CONTRIBUTIONS OF BAT SWING METRICS TO EXIT VELOCITY IN COLLEGIATE BASEBALL PLAYERS

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Introduction

Hitting a baseball off a tee can seem as a simple task, however, it is a multifaceted task that involves appropriate speed and timing with appropriate mechanics. Understanding the contributions of how a batter's swing and its influence on exit velocity off a tee is important when coaching what portions of swing mechanics create the greatest exit velocity. Recent investigations have shown that Muscular power in the upper and lower extremities has been shown to significantly improve various metrics of the baseball swing including bat speed and ball-exit velocity, both of which are strong determinants of hitting success [1,2]. As it has been found in the literature that physical performance characteristics, namely, power produced during explosive physical activity, enhances exit velocity, there, however, is little to no research indicating what bat swing specific metrics contribute to exit velocity.

Purpose

The purpose of this study was to examine what contributions of bat swing metrics influence exit velocity in collegiate baseball players.

Methods

Collegiate baseball players (n=37; Mean±SD; age=20.4±1.4 yrs, height=1.82±0.08 m, bodyweight=86.8±7.7 kg) performed testing procedures including 10 swings for maximum batted ball velocity off a tee, with a total of 382 swings among all subjects. Each swing condition was performed with a Blast accelerometer (Blast Motion, San Marcos, CA) attached to the end of their own baseball bats. A zero-order correlation matrix was run between all of the independent variables (accelerometer metrics), in order to remove variables with high shared variance. Following the zero-order correlation, a forward-entry-model multiple regression analysis was used to determine significant contributing metrics to batted ball velocity ($p<0.05$). A Jackknife statistical analysis was performed to estimate bias.
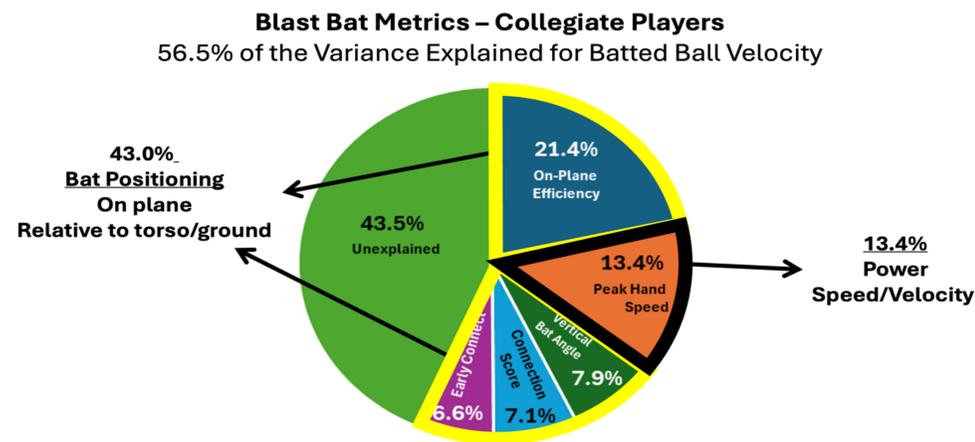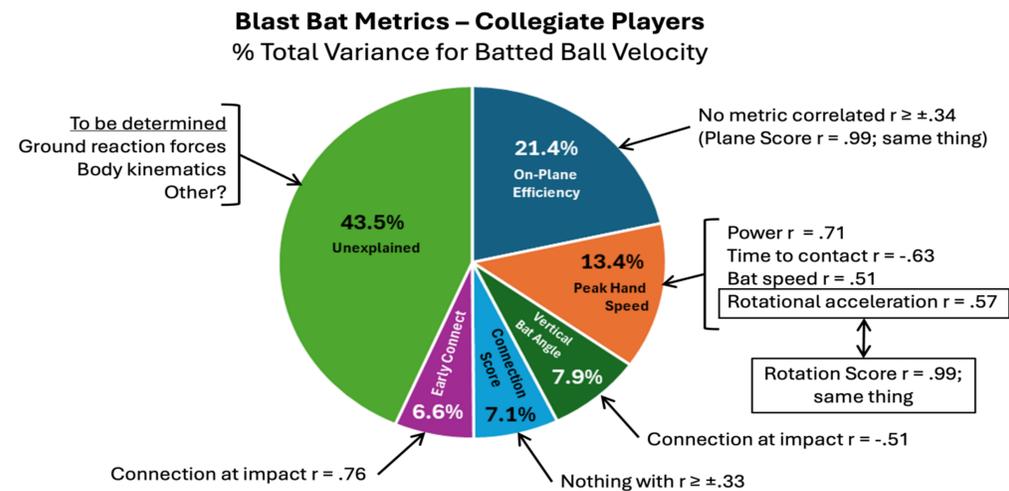

Blast Bat Metrics – Collegiate Players
% Total Variance for Batted Ball Velocity

Blast Bat Metrics – Collegiate Players
56.5% of the Variance Explained for Batted Ball Velocity

Figure 1. Relative Contributions of Bat Swing Metrics to Exit Velocity

Results

Seven variables significantly contributed to the regression, Bat Power (kW) (r=0.396), On-Plane Efficiency (%) (r= 0.467), Connection Score (r=0.509), Peak Hand Speed (mph) (r=0.528), Early Connection (degrees) (r=0.547), Vertical Bat Angle (degrees) (r=0.557), Time-to-Contact (seconds) (r=0.562). The adjusted R-square indicated that 56.2% of the variance in batted ball velocity was accounted for by multiple regression. The standard error of the resulting prediction equation for exit velocity was 4.38 mph. All variables entered into the multiple regression exhibited no bias and had homogeneity of variance for all independent variables.

Figure 2. Athlete swinging at ball off of force instrumented tee

Conclusions & Practical Applications

CONCLUSIONS: The findings of the present study found 7 out of 12 metrics contributed significantly to the 56.2% variance accounted for by bat swing metrics alone. The other 43.8% of unexplained variance or variance unaccounted for may come from other factors such as ground reaction forces, body kinematics, and more. **PRACTICAL APPLICATION:** By understanding the contributions that influence ball exit velocity, coaches can understand what areas of focus that some athletes may need in order to achieve max exit velocity. As pitch type and pitch location will likely affect swing mechanics and the decision-making process, further research is warranted to investigate how these factors play a role in may affect swing-related metrics, especially when facing a live pitcher.

Acknowledgements

References

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