The relationship between session RPE, running, and accelerometer derived measures in handball

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Abstract

The aim of the study was to examine the relationship between session RPE, mean heart rate, running, and accelerometer derived measures. The study included twelve young female handball players from the U17/18 national team of the German Handball Federation. The final model shows a fit of $R^2 = 0.22$ and shrinks 12 coefficients to zero with an intercept of $\beta_0 = 676.9$. The remaining two coefficients are time spent in speed zone high ($\beta_1 = 4.66$) and time spent in speed zone very low ($\beta_2 = 0.03$). The results indicated that session RPE may be not a "standalone" tool for monitoring game-based training drills.

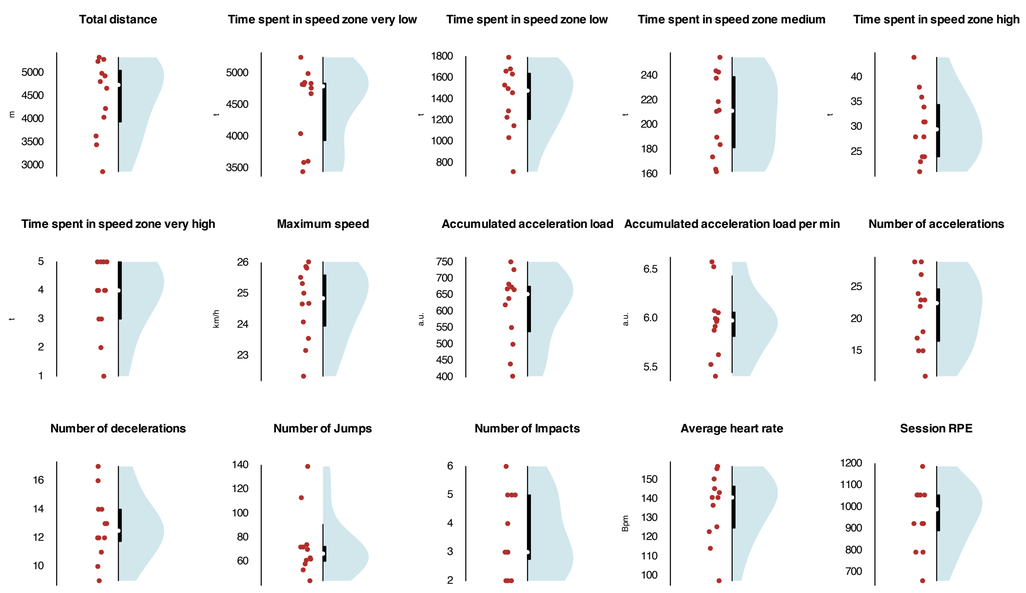

Figure 1: *Raw values (n=12), boxplots (median, interquartile range, minimum, maximum) and kernel density estimation of the variables used in the lasso regression model. The variables were obtained from a LPS system, questioning and heart rate measurement during a complete handball training session.*

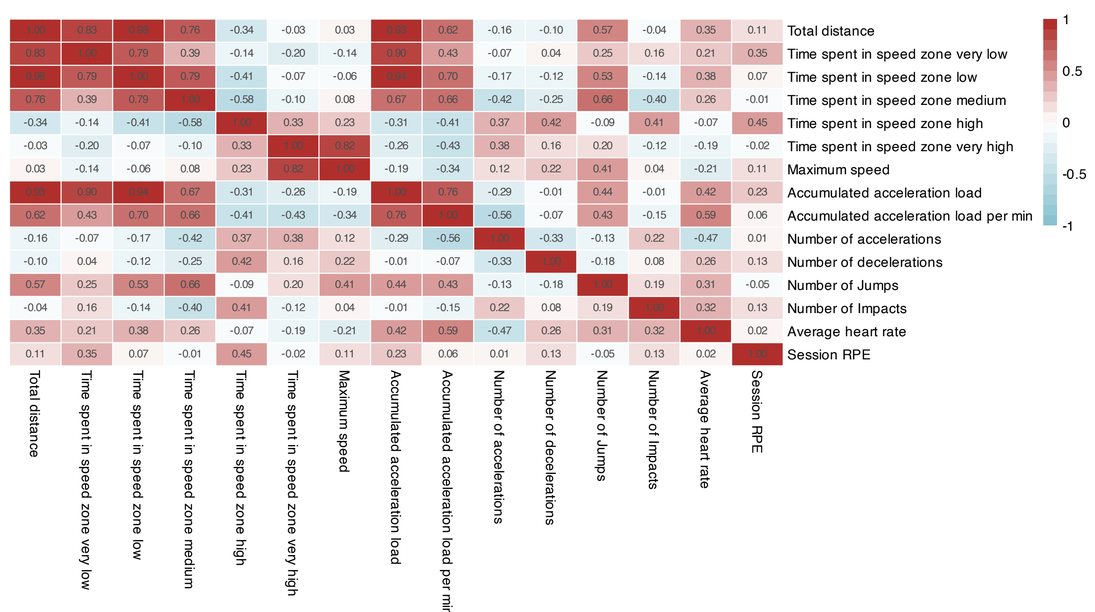

Figure 2: *Correlation matrix showing pearson's correlation coefficient of the variables used in the lasso regression model. The variables were obtained from a LPS system, questioning and heart rate measurement during a complete handball training session.*

Introduction

Session rate of perceived exertion (session RPE) can be considered as a valid "standalone" tool for monitoring subjective training "load" in a wide range of sports and athlete types (Liu et al., 2023; Foster et al., 2021; Haddad et al., 2017). Moreover, session RPE showed training mode dependent strong relationships with accelerometer derived and heart rate measures in team sports (Kuhlman et al., 2023; McLaren et al., 2018). However, there is a lack of research concerning the relationships of these measures in handball. Therefore, the aim of the study was to examine the relationship between session RPE, mean heart rate, running, and accelerometer derived measures.

Methods

The study included 12 young female handball players (17.0 ± 0.1 years; 174 ± 10 cm; 70 ± 9 kg) from the U17/18 national team of the German Handball Federation. A complete training session, including warm-ups and game-based training drills, were monitored using an established tracking system (Kinexon Perform LPS, 20 Hz), heart rate sensors (Acentas Team, V.2,14), and the session RPE. Variables from Kinexon were preselected by hand (total distance; maximum speed; time spent in very low, low, medium, high, and very high speed zone; accumulated acceleration load per minute; number of acceleration/deceleration, jumps, and impacts). Factors influencing the session RPE were quantified through lasso regression ($\alpha = 0.9$, $\lambda = 38.8$).

Variables

Total distance Total distance covered in meter during a phase

Maximum speed Highest speed value in km/h of a phase

Time spent in speed zone Time spent in speed zones. The following five categories were used: very high: ≥ 22 km/h, high: 16 to 22 km/h, medium: 10 to 16 km/h, low: 4 to 10 km/h, very low: < 4 km/h

Accumulated acceleration load per minute The metric is calculated from IMU data and captures all movements in the X,Y, and Z axis (e.g. motion, jumps, and impacts) in relation to recorded time of a phase. Equation is described in Boyd et al. (2011) with $\sum_{i=1}^{n} \sqrt{\frac{(a_{y1}-a_{y-1})^2+(a_{x1}-a_{x-1})^2+(a_{z1}-a_{z-1})^2}{100}}$

Number of accelerations Number of accelerations in a phase. This metric counts the accelerations an athlete performs during the match. An acceleration event is detected if the athlete maintains an acceleration over an specific threshold ($2\,m/s^2$) over a minimum duration (0.5 s).

Number of decceclerations Number of decelerations in a phase. This metric counts the decelerations an athlete performs during the match. A deceleration event is detected if the athlete maintains a deceleration over an specific threshold ($-1.5\,m/s^2$) over a minimum duration (0.5 s)

Number of jumps This metric counts all jumps of a phase. LPS as well as IMU data is used to detect jump events. To trigger jump event the athlete has to be in the air between 0.35 to 0.99 s

Number of impacts Number of collision events between players during match. This metric is threshold based and counts the events when two players collide. LPS as well as IMU data is used to detect impacts. To trigger an impact a big magnitude acceleration has to be registered from two players, who stand next to each other, at the same time.

Results

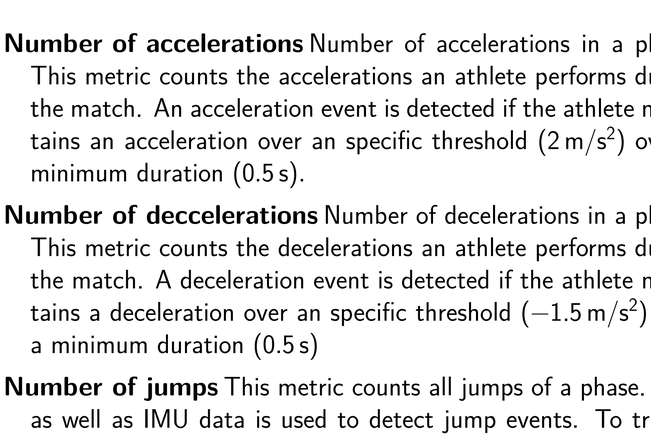

Figure 3: *Mean squared error dependent on the regularization parameter log(λ). Showing how error increase with numbers of variables included in the model.*

The final model shows a fit of $R^2 = 0.22$ and shrinks 12 coefficients to zero with an intercept of $\beta_0 = 676.9$. The remaining two coefficients are time spent in high speed zone ($\beta_1 = 4.66$) and time spent in very low speed zone ($\beta_2 = 0.03$).

Discussion

The results show that in handball under training mode the session RPE cannot be fully explained by heart rate, running, and accelerometer derived measures. Due to the small sample size the estimated coefficients may be unstable and sensitive to small changes in the data. The results indicated that session RPE may be not a "standalone" tool for monitoring game-based training drills. Further studies with larger data to examine the relationship between session RPE, heart rate, running, and accelerometer derived measures are needed.

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