Lower Body Power is Related to Hitting Performance in Youth Baseball Athletes

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Baseball hitting is a linear and rotational motion requiring force generated at the lower extremities to be transferred through the pelvis, trunk, upper extremities, and finally the bat to maximize hitting performance [2,3]. Therefore, strength and conditioning coaches seek to improve lower body power in baseball athletes [5]. They implement a battery of lower body power tests to monitor training progress. Prior research suggests that broad and vertical jumps are associated with hitting performance [1,4]; however, it is unknown if a more sport-specific single leg jump with a rotational component is more closely related to hitting performance.

The purpose of the study was to determine the relationship between a battery of lower body power tests (vertical jump, broad jump, and single leg lateral rotational jump) with youth hitting performance.

Fifty-one youth (9-17 yrs) baseball athletes [right-handed (n = 48); 11.5 ± 1.7 yrs, 152.4 ± 13.2 cm, 50.5 ± 15.5 kg] who were active on a team roster and injury free for the past six months participated. Prior to data collection, participants signed consent forms, and their anthropometric measurements (age, height, weight) were recorded. Each participant rotated at random through a battery of tests, including two trials each of a maximal effort standing broad jump (SBJ), triple broad jump (TBJ), and single leg lateral rotational jump (LRJ) (bilaterally), and three maximal effort swings off a stationary tee positioned in the center of the strike zone.

For the SBJ and TBJ, participants aligned their toes with a starting line and then jumped as far as possible consecutive times for the SBJ and TBJ, respectively. For the single leg LRJ, the jump was initiated with a countermovement followed by an explosive rotational jump off one leg landing on both feet simultaneously. Hitting performance (exit velocity) was measured using a Rapsodo[®] Hitting 2.0 (Figure 1) unit positioned 4.3 meters from home plate. Peak values for the SBJ, TBJ, single leg LRJ, and exit velocity were used for analysis.

Pearson-product moment correlations were used to determine bivariate associations between jump distances (cm) and exit velocity (mph). A forward multiple linear regression, including height (cm) and jump distances, was performed to determine the best predictor of exit velocity. Height was entered initially to estimate the proportion of variance accounted for by the anthropometric measure. The additional predictive value of each jump distance, above and beyond the predictive effects of height, was also estimated ($\Delta R2$). Statistical significance was set a priori to p < .05.

The mean peak exit velocity was 56.1 ± 8.0 mph. Descriptive statistics are reported in Table 1. Bivariate correlations determined SBJ, TBJ, and single-leg LRJ distances were all significantly and positively related to exit velocity (all p-values < .001) (Table 2).



Fig. 1. Rapsodo[®] Hitting 2.0-Unit Screen

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Variable	Value (Mean ± SD)
Height, cm	152.4 ± 13.2
Exit Velocity, mph	56.1 ± 8.0
Jumps	
SBJ, cm	161.4 ± 27.9
TBJ, cm	495.4 ± 83.7
D SLLRJ, cm	129.2 ± 22.5
ND SLLRJ, cm	130.6 ± 23.0

Fable 1. Descriptive state	istics
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Note: Bold = p < .05; Standing Broad Jump = SBJ; Triple Broad Jump = TBJ, SLLRJ = Single Leg Lateral Rotational Jump, D = Dominant, ND = Non-Dominant

Table 2.	Bivariate	correlations
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Variable	Correlation Value	p-Value
Height, cm	.812	<.001
Jumps		
SBJ, cm	.728	<.001
TBJ, cm	.697	<.001
D SLLRJ, cm	.580	<.001
ND SLLRJ, cm	.626	<.001

Note: Bold = p < .05; Standing Broad Jump = SBJ; Triple Broad Jump = TBJ, SLLRJ = Single Leg Lateral Rotational Jump, D = Dominant, ND = Non-Dominant

The regression analysis indicated that body height accounted for 65.9% of the variance in exit velocity alone. The predictive model was improved by adding peak SBJ [Δ R2 = .090; R2 = 0.749, F(2, 48) = 71.7, p < .001]. On average, the model predicted a 1.1 mph increase in exit velocity for every 10 cm increase in peak SBJ (β = .376, p = < .001).

The finding from this study indicates most of the variance above and beyond that of the athletes' anthropometric measurements was the SBJ. These findings agree with previous examinations relating SBJ performance to hit ball kinetic energy in youth baseball athletes [4]. The SBJ is the most common jump test strength and conditioning coaches use. Compared to the other jump tests used in this study, it is the easiest to perform, leading to a potential bias towards more experienced, skilled athletes over novice athletes. Future studies should examine higher-skilled athletes performing all of the tests utilized in the current study and determine whether the same relationship exists.

Although all lower body power tests were related to hitting performance, the SBJ best predicted exit velocity. This finding may be due to the simplicity of the standing broad jump, whereas the TBJ and single leg LRJ required a lot more coordination from novice athletes. Therefore, when strength and conditioning coaches design time-efficient testing protocols, the standing broad jump may be the best lower body power test to monitor training progress related to improved hitting performance in youth baseball athletes.

Statement of Research Advisor

Trent contributed to the understanding of how frequently utilized lower body tests are related to youth hitting performance. The findings from this study indicates that most of the variance above and beyond that of the athletes' anthropometric measurements was in the SBJ. These results will aid strength and conditioning coaches in selecting the most effective test for monitor training progression. Trent strengthened his research skills by assisting in all aspects of the study, including research design, data collection, statistical analysis, results interpretation, and abstract writing.

- Gretchen Oliver, Department of Nutritional Sciences, School of Kinesiology

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Authors Biography



Trent Agee is a senior-year student pursuing a B.S. in Nutrition Science at Auburn University. He has been a research assistant for the past 2 years and is currently a research fellow in the Sports Medicine & Movement Laboratory, focusing on jump and hitting performance. He will start medical school next fall.



Nicole Bordelon is a post-doctoral researcher in Auburn University's Sports Medicine and Movement Laboratory and a Sports Science Consultant for the University of Maryland Softball. One of her primary research interests is in baseball and softball hitting performance.



Dr. Oliver is a full professor in the School of Kinesiology and Director of the Sports Medicine & Movement Laboratory at Auburn University. She is the President of the American Baseball Biomechanics Society, Executive Board Member of the International Shoulder Group, and Executive Board Member of the International Society of Biomechanics in Sports. Her primary research focuses on injury prevention and performance enhancement in youth baseball and softball athletes. Among her peers, she is the expert in youth baseball and softball injury prevention and is world-renowned for her research expertise in windmill softball pitching.