IDENTIFYING FORCE PLATE METRICS ASSOCIATED WITH INJURY RISK IN NCAA DIVISION-I FEMALE TEAM-SPORTS

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BACKGROUND

- Injuries in female college athletes have been associated with fatigue, decreased strength, poor neuromuscular control.
- Movement strategies and neuromuscular capabilities may be assessed using force plate systems during various movements, such as countermovement jumps (CMJ).
- Thus, recent interest has sparked efforts in identifying whether CMJ assessments can predict injury risk in tactical, professional, and collegiate athletes, which is dependent on the injury definition and predictor metrics, warranting additional investigation.
- **PURPOSE:** Identify whether CMJ force-time metrics are associated with incidence of non-contact lower body injuries in female collegiate athletes while controlling for age, previous injury, and sport.

METHODS

STUDY DESIGN: Retrospective cohort analysis of routine injury and performance monitoring from 2020-2022

WHO: 148 female National Collegiate Athletics Association Division I athletes

(Ice Hockey, 32; Field Hockey, 30; Soccer, 34; Lacrosse, 51).

INJURY DEFINITION: recorded by medical staff, were defined as: any non-contact lower body injury that occurred because of participating in sport competition or training within three months following CMJ testing.

COUNTERMOVEMENT JUMP TESTING (CMJ): 2 maximal effort, no arm-swing, vertical CMJs on dual force plates (502 total jump assessments).

ANALYSES: Odds ratios (OR) and their 95% confidence intervals (CI) from univariate and multivariate generalized estimating equation (GEE) models are reported with a greater risk for injury being demonstrated as values greater than one.

Although CMJ force-time metrics may appear to be associated with injury risk, the aligned differences in injury risk and eccentric abilities across sports may have negated these associations.

Thus, CMJs from one timepoint may not be useful for injury predictability, but assessing and improving eccentric capabilities across sports may help combat non-contact lower limb injuries in female sports.

Table 1. Multivariate generalized estimating equations with binary outcome (injury status).

Predictor Variable	Eccentric Deceleration Impulse (N×s)	Eccentric Mean Power (W×kg^{-1})	Eccentric Mean Force Asym (%)	Eccentric Deceleration Impulse Asym (%)
Age (years)	0.86 [0.69;1.07]	0.85 [0.68;1.05]	0.84 [0.68;1.03]	0.83 [0.66;1.03]
Previously Injured	2.55 [1.23;5.31] *	2.39 [1.16;4.93]*	2.41 [1.18;4.95] *	2.57 [1.25;5.27] *
Sport Ice Hockey	0.14 [0.03;0.62]*	0.12 [0.03;0.55] *	0.12 [0.03;0.48] *	0.13 [0.03;0.50]*
Sport Lacrosse	0.67 [0.31;1.43]	0.66 [0.31;1.41]	0.66 [0.31;1.40]	0.67 [0.32;1.44]
Sport Soccer	0.48 [0.26;0.88]*	0.49 [0.27;0.89]*	0.50 [0.27;0.91] *	0.50 [0.28;0.89]*
Eccentric Deceleration Impulse (N×s)	0.99 [0.97;1.02]			
Eccentric Mean Power (W×kg^{-1})		0.98 [0.68;1.41]		
Eccentric Mean Force Asym (%)			0.99 [0.94;1.04]	
Eccentric Deceleration Impulse Asym (%)				0.98 [0.95;1.02]

*, Statistically significant association with injury status at p< 0.05; Reference Sport was Field Hockey

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RESULTS

- A total of 40 athletes were injured within 3 months of CMJ testing.
- Majority of injuries occurred in Field Hockey (38.8%), followed by Soccer (24.4%), Lacrosse (13.6%), and Ice Hockey (5.9%).
- Eleven of 40 athletes (27.5%) sustained additional injuries after their first injury during the study period.
- Majority of injuries occurred at the knee (35.6%) and thigh musculature (17.8%) with pain (35.6%) and strains or sprains (28.9%) being the most common type of injury.
- Eccentric Deceleration Impulse and Eccentric Mean Power were significantly lower when the jump occurred within 3 months of an injury (Table 2).
- Those who sustained an injury were more likely to sustain another injury (6.52 [CI95% = 3.71; 11.46]).
- As age increased by one year, injury odds ratios decreased (0.80 [CI95% = 0.66; 0.98]).
- Eccentric Mean Power (0.75 [0.56;1.00]) and Eccentric Mean Force Asymmetry (0.96 [0.93;1.00]) were significant predictors of injury after controlling for age and previous injury.
- After including sport as a predictor variable no CMJ force-time metrics were significant Table 1.

Table 2. Countermovement Jump Force-Time Metrics by Injury Status.

	Non-Injured	Injured
Deceleration Impulse (N×s)	85.00±16.21	79.37±11.57 *
Eccentric Mean Power (W×kg^{-1})	6.48±0.95	6.19±0.81 *
Eccentric Mean Force Asym (%)	6.39±5.23	5.87±4.01
Deceleration Impulse Asym (%)	7.84±6.30	7.35±5.82
Concentric Mean Power (W×kg^{-1})	24.28±3.40	24.31±3.09
Concentric Impulse (N×s)	156.05±20.71	153.12±17.08
Concentric Impulse Asym (%)	4.88±3.96	4.74±4.09
Concentric Mean Force Asym (%)	4.91±3.99	4.74±4.10
Jump Height (cm)	30.24±5.48	29.42±4.73
RSI Modified (m×s^{-1})	41.93±9.56	40.52±8.36
Landing Impulse Asym (%)	14.20±11.29	12.97±12.37

*, statistically different than non-injured counterparts at p < 0.05

Asym, limb asymmetry; RSI, reactive strength index

CONCLUSIONS

- As performances in the eccentric phase increased the odds of a non-contact lower extremity injury decreased.
- After controlling for age, previous injury, and sport, no CMJ force-time metrics significantly predicted injury.

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