Asymmetrical Landing Forces Detect Neuromuscular Fatigue

Elijah M. Walker
Boise State University

Jeff W. Wilkins
Boise State University

Kayla D. Seymore
Boise State University

Tyler N. Brown
Boise State University
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Walker, E.M., Wilkins, J.W., Seymore, K.D., and Brown, T.N.

INTRODUCTION

Neuromuscular fatigue decreases performance and increases injury risk. Specifically, females exhibit decreased power production and maximal jump height due to muscular fatigue, and larger peak vertical ground reaction forces (vGRF) during landing, which can increase musculoskeletal injury risk. Lower limb asymmetry can further elevate injury risk, as females are more likely to suffer injuries in their non-dominant limb. Detection of increased and asymmetrical landing forces could help identify fatigued players at risk of injury. Yet, coaches and practitioners currently lack an easy, reliable method for detecting neuromuscular fatigue. Thus, the purpose of this study was to determine a vGRF metric that readily identifies fatigue decrements from a competitive soccer season.

HYPOTHESIS

Starters would exhibit larger decrements in performance and greater limb asymmetry for landing forces at the completion of a competitive soccer season than non-starters.

METHODS

Subjects: 31 female athletes participated (Table 1). Each was defined as starter or non-starter based on minutes played and matches started (starters > 850 minutes played; ≥ 10 games started).

<table>
<thead>
<tr>
<th>Age (yrs)</th>
<th>Ht (m)</th>
<th>Wt (kg)</th>
<th>N</th>
</tr>
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<tbody>
<tr>
<td>Starter</td>
<td>19.9 ± 1.0</td>
<td>1.7 ± 0.7</td>
<td>64.4 ± 6.3</td>
</tr>
<tr>
<td>Non-starter</td>
<td>18.6 ± 1.1</td>
<td>1.7 ± 0.6</td>
<td>62.1 ± 7.3</td>
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</tbody>
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Testing: Each participant completed testing immediately prior to and following (within one week) the completion of a competitive soccer season. During each session, participants performed five successful trials of a forward vertical jump task (Fig. 1)

RESULTS

Biomechanical Data: During each trial, vGRF was recorded using two force platforms (2400 Hz; OR-6, AMTI, Watertown, MA).

Biomechanical Analysis: During the landing phase of each trial, peak vGRF for both limbs (dominant and non-dominant) was calculated, and symmetry angle (SA) of peak vGRF between limbs were determined according to Zifchock et al. [1] (Fig. 2; Eq. 1).

Eq. 1: \( SA = (45° - \tan^{-1} X_{left}/X_{right})/90° + 100\%

CONCLUSION

Ground reaction force data may be an easy, reliable method for detecting neuromuscular fatigue and injury risk. Starters on a female soccer team increased peak vGRF and subsequent injury risk following the completion of their competitive season. But, limb asymmetries in landing force did not further increase at the completion of the season.

REFERENCES