Prediction of Overuse Syndromes in College Athletes through Preseason Screening

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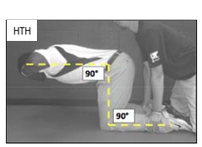
BACKGROUND AND PURPOSE

- Lower extremity (LE) injuries account for over 50% of all injuries sustained by intercollegiate athletes[1]
  - 8.13 injuries per 1000 athlete-exposures
- Pre-participation identification of risk factors may enhance the effectiveness of injury prevention efforts
  - Poor core muscle endurance has been associated with the occurrence of acute LE sprains and strains[2]
  - Pre-participation surveys relating to functional status also appear to have injury prediction value[3,4]
- Limited research evidence is available to guide screening for identification of overuse injury risk[5]
- The purpose of this study was to identify any pre-participation performance capabilities, physical limitations, or personal characteristics associated with subsequent occurrence of an overuse core or LE musculoskeletal injury

PARTICIPANTS AND PROCEDURES

- Participants were 100 NCAA Division I college athletes from 9 different teams
  - 30 male athletes (Tennis, Golf, Track/ Cross Country)
  - 70 female athletes (Tennis, Golf, Track/ Cross Country, Volleyball, Soccer, Basketball)
- Potential predictors of injury, quantified at pre-participation physical examination prior to first practice session
  - Core muscle endurance tests: Wall Sit Hold (WSH), Horizontal Trunk Hold (HTH), Y-Balance
  - Survey for effects of previous injuries on functional capabilities: Assessment of Functional Status (AFS)
- Electronic injury documentation system used for injury surveillance throughout sport season
  - Overuse injury: Core or LE musculoskeletal injury without clearly defined onset
  - Acute injury: Core or LE musculoskeletal sprain or strain associated with clearly defined traumatic event
- Data analysis procedures:
  - Receiver operating characteristic (ROC) analyses utilized to establish cut-points for each variable
  - Odds ratio (OR), and relative risk (RR) calculated to assess associations with injury occurrence
  - Logistic regression analysis used to identify the strongest set of predictors for core or LE overuse injury



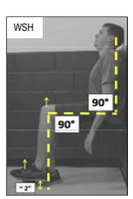


Table 1

Variable	Gender	Mean	SD
AFS	male	94.33	8.05
	female	86.09	13.87
WSHAsym	male	24.95	18.88
	female	24.44	17.69
HTH	male	56.47	25.29
	female	54.19	30.40

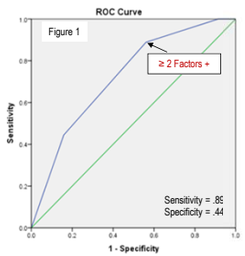
Table 2

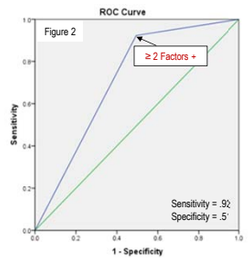
Any Core or LE Musculoskeletal Injury Injured = 18 Uninjured = 82				Overuse Core or LE Musculoskeletal Injury Injured = 13 Uninjured = 87				Acute Core or LE Musculoskeletal Injury Injured = 7 Uninjured = 93			
Predictor	**Cut-Point**	**OR**	**P-value**	**Predictor**	**Cut-Point**	**OR**	**P-value**	**Predictor**	**Cut-Point**	**OR**	**P-value**
AFS	≤ 97	4.15	.044	AFS	≤ 97	2.61	.184	AFS	≤ 95	4.33	.149
HTH	≤ 62 s	3.72	.033	HTH	≤ 61 s	3.88	.063	HTH	≤ 31 s	5.19	.047
WSHAsym	≥ 25%	2.33	.088	WSHAsym	≥ 32 %	3.67	.033	WSHAsym	≥ 24%	1.77	.367

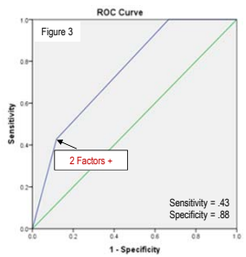
Table 3

Any Core or LE Musculoskeletal Injury Injured = 18 Uninjured = 82				Overuse Core or LE Musculoskeletal Injury Injured = 13 Uninjured = 87				Acute Core or LE Musculoskeletal Injury Injured = 7 Uninjured = 93			
Predictor	**Cut-Point**	**Adj OR***	**90% CI**	**Predictor**	**Cut-Point**	**Adj OR**	**90% CI**	**Predictor**	**Cut-Point**	**Adj OR**	**90% CI**
AFS	≤ 97	4.17	1.11, 15.58	AFS	≤ 97	2.52	0.65, 9.82	AFS	≤ 95	4.36	0.69, 27.67
HTH	≤ 62 s	3.90	1.26, 12.12	HTH	≤ 61 s	4.12	1.07, 15.87	HTH	≤ 31 s	5.24	1.35, 20.29
WSHAsym	≥ 25%	2.64	1.03, 6.76	WSHAsym	≥ 32 %	3.91	1.38, 11.09	WSHAsym	≥ 24%	-	-
3-Factor Model	**≥ 2 Factors +**	**OR = 6.26**	**1.73, 26.27**	**3-Factor Model**	**≥ 2 Factors +**	**OR = 12.28**	**2.14, 70.52**	**2-Factor Model**	**2 Factors +**	**OR = 5.59**	**1.43, 21.84**

* Adjusted Odds Ratio (Adj OR)







RESULTS

- Descriptive statistics for males and females presented in Table1
- 18% (18/100) of the athletes sustained either an acute or overuse core or LE musculoskeletal injury
- Results of univariable analyses for: 1) overuse or acute, 2) overuse only, and 3) acute only presented in Table 2
  - Comparison of injury occurrence for high-risk versus low-risk status
- Logistic regression analyses yielded a different prediction model for each category of injury type (Table 3)
  - 3-factor model for any core or LE musculoskeletal injury: 1) AFS, 2) HTH, 3) WSH-Asymmetry (WSHAsym)
  - 3-factor model for overuse core or LE musculoskeletal injury: 1) AFS, 2) HTH, 3) WSHAsym
  - 2-factor model for acute core or LE musculoskeletal injury: 1) AFS, 2) HTH
- ROC analyses identified number of positive factors for optimal discrimination of high-risk from low-risk cases
  - ROC curves for each category of injury type presented in Figures 1-3
- RR values demonstrate substantial difference between high-risk and low-risk classification for each injury category
  - Overuse or acute injury: ≥ 2 factors positive (AFS ≤ 97, HTH ≤ 62 s, WSHAsym ≥ 25%) = 4.9 X greater risk
  - Overuse injury: ≥ 2 factors positive (AFS ≤ 97, HTH ≤ 61 s, WSHAsym ≥ 32%) = 9.8 X greater risk
  - Acute injury: Both of 2 factors positive (AFS ≤ 95, HTH ≤ 31 s) = 4.6X greater risk

CLINICAL RELEVANCE

- The combination of AFS, HTH and WSHAsym can quantify risk for occurrence of overuse core or LE injury
  - A larger number of overuse injury cases is needed to improve prediction model accuracy and precision
- Pre-participation screening for assessment of injury risk can identify a subset of athletes who would derive benefit from an intervention that addresses modifiable risk factors for overuse or acute musculoskeletal injury

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