

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

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## PURPOSE

- 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

## 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 5<sub>90</sub>: time spent at a HR ≥ 90% of max HR
  - Zone 5<sub>80</sub>: time spent at a HR ≥ 80% of max HR
- Baseline times, spent in Zone 5<sub>90</sub> and Zone 5<sub>80</sub>, 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

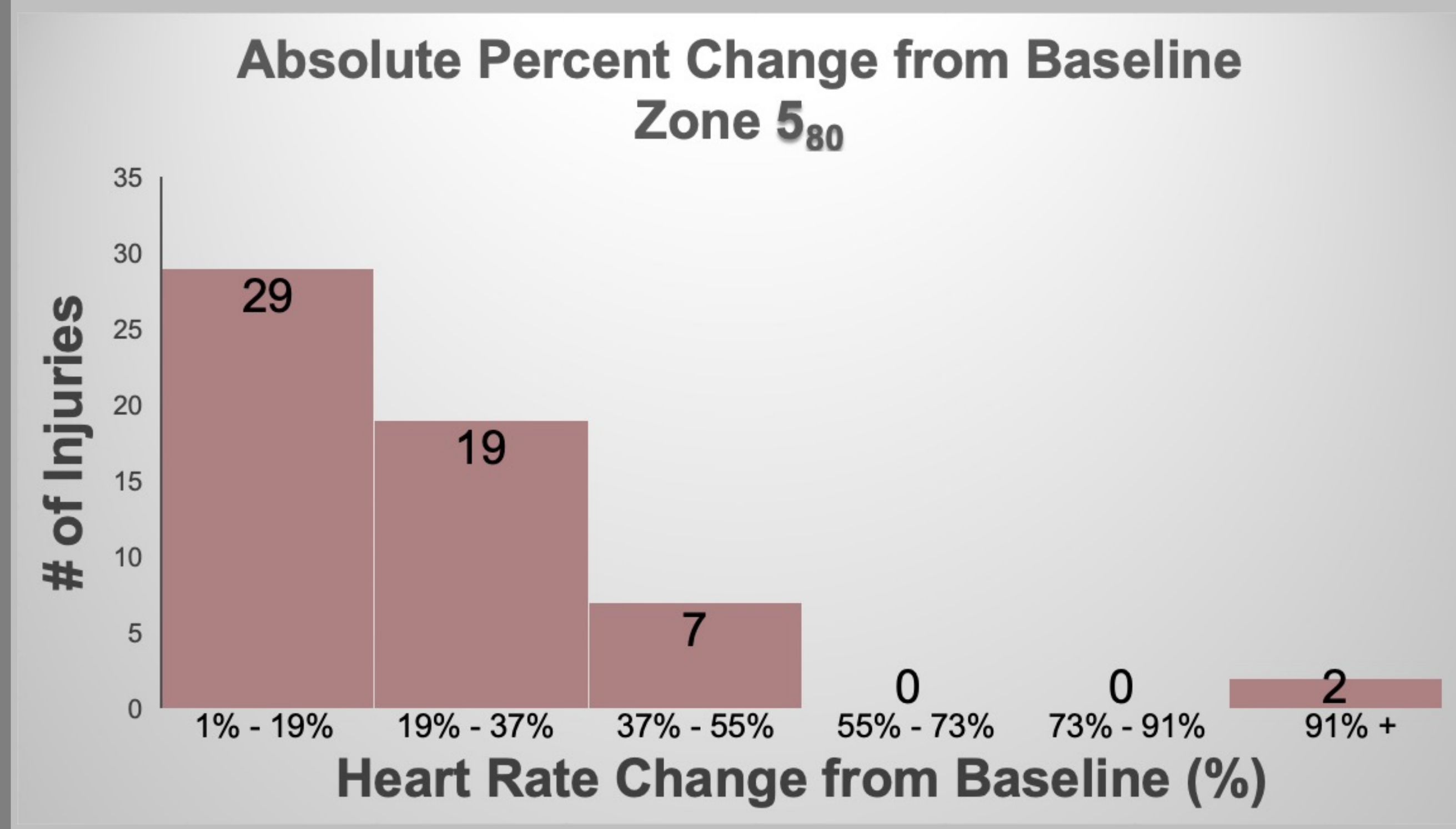
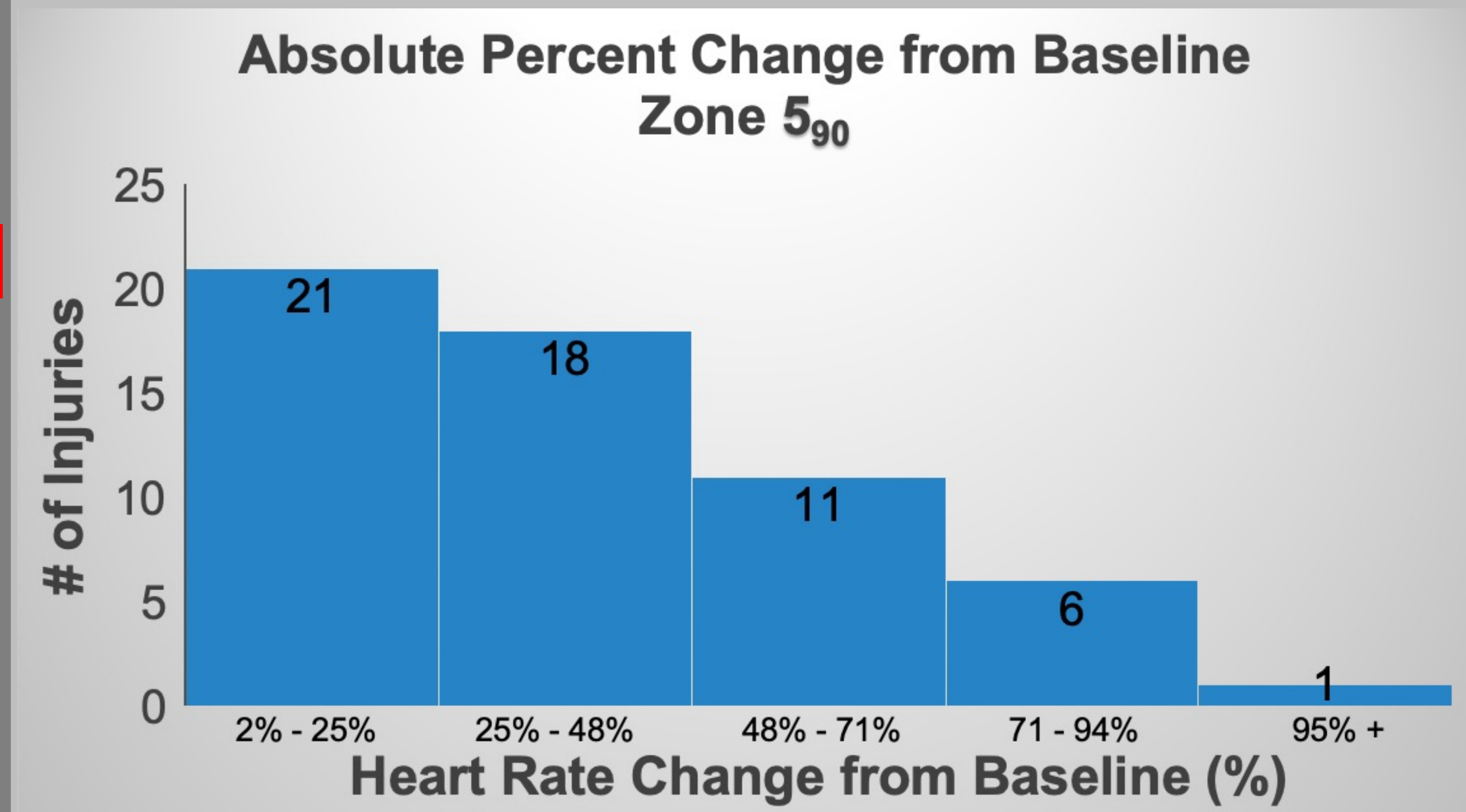
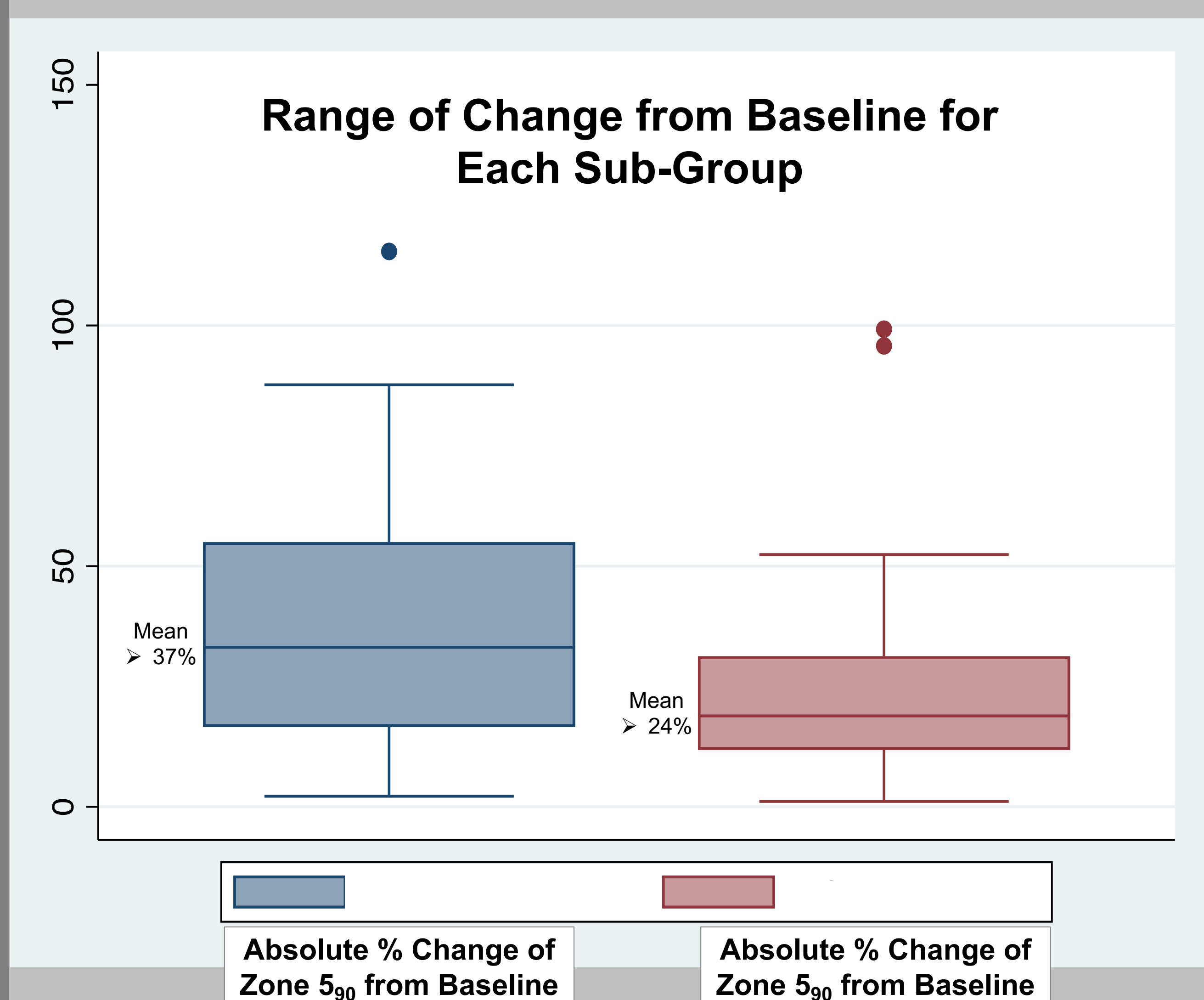
## RESULTS

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

	Zone 5 <sub>90</sub>	Zone 5 <sub>80</sub>
4-Week Baseline Range	1m 1s - 19m 19s	10m 52s - 46m 37s
4-Week Baseline Mean	6m 49s	24m 57s
Week Preceding Injury Range	21s - 23m 7s	7m 1s - 54m 39s
Week Preceding Injury Mean	7m 3s	25m 36s

- Mean ratio of 1-week over baseline, Zone 5<sub>90</sub>:
  - 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 5<sub>90</sub> was 37.37% [CI: 30.60 - 44.14]
- Mean ratio of 1-week over baseline, Zone 5<sub>80</sub>:
  - 1.04 [CI: 0.92 - 1.12]
- 29 injuries had increased exertion over baseline with a mean ratio of 1.27 [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 5<sub>80</sub> was 23.85% [CI: 18.70 - 29.00]

## DATA



## 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 5<sub>90</sub>**
    - Increase Mean Ratio: 1.43
    - Decrease Mean Ratio: 0.68
    - Absolute Change from Baseline: 37%
  - Zone 5<sub>80</sub>**
    - 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.

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