Strength and Power Thresholds to Identify High and Low Linear Sprint Speed Performers in Collegiate American Football Players

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Introduction

Lower body strength and power have been shown to be one of the driving factors of sport success from a physical standpoint. Recent investigations have shown correlations between absolute and relative lower body strength and performance within different athletic key performance indicators such as jumping, sprinting, and changing directions efficiently. A growing body of literature suggests substantial relationships between strength and sprinting performance, with increases in strength coinciding with improvements in sprint performance over shorter distances. However, questions still remain, pertaining to the topic of whether there is an optimal strength threshold above which further developing maximal strength fails to complement improvements in dynamic tasks such as sprinting

Purpose

The aim of this study was to provide practitioners with lower body strength and power thresholds that can discriminate between slow and fast performers, specifically looking at linear sprint speed performance. We hypothesize that by using logistic regression, supplemented with Receiver Operator Curve analyses, we can determine optima cut-off points (i.e., relative strength thresholds) that are able to significantly discriminate between fast and slow sprint performers.

Methods

An ex post facto quasi-experimental study design using data from an NCAA American Football team was used to examine lower body strength associations with linear sprint speed. To account for the effect of body weight on relative strength levels and speed, the sample was further divided into a "high body mass" (n = 147, body mass = 116.4 ± 13.7 kg) and a "low body mass" (n = 147, body mass = 86.4 ± 6.1) group, using a median split analyses for body weight. Linear speed was assessed via the 40-yard dash test, and athletes within respective subgroups were classified as "slower", or "faster" performers, using the 50th percentile as cut-off points (median-split analysis). Further, we employed logistic regression analyses, supplemented with the use of Receiver Operator Curves (ROC) for each lower body relative strength and power test, within each respective subgroup of athletes, to establish cut-off scores (i.e., thresholds) that maximized the positive predictive value (i.e., sensitivity) and minimized the false positive rate (i.e., 1-specificity) associated with "slower" and "faster" performers.

Table 1. Receiver operator curve summary statistics for all lower body strength and power assessments within the "high body mass" group.

Metric	Accuracy	Specificity	Sensitivity	AUC	Cutoff (Threshold)
Relative Squat (Ratio)	0.735	0.743	0.726	0.780	2.01
Relative Hang Clean (Ratio)	0.755	0.757	0.753	0.848	1.28
Broad Jump (m)	0.777	0.759	0.795	0.883	2.64
Vertical Jump (cm)	0.828	0.810	0.846	0.903	72.64

*AUC = Area under the curve, KS Cutoff = Kolmogorov Smirnov Cutoff

Results

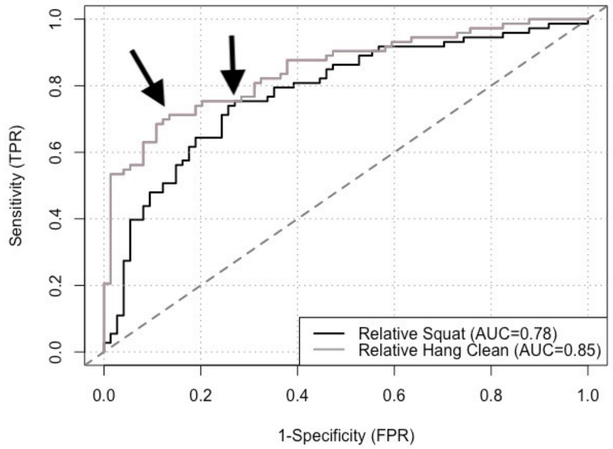
Findings from this investigation revealed that optimal cut-off scores differed between the two bodyweight-based groups of athletes, as well as the lower body strength and power tests, which may be used as training targets within the applied strength and conditioning setting. All models were able to significantly distinguish between slower and faster performers, and AUC values ranged from 0.695 to 0.903.

Table 2. Receiver operator curve summary statistics for all lower body strength and power assessments within the "low body mass" group.

Metric	Accuracy	Specificity	Sensitivity	AUC	Cutoff (Threshold)
Relative Squat (Ratio)	0.639	0.649	0.630	0.751	2.31
Relative Hang Clean (Ratio)	0.612	0.622	0.603	0.695	1.56
Broad Jump (m)	0.673	0.691	0.654	0.753	2.87
Vertical Jump (cm)	0.704	0.741	0.667	0.779	84.1

*AUC = Area under the curve, KS Cutoff = Kolmogorov Smirnov Cutoff

Figure 1. Receiver Operator Curves and AUC values for the "heavy" group and lower body relative strength assessments.



Conclusions & Practical Applications

Thresholds and model summary statistics differed based on the respective physical performance assessment and the group to which they were applied (high vs. low body mass groups). Pending further longitudinal investigations of how increases in strength and changes in speed complement each other, methods and findings from this study may be used to benchmark athletes, and to further individualize training implementations aimed at improving linear sprint speed performance through targeted interventions within the realms of strength and conditioning. Caution is advised when trying to generalize established thresholds past the population used within this study. Thresholds and findings will most likely vary based on factors such as sex, training age, sport, and measurement devices used.

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