

Preseason Screening of Collegiate Football Players for Assessment of Injury Risk

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BACKGROUND AND PURPOSE

- Football players sustain an estimated 1.2 million injuries per year, 40% of which are sprains and strains¹
- Sports injury prevention is widely advocated, yet little research evidence supports specific risk-reduction methods
- Reduction of risk for sport-related musculoskeletal injuries may depend on individualization of interventions
- Functional tests, survey responses, and individual attributes may differentiate high-risk from low-risk athletes²
- Research associating pre-season status and subsequent injury has not typically accounted for exposure duration
- The hazard imposed by high-risk pre-season status can be quantified by Cox regression analysis
- The purpose of this study was to identify any pre-season characteristics or performance deficiencies among college football players that may predict subsequent occurrence of a core or lower extremity (LE) sprain or strain

PARTICIPANTS AND PROCEDURES

- 85 NCAA Division I-FCS football players who were available for pre-participation screening
- Electronic injury documentation system used for injury surveillance throughout the season
 - Separate analyses conducted with 2 different operational definitions of injury:
 - Core or LE sprain or strain that required evaluation and also required some amount of treatment
 - Core or LE sprain or strain that resulted in some amount of "lost time" from full sport participation
- Relative predictive power of exposure to game conditions and pre-participation measures of injury risks compared
 - Anthropometric variables: Body Mass Index (BMI), estimated Mass Moment of Inertia (MMOI)
 - Core muscle endurance: Horizontal Trunk Hold (HTH), Wall Sit Hold (WSH; average of right & left extremities)
 - Low back dysfunction survey: Oswestry Disability Index (ODI)
 - Neuromuscular function: Visuomotor reaction time (RT), Y-balance anterior reach (Rch)
 - RT derived from Dynavision D2 system (Dynavision Intl., West Chester, OH), 60-s "Proactive" test
 - Reach distance (average of right and left extremities) normalized to leg length (RchAvg)
 - Reach asymmetry (RchAsym; bilateral difference between right & left extremities)
- Data analysis procedures for assessment of association between potential predictors and injury occurrence
 - Receiver operating characteristic (ROC) analyses used to identify cut-points for dichotomization of variables
 - Logistic regression analysis utilized to develop prediction models
 - Cox regression analysis utilized to assess the hazard imposed by risk factors in relation to exposure time

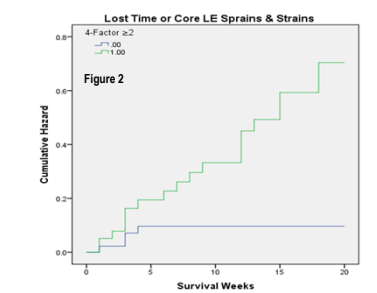
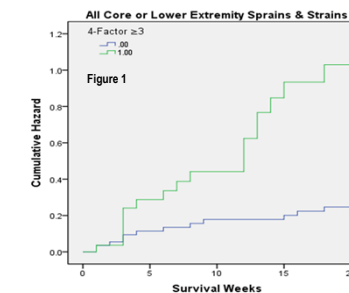
RESULTS

- Univariable analyses identified 9 variables that were associated with injury occurrence (Table 1)
- Logistic regression analyses identified different sets of predictors for the 2 injury definitions (Table 2)
 - Starter ≥ 1 game, RchAsym $\geq 2.8\%$, and ODI ≥ 4 included in both prediction models
 - HTH ≤ 52 s included in 4-factor prediction model for all core or LE sprains and strains
 - MMOI ≥ 449 kg-m² included in 4-factor prediction model for lost time core or LE sprains and strains
- For both prediction models, number of cumulative risk factors was associated with injury incidence (Table 3)
- Cumulative hazard for high-risk vs. low-risk players clearly differed over course of football season (Figures 1&2)

Table 1 All Core or LE Sprains & Strains				Lost Time Core or LE Strains & Strains			
Predictor	Cut-Point	Odds Ratio	P-value	Predictor	Cut-Point	Odds Ratio	P-value
Starter	≥ 1 game	4.47	.002	Starter	≥ 1 game	3.41	.014
RchAsym	$\geq 2.8\%$	4.75	.011	RchAsym	$\geq 2.8\%$	5.00	.022
ODI	≥ 4	2.39	.065	ODI	≥ 4	2.01	.139
HTH	≤ 52 s	2.36	.070	HTH	≤ 52 s	2.43	.089
MMOI	≥ 449 kg-m ²	2.49	.096	MMOI	≥ 483 kg-m ²	6.32	.043
Game Play	≥ 10 games	3.78	.005	Game Play	≥ 10 games	3.17	.021
RchAvg	≤ 0.505	1.91	.197	RchAvg	≤ 0.534	1.46	.312
RT*	≥ 765 ms	1.98	.147	RT*	≥ 765 ms	1.80	.209
BMI	≥ 29.2	1.80	.146	BMI	≥ 37.1	6.32	.043
* n=76 (23 injured; 53 uninjured)				* n=76 (21 injured; 55 uninjured)			

Table 2 All Core or LE Sprains & Strains				Lost Time Core or LE Strains & Strains			
Predictor	Cut-Point	Odds Ratio	Hazard Ratio	Predictor	Cut-Point	Odds Ratio	Hazard Ratio
Starter	≥ 1 game	4.55	2.51	Starter	≥ 1 game	3.66	2.46
RchAsym	$\geq 2.8\%$	5.87	3.89	RchAsym	$\geq 2.8\%$	5.28	4.41
ODI	≥ 4	2.43	1.83	ODI	≥ 4	2.22	2.20
HTH	≤ 52 s	2.10	1.64	MMOI	≥ 483 kg-m ²	7.66	4.55
4-Factor Model	≥ 3 Factors +	6.75	3.75	4-Factor Model	≥ 2 Factors +	9.27	6.24

Table 3 All Core or LE Sprains & Strains				Lost Time Core or LE Sprains & Strains			
Risk Factors	Injury	No Injury	Incidence	Risk Factors	Injury	No Injury	Incidence
0	0	5	0.00%	0	0	8	0.00%
1	2	15	11.8%	1	4	33	10.8%
2	10	25	28.6%	2	12	15	44.4%
3	12	8	60.0%	3	7	6	53.8%
4	6	2	75.0%	4	0	0	-
Total	30	55	n=85	Total	23	62	n=85



CLINICAL RELEVANCE

- Preseason screening can classify the injury risk level of collegiate football players
- High-risk players exhibit greater injury hazard than low-risk players over the entire season
- Although high level of exposure to game conditions is clearly a major risk factor, players who possess multiple risk factors appear to sustain more injuries whether starters or non-starters

REFERENCES

- Saal JA. Common American football injuries. *Sports Med*. 1991;12:132-147.
- Gabbe BJ, et al. Reliability of common lower extremity musculoskeletal screening tests. *Phys Ther Sport*. 2004;5:90-97.
- Bahr B, Krosshaug T. Understanding injury mechanisms: a key component of preventing injuries in sport. *Br J Sports Med*. 2005;39:324-329.
- Kiesel K, et al. Can serious injury in professional football be predicted by a preseason functional movement screen? *N Am J Sports Phys Ther*. 2007; 2:147-158.
- Vesia M, et al. Correlations of selected psychomotor and visuomotor tests with initial Dynavision performance. *Percept Motor Skills*. 2008;107:14-20.