Common Jump Force Profiles of College Athletes Differ by Sport, Gender, and Performance
Jennifer L. Sanfilippo\textsuperscript{1}, Jacob A. Siedlik\textsuperscript{2}, Joseph P. Weir\textsuperscript{2}, Bryan C. Heiderscheit\textsuperscript{1}
\textsuperscript{1}University of Wisconsin-Madison, Madison, WI. \textsuperscript{2}University of Kansas, Lawrence, KS.

Attempts have been made to characterize force profiles during a countermovement jump (CMJ) among athletes to explain performance differences due to gender, sport and experience. While useful, these approaches have emphasized discrete force variables thereby ignoring potentially valuable information contained in the remainder of the force-time signature. Applying methods such as principal component analysis (PCA) may better differentiate force profiles and provide additional insights into jump performance.

**Purpose:** To define common force profiles among collegiate athletes, and determine if differences exist between gender, sport and resulting jump height.

**Methods:** Division 1 collegiate athletes (n= 152 females, 334 males) from eight sports (basketball, football, golf, ice hockey, soccer, softball, volleyball, and wrestling) participated. Vertical ground reaction forces were recorded (800 Hz) for each athlete’s maximal effort CMJ, and analyzed over the entire pushoff phase. Force-time plots were normalized to peak force and jump duration prior to the statistical analyses. PCA was paired with a k-means clustering algorithm to determine relevant force-time plot groupings. Force profile distribution across gender and sports were explored using Chi-square.

**Results:** The first four principal components accounted for 85.7% of the variance in the data set. Thus, a four cluster solution was calculated defining four force profile clusters. Cluster 2 jumps (n=120; shape = extended force plateau) were associated with higher jump heights than the other clusters (p<.001, mean differences = 10.6 to 15.5%). Females most commonly exhibited cluster 3 (bimodal with even peaks) and cluster 4 (bimodal with larger second peak) force profiles (p<.001), while males were evenly distributed between clusters 2-4 with fewer cluster 1 profiles (distinct peak near take off). Specific clusters were more common among certain sports [all p<.047: basketball (cluster 3), football (cluster 2), ice hockey (clusters 3 and 4)].

**Conclusions:** Using a CMJ data set involving a variety of collegiate athletes, four distinct force profiles emerged with different profiles preferred by different sports and genders. One profile showed a marked advantage in jump height. The advantage of this force-time profile requires further study.