Quantification of Ankle Sprain Risk Among College Football Players

Jessica L. Guadagno, MS, ATC, Gary B. Wilkerson, EdD, ATC

THE UNIVERSITY of TENNESSEE CHATTANOOGA

BACKGROUND AND PURPOSE

- Ankle ligament sprains are the most common injuries that result from participation in sports[1]
- Lateral, medial, and syndesmotic ankle sprains account for approximately 13% of all football injuries[2]
- Studies pertaining to risk factors for ankle sprain occurrence have generated inconsistent findings[3-7]
- Reported risk factors include:
  - Sport/gender
  - Postural balance
  - Shoe type
  - Foot alignment
  - Level of competition
  - Antagonist strength ratio
  - Body mass index
  - History of ankle sprain
  - Estimated mass moment of inertia (MOI)
- Identification of players who possess elevated risk may enhance the effectiveness of preventive interventions
- The purpose of this study was to evaluate anthropometric factors, core muscle endurance, self-rated joint function, injury history, and game exposure as predictors of ankle sprain occurrence in college football players

SUBJECTS AND PROCEDURES

- 173 NCAA Division I-FCS football players who participated in either one or both of two consecutive seasons
  - Age (19.7 1.4 years), Height (184.6 7.9 cm), Weight (102.4 19.3 kg)
  - 52 participated both years; treated as separate cases for each year
- Potential predictors of ankle sprain quantified at pre-participation physical examination prior to first practice session
  - Anthropometric factors: Height, weight, estimated mass moment of inertia (MOI), foot width index (FWI)
  - Core muscle endurance: Trunk flexion hold (TFH), horizontal trunk hold (HTH), wall sit hold (WSH)
  - Self-rated joint function: Foot and Ankle Ability Measure-Sport (FAAM-S), Oswestry Disability Index (ODI)
  - History of core and/or lower extremity injury
- Electronic injury documentation system used for injury surveillance throughout both seasons
  - Ankle sprain defined as acute lateral, medial, and/or syndesmotic ligament injury
  - An injury that required evaluation by athletic trainer and modification of sport activity to any extent
- Games played (GP) and games started (GS) tracked throughout both seasons
- Data analysis procedures
  - Receiver operating characteristic (ROC) analysis used to identify high-risk versus low-risk cut-points
  - Univariable analyses assessed sensitivity (Sn), specificity (Sp), odds ratio (OR), and relative risk (RR)
  - Logistic regression analysis used to identify a set of 3-5 strongest predictors
  - Final prediction model evaluated on the basis of its Sn, Sp, OR, and RR

RESULTS

- Over the course of the two seasons, 28 ankle sprains were sustained by 26 players
  - 20 lateral, 1 medial, and 7 syndesmotic
- Anthropometric factors, self-ratings of joint function, and previous lower extremity injuries were found to be stronger than core endurance performance values as predictors of ankle sprain (Table 1)
- Backward step-wise logistic regression analysis yielded a 5-factor prediction model that included:
  - Playing in ≥ 4 games
  - FAAM-S score ≤ 95
  - History of hamstring strain (HS Hx)
  - MOI (kg·m^2)
  - History of low back or sacroiliac injury (LBSI Hx)
- Each of the factors retained by logistic regression analysis yielded an adjusted odds ratio greater than 2.5
  - A 5-factor prediction model with ≥ 2 positive factors was found to have an OR of 6.75 and RR of 5.31
  - The same prediction model with ≥ 3 positive factors was found to have an OR of 8.19 and RR of 4.97

Table 1

Predictor	Cut Pt.	Sn	Sp	OR	RR
GP	≥4 games	.85	.46	4.73	3.92
GS	≥ 1 game	.69	.66	4.37	3.47
FAAM-S	≤95	.23	.91	4.24	2.99
BMI	≥27.6	.81	.40	2.82	2.46
HS Hx	+	.46	.78	2.96	2.44
MOI	≥338 kg·m^2	.73	.50	2.75	2.39
HTH	≤28 sec	.54	.70	2.73	2.31
FWI	≥.44	.60	.61	2.35	2.06
LBSI Hx	+	.15	.93	2.25	1.92
AS Hx*	+	.35	.73	1.42	1.34
ODI	≥2	.39	.63	1.08	1.06

*AS Hx = Ankle Sprain History

Table 2

Predictor	P-Value	Adj. OR
GP	0.003	6.26
MOI	0.014	3.59
FAAM-S	0.060	3.19
LBSI Hx	0.117	3.06
HS Hx	0.056	2.53

Table 3

Risk Factors	Ankle Sprain			Injury Incidence
	No	Yes	Total	
0	22	0	22	0.0%
1	59	4	63	6.3%
2	50	9	59	15.3%
3	14	11	25	44.0%
4	2	2	4	50.0%
Total	147	26	173	

Figure 1. 5-Factor ROC Curve

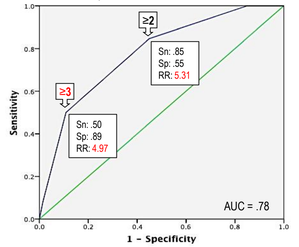

Figure 2. Cumulative Injury Incidence

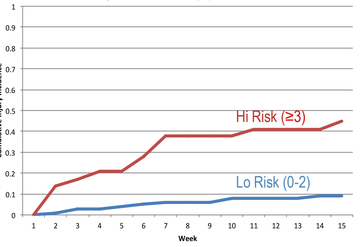

Table 4

5-Factor Model		
Factors +	Injury	No Injury
≥ 3	13	16
0 - 2	13	131
Total	26	147

Table 5

5-Factor Model ≥ 3 vs. 0-2 Positive Factors
Fisher's Exact One-Sided p < .001
Sensitivity: .50 Specificity: .89
Odds Ratio: 8.19 90% CI: 3.78 – 17.83
Relative Risk= .448 / .090 = 4.97 90% CI: 2.86 – 8.62

CLINICAL RELEVANCE

- The cut-point for the 5-factor model could be chosen as either ≥ 2 or ≥ 3 positive factors
  - ≥ 2 positive factors yields greatest sensitivity, thereby missing fewer cases
  - ≥ 3 positive factors yields greater specificity, thereby facilitating concentration of time and resources on highest-risk athletes
- Contrary to previous research findings, history of ankle sprain did not prove to be one of the strongest predictors
- BMI, HTH and FWI are each strong predictors individually, but were not retained in the logistic regression analysis model
- The majority of ankle sprains occurred within the first 7 weeks of participation, but difference between groups persisted (Figure 2)
- Factors with the greatest predictive power are not directly modifiable, but may be offset to some extent by preventive measures
  - Players in the high-risk category should be prophylactically taped or braced
  - Modifiable factors such as muscle strength, neuromuscular control, and postural stability should be addressed to reduce risk

REFERENCES

1. Fallat L et al. Sprained ankle syndrome: prevalence and analysis of 639 acute injuries. *J Foot Ankle Surg.* 1998;37:280-285.
2. Marshall SW et al. Fall sports qualifying report: 2004-2009 academic years. Datalys Center for Sports Injury Research and Prevention: Indianapolis, IN. December 2009.
3. Beynnon BD et al. Predictive factors for lateral ankle sprains: a literature review. *J Athl Train.* 2002;37:376-380.
4. Waterman BR et al. Risk factors for syndesmotic and medial ankle sprain. *Am J Sports Med.* 2011;39:992-998.
5. Milgrom C et al. Risk factors for lateral ankle sprain: a prospective study among military recruits. *Foot Ankle.* 1991;12:26-30.
6. Beynnon BD et al. First-time inversion ankle ligament trauma. *Am J Sports Med.* 2005;33:1485-1491.
7. McHugh MP et al. The effectiveness of balance training intervention in reducing the incidence of noncontact ankle sprains in high school football players. *Am J Sports Med.* 2007;35:1289-1294.