Using external load metrics to predict game performance in high school basketball athletes

Philip J. Agostinelli[1], Anthony Zimmer[2], Peter John De Chavez[3], Shelby Alfred[4], Jason Berry[2], Kristin L. Osterberg[1]

[1]Gatorade Sports Science Institute, PepsiCo Global R&D, Bradenton FL, USA, [2]IMG Academy, Bradenton FL, USA, [3]Data Science & Analytics, PepsiCo Global R&D, Plano TX, USA, [4]Gatorade Sports Science Institute, PepsiCo Global R&D, Valhalla NY, USA

RESEARCH QUESTION

Can external load metrics commonly used by high school sports academies effectively predict performance?

METHODS

Data: 239 youth basketball athletes were collected during the 2022-2023 and 2023-2024 school years. Data from 33 athletes were excluded from the analysis due to missing values.

Predictors: Potential predictor variables included overall averages from 50 different Catapult external load outcomes that are commonly used by Sports Scientists

Outcomes: Hudl Game Stats (including value points system (VPS), points, rebounds, blocks, and turnovers).

Analysis: PLS regression was used to screen out relatively unimportant predictors followed by stepwise regression to identify significant predictors for outcomes. Shapiro–Wilk's test was used to assess normality. Box-Cox transformation technique was used to identify optimal data transformation.

Table 1. Subject Characteristics

Age	16.1 ± 1.6 yrs
Body Mass	76.8 ± 14.4 kg
Height	183.0 ± 11.3 cm
Male/Female	202/36

Data are presented as mean ± SD

Table 2. Descriptive Statistics for Outcomes

Variable	N	Mean	StDev	Min	Maximum
Minutes	206	17.70	5.37	3.5	33.95
Points	206	6.31	4.09	0	24.24
Rebounds	206	3.45	1.93	0	11.05
Blocks	206	0.23	0.27	0	1.73
Steals	206	0.85	0.53	0	3.5
Foul	206	1.44	0.59	0	3.67
Charge	206	0.05	0.07	0	0.45
Turnovers	206	1.64	0.75	0	4.63
VPS	206	1.31	0.45	0.3	3.25

VPS = Value Point System; SE = standard Error, StDev = standard deviation

RESULTS

Average inertial movement analysis (IMA) high band jump count ($p<0.001$), average practice session duration ($p<0.001$) and their interaction ($p=0.001$) were significant predictors for VPS ($R^2 = 22.9\%$).

IMA high band jump count ($p=0.003$) and average practice session duration ($p=0.01$) were significant predictors for points ($R^2 = 10.4\%$).

Average time spent in Player Load Band 1 (low workloads) was inversely associated with steals ($R^2 = 7.7\%$, $p = 0.001$).

Table 3. Value Point System Regression Coefficients

Variable	Coef	SE Coef	T-Value	P-Value
Constant	1.34320	0.09870	13.61	0.000
Total Duration	-0.00007	0.00002	-3.77	0.000
IMA High Band Jumps	0.02298	0.00493	4.66	0.000
Interaction	-0.00069	0.00020	-3.54	0.001

IMA = inertial Movement Analysis; *underwent Box-Cox transformation

Table 4. Points Regression Coefficients

Variable	Coef	SE Coef	T-Value	P-Value
Constant	3.382	0.498	6.79	<0.001
Total Duration	-0.0002	0.00009	-2.62	0.010
IMA High Band Jumps	0.0282	0.0092	3.08	0.003

*underwent Box-Cox transformation

Table 5. Steals Regression Coefficients

Variable	Coef	SE Coef	T-Value	P-Value
Constant	0.908	0.390	2.33	0.022
PL B1 Duration	-0.0003	0.00008	-3.33	0.001

PL = PlayLoad; B1 = Band 1; *underwent Box-Cox transformation
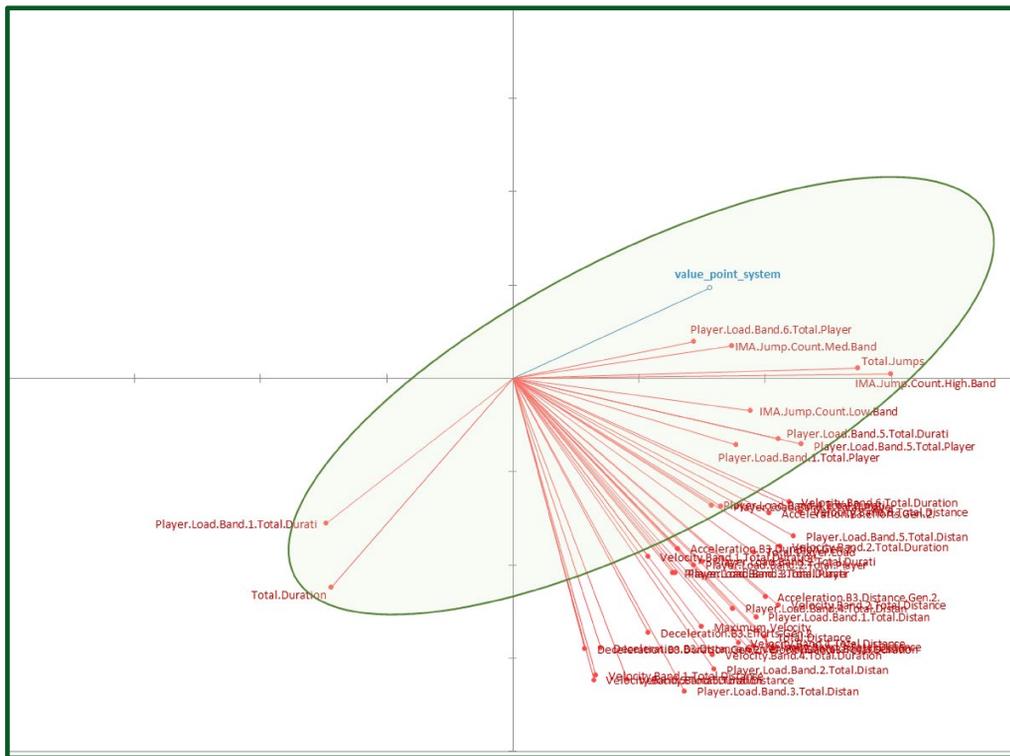

Figure 1. PLS for Value Point System

CONCLUSIONS

Average frequency of high intensity jumps, and average practice session time were the largest predictors of overall game performance in high school basketball athletes, as defined by the value-point-system.

However, average external load metrics provided minimal insight into individual game statistics.

Future research should integrate related covariates that may provide additional predictive insight such as, anthropometrics, age, directional external load metrics, and fitness.

ACKNOWLEDGMENTS