PREDICTIVE QUALITIES OF COUNTERMOVEMENT JUMP METRICS TO LINEAR AND LATERAL SPEED ABILITIES

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ABSTRACT

Sport scientists are constantly in the quest of finding and utilizing the most valid and efficient testing protocols for quantifying athleticism. The goal is to find the least number of tests in a battery, that still hold the most meaning to profile aspects of athleticism: speed, strength, stamina, skill, suppleness, and strategy. Using too many tests can be burdensome for the athletes and coaches, requiring a lot of time and energy, but in the meantime, using too little tests run the risk of missing a critical component of athleticism evaluation. **PURPOSE**: the purpose of this study was to identify the relationships and predictive measures of countermovement jump metrics across linear and lateral speed tests. **METHODS**: Male varsity student-athletes at the NCAA Division III level participated in this study (n = 93; 20.75 ± 1.62 years; 182.15 ± 8.61 cm; 93.89 ± 18.26 kg). All reported to the lab for one testing session, lasting approximately 45 minutes. Following a standardized dynamic warm-up, participants completed three maximal countermovement jumps (CMJ) on a force plate system (Hawkin Dynamics, Westbrook, ME). Several kinematic and kinetic metrics were collected from the jumps. Following the CMJ test, they completed three maximal-effort 18-meter sprints using a laser timing system (VALD Performance, Newstead, Queensland, Australia). A 9-meter split was taken between the start and 18-meter finish to collect an initial 9-meter split (9m), and a "flying" 9-meter time (FLY9), in addition to the total 18-meter time (18m). Finally, each subject completed two attempts of the 505 Agility test, using a similar laser timing system, where total time of completion was recorded (505). The 9m time was then subtracted from the 505 time to calculate their change of direction deficit (CODD). Pearson Product moment correlations and regression analyses were used to calculate relationships and predictive qualities between measures. **RESULTS**: Jump height (JH), Average Relative Propulsive Force (ARPF), and Reactive Strength Index – Modified (mRSI) displayed the most correlations to all speed metrics collected, ranging from coefficients of -0.53 to -0.82. Linear regression demonstrated high predictive ability of JH, ARPF, and mRSI on these aspects of speed (R^2 = 0.30 to 0.68; p < 0.001). **CONCLUSION**: Output and process-oriented CMJ metrics from force plate testing can provide the ability to predict an athlete's ability to sprint and change directions. **PRACTICAL APPLICATIONS**: In sport science, time, space, and technology can be barriers to testing. Since sport science testing is usually in a team-setting, efficiency is key. This study provides evidence that if speed testing cannot be completed due to a variety of barriers, the data collected from maximal CMJ force plate tests can give professionals the ability to predict speed performance. Even with the advancement in sport technology, recording JH is a simple metric that can be collected from CMJ tests, using a wide-variety of equipment, which demonstrates its high relation and ability to predict characteristics of athleticism, such as linear speed and change-of-direction abilities.

INTRODUCTION

Sport scientists use technology to collect, analyze, and visualize relevant data and information to help drive decision-making for all members of the high-performance unit. The data can be used to profile athletes and create benchmarks for specific standards of all domains of athleticism (strength, speed, stamina, suppleness, skill, and strategy).

Between the variety of tests that could measure each of the components of athleticism, the result could be exponential and overwhelming. Therefore, a purpose of sport scientists is to find the most efficient battery of testing that is short on time, but long in meaning and impact for the high-performance unit. That means finding tests that share criterion validity: the data the instrument collects can extend and relate to other tests.

A commonly-used test that translates across athleticism is the vertical jump. Jump height (JH) has been shown to be a reliable tool in measuring lower body performance, and correlates with linear and lateral speed (3, 4). But with the advancement of technology, force plates can measure the kinetic aspect of the vertical jump, providing more metrics that could be used to correlate movement patterns with sport skill outcomes for the sake of athlete profiling and benchmarking (1).

PURPOSE & HYPOTHESIS

The purpose of this study was to report any predictive measures the kinematics and kinetics of the countermovement vertical jump have on linear and lateral speed performance. It is hypothesized that several jump metrics will be able to predict speed performance in the collegiate athletes utilized in this study.

METHODS

Number of Subjects = 93

Body Mass: 93.89 + 18.26 cm

Height: 182.15 + 8.61 cm

Age: 20.75 + 1.62 years

Countermovement Jumps

- Jump Height
- Braking Rate of Force Development
- Average Relative Propulsive Force
- Relative Propulsive Impulse
- Reactive Strength Index - Modified

(Hawkin Dynamics, Westbrook, ME)

18-Meter Sprints

- Total time
- "FLY9"
- Initial 9-meter Acceleration

(VALD Performance, Queensland, Australia)

505 Agility Test

- Total time
- CODD
  - 505 9m – Linear 9m = CODD

(Zybek Sports, Boulder, CO)

RESULTS

	Jump Height	Avg. Rel. Prop. Force	mRSI
9-m	-0.72	-0.54	-0.57
Fly9	-0.83	-0.65	-0.72
18-m	-0.82	-0.63	-0.69
505	-0.70	-0.47	-0.56
CODD	-0.27	-0.13	-0.22

Table 1: Correlation coefficients between jump metrics and speed

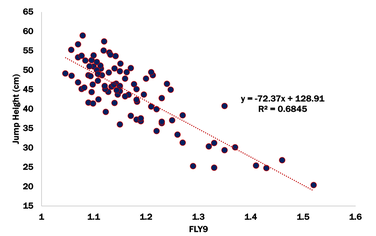

Figure 3: Linear regression between FLY9 and Jump Height
p < 0.001

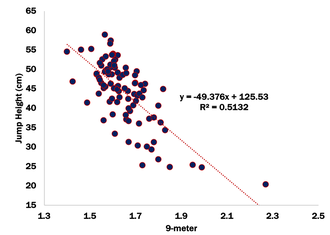

Figure 3: Linear regression between 9-m and Jump Height
p < 0.001

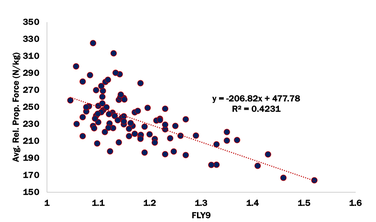

Figure 3: Linear regression between FLY9 and Average Relative Propulsive Force
p < 0.001

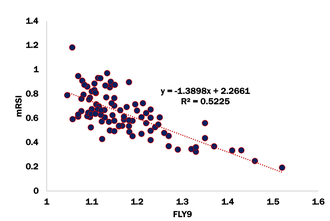

Figure 3: Linear regression between FLY9 and mRSI
p < 0.001

CONCLUSIONS & PRACTICAL APPLICATIONS

The results from this study demonstrate the continued effectiveness of using the outcomes from a maximal countermovement vertical jump in its relations to other athletic-based skills. Specifically, jump performance correlates highly, and can be a predictor of linear speed capabilities. On the contrary, jump metrics do not seem to relate well with change of direction abilities, as quantified by the CODD (505 time minus linear 9-meter time). This then assumes other physical qualities, besides the features from a CMJ, are needed for effective change of direction abilities. Further research is needed to better understand what positively effects CODD.

This data can aid strength and conditioning specialists in constantly finding ways to improve CMJ performance in their training routines. In addition, sport scientists can better profile athletes based on an athletes' simple ability to vertically jump.

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