Dynamic Strength Index and Countermovement Jump in Female and Male Collegiate Basketball Athletes Across a Season

Taylor J. Tiessen[1], Kelly L. Lockwood[1], Michael W.R. Holmes[1], Nicole J. Chimera[1]
[1]Department of Kinesiology, Brock University, St. Catharines, Canada
Email: ttiessen@brocku.ca

Summary

Force plates are widely used in strength and conditioning to assess jump performance, providing valuable insights for training interventions. This study examined countermovement jump (CMJ), isometric mid-thigh pull (IMTP), and lower extremity kinematics across a basketball season in females and males; significant differences were identified in dynamic strength index (DSI), CMJ jump height (JH), and kinematic CMJ strategies between females and males over the season.

Introduction

DSI is the ratio of peak force in a dynamic task to peak force in a maximal strength task (CMJ:IMTP); with values <0.60 indicating a need for power-focused training and >0.80 suggesting a training emphasis on strength [1]. Variability exists in DSI between female and male athletes [2] and CMJ JH performance across a season in hockey and rugby [3,4]; however, a lack of data exists on DSI in basketball athletes. The purpose of this study was to compare DSI, CMJ JH, and lower extremity kinematics in female and male collegiate basketball athletes at four timepoints across a competitive season.

Methods

Collegiate basketball athletes (n=18; 12 females, 6 males) were assessed across four timepoints: pre-season (TP1), early-season (TP2), late-season (TP3), and off-season (TP4). Three CMJ trials and two IMTP trials were performed per athlete at each timepoint. Forces were recorded using bilateral force plates (1000Hz, Hawkin Dynamics, ME, USA). Three-dimensional kinematic data were captured through OpenCap (Stanford University, CAL, USA) using two iPads (120Hz; Apple Inc., 7th generation). Mean peak force values from CMJ and IMTP trials were used to compute DSI. Mean and standard deviation for DSI, CMJ JH, and bilateral peak ankle dorsiflexion (DF), knee flexion (KF), and hip flexion (HF) angles during the eccentric phase of CMJ were calculated. Repeated-measures ANOVA were used to identify significant differences in DSI, CMJ JH, and peak DF, KF, and HF angles between sex and across timepoints; pairwise comparisons were used for post hoc testing (p<.05, IBM SPSS, v.29).

Results and Discussion

There was a significant time x sex interaction in DSI (p=.011); females had significantly higher DSI in TP1 vs. TP2 (p=.002) and TP3 (p=.009), while males had significantly higher DSI in TP2 compared to TP1 (p=.010) and TP3 (p=.040) (Figure 1). There was a significant main effect of time for JH (p=.011); JH for males was significantly higher than females at each of the four timepoints (p<.001) (Table 1). There were no main effects for sex in peak HF (p=.378). However, HF strategies differed between sexes over time, with females using greater right HF at TP3 (p=.004) and TP4 (p=.004) vs. TP1 and greater left HF at TP2 vs. TP1 (p=.006) (Table 1). Males exhibited greater right HF at TP1 vs. TP2 (p=.033) and TP3 (p=.031). There were no significant effects for sex or time in peak DF or KF kinematics (p<.05).

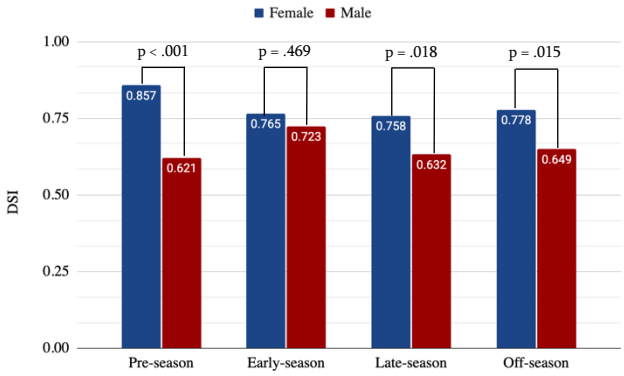

Figure 1: Mean DSI across a season for females and males.

Conclusions

Male basketball players exhibited lower DSI and higher CMJ JH than females, with males using lower HF at each timepoint and females using significantly greater HF at later timepoints. These results suggest the need for sex specific training as females may benefit from training focused on strength, while males may benefit from explosive training across a season.

References

[1] Sheppard J et al. (2011). *JASC*, **19**: 4-10.
[2] Thomas C et al. (2017). *Sports (Basel)*, **5**: 71.
[3] Gabbett T (2005). *BJSM*, **39**: 675-680.
[4] Gannon E et al. (2021). *JSCR*, **35**: 1338-134.

Table 1: Mean + SD CMJ JH and corresponding changes in peak right (R) and left (L) HF across a season in females and males.

	TP1		TP2		TP3		TP4	
	JH (cm)	Peak HF (°)	JH (cm)	Peak HF (°)	JH (cm)	Peak HF (°)	JH (cm)	Peak HF (°)
Female	28.4±3.3	R=76.0±11.4 L=75.5±11.8	28.3±3.5	R=78.5±12.4 L=78.3±12.7	29.2±4.3	R=81.9±14.1 L=81.8±13.8	29.0±3.1	R=82.5±12.6 L=80.1±10.8
Male	41.9±6.5	R=77.3±13.1 L = 80.1±15.1	43.2±6.9	R=74.8±14.8 L=74.5±16.0	45.2±6.7	R=73.4±12.5 L=73.2±13.2	45.2±6.0	R=71.4±13.9 L= 71.5±14.4