COMPARISON OF TWO MODELS FOR PREDICTION OF CORE AND LOWER EXTREMITY SPRAINS AND STRAINS IN COLLEGE FOOTBALL PLAYERS

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BACKGROUND AND PURPOSE

- Football injury incidence greatest among NCAA sports; lower extremity (LE) sprains and strains most common[1]
  - LE sprains and strains are the most common football injury types (3.9/1000 exposures)
- Pre-participation identification of injury risk factors is a key consideration for prevention of sprains and strains[2]
  - Individualized training for high-risk athletes may facilitate more efficient utilization of time and resources
- Optimal core muscle endurance is believed to be an important factor in LE injury prevention[1]
  - Performance capabilities of core muscles contribute to dynamic stability of LE joints
- Survey instruments for quantification of joint function have been shown to predict football injury risk[3]
  - 0-100 function/disability scale appears to be more valuable than simple yes-no injury history questioning
- The purposes of this study were to validate a previously developed model for prediction of core or LE sprain or strain among college football players by analyzing a three-year dataset, and to compare it to an alternative model

SUBJECTS AND PROCEDURES

- 256 NCAA Division I-FCS football players who were available for pre-participation screening
  - 2009: n = 83; 2010: n = 88; 2011: n = 85
  - Age: 19.7 1.5 years; Height: 1.84 0.08 m; Weight: 101.08 19.28 kg
  - Players who participated more than one year were treated as separate cases for each year
- Exclusionary criteria:
  - Injury-imposed physical limitations at the time of testing
  - Non-scholarship players who were not available on day of testing
- Electronic injury documentation system used for injury surveillance throughout each of the three seasons
  - Core or LE sprain or strain that required evaluation by athletic trainer and modification of sport activity
- Relative predictive power of survey scores compared to that of other pre-participation measures of injury risk
  - Anthropometric variables : Body Mass Index (BMI), Estimated Moment of Inertia (MOI)
  - Core muscle endurance: Trunk Flexion Hold (TFH), Wall Sit Hold (WSH), Horizontal Trunk Hold (HTH)
  - Joint function surveys: Oswestry Disability Index (ODI), Foot and Ankle Ability Measure - Sport score (FAAM-S), International Knee Documentation Committee knee function score (IKDC)
  - Predisposing factors: Injury history and high frequency of exposure to game conditions
- Receiver operating characteristic (ROC) analysis utilized to establish dichotomization cut-point for each variable
- Fisher's exact test, odds ratio (OR), and relative risk (RR) were used to assess associations with injury occurrence
  - Separate analyses performed to compare predictive power of a previously developed 3-factor model that included starter status, ODI, and WSH with a 3-factor model that was based on survey scores only

RESULTS

- Results of univariable analysis of each potential predictor that demonstrated a meaningful association between exposure and injury from the 3-season cumulative dataset presented in Table 1
- Comparison of two different 3-factor prediction models presented in Tables 2-7 and Figures 1-2
- 3-Factor Model A (derived from previous single-season analyses: Starter Status, ODI, WSH)
- 3-Factor Model B (derived from joint function survey scores: IKDC, FAAM-S, ODI)

Table 1. 3-Season Association Between Exposure and Injury Occurrence

Predictor	Cut-Point	AUC	P-value	Sn	Sp	OR	90% CI	RR	90% CI
Starter Status	≥1 game	.66	>.001	.61	.72	4.03	2.58 – 6.29	2.23	1.72 – 2.89
Games Played	≥4 games	.65	>.001	.74	.50	2.78	1.76 – 4.38	1.89	1.50 – 2.57
IKDC Score	≤98	.62	.001	.58	.64	2.49	1.62 – 3.82	1.71	1.33 – 2.21
FAAM-S Score	≤98	.56	.005	.22	.90	2.65	1.46 – 4.79	1.65	1.27 – 2.14
ODI Score	≥4	.62	.002	.41	.77	2.32	1.47 – 3.67	1.60	1.26 – 2.04
Wall Sit Hold	≤88-41-30 s	.55	.007	.58	.58	1.94	1.27 – 2.97	1.49	1.15 – 1.92
Moment of Inertia	≥450 kg·m²	.53	.036	.18	.90	2.08	1.13 – 3.84	1.48	1.11 – 1.97
Body Mass Index	≥30.5	.54	.012	.45	.70	1.88	1.21 – 2.90	1.44	1.13 – 1.84

Table 2. Model A – Starter Status, High ODI, Low WSH

Risk Factors	Injury	No Injury	Incidence
0	9	47	16.1%
1	36	76	32.1%
2 or 3	58	30	44.5%
Total	103	153	

Table 3. Model A – Odds Ratio and Relative Risk

Risk Factors	1	2 or 3
0	OR = 2.47 RR = 1.99	OR = 10.10 RR = 2.76

Table 4. Model B – Low IKDC, Low FAAM-S, High ODI

Risk Factors	Injury	No Injury	Incidence
0	27	79	25.5%
1	35	50	41.2%
2 or 3	41	24	63.1%
Total	103	153	

Table 5. Model B – Odds Ratio and Relative Risk

Risk Factors	1	2 or 3
0	OR = 2.05 RR = 1.62	OR = 5.00 RR = 2.47

Figure1. Model A – ROC Curve

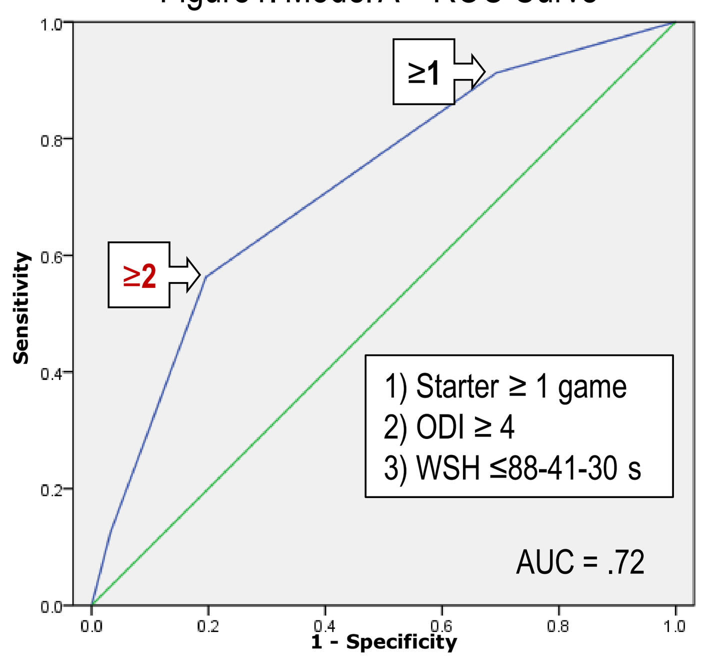

Table 6. Model A – Discrimination Power

	Injury	No Injury
≥ 2 Factors	58	30
0 or 1 Factor	45	123
Total	103	153

Fisher's Exact One-Sided p < .001

Sensitivity: .56 Specificity: .80

+LR = 2.87 –LR = .54

Odds Ratio = 2.87 / .54 = 5.28 90% CI: 3.31 – 8.44

Relative Risk = .659/.268 = 2.46 90% CI: 1.93 - 3.14

Figure 2. Model B – ROC Curve

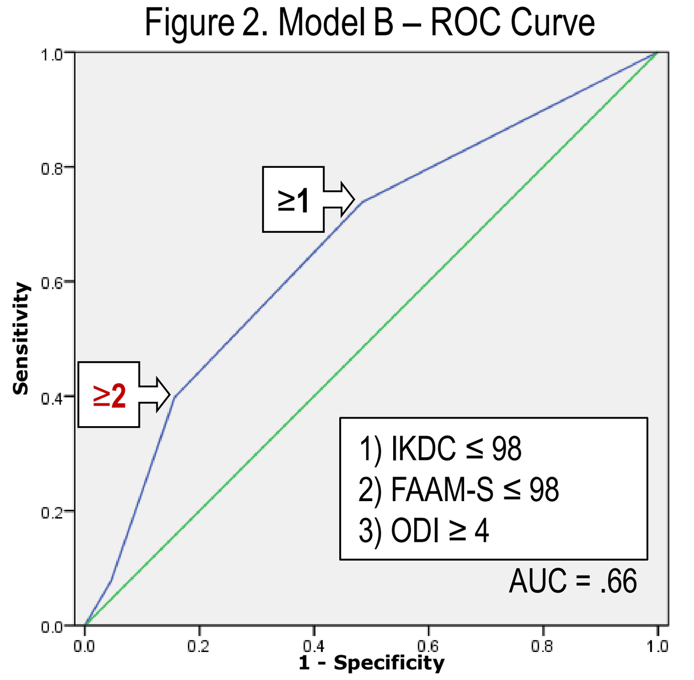

Table 7. Model B – Discrimination Power

	Injury	No Injury
≥ 2 Factors	41	24
0 or 1 Factor	62	129
Total	103	153

Fisher's Exact One-Sided p < .001

Sensitivity = .40 Specificity = .84

+LR = 2.54 –LR = .71

Odds Ratio = 2.54 / .71 = 3.55 90% CI: 2.17 – 5.82

Relative Risk = .631/.325 = 1.94 90% CI: 1.54 - 2.45

CONCLUSIONS

- The results of the analysis of 3 consecutive seasons of cumulative football injury data validate the predictive value of the previously developed model that included Starter Status, ODI, and WSH
  - Game exposure (games started or games played) is a factor that can be reasonably anticipated prior to the beginning of a season, but it cannot be precisely quantified prospectively
  - Although the WSH (and other core muscle endurance tests) provide valuable information to quantify injury risk, the administration of surveys requires very little expenditure of time and effort
- The 3-factor prediction model based solely on joint function survey scores (IKDC, FAAM-S, ODI) provided a level of discriminatory power that approached the level of the previously developed 3-factor mode

REFERENCES

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3. Wilkerson, GB., Giles, JL., & Seibel, DK. Prediction of core and lower extremity strains and sprains in collegiate football players: A preliminary study. *J Athl Train. 2012;7 (in press).*