MAXIMUM EYE TEMPERATURE IN THE ASSESSMENT OF STRESS IN RACEHORSES, COMPARING THE RESULTS WITH SALIVARY CORTISOL CONCENTRATION, RECTAL TEMPERATURE AND HEART RATE

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Stress in racehorses

- Detection of stress is important in young racehorses
- Extreme physical demands in early stages of racing careers
- Physiological assessment of stress
  - saliva cortisol concentration
  - heart rate
  - rectal temperature
- All of these methods require physical contact
Stress in racehorses

- Infrared thermography (IRT)
  - non-invasive technique for measuring stress in horses

- Significant correlations between maximum eye temperature and both salivary and plasma cortisol concentration (Cook et al. 2001)

- No studies on the use of IRT as a measure of stress in racehorses in their first year of racing

- No studies reporting the agreement between maximum eye temperature and core temperature
Aims of study

- Investigate agreement between maximum eye temperature (using thermography), and rectal temperature in racehorses

- Comparing the results with:
  - salivary cortisol concentration
  - heart rate

- at rest and after exercise
Data collection

- Partynice racecourse - August 2015 (middle of racing season)
- 19 clinically healthy horses (10 Thoroughbred and 9 Arabian Horses)
- 4 measurement techniques used on the 3 days of intensive training scheduled in the training timetable (Tuesday, Friday and the following Tuesday).
Data collection - thermography

- Infratec Variocam HR
- 640 x 480 pixels
- Uncooled, 7.5 – 14 µm
- ε = 1
- Imaging distance 1m
- Analysis in Infratec IRBIS 3 Professional software
Data collection – thermography

Thermographic images of the left eye were taken:
- when horses were at rest before training (BT)
- within 5 minutes after the end of training (T+5)
- 2 hours after training (T+120)

Maximum eye temperature at the lacrimal caruncle was used

$$T_{\text{max}} = \text{maximum eye temperature averaged over the 3 training days}$$
Data collection - cortisol assay

- Saliva collected: BT, T+5; T+120
- Using Salivatte® probes (SARSTEDT, Germany).
- Gathered from the mouth by running a cotton swab between the cheek and teeth
- Cortisol assay
- SCC = salivary cortisol concentration averaged over the 3 training days
Data collection – heart rate

- Heart rate measured: BT, T+5; T+120
- Using a stethoscope (Littmann, model Classic II SE)
- HR = heart rate averaged over the 3 training days
Data collection – rectal temperature

- Rectal temperature measured: BT, T+5; T+120
- Taken with an electronic veterinary rectal thermometer (KRUUSE Digi-Vet SC 12, Denmark)
- TR = rectal temperature averaged over the 3 training days
Statistical analysis

- Different physiological contexts
  - data for BT, T+5; T+120 were analysed separately

- **STATISTICA v. 10** (StatSoft, Tulsa, USA)

- Data for saliva cortisol concentration and heart rate were not normally distributed
  - log transformed to facilitate parametric analysis.

- Effect of training assessed by ANOVA and Tukey post hoc testing

- Agreement between $T_{\text{max}}$ and TR was evaluated using Bland Altman plots.

- Correlations between measured parameters calculated using the Pearson correlation coefficient, $r$. 
Results
Results

Agreement between maximum eye temperature and rectal temperature BT, T+5 and T+120. The best agreement was observed at T+120. The bias between $T_{\text{max}}$ and TR was 1.1°C (TR $>$ $T_{\text{max}}$)

BLAND ALTMAN PLOT
Results

The only significant correlation between measured parameters was between $T_{\text{max}}$ and TR before training.

Table 1. Pearson product-moment correlation coefficients at BT, T+5 and T+120

<table>
<thead>
<tr>
<th></th>
<th>$T_{\text{max}}$</th>
<th>TR</th>
<th>log(SCC)</th>
<th>log(HR)</th>
</tr>
</thead>
<tbody>
<tr>
<td>BT</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TR</td>
<td>$r = 0.554$</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>$p = 0.014$</td>
<td></td>
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<tr>
<td>log(SCC)</td>
<td>$r = 0.248$</td>
<td>$r = 0.001$</td>
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<tr>
<td></td>
<td>$p = 0.307$</td>
<td>$p = 0.998$</td>
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<tr>
<td>log(HR)</td>
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<td>$r = -0.220$</td>
<td>$r = 0.405$</td>
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<tr>
<td></td>
<td>$p = 0.602$</td>
<td>$p = 0.366$</td>
<td>$p = 0.085$</td>
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<thead>
<tr>
<th></th>
<th>$T_{\text{max}}$</th>
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<th>log(SCC)</th>
<th>log(HR)</th>
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<tbody>
<tr>
<td>T+5</td>
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<tr>
<td>TR</td>
<td>$r = 0.401$</td>
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<td>$p = 0.089$</td>
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<tr>
<td>log(SCC)</td>
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<td>$p = 0.597$</td>
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<td>log(HR)</td>
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<tr>
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<td>$p = 0.560$</td>
<td>$p = 0.482$</td>
<td>$p = 0.536$</td>
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<table>
<thead>
<tr>
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<th>log(HR)</th>
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<tr>
<td>T+120</td>
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<tr>
<td>TR</td>
<td>$r = 0.228$</td>
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<td></td>
<td>$p = 0.347$</td>
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<tr>
<td>log(SCC)</td>
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<td>$r = 0.145$</td>
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<td>$p = 0.778$</td>
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<tr>
<td>log(HR)</td>
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<td>$p = 0.250$</td>
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<td>$p = 0.165$</td>
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Conclusion

- Maximum eye temperature, rectal temperature, salivary cortisol concentration and heart rate were all elevated by exercise in racehorses.

- The only significant correlation between these parameters was between eye and rectal temperature before exercise.

- Agreement between eye and rectal temperatures was limited at all time points.
Discussion

- Doubt on maximum eye temperature as a valid estimate of rectal temperature, and may limit the ability of IRT to identify individual febrile horses.

- Teunissen and Daanen (2011) found that eye temperature at rest in humans was, on average, around 1.4°C lower than oesophageal temperature.
The findings question the validity of eye temperature for the detection of fever or the evaluation of stress in racehorses undergoing training.
We would like to thank the trainers and riders from Wrocławski Tor Wyścigów Konnych Partynice for their help with the study.