Vertical ground reaction force magnitudes and rates not positively correlated with prospective running injury

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Research Question
Do vertical ground reaction forces (VGRF) measured at baseline predict prospective injury development?

• Hypothesis: VGRF theorized to cause injury; therefore, baseline VGRF should positively correlate with prospective injury

Methods
Recruitment: n = 44, 22 male, age 30±10
Baseline biomechanics: 10 left and 10 right stances used to calculate VGRF magnitude and rate

Prospective injury: 26 weekly internet surveys
• Number of injuries
• Location of each injury
• Pain caused by each injury
• Days of running missed due to each injury

Analyses: Pearson correlations between ipsilateral VGRF (magnitude, rate, PCs) and injury (number, pain, days missed)

Results
Traditional metrics show no positive VGRF-injury correlations
• Rate negatively correlated with number of \( r = -0.31, p < 0.01 \), and pain caused by \( r = -0.26, p = 0.01 \), injuries

4 PCs accounted for >90% of VGRF variance
PC2 positively correlated with number of \( r = 0.31, p < 0.01 \), and pain caused by \( r = 0.25, p < 0.05 \), injuries
• High PC scores \( \rightarrow \) low magnitudes and rates
• Corroborates negative rate-injury correlation

Table 1: Correlations and coefficients of determination – \( r^2 \) – between bilateral VGRF (magnitude, rate, PCs) and injuries (number, pain, days missed).

<table>
<thead>
<tr>
<th></th>
<th>Number</th>
<th>Pain</th>
<th>Days Missed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Magnitude</td>
<td>-0.19</td>
<td>-0.16</td>
<td>-0.11</td>
</tr>
<tr>
<td>Rate</td>
<td>-0.31</td>
<td>-0.26</td>
<td>-0.12</td>
</tr>
<tr>
<td>PC1</td>
<td>-0.12</td>
<td>-0.04</td>
<td>-0.07</td>
</tr>
<tr>
<td>PC2</td>
<td>0.31</td>
<td>0.25</td>
<td>0.14</td>
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<tr>
<td>PC3</td>
<td>-0.06</td>
<td>-0.04</td>
<td>-0.06</td>
</tr>
<tr>
<td>PC4</td>
<td>0.06</td>
<td>0.02</td>
<td>0.02</td>
</tr>
</tbody>
</table>

Contrary to theory, VGRF magnitude and rate did not predict injury
• In fact, rate negatively correlated with injury
• Consistent with earlier prospective work

PCM results suggest method useful for objectively identifying biomechanical waveform features that may predict injury
VGRF may, however, be insufficient to identify at-risk runners

Future work will examine efficacy of other predictors
• Internal loading of injury-prone structures is the most direct cause of injury; therefore, modelled internal loads should predict injury

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References