CAN HEART RATE BAND DURATION PREDICT TOTAL DISTANCE IN COLLEGIATE WOMEN'S SOCCER?

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PURPOSE

The aim of this study is to examine if time spent in heart rate (HR) bands, heart rate exertion (HRE), position, and minutes played can predict total distance (TD) over a season in a NCAA DII women's soccer team.

INTRODUCTION

TD can help identify external player load and plan future training programs. With advances in technology, TD can be measured using optical and GPS tracking systems. However, there may be limited access to these technologies in many women's soccer settings due to a variety of reasons. Heart rate (HR) is used as an index of internal workload that has a strong relationship with external workload. Due to its availability, HR has been used as index to estimate external load (i.e., TD). We are unaware of any literature using internal load measures as a predictor of external load measures such as TD over a season of a NCAA DII women's soccer team. As external workload (TD) can be affected by players' position and minutes played, it is important to determine if these two variables can affect the variance in TD.

METHODS

Data was collected from 32 field players (18-23 years old) from the university women's soccer team throughout the 2022 and 2023 seasons. Data were averaged over the course of all matches played in a season. The players were divided by position according to the NCAA team roster, into 3 groups forwards (n =13), midfielders (n =10), defenders (n =9), and playing time was discretized in four-time intervals 0-221/2 min, 221/2-45 min, 45-671/2 min, and 671/2 – 90 min, and goalkeepers were excluded from the data set. We used Catapult S5 GPS/IMU (2021 and 2022 seasons) and Catapult S7 GPS/IMU (2023 season) sensor data integrated with Polar heart rate monitors to collect total distance, time in seconds spent in each heart rate bands, HRE. The data were retrieved from Openfield Cloud 4.0 and summarized in Microsoft Excel for further analyses. Upon initial retrieval, HR data consisted of eight bands which were further reduced to 4 bands - HR bands 1+2, HR bands 3+4, HR bands 5+6, and HR bands 7+8. We used SAS proc reg to adjust linear multiple regression models using a stepwise method and entry p value of 0.15.

REFERENCES

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RESULTS

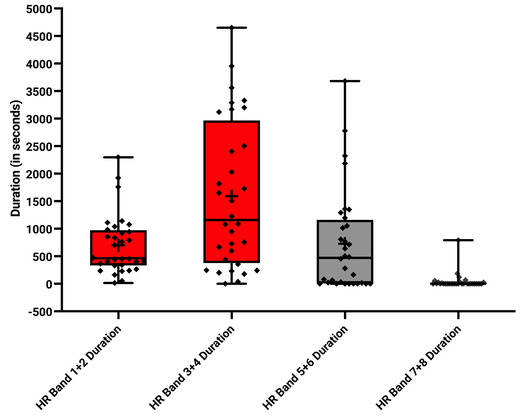

Figure 1. Average duration in seconds spent in heart rate bands 1+2, heart rate bands 3+4, heart rate bands 5+6, and heart rate bands 7+8. Center lines show the medians; plus symbols show the mean; box limits indicate the 25th and 75th percentiles; whiskers extend to the minimum and maximum values.

Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	1	115.42126	525.15177	0.22	0.8279
Time block	1	-160.67282	391.38748	-0.41	0.6851
Position	1	58.66285	152.61030	0.38	0.7041
HR Band 1+2 Duration (sec)	1	1.597926	0.52712	3.00	0.0063
HR Band 3+4 Duration (sec)	1	1.60334	0.73354	2.19	0.0388
HR Band 5+6 Duration (sec)	1	1.65524	1.24244	1.33	0.1953
HR Band 7+8 Duration (sec)	1	1.47134	2.88129	0.51	0.6143
Average HRE	1	0.04915	0.45329	0.11	0.9145

Duration in combined HR bands 1+2 and 3+4 entered the regression model (p = 0.0063 and 0.039, respectively) resulted in an adjusted $R^2 = 0.94$.

RESULTS

The table below displays mean and SD values for TD, time spent in HRbands, and HRE. Duration in combined HR bands 1+2 and 3+4 entered the regression model (p = 0.0063 and 0.039, respectively) resulted in an adjusted $R^2 = 0.94$. The intercept value was 115.42 (SE = 525.15) and coefficients of the two variables that entered the model were βHR1+2 = 1.60 (SE = 0.53) and βHR3+4 = 1.60 (SE = 0.73).

Variable	Average	SD
Average Total Distance (m)	4965.18	2504.15
HR Band 1+2 Duration (sec)	699.97	536.58
HR Band 3+4 Duration (sec)	1591.50	1337.67
HR Band 5+6 Duration (sec)	726.56	923.22
HR Band 7+8 Duration (sec)	40.99	142.81
Average HRE	5124.15	2799.25

m = meter, HR = Heart Rate, sec = seconds, HRE = Heart Rate Exertion

CONCLUSIONS

Our findings suggest that time spent in HR bands 1+2 and 3+4 can accurately predict TD in women's NCAA DII soccer and could be used as a proxy marker of TD when optical and GPS systems are not available.

PRACTICAL APPLICATIONS

Time spent in HR bands may be more accessible and accurately predict players TD over the season, which can be a useful index of a team's external load over the course of NCAA seasons.

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Presented at the National Strength and Conditioning Association National Conference, July 10th - July 13th 2024, Baltimore, Maryland, USA