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

BACKGROUND AND PURPOSE

• Athletics with poor postural stability have been shown to possess elevated risk for lower extremity (LE) injury1-3
• An association between rapid fatigue of the core musculature and acute core or LE injury has been documented
  • Between initiation of practice sessions and end of the fall sport season, 35% (8/23) of the athletes were injured
• History of LE injury has been associated with increased risk for subsequent injury4
• 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 (9), 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 (mm/s2) 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 low 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 χ2 (3) = 13.10; p = .004; Naglekerke R2 = .60
    • Sensitivity 63% Specificity 80% OR = 28 (90% CI: 3.59 – 218.40)

Table 1

<table>
<thead>
<tr>
<th>Factor</th>
<th>Injury</th>
<th>No Injury</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sway (mm/s²)</td>
<td>≥ .023</td>
<td>&lt; .023</td>
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<tr>
<td>Fisher’s exact p = .029</td>
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<tr>
<td>Sensitivity 63% Specificity 87%</td>
<td>OR = 10.83 (90% CI: 1.92 – 61.30)</td>
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Table 2

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<tbody>
<tr>
<td>HTH time (s)</td>
<td>≤ 58</td>
<td>&gt; 58</td>
</tr>
<tr>
<td>Fisher’s exact p = .004</td>
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<tr>
<td>Sensitivity 88% Specificity 47%</td>
<td>OR = 6.13 (90% CI: 0.87 – 43.21)</td>
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Table 3

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<thead>
<tr>
<th>Factor</th>
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<tbody>
<tr>
<td>BMI ≥ 22.7</td>
<td>5/8</td>
<td>3/15</td>
</tr>
<tr>
<td>Fisher’s exact p = .003</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sensitivity 63% Specificity 80%</td>
<td>OR = 6.67 (90% CI: 1.34 – 33.13)</td>
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</table>

Figure 1

Figure 2

Figure 3

Figure 4

Table 4

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<thead>
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<th>Factors +</th>
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</thead>
<tbody>
<tr>
<td>&lt; .023</td>
<td>1 7</td>
<td>5 15</td>
</tr>
<tr>
<td>≥ .023</td>
<td>7 8</td>
<td>3 12</td>
</tr>
<tr>
<td>HTH ≤ 58 s</td>
<td>1 7</td>
<td>1 15</td>
</tr>
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Table 5

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<tr>
<th>3-Factor Model</th>
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</thead>
<tbody>
<tr>
<td>HTH ≤ 58 s</td>
<td>1 7</td>
<td>1 15</td>
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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