Non-Contact Lower Extremity Injury in Female Collegiate Soccer Athletes and Deviations from Baseline Maximal Exertion

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The first purpose of this study was to determine whether deviations in workload (defined by heart rate) may predispose soccer athletes to injury.

An additional purpose was to grow the literature in female-specific populations given most existing studies focus on males.

PURPOSE

METHODS AND STUDY DESIGN

A retrospective chart review was conducted with an NCAA Division I Women's Soccer Team.

Data spanned 2017-2020 and included:

- Non-contact lower extremity injuries resulting in missed training time
- Wearable heart rate (HR) monitor data

Heart Rate zones were determined by an individual's maximum HR:

- Zone 590: time spent at a HR ≥ 90% of max HR
- Zone 580: time spent at a HR ≥ 80% of max HR

Baseline times, spent in Zone 590 and Zone 580, were defined as the 4 weeks preceding injury. These were compared to the Zone 5 times in the week leading up to, but not including, the day of injury.

A one-sample t-test was used for statistical analysis.

RESULTS

57 non-contact lower extremity injuries occurred in 29 athletes between the years 2017-2020.

<table>
<thead>
<tr>
<th>Zone 590</th>
<th>Zone 580</th>
</tr>
</thead>
<tbody>
<tr>
<td># of Injuries</td>
<td># of Injuries</td>
</tr>
<tr>
<td>1m 1s - 19m 19s</td>
<td>10m 52s - 46m 37s</td>
</tr>
<tr>
<td>6m 49s</td>
<td>24m 57s</td>
</tr>
<tr>
<td>21s - 23m 7s</td>
<td>7m 1s - 54m 39s</td>
</tr>
<tr>
<td>7m 3s</td>
<td>25m 36s</td>
</tr>
</tbody>
</table>

- Mean ratio of 1-week over baseline, Zone 590:
  - 1.03 [CI: 0.91 - 1.15]
- 27 injuries had increased exertion over baseline with a mean ratio of 1.43 [CI: 1.32 - 1.53] and 30 injuries had decreased exertion below baseline with a mean ratio of 0.68 [CI: 0.59 - 0.76]
- The absolute percent change from baseline for all injuries in Zone 590 was 37.37% [CI: 30.60 - 44.14]
- Mean ratio of 1-week over baseline, Zone 580:
  - 1.04 [CI: 0.92 - 1.12]
- 29 injuries had increased exertion over baseline with a mean ratio of 1.7 [CI: 1.18 - 1.36] and 28 injuries had decreased exertion below baseline with a mean ratio of 0.80 [CI: 0.74 - 0.85]
- The absolute percent change from baseline for all injuries in Zone 580 was 23.85% [CI: 18.70 - 29.00]

LIMITATIONS

- Only one team included in the study
- Relatively small sample size
- One individual could account for multiple injuries
- Inherent inconsistency of wearable HR technology
- Accuracy
- Wearing habits
- No non-injured control group
- No possible confounders included in the analysis

CONCLUSIONS/SIGNIFICANCE

An association of injuries and HR data above baseline was anticipated, but an association with HR below baseline was also surprisingly seen.

Zone 5 was separated into two subgroups, defined as HR ≥ 80% and HR ≥ 90%, and were analyzed separately.

The overall change from baseline mean ratio was near 1 and was not statistically significant for both definitions of Zone 5.

The absolute change from baseline, however, did show a significant deviation.

Each sub-group did show significant results:

- Zone 590
  - Increase Mean Ratio: 1.43
  - Decrease Mean Ratio: 0.68
  - Absolute Change from Baseline: 37%

- Zone 580
  - Increase Mean Ratio: 1.27
  - Decrease Mean Ratio: 0.80
  - Absolute Change from Baseline: 24%

The results of this study indicate an association between changes in HR from baseline and injury.

A greater than 25% change in HR during a 1-week rolling average compared to baseline may predispose to injury as:

- Increases in HR over baseline may correspond to over-exertion and excess workload, increasing injury risk; and
- Decreases in HR below baseline may correspond to deconditioning or inconsistent workload, predisposing an athlete to injury when workload is then increased.

Female collegiate soccer teams may consider utilization of ideal conditioning zones as a component of injury prevention programs to minimize injury risk.

REFERENCES