Lower Extremity Injury Risk Among College Athletes Participating in Non-Contact Sports

Stephanie Medina, MS, ATC, Casey Chiesa, MS, ATC, Gary B. Wilkerson, EdD, ATC, Marisa A. Colston, PhD, ATC

THE UNIVERSITY of TENNESSEE CHATTANOOGA

BACKGROUND AND PURPOSE

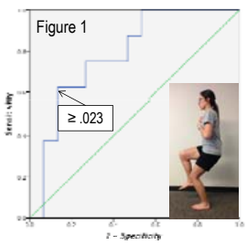
- Athletes with poor postural stability have been shown to possess elevated risk for lower extremity (LE) injury[1-3]
- An association between rapid fatigue of the core musculature and acute core or LE injury has been documented[2]
  - Relatively little evidence currently exists to associate pre-participation status to subsequent overuse injury
- Prior history of LE injury has been associated with increased risk for subsequent injury[4]
- The purpose of this study was to identify predictors of chronic and acute LE injuries in college athletes who participate in non-contact sports on the basis of pre-participation survey responses and neuromuscular capabilities

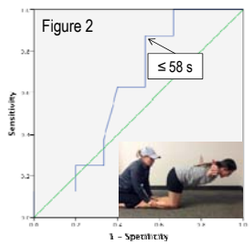
PARTICIPANTS AND PROCEDURES

- Participants were 23 NCAA Division I non-contact athletes who were available for pre-participation screening
  - Cross-Country (2 male; 8 female), Men's Tennis (8), Golf (2 male; 3 female)
- Electronic documentation system used to record any injury that occurred during subsequent fall sport season
  - Injury definition: Core or LE (Core/LE) sprain or strain that required evaluation and treatment
- Relative predictive power of injury risk factors compared through univariable analyses
  - History of injury within the previous 12-month period derived from pre-participation survey
  - Body Mass Index (BMI) calculated from height and body weight measurements
  - Core muscle endurance assessed by Horizontal Trunk Hold (HTH) ; time (seconds) to failure (Figure 1)
  - Postural sway quantified by Sway Balance smart phone app (Sway Medical, Tulsa, OK)
    - Single-leg squat position (45 degrees knee flexion) maintained for 10 seconds
    - Composite postural sway value derived from rate of body mass acceleration (m/s^3) in 3 planes
      - Variability (postural sway) represented by standard deviation of mean value within each plane
      - Anterior-posterior, medial-lateral, and superior-inferior variability averaged for both extremities
      - Right and left extremity values averaged to produce a single postural sway value
- Data analysis methods:
  - Receiver operating characteristic (ROC) analyses identified cut-points for dichotomization of variables
  - Cross-tabulation analyses used to assess univariable exposure-outcome associations
  - Logistic regression analysis used to identify the strongest set of predictor variables

RESULTS

- Between initiation of practice sessions and end of the fall sport season, 35% (8/23) of the athletes were injured
  - 2 low back strain, 2 sacroiliac sprain, 1 gluteal strain, 1 hamstring strain, 2 medial tibial stress syndrome
- Univariable analysis identified 3 factors as providing substantial predictive power for Core/LE injury (Figures 1- 3)
  - Self-reported injury within previous 12 months did not predict subsequent Core/LE injury occurrence
  - Sway, HTH, and BMI demonstrated strong association with Core/LE injury occurrence
    - Athletes with Sway ≥ .023 were almost 11 X more likely to sustain a Core/LE injury (Table 1)
    - HTH time ≤ 58 s demonstrated high sensitivity, but relatively poor specificity (Table 2)
    - 63% (5/8) of athletes with BMI ≥ 22.7 were injured vs. 20% (3/15) of athletes with BMI < 22.7 (Table 3)
- Logistic regression analysis identified best predictor set for Core/LE injury (Table 4)
  - Sway, HTH, and BMI included in 3-factor prediction model (Figure 4,Table 5)
    - Logistic regression model χ^2 (3) = 13.10; P = .004; Naglekerke R^2 = .60
    - ≥ 2 positive factors: χ^2 (1) = 9.67; Fisher's exact 1-sided P = .003
      - Sensitivity 88%, Specificity 80%, OR = 28 (90% CI: 3.59 – 218.40)





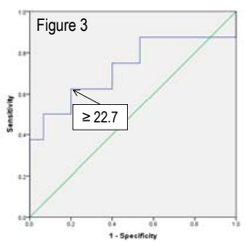


Table 1		
Sway	Injury	No Injury
≥ .023	5	2
< .023	3	13
Total	8	15

Fisher's exact p = .026
Sensitivity 63% Specificity 87%
OR = 10.83 (90% CI: 1.92 – 61.30)

Table 2		
HTH	Injury	No Injury
≤ 58 s	7	8
> 58 s	1	7
Total	8	15

Fisher's exact p = .118
Sensitivity 88% Specificity 47%
OR = 6.13 (90% CI: 0.87 – 43.21)

Table 3		
BMI	Injury	No Injury
≥ 22.7	5	3
< 22.7	3	12
Total	8	15

Fisher's exact p = .058
Sensitivity 63% Specificity 80%
OR = 6.67 (90% CI: 1.34 – 33.13)

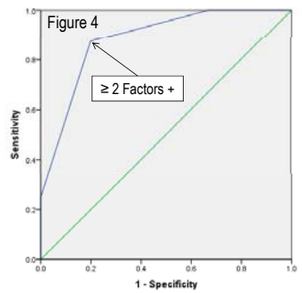


Table 4			
Factors +	Injury	No Injury	Incidence
0	0	5	0%
1	1	7	13%
2	5	3	63%
3	2	0	100%
Total	8	15	35%

Table 5		
3-Factor Model	Injury	No Injury
≥ 2	7	8
0 or 1	1	7
Total	8	15

OR = 28

CLINICAL RELEVANCE

- Pre-season screening of various attributes can quantify the injury risk level of individual college athletes
  - Odds for Core/LE injury was 28 X greater for players who exhibited 2 or more of the identified risk factors
  - Injury incidence dramatically increased with each additional positive risk factor
- The measures used to develop the prediction model can be easily acquired during pre-participation screening
  - Single-leg squat postural sway can be quantified in < 2 minutes per athlete
  - HTH test can be administered in 1-2 minutes per athlete
- Individualized training that targets deficiencies in postural stability and core endurance may reduce injury risk

REFERENCES

1. Plisky PJ, Rauh MJ, Kaminski TW, Underwood FB. Star excursion balance test as a predictor of lower extremity injury in high school basketball players. *J Orthop Sports Phys Ther.* 2006;36(12):911-919.
2. 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;47(3):264-272.
3. McGuine TA, Greene JJ, Best T, Leverson G. Balance as a predictor of ankle injuries in high school basketball players. *Clin J Sports Med.* 2000;10(4): 239-244.
4. Steffen K, Myklebust G, Anderson TE, Holme I, Bahr R. Self-Reported injury history and lower limb function as risk factors for injuries in female youth soccer. *Am J Sports Med.* 2008;36(4):700-708.