographic measurements in elite and non-elite Arabian endurance horses: predictive value for performance ability and readiness to compete."

The lay abstract is below:

The goal of this study is to see if fitness and appropriate conditioning, assessed by the beat-to-beat variation in heart rate (heart rate variability - HRV), are correlated with ability to finish, performance ability, or metabolic derangements that necessitate treatment. In addition, we wish to determine if endurance horses that perform better have larger heart size and better function, as measured by echocardiography.

Adequate fitness without overtraining and associated fatigue is a critical component of the successful competitor. There are several ways that horses can be evaluated for fitness, such as measuring training heart rates and lactate concentrations, however recently, HRV has been used in human athletes to more sensitively assess fitness and conditioning. It has also been used to assess physical and emotional stress, pain and mortality risk. Fit horses are thought to have a relatively greater parasympathetic nervous system input, and less of a sympathetic component than unfit horses. This

contributes to their slow resting heart rates and quicker recovery times in the veterinary holds, during and after a ride. This parasympathetic and sympathetic input can be estimated with HRV.

We postulate that those horses that perform better and recover more quickly will have different HRV, with evidence of greater parasympathetic input than those that are less successful. We further hypothesize that HRV may allow recognition of over-conditioned horses that are more likely to be eliminated from competition, or suffer from physical ailments.

Results from studies performed in Thoroughbred and Standardbred racehorses suggest that larger heart size is correlated with superior aerobic (long distance) capacity. Heart size can be estimated with reasonable accuracy from ultrasound of the heart. Since endurance competition is such a highly aerobic sport, we postulated that larger heart size and superior cardiac function would be selected for in elite endurance horses.

We will measure HRV in elite and non-elite Arabian endurance horses, along with Arabians not used for endurance competition, by collecting an electrocardiogram for 30 minutes. We will also compare ultrasonographic findings of the heart in these same horses. We will use a portable ultrasound machine and travel to the individual horses, to examine them in their home surroundings, while in a resting state.

The data obtained from the HRV and ultrasounds will be compared between the groups for significant differences.