COUNTERMOVEMENT JUMP PROFILING OF NCAA DIVISION III STUDENT-ATHLETES

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ABSTRACT

Historically, the primary metric identifying countermovement jump (CMJ) performance was jump height (JH). But now, with the advancement of sports technology, sports scientists and professionals can quantify the process and patterns behind an athlete's CMJ JH output. **PURPOSE:** the purpose of this study was to provide normative and profiling data of both the kinematics (output) and kinetics (process) of CMJ performances across a range of NCAA Division III student-athletes. **METHODS:** 236 student-athletes from an NCAA Division III institution participated in this study (105 males: 20.9 ± 1.5 years, 183.64 ± 6.84 cm, 80.87 ± 9.33 kg; 131 females: 20.38 ± 1.07 years, 167.67 ± 7.17 cm, 70.2 ± 13.88 kg). The teams included baseball (BSB), softball (SFB), men's and women's soccer (MSC, WSC), women's lacrosse (LAX), men's and women's tennis (MTN, WTN), volleyball (VB), and men's and women's basketball (WBB, MBB). The CMJ was part of their annual preseason battery of testing. All participants performed four maximal CMJ, with hands placed on their hips throughout the entire jump, on a force plate (Hawkin Dynamics, Westbrook, Maine). The specific metrics collected from each jump were JH, countermovement depth (CD), braking rate of force development (BRFD), average relative propulsive force (ARPF), relative propulsive impulse (RPI), and reactive strength index-modified (mRSI). Analysis of variance (ANOVA) was utilized to calculate significant differences in CMJ jump metrics between genders, and between teams. A Bonferroni post-hoc analysis was then used to find the specific differences. **RESULTS:** Several significant differences in jump metrics resulted between all teams. In general, males had more positive CMJ metrics compared to the females ($p < 0.001$). Within the male groups, BSB, MBB, and MSC had significantly higher JH than MTN ($p < 0.001$). MBB displayed significantly less CD during their jumps compared to other male teams ($p < 0.005$). BSB and MBB organized their jumps with higher BRFD, ARPF, and mRSI, compared to MSC and MTN ($p < 0.001$). No significant differences were shown between female teams across most CMJ metrics. But WBB displayed significant higher mRSI compared to other female teams ($p < 0.006$). **CONCLUSIONS:** Due to the differing demands of each sport, significant differences were reported across a variety of both output and process-oriented metrics during the countermovement jump. The data provided evidence of how specific training stress and adaptations create modified movement patterns across a variety of sports. **PRACTICAL APPLICATIONS:** The data presented could be used to help profile and benchmark kinematic and kinetic variables across collegiate student-athletes during a commonly used athletic assessment in the CMJ. The data provides information for recruiting, retention, and specific training and return-to-play parameters for collegiate student-athletes.

INTRODUCTION

The countermovement vertical jump is one of the most commonly-used tests to measure athleticism because of is ease to perform, time-efficiency, reliability, and highly-valuable insight into an athlete's neuromuscular abilities (6). In addition, countermovement jump height has been significantly correlated to several other athletic skills, such as swim speed (8), change of direction (5), linear sprint speed (4), muscular strength (2), golf club head speed (7), and body composition (1). Therefore, the results from an athlete's countermovement vertical jump can be very beneficial for the sake of total athleticism profiling and benchmarking.

Due to the advancements and innovation in technology, the use of force plates is becoming more available for sports scientists and strength and conditioning professionals. Because of its innovations, force plates are able to gather a plethora of data from one countermovement jump, which can be overwhelming. Specific metrics besides jump height are now becoming more focused on due to their ability to truly provide meaningful data on the movement process of the athlete that leads to the jump height outcome (3).

PURPOSE & IMPORTANCE

The purpose of this study was to profile and compare specific process and outcome metrics of the countermovement vertical jump across ten different sports at the NCAA Division III level. The data could help sports scientists in creating benchmarks for jump performance for the sake of recruiting and athletic development.

METHODS

	MALES	FEMALES	TOTAL
Total Number	105	131	236
Age	20.99 ± 1.50 years old	20.38 ± 1.07 years old	20.69 ± 1.29
Body Mass	80.87 ± 9.33 kilograms	70.2 ± 13.88 kilograms	75.54 ± 11.57
Height	183.64 ± 6.84 centimeters	167.67 ± 7.17 centimeters	175.66 ± 7.01

Table 1: Descriptive statistics of NCAAA DIII student-athletes

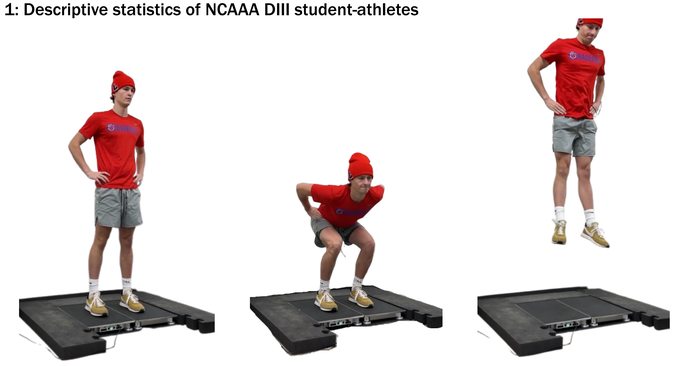

Figure 1: The Countermovement Jump

Figure 2: Dual Force Plates
(Hawkin Dynamics, Westbrook, Maine, USA)

JUMP METRICS	UNITS
Jump Height (JH)	centimeters (cm)
Countermovement Depth (CD)	centimeters (cm)
Braking Rate of Force Development (BRFD)	Newtons/second (N/s)
Average Relative Propulsive Force (ARPF)	Percent of body mass (%)
Relative Propulsive Impulse (RPI)	Newton-seconds/kilogram (N.s/kg)
Reactive Strength Index – Modified (mRSI)	Unitless ratio

Table 2: Selected jump metrics for profiling

RESULTS

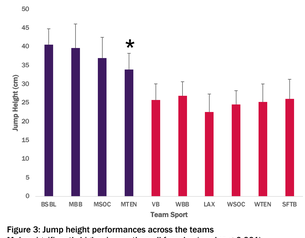

Figure 3: Jump height performances across the teams
Males significantly higher jumps than all females (p-value < 0.001)
*denotes significant difference from BSB, MBB, and MSOC (p-value < 0.001)

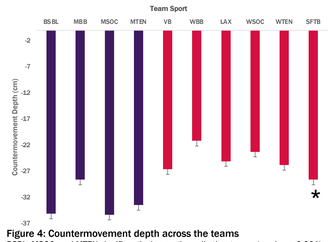

Figure 4: Countermovement depth across the teams
BSBL, MSOC, and MTEN significantly deeper than all other teams (p-value < 0.001)
*denotes significant difference from WBB and WSOC only amongst females (p-value < 0.001)

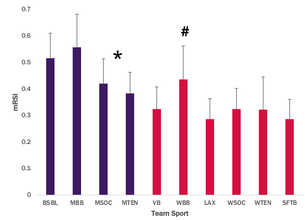

Figure 5: mRSI performances across the teams
Males significantly higher jumps than all female teams (p-value < 0.001)
*denotes significant difference from BSB and MBB (p-value < 0.001)
#denotes significant differences from all females except WTEN (p-value < 0.001)

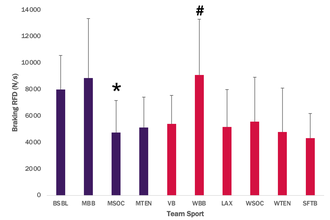

Figure 6: BRFD performances across the teams
Males significantly higher jumps than all female teams (p-value < 0.001)
*denotes significant difference from BSB and MBB (p-value < 0.001)
#denotes significant differences from VB and SFTB only amongst females (p-value < 0.001)

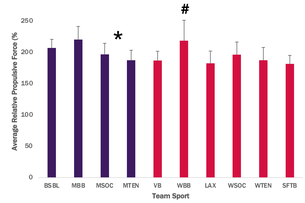

Figure 7: ARPF performances across the teams
Males significantly higher jumps than all female teams (p-value < 0.001)
*denotes significant difference from BSB and MBB (p-value < 0.001)
#denotes significant differences from VB and SFTB only amongst females (p-value < 0.001)

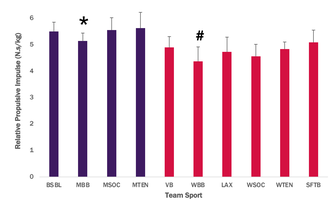

Figure 7: RPI performances across the teams
Males significantly higher jumps than all female teams (p-value < 0.001)
*denotes significant difference from BSB only amongst males (p-value < 0.001)
#denotes significant differences from VB and SFTB only amongst females (p-value < 0.001)

CONCLUSIONS & PRACTICAL APPLICATIONS

Each team sport has specific movement-pattern demands to be successful. While a countermovement jump is considered a universal skill, sports science technology is now able to distinguish different movement patterns during this common skill. The results from this study show various jumping strategies between teams. Male athletes tended to have greater jump heights than females. Specific differences in jump process exist between different sports. More profiling is warranted to draw stronger conclusions on movement pattern differences, which can then lead to more team-specific training programs.

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