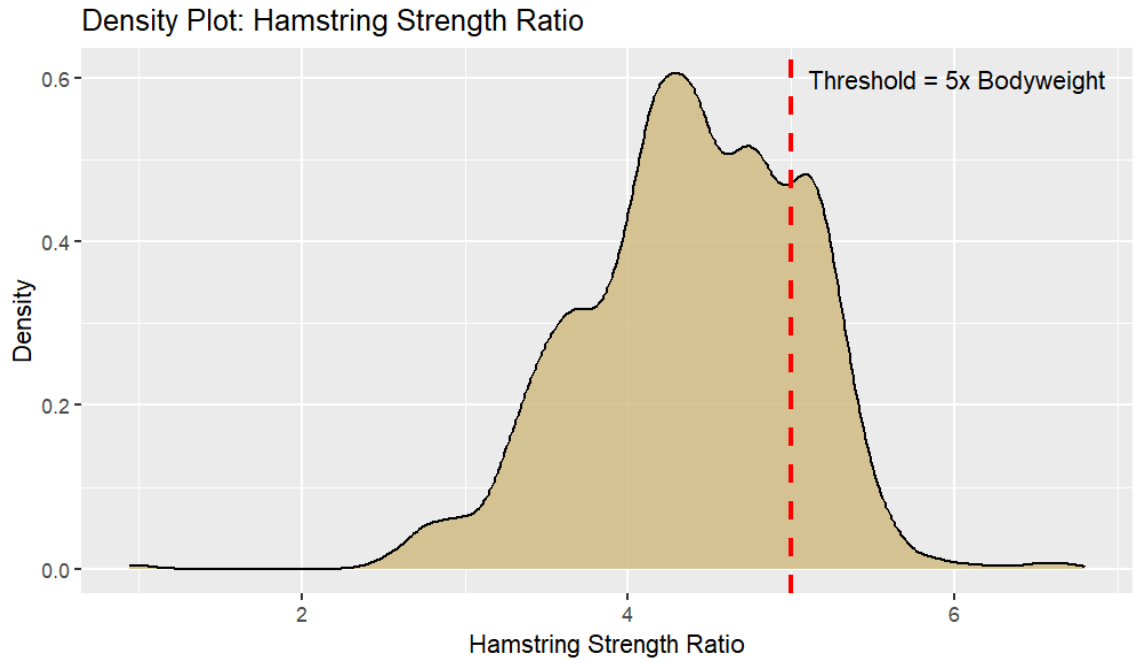
Defining Thresholds and Trends in Women's Sports

Sydney Stanton and Carter Zborowski

Question 1:

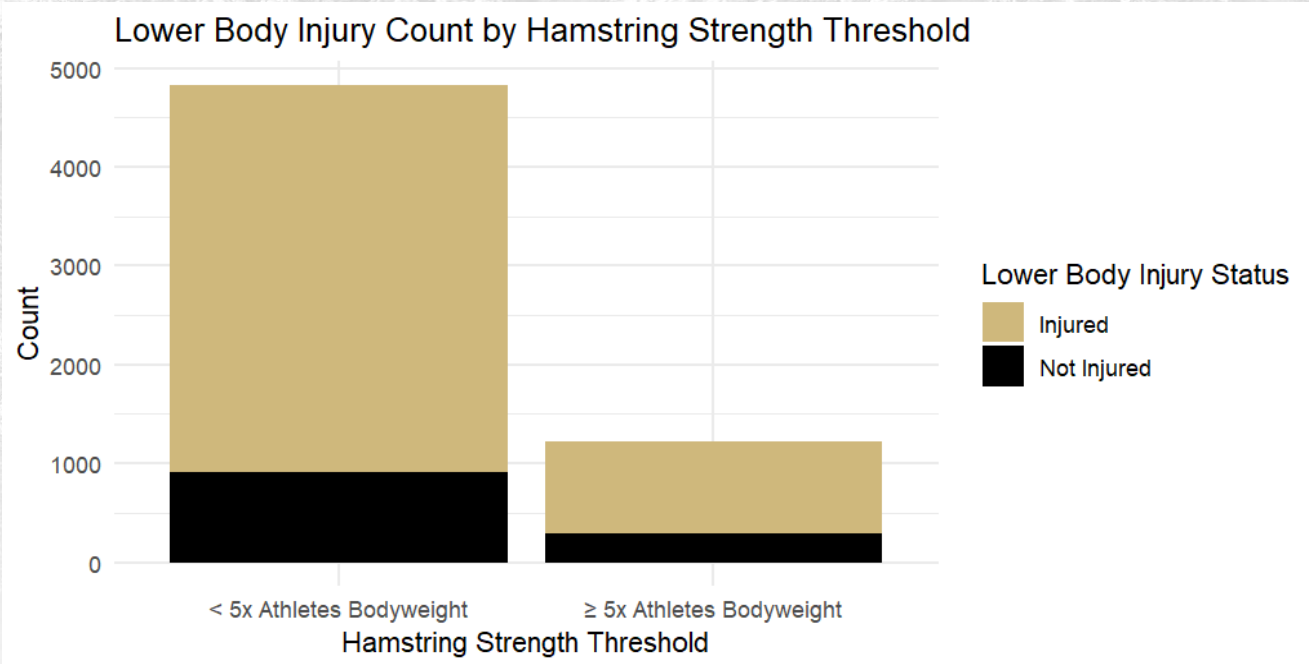
What are meaningful thresholds for strength metrics as they relate to lower body injury risk?

Hamstring Strength Threshold



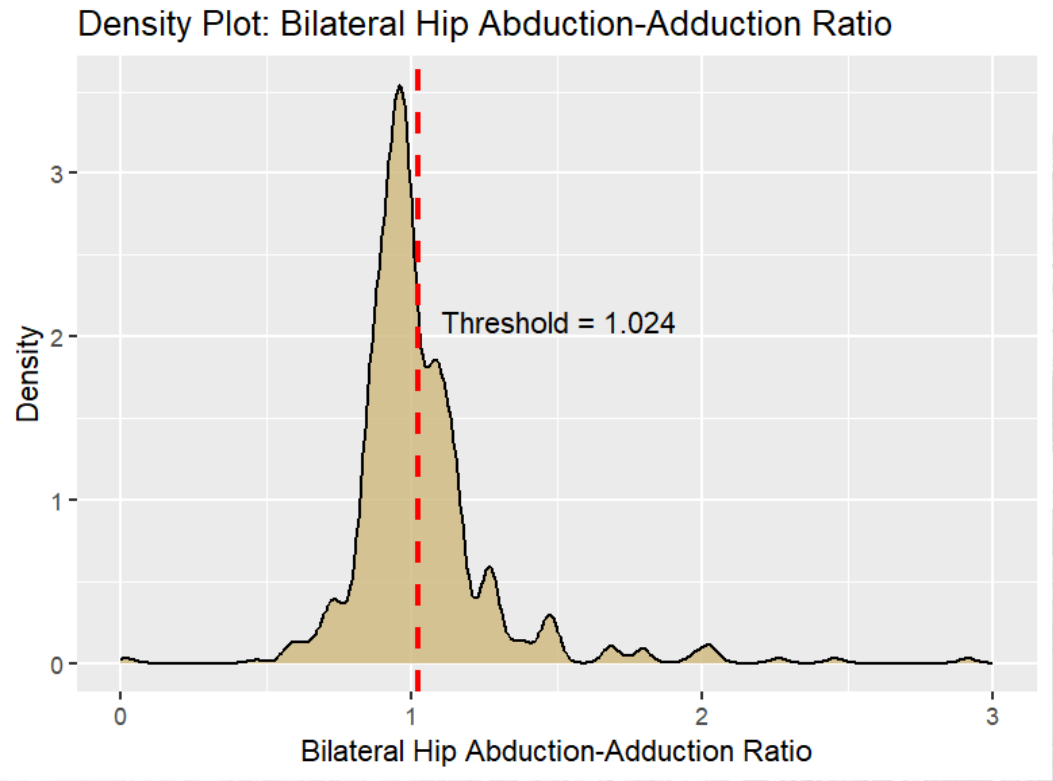
Female athletes who are above the threshold have a 22% lower risk of a lower body injury.

Statistically Significant:
p-value= 0.000672

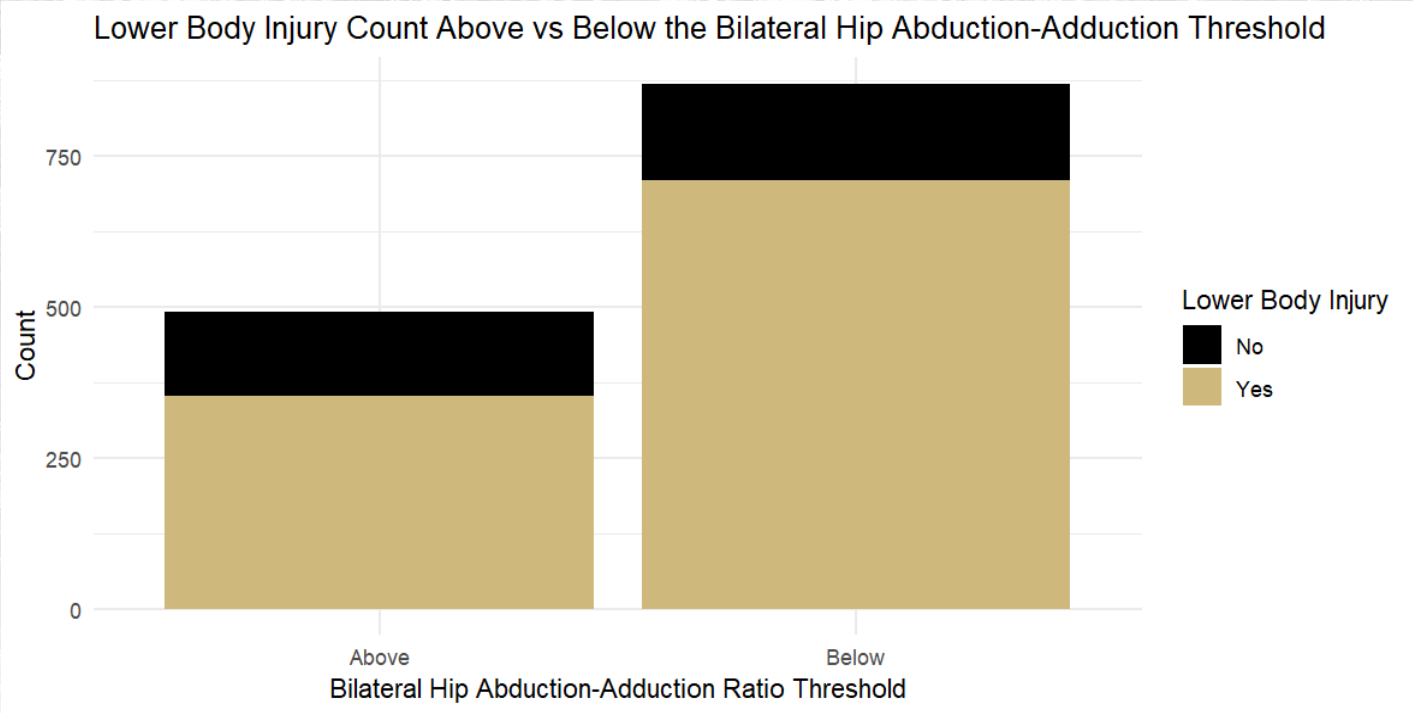


Hip Performance Metrics Thresholds

Bilateral Hip Abduction Adduction Threshold

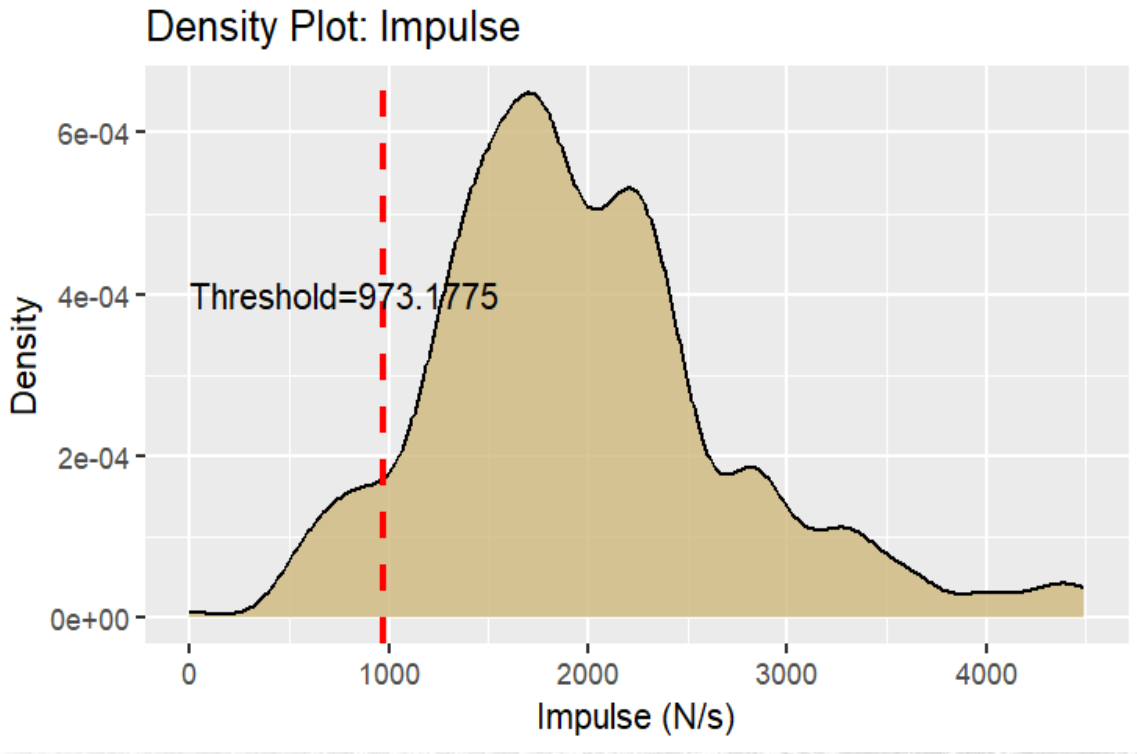


Female athletes who are above the threshold have about a 45% lower risk of a lower body injury.

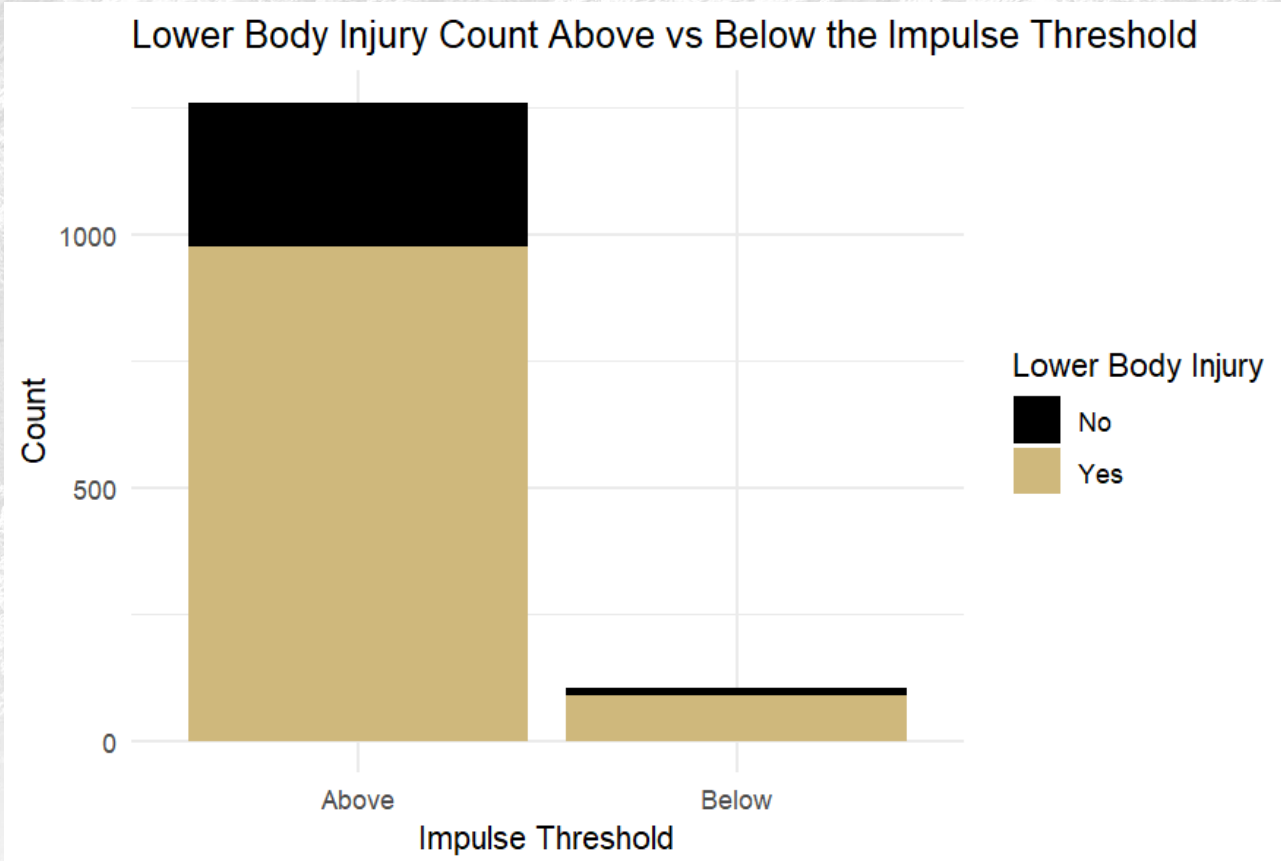


Statistically Significant:
p-value= 1.15e^-06

Impulse Threshold

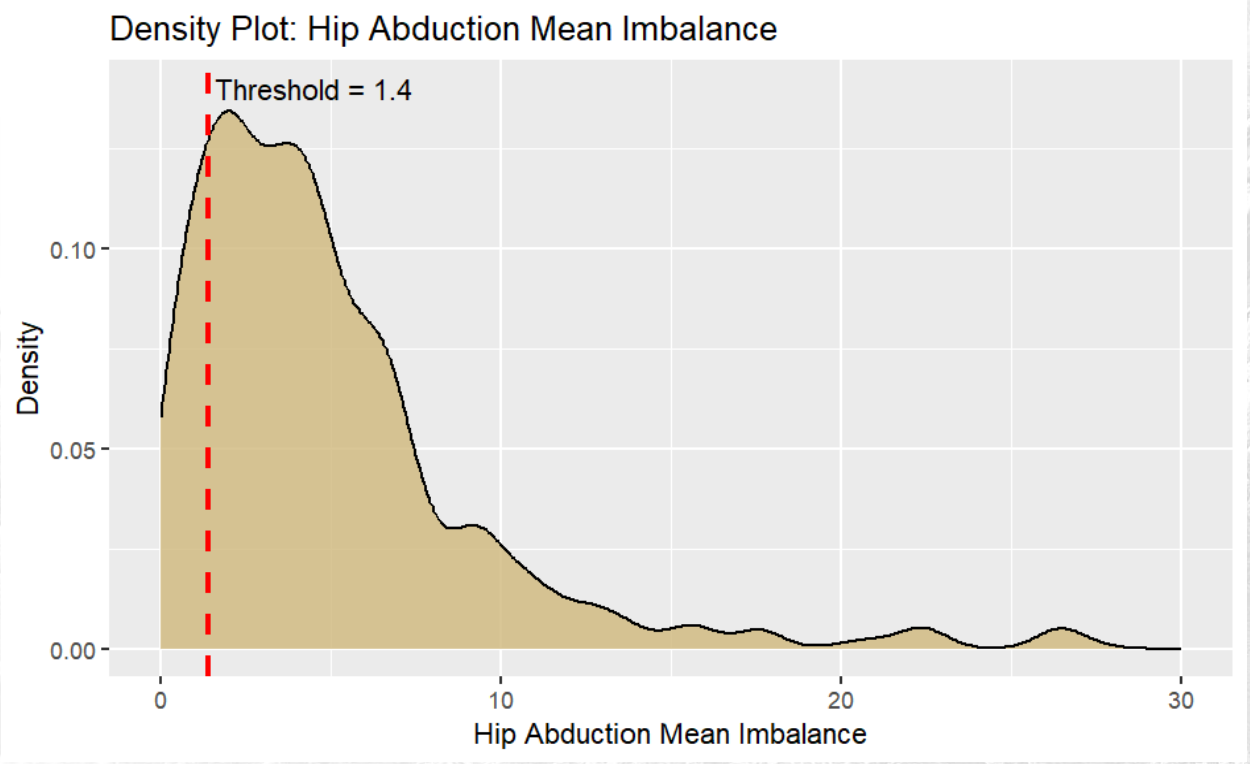


Female athletes who are above the threshold have about a 46% lower risk of a lower body injury.



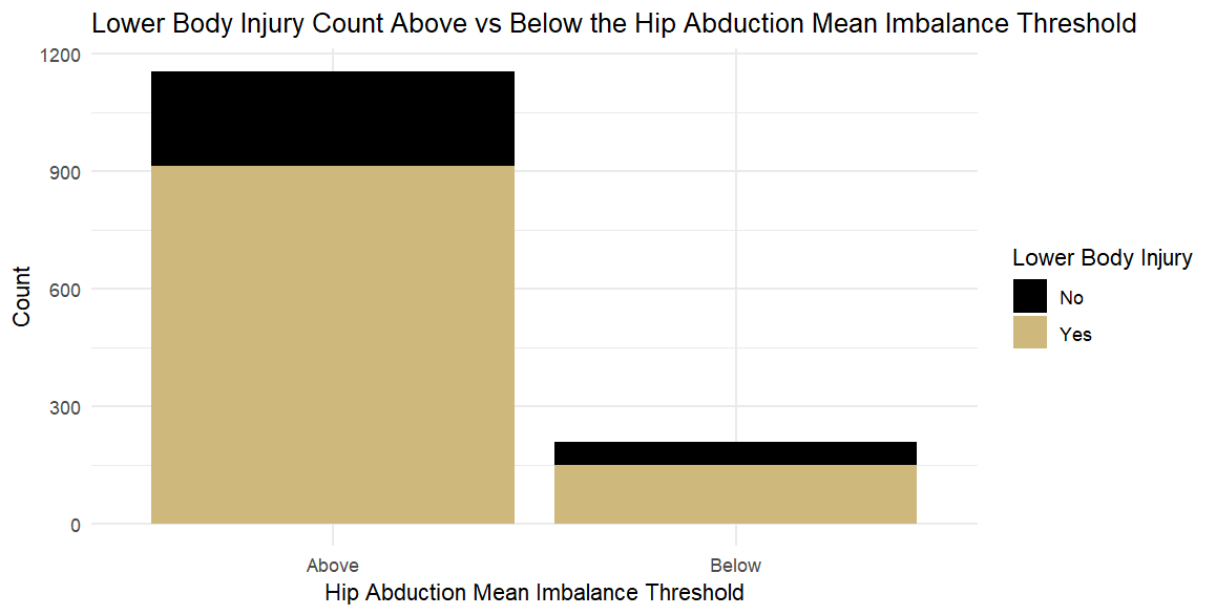
Statistically Significant:
p-value= 0.0153

Average Hip Abduction Imbalance Threshold



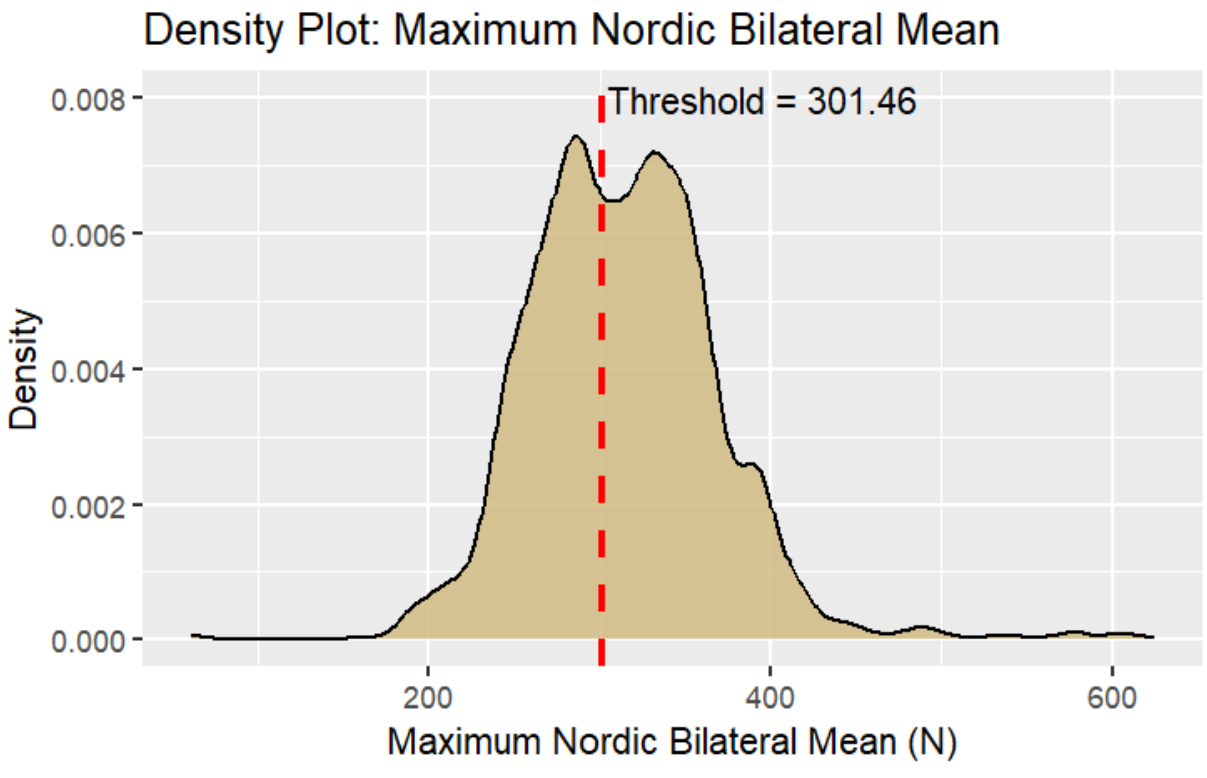
Female athletes above the threshold have 1.48 times higher odds of sustaining a lower body injury.

Statistically Significant:
p-value= 0.0126

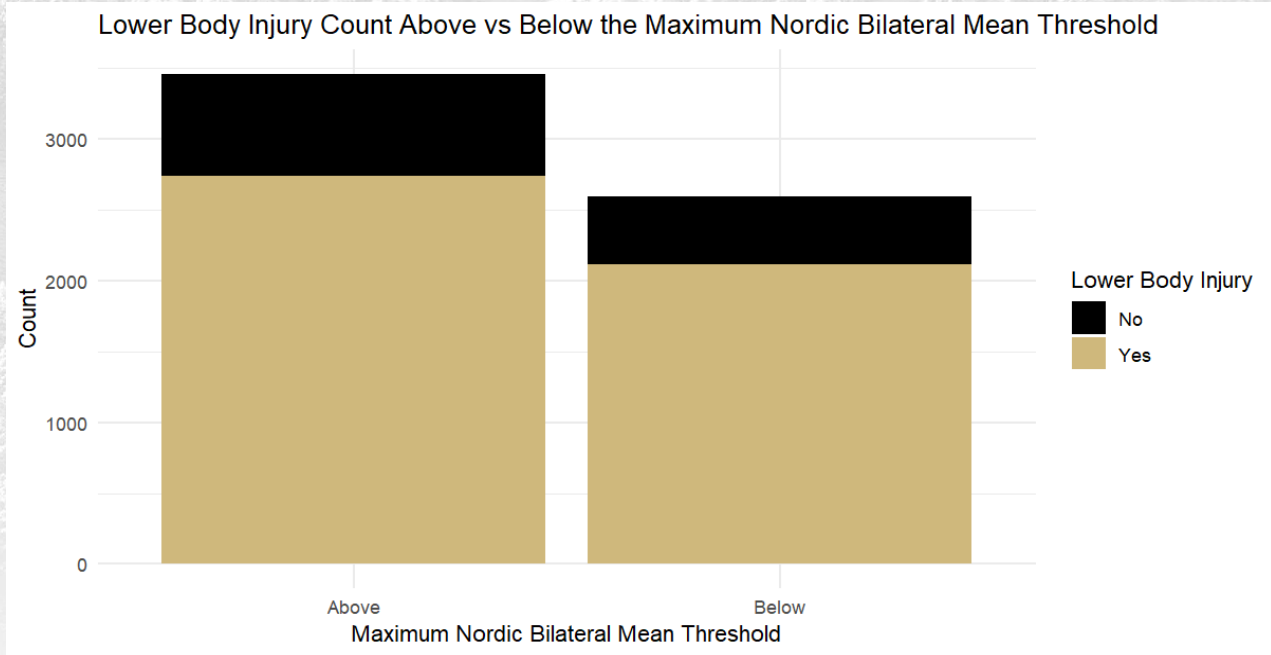


Nordic Performance Metrics Thresholds

Average Maximum Nordic Bilateral Threshold

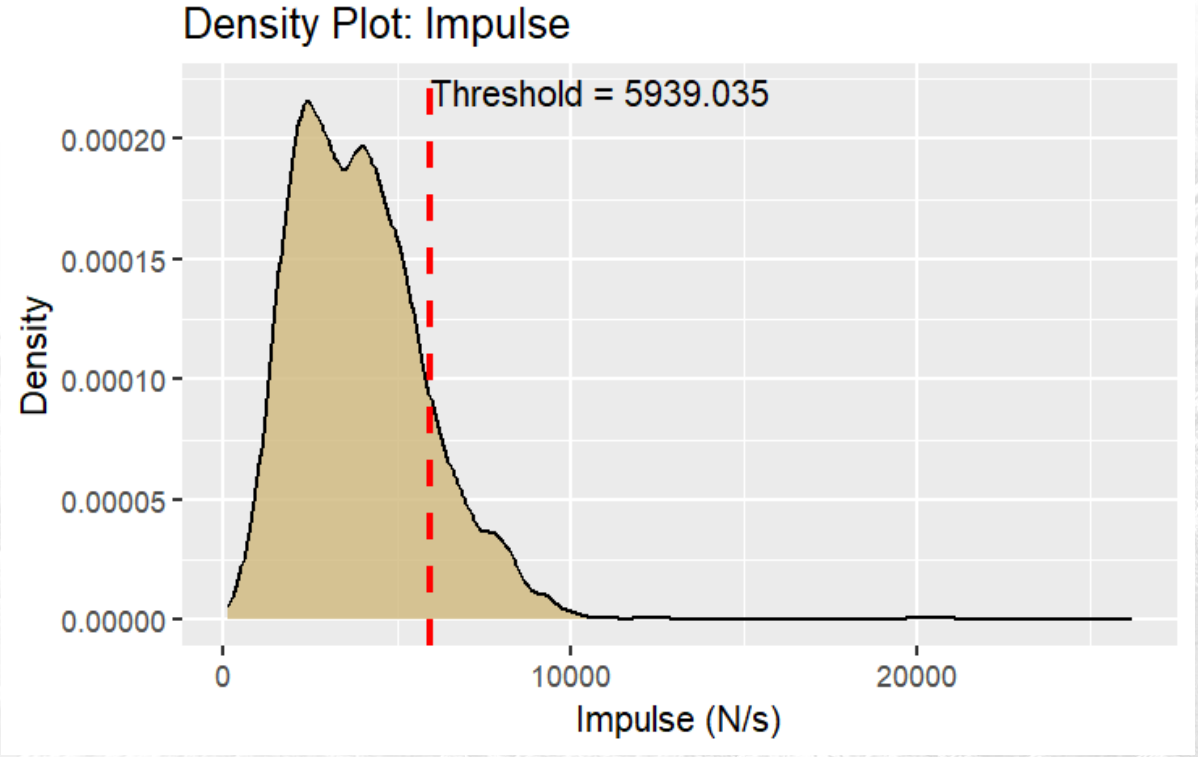


Female athletes who are above the threshold have about 17% lower risk of a lower body injury.

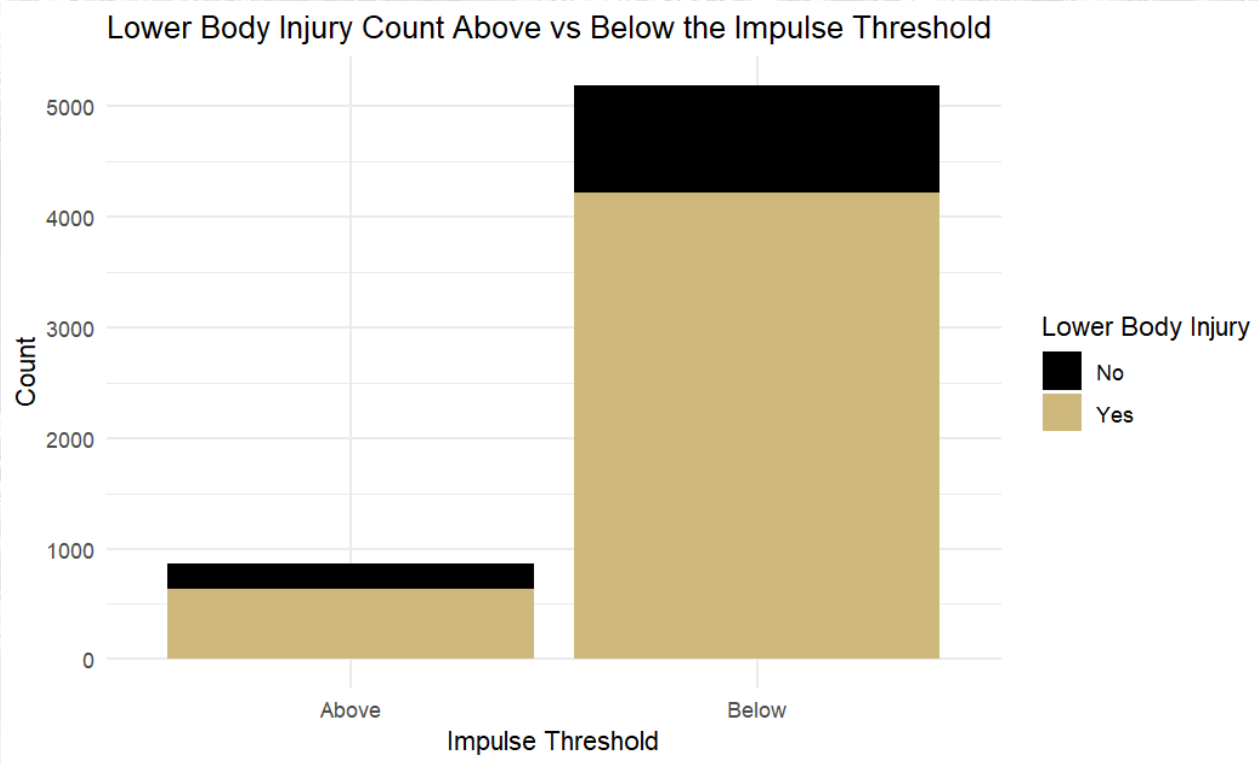


Statistically Significant:
p-value= 0.0028

Impulse Threshold



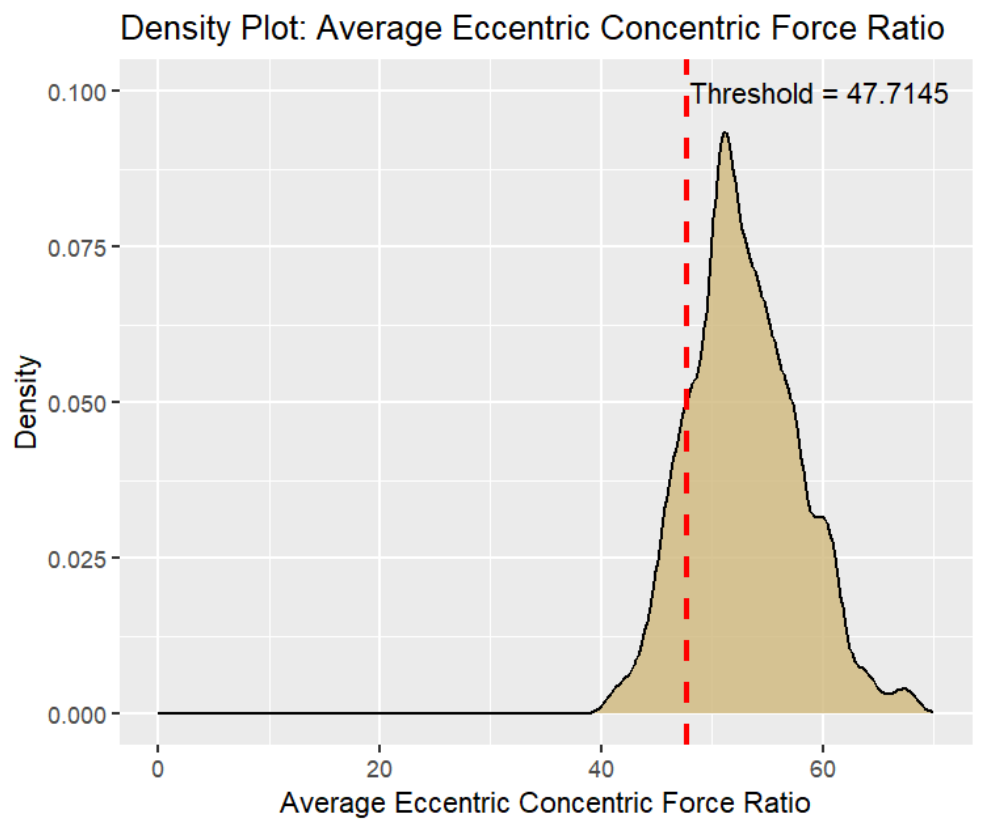
Female athletes who are above the threshold have about a 38% lower risk of a lower body injury.



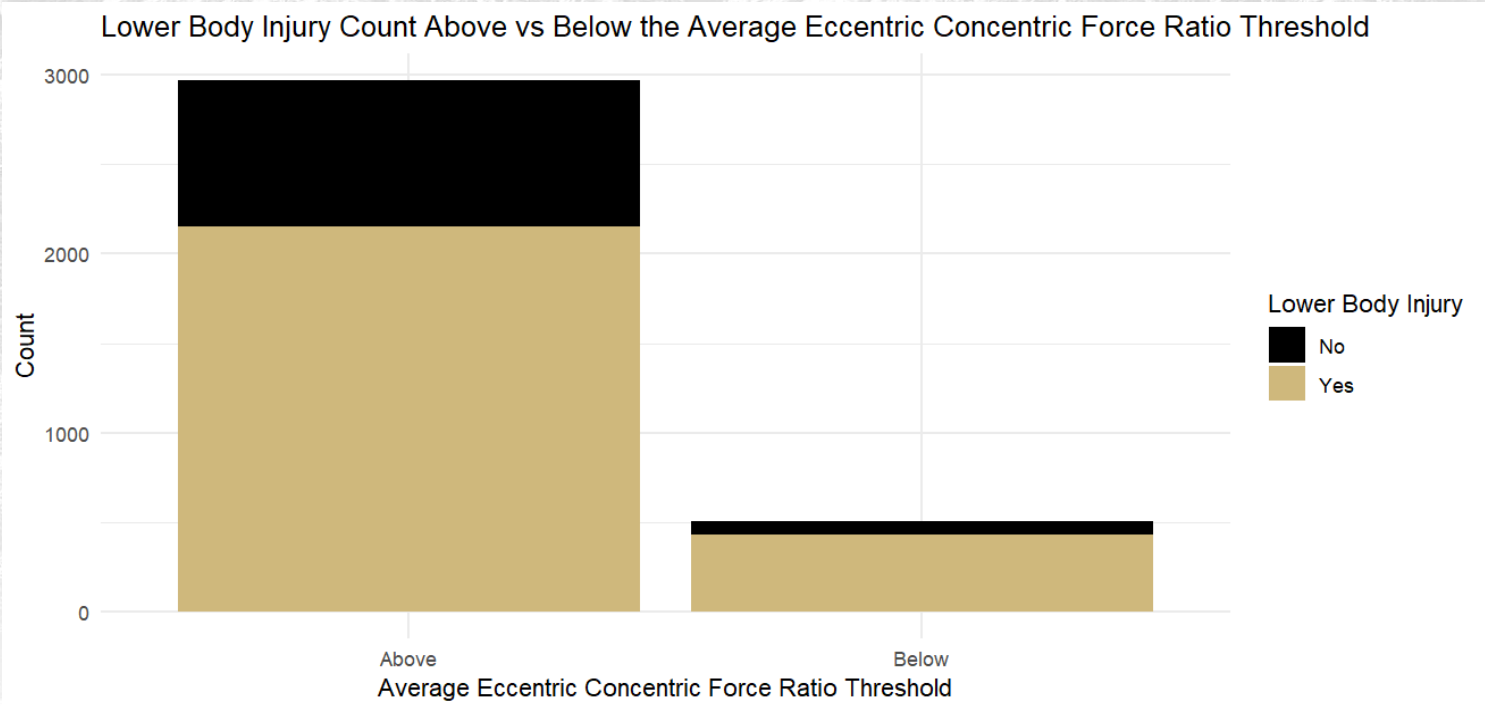
Statistically Significant:
p-value = 1.5e^-09

Countermovement Jump Metrics Thresholds

Average Eccentric Concentric Force Ratio Threshold

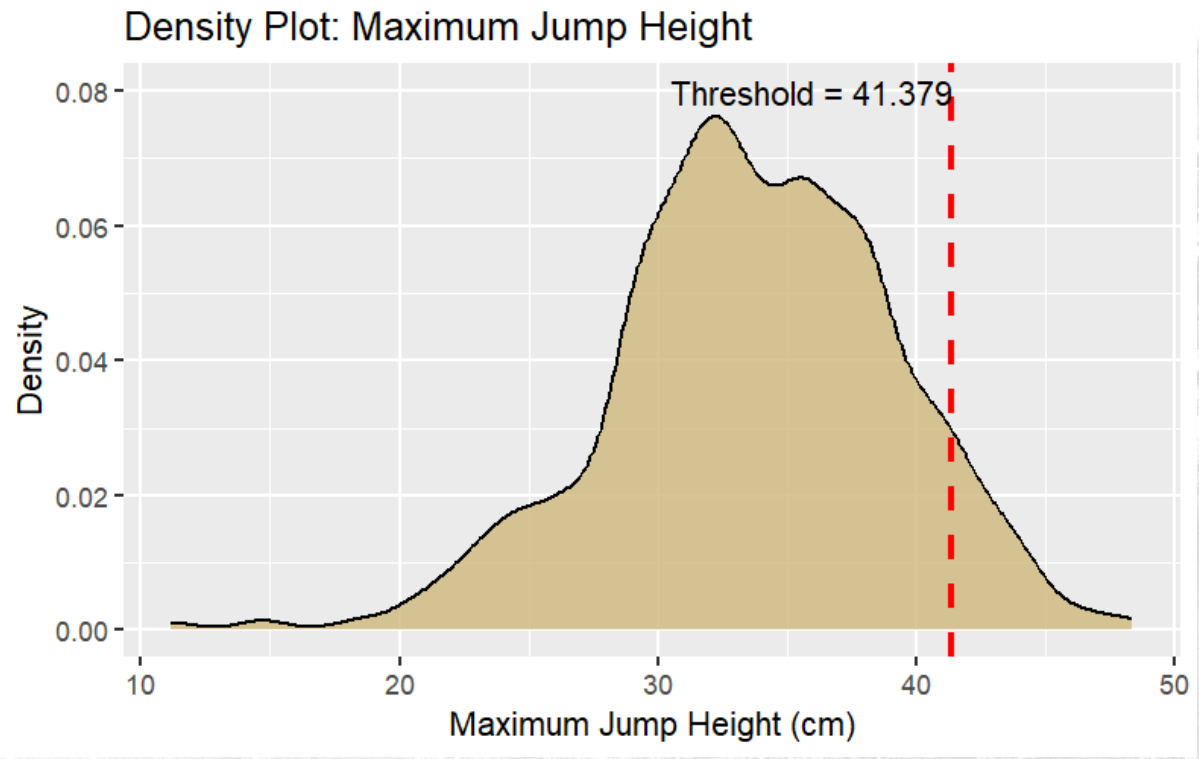


Female athletes who are above the threshold have about a 54% lower risk of a lower body injury.

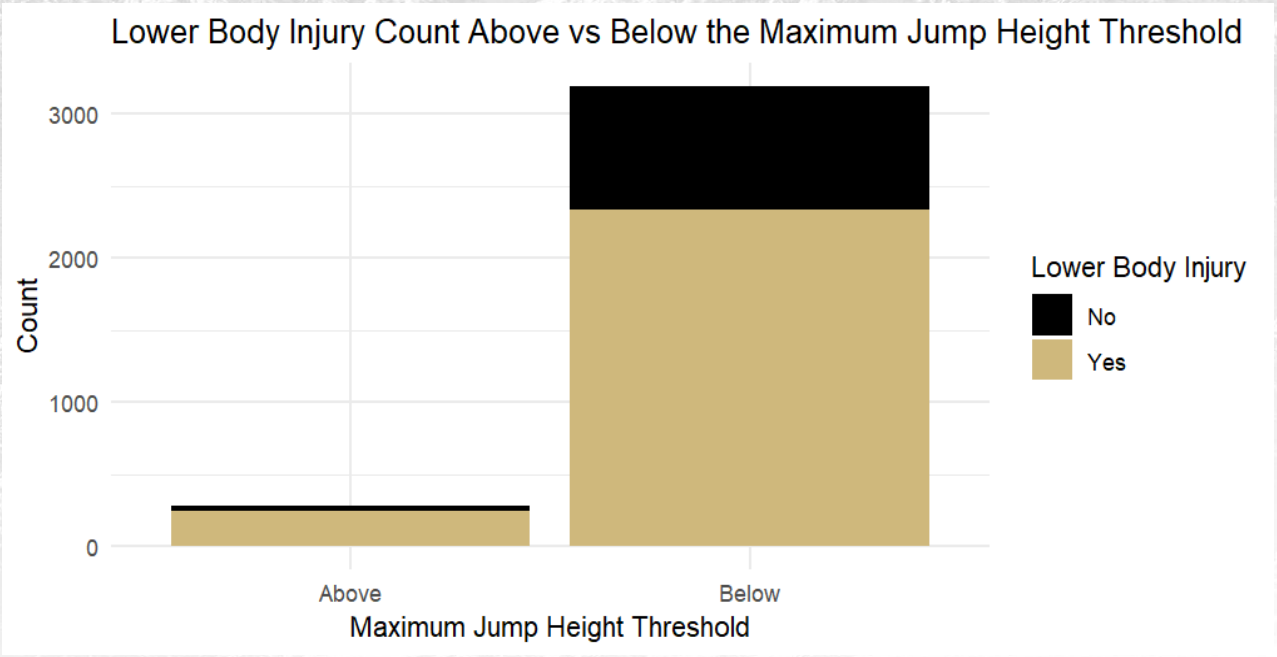


Statistically Significant:
p-value= 3.87e^-09

Maximum Jump Height Threshold

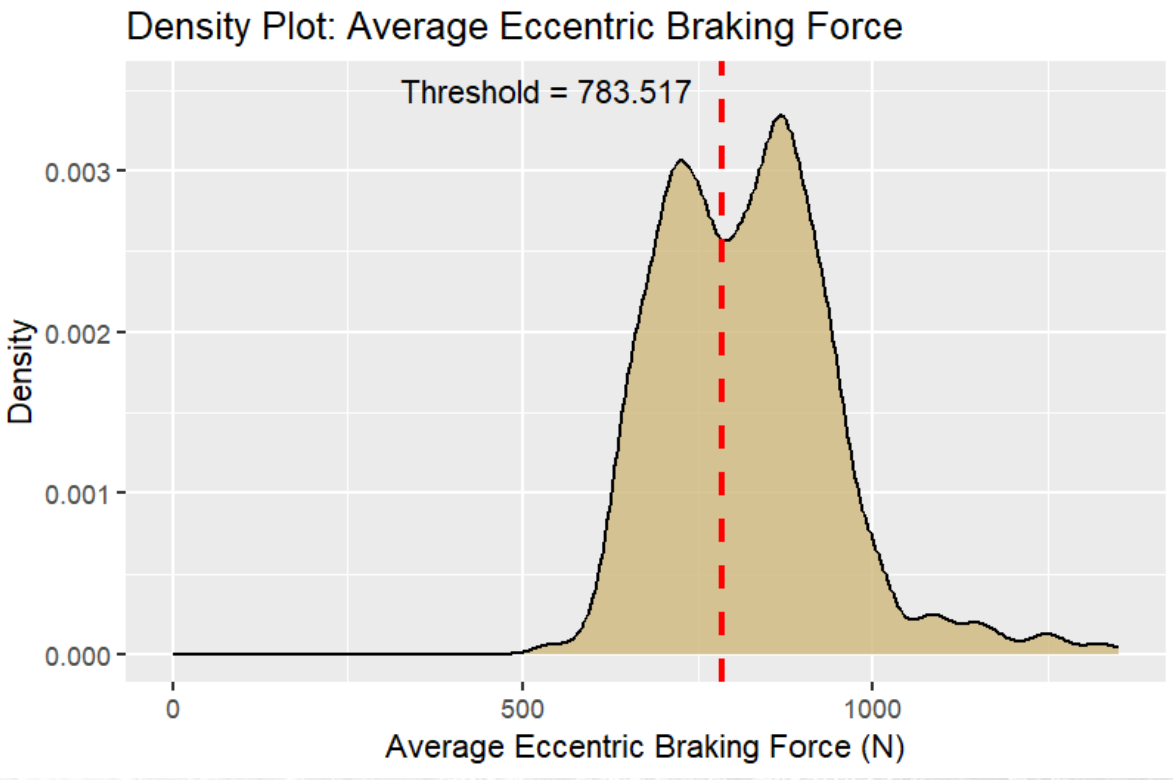


Female athletes who are above the threshold have 2.66 times higher odds of sustaining a lower body injury.

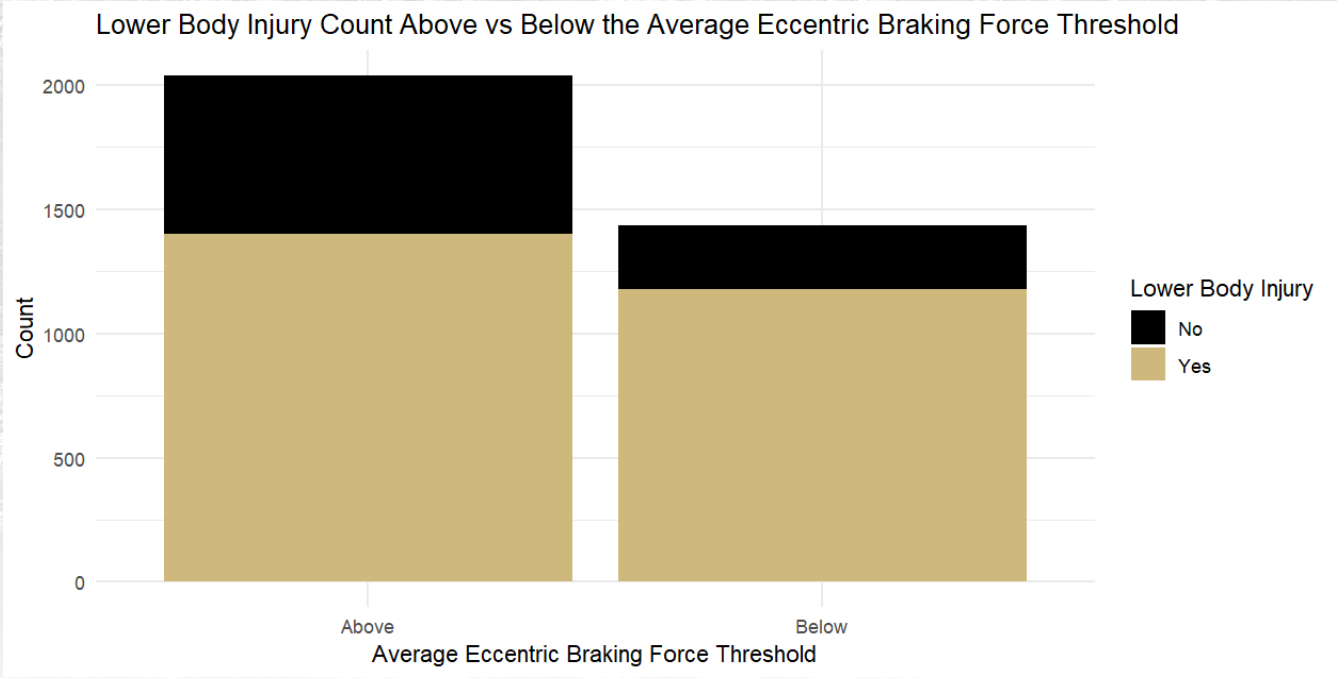


Statistically Significant:
p-value= 1.66e^-07

Average Eccentric Braking Force Threshold



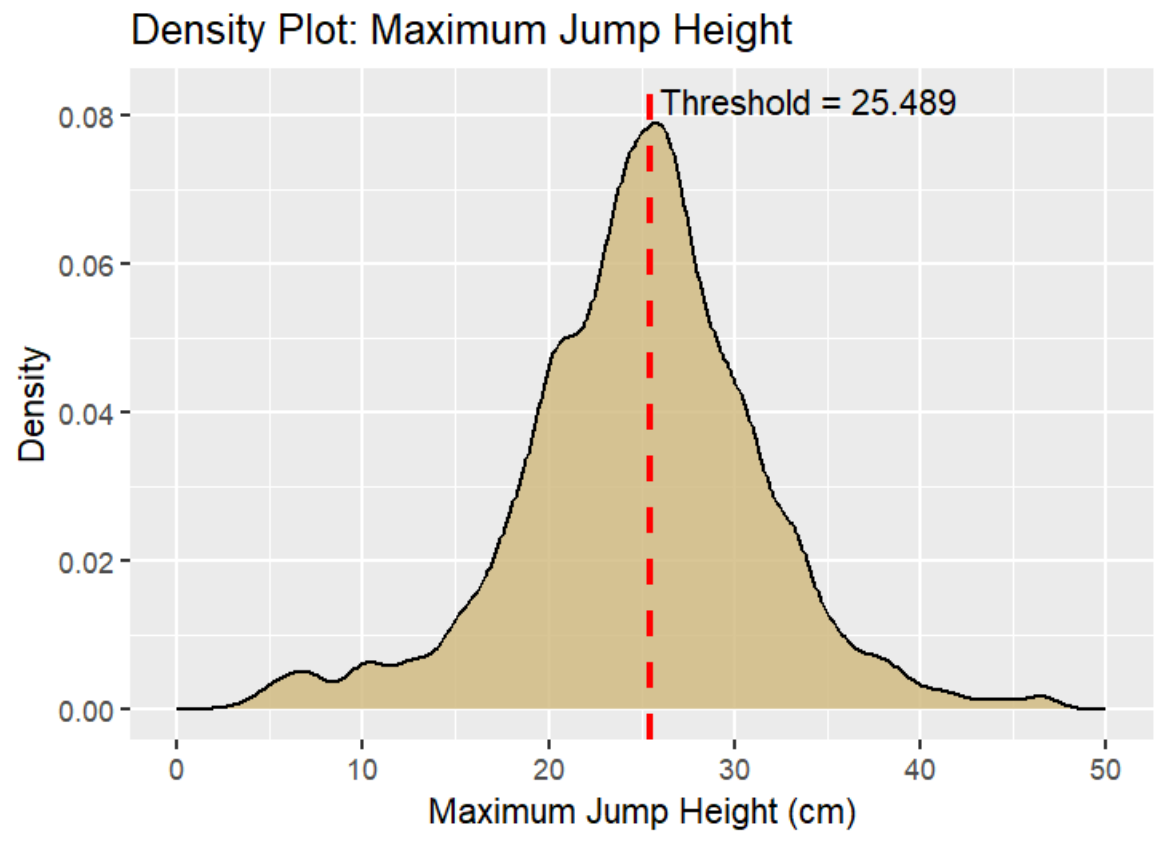
Female athletes who are above the threshold have about a 53% lower risk of a lower body injury.



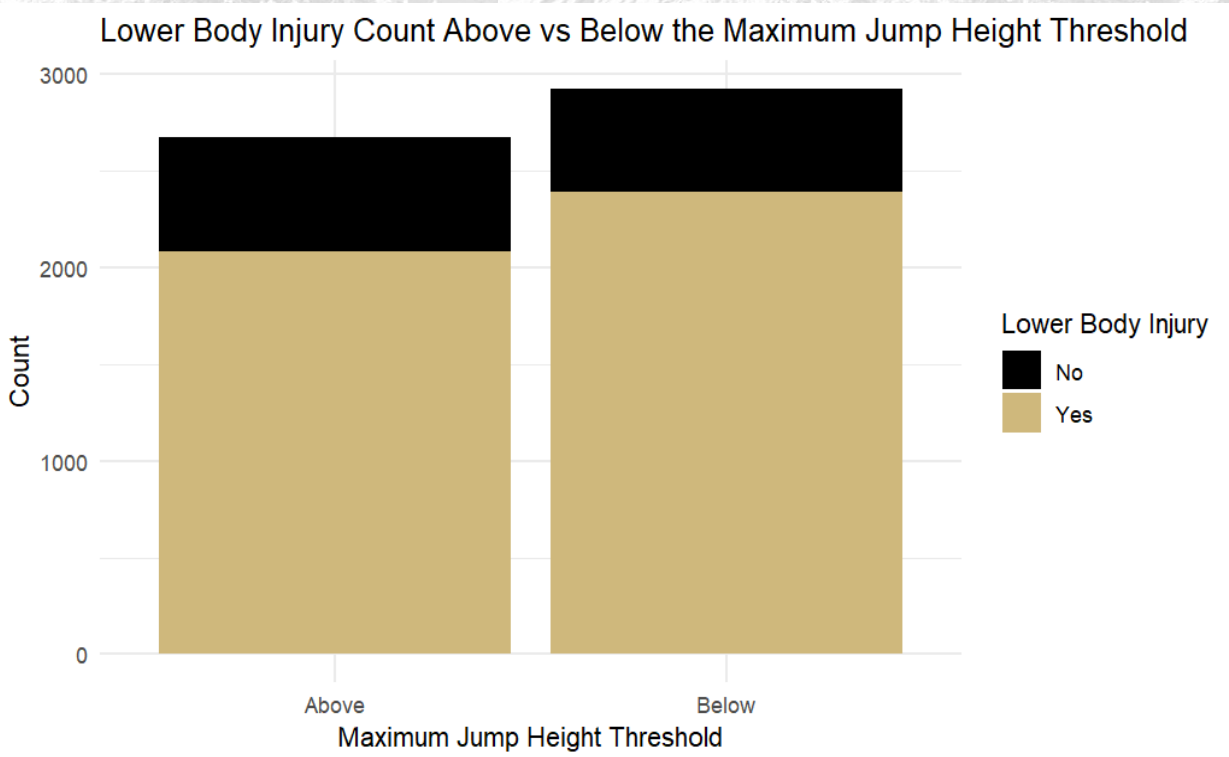
Statistically Significant:
p-value= 2e^16

Hop Jump Metrics Thresholds

Maximum Jump Height Threshold

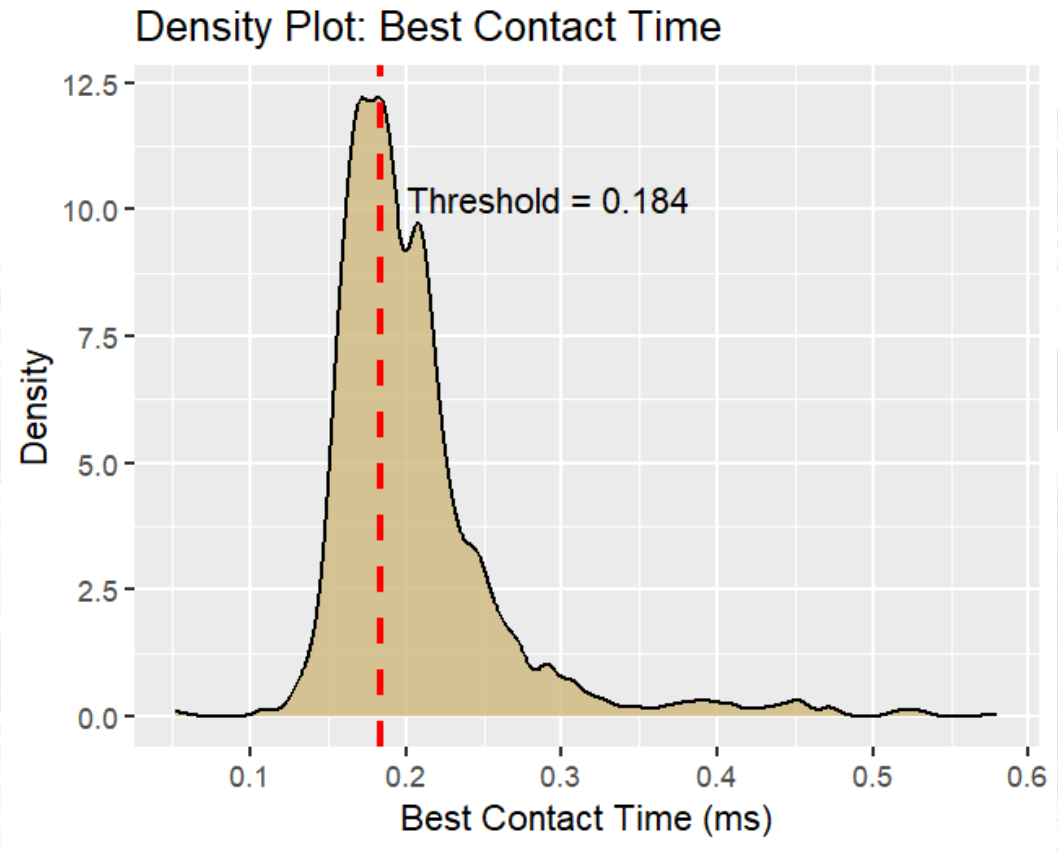


Female athletes who are above the threshold have about a 22% lower risk of a lower body injury.

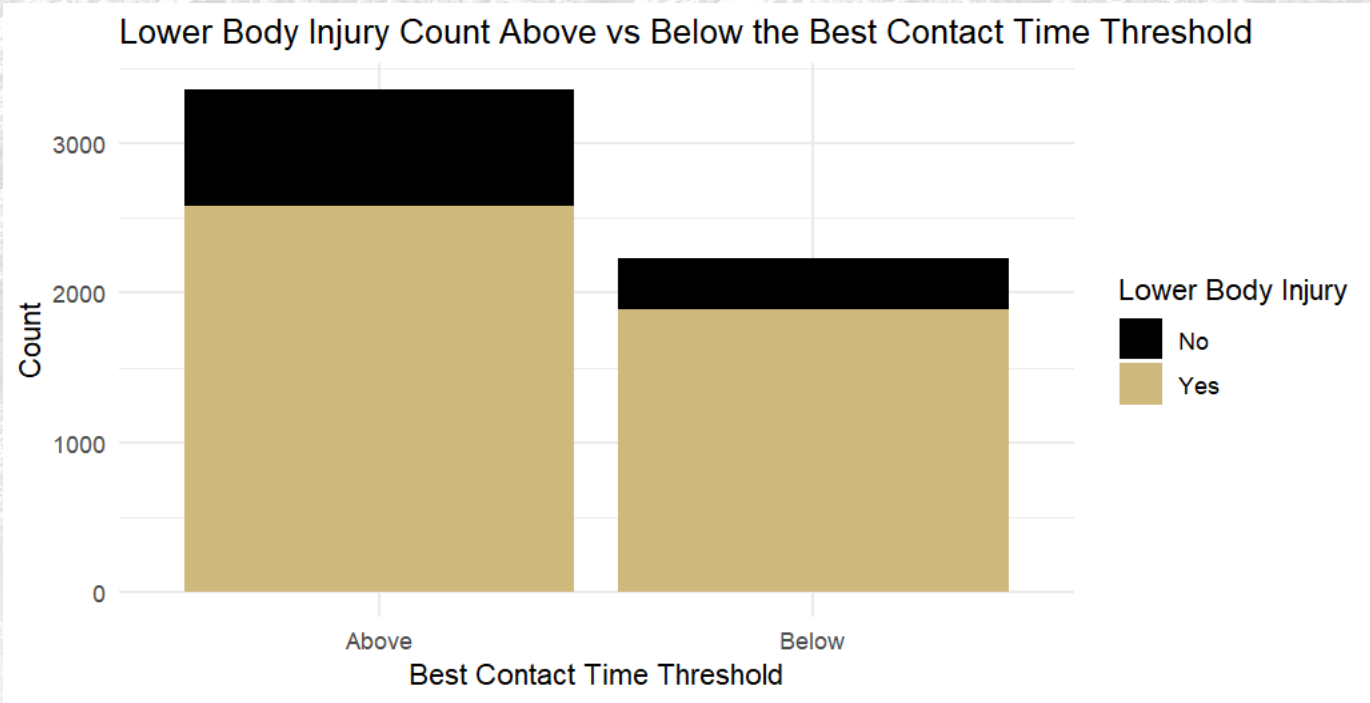


Statistically Significant:
p-value= 0.000293

Best Contact Time Threshold



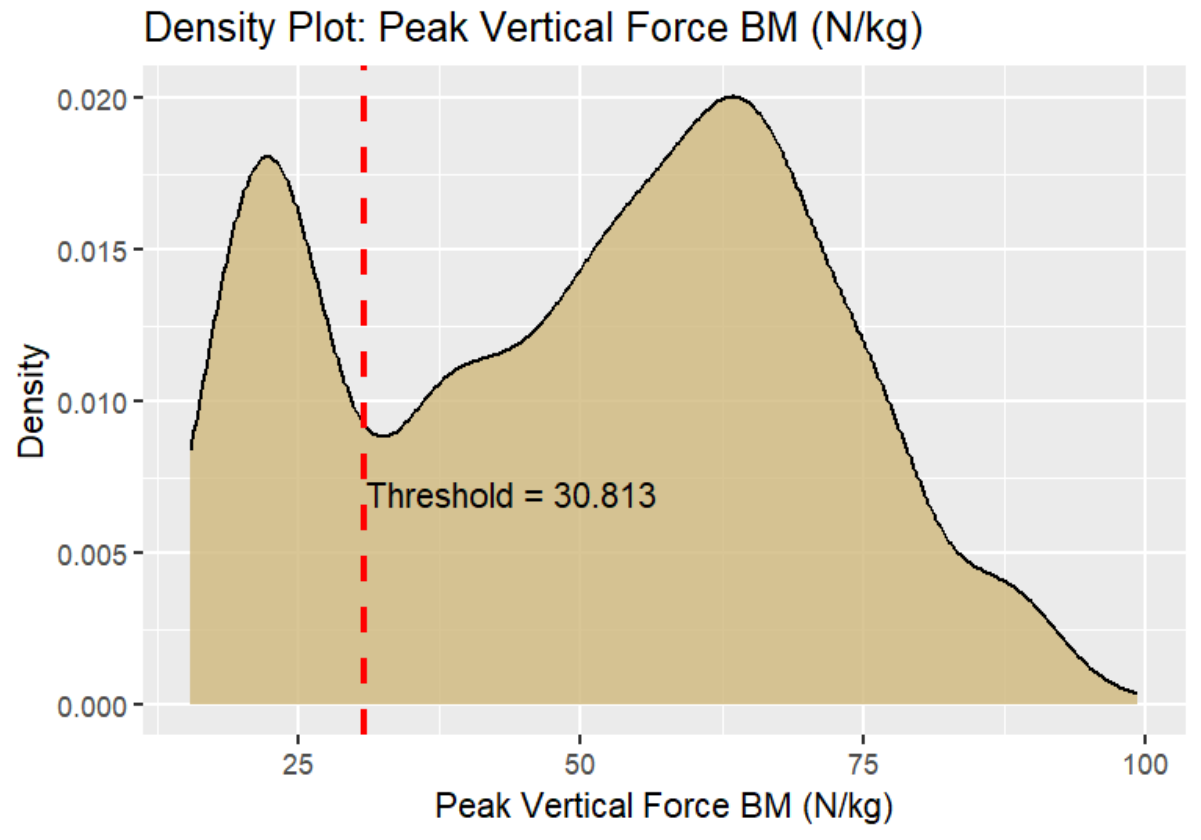
Female athletes who are above the threshold have about a 40% lower risk of a lower body injury.



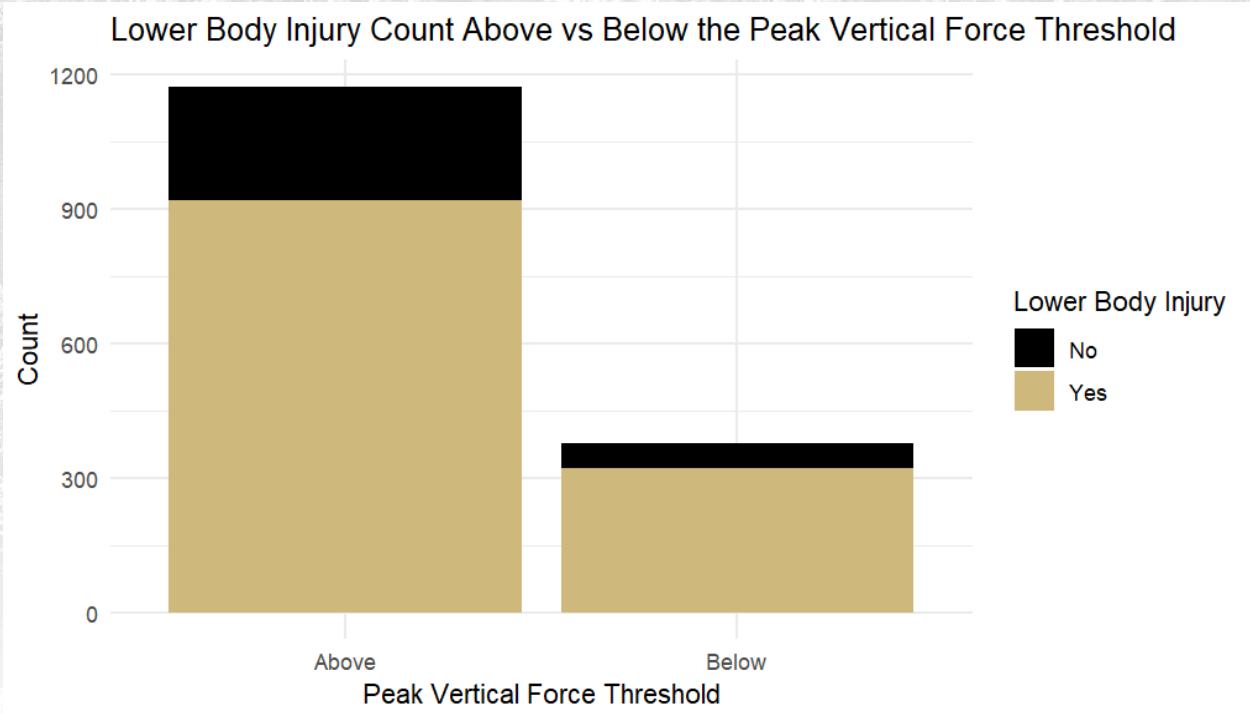
Statistically Significant:
p-value= 8.93e^-13

Isometric Mid-Thigh Pull Test Thresholds

Peak Vertical Force Threshold

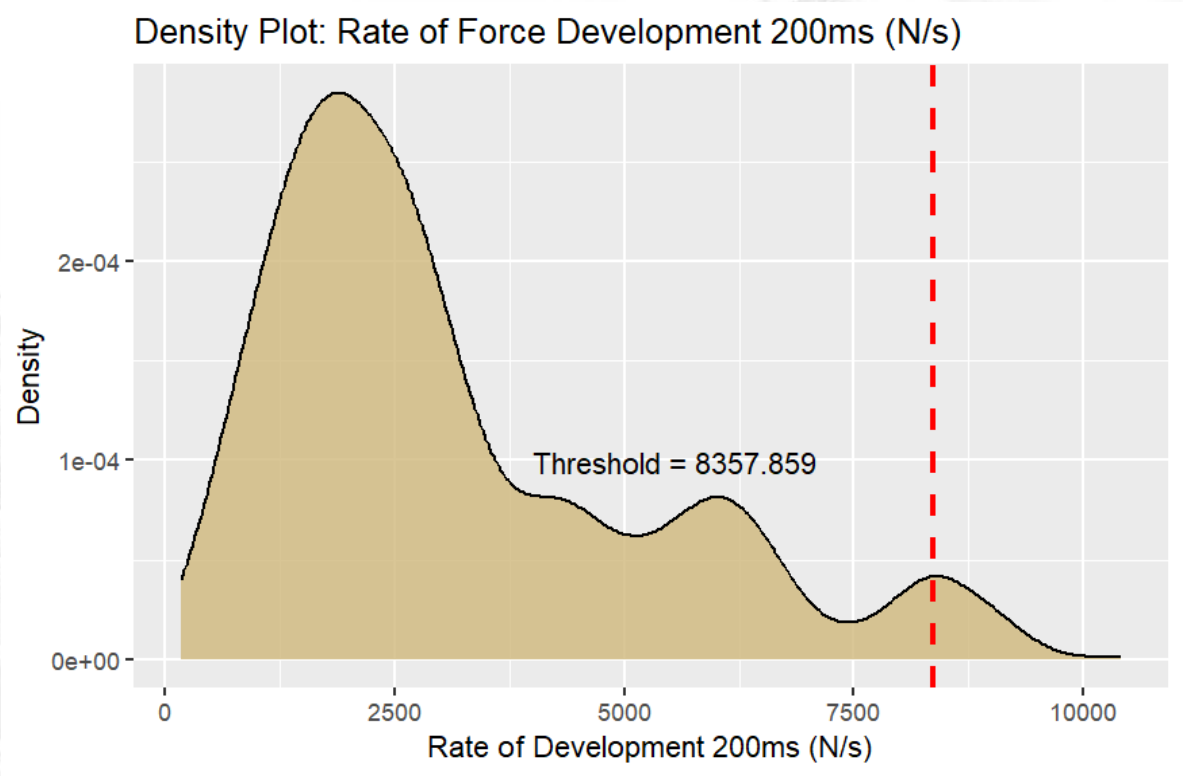


Female athletes who are above the threshold have about a 38% lower risk of a lower body injury.

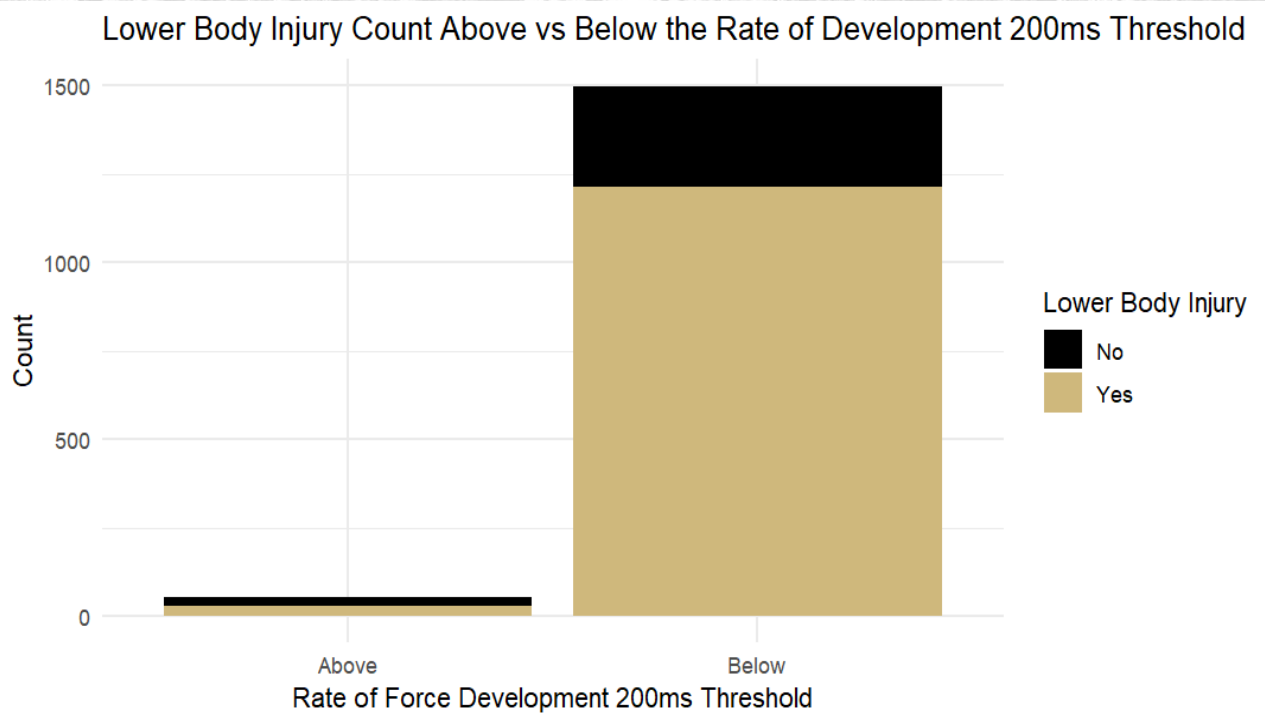


Statistically Significant:
p-value= 0.0032

Rate of Force Development at 200ms Threshold

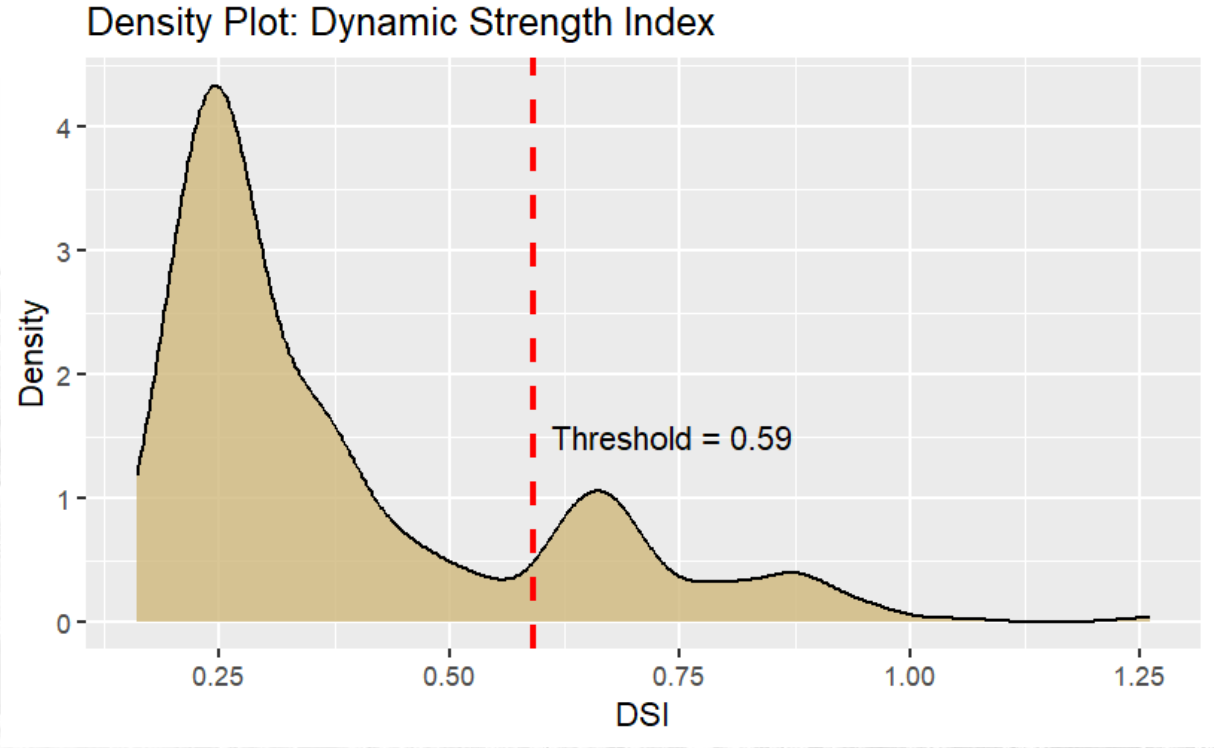


Female athletes who are above the threshold for rate of force development at 200ms have about a **72% lower risk** of a lower body injury.

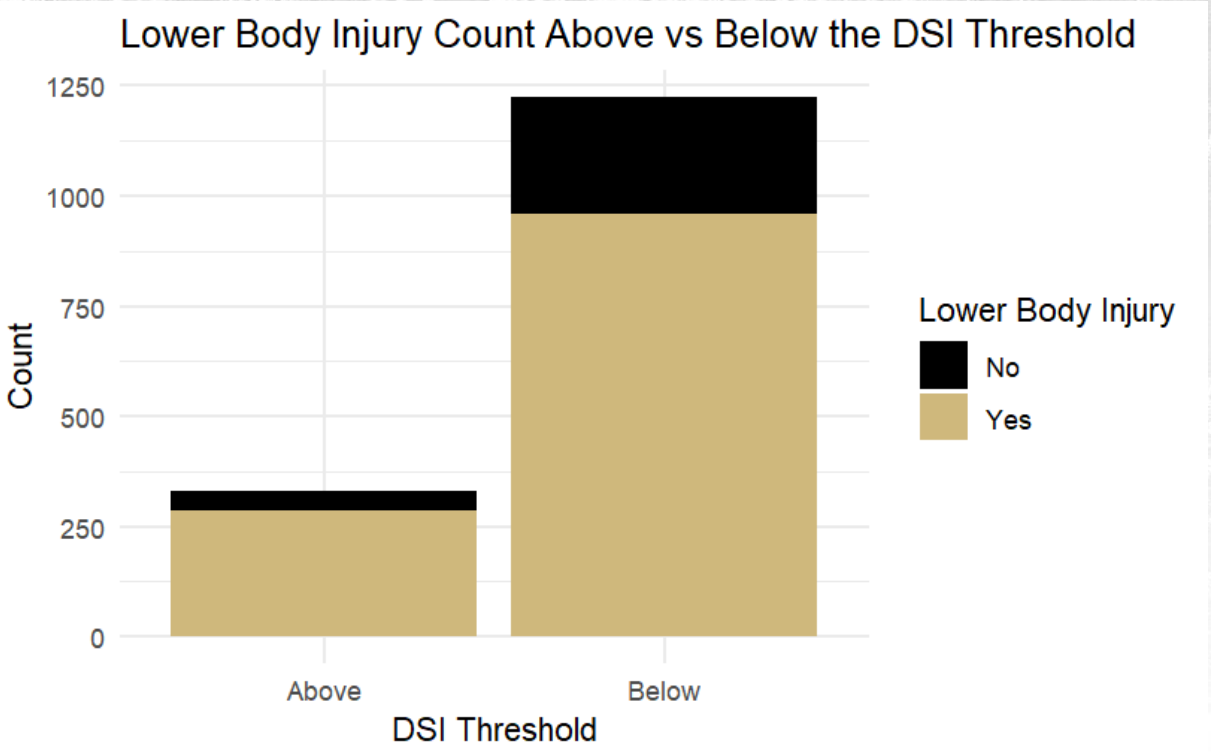


Statistically Significant:
p-value= 8.34e^-06

Dynamic Strength Index (DSI) Threshold



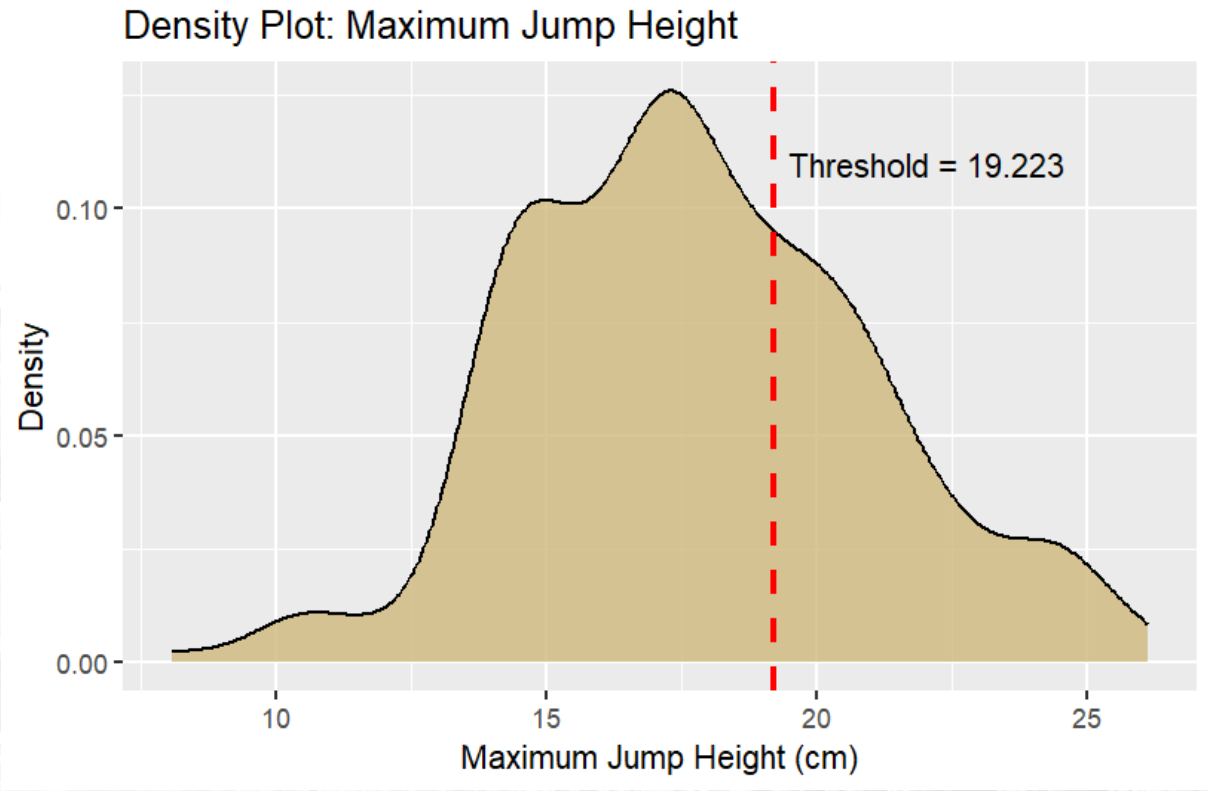
Female athletes above the threshold have 1.78 times higher odds of sustaining a lower body injury.



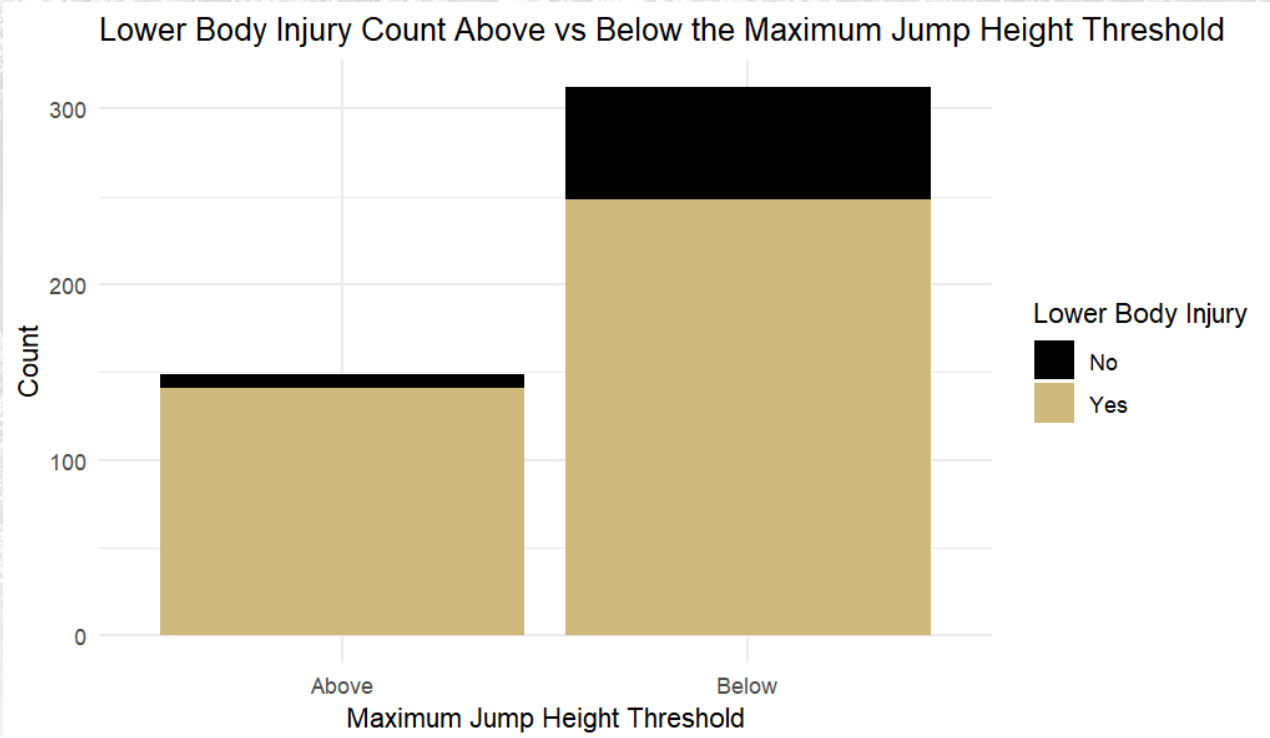
Statistically Significant:
p-value= 0.00103

Single Leg Jump Metrics Thresholds

Maximum Jump Height Threshold

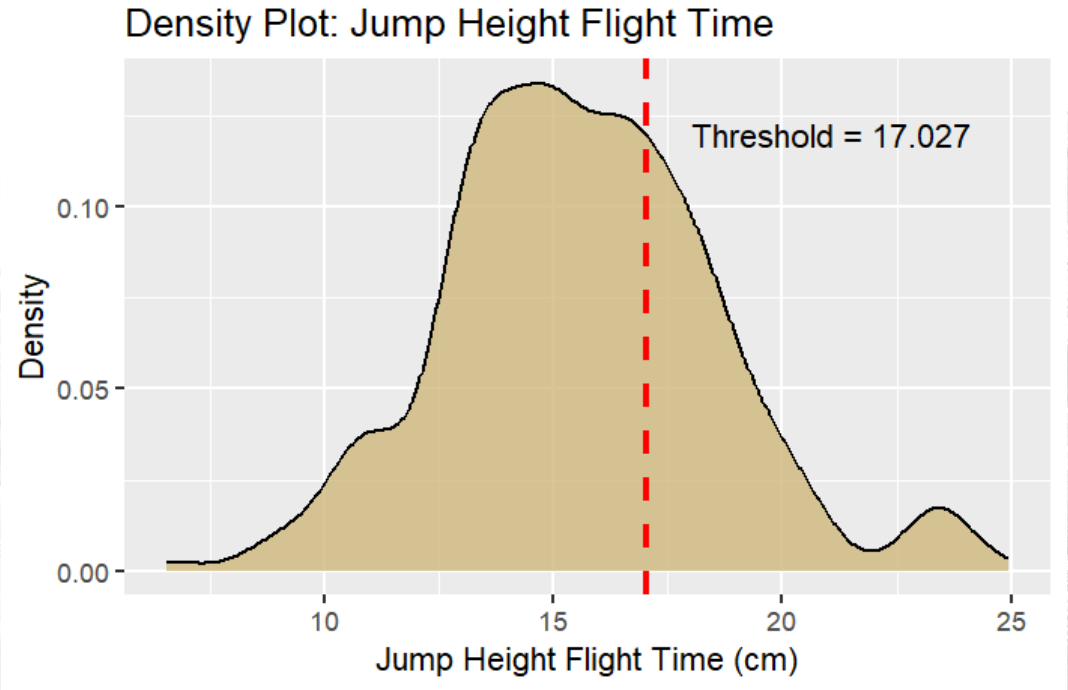


Female athletes above the threshold have 4.55 times higher odds of sustaining a lower body injury.



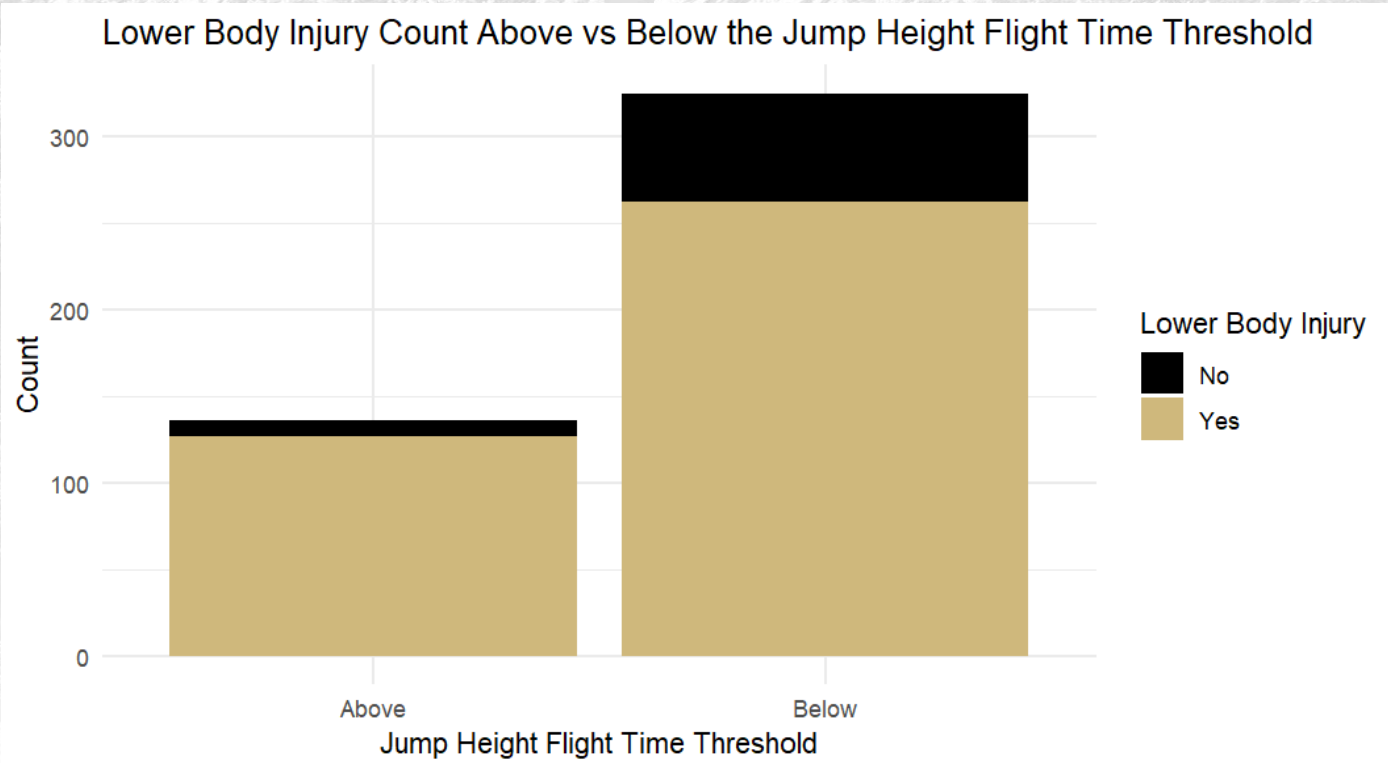
Statistically significant: p-value= 0.000101

Jump Height Flight Time Threshold

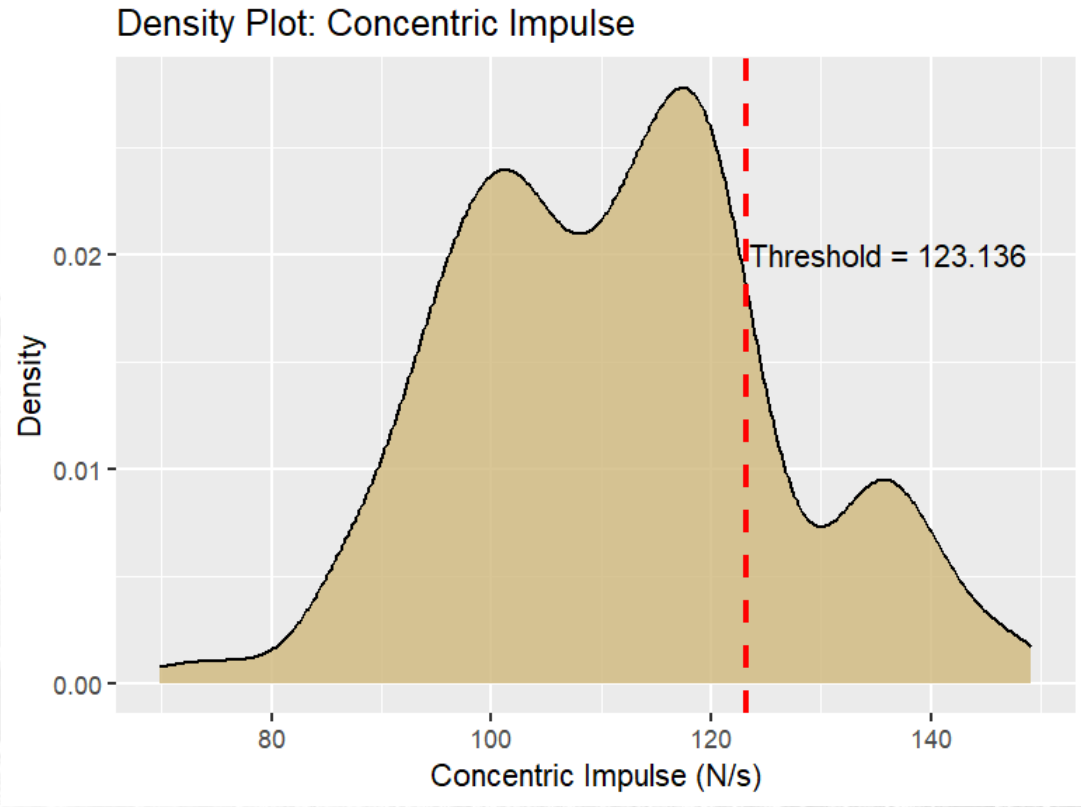


Female athletes above the threshold have 3.39 times higher odds of sustaining a lower body injury.

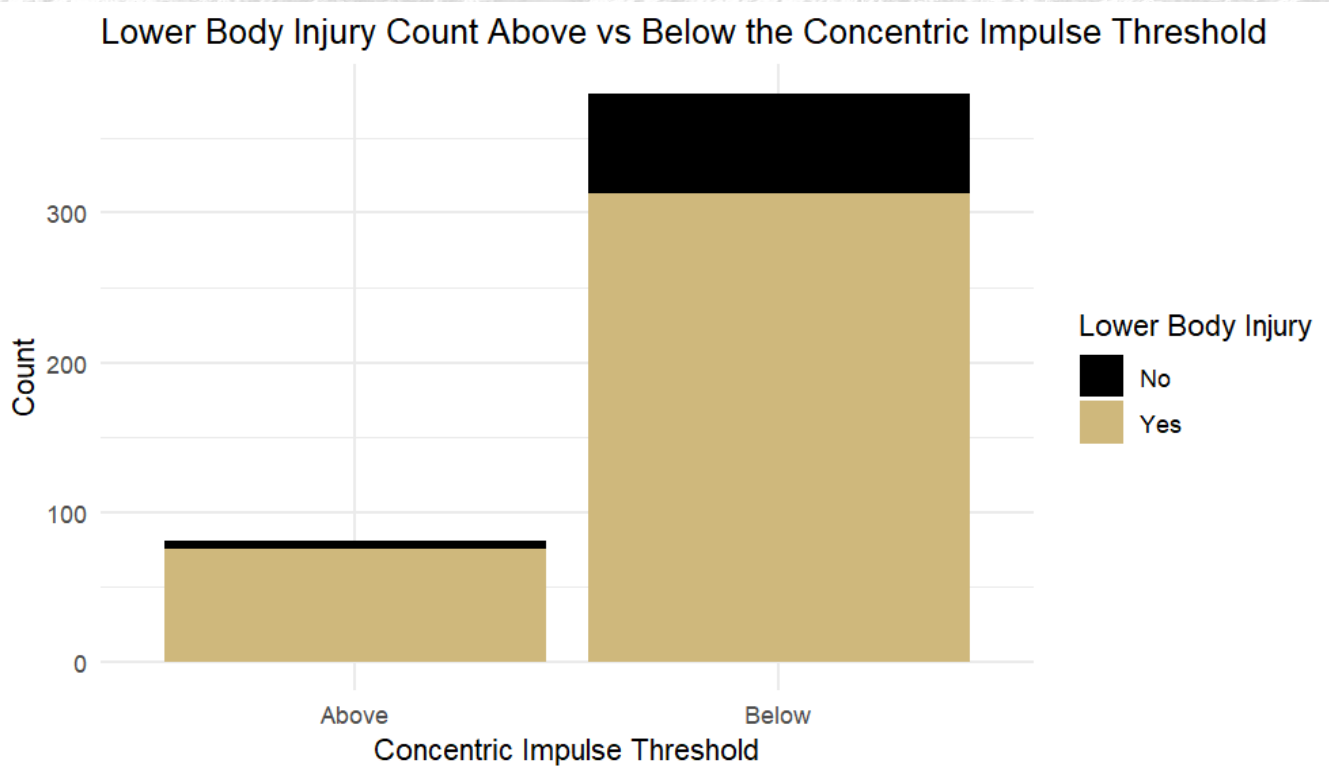
Statistically significant:
p-value= 0.00103



Concentric Impulse Threshold



Female athletes above the threshold have 3.25 times higher odds of sustaining a lower body injury.



Statistically significant: p-value= 0.0142

Question 2:

What trends in strength do we see across the women's team sports?

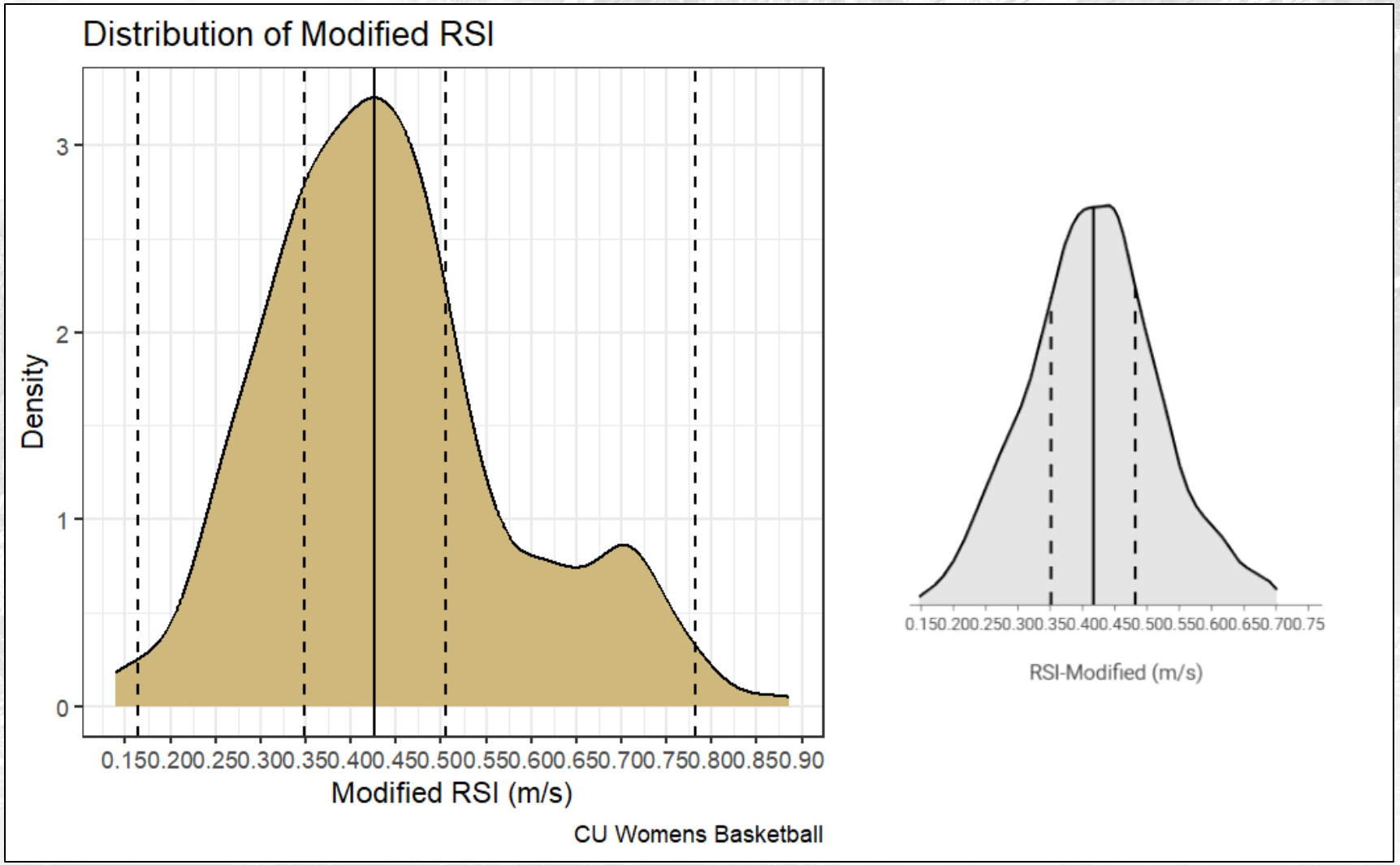
CMJ Metrics

Modified RSI

Women's Basketball

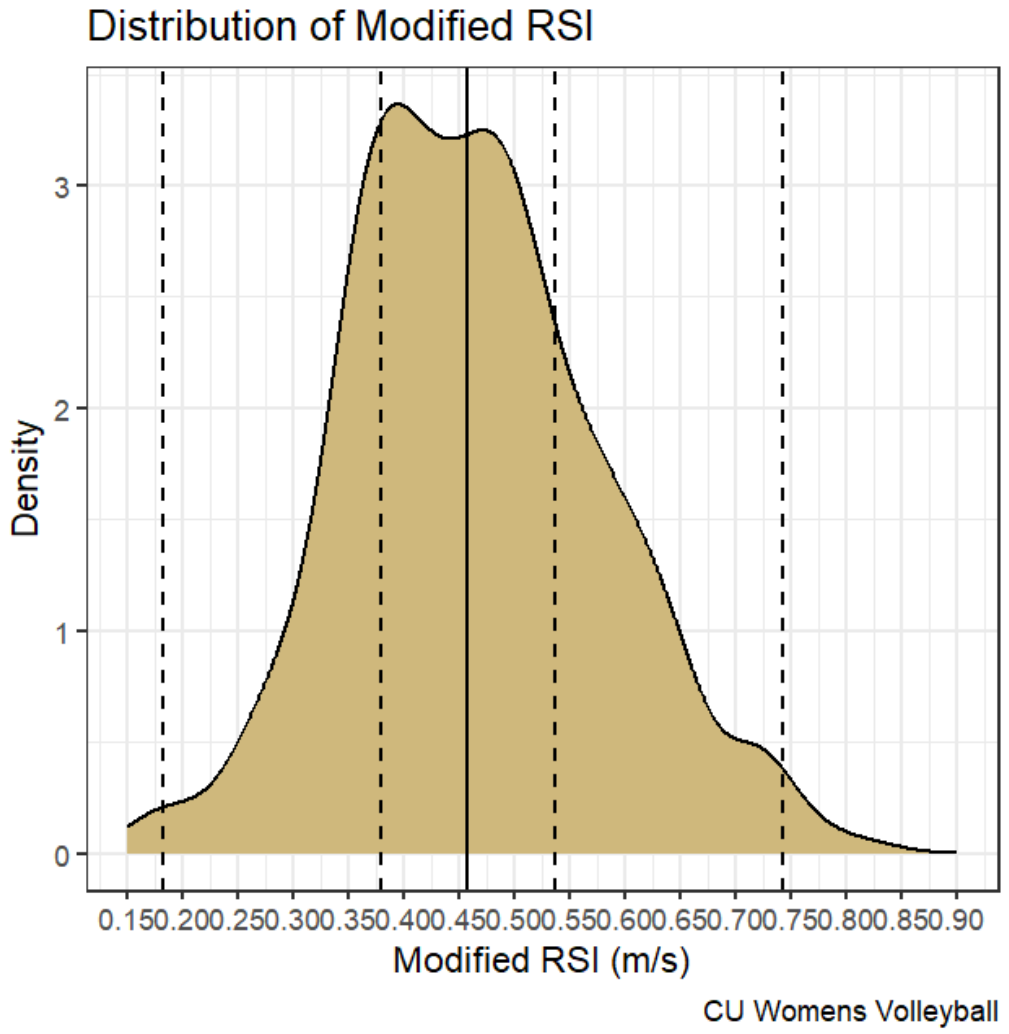
Normative Percentiles:
25th: 0.351
50th: 0.417
75th: 0.482

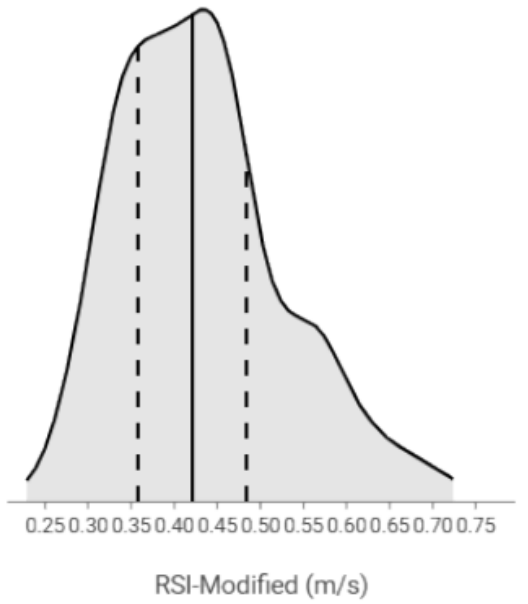
CU Data Percentiles:
25th: 0.348
50th: 0.426
75th: 0.505



Modified RSI

Women's Volleyball





Normative Percentiles:
25th: 0.358
50th: 0.421
75th: 0.484

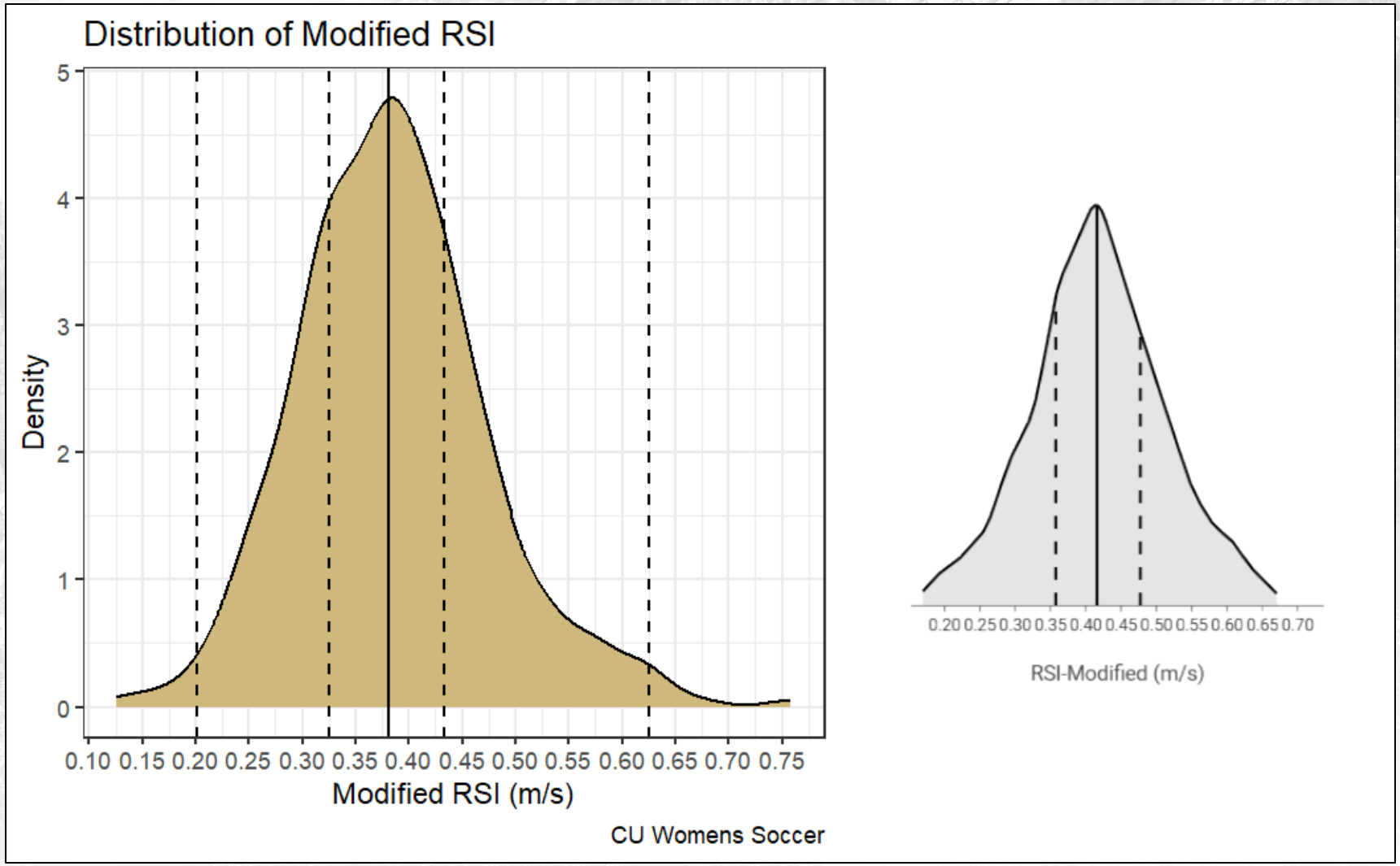
CU Data Percentiles:
25th: 0.380
50th: 0.457
75th: 0.536

Modified RSI

Women's Soccer

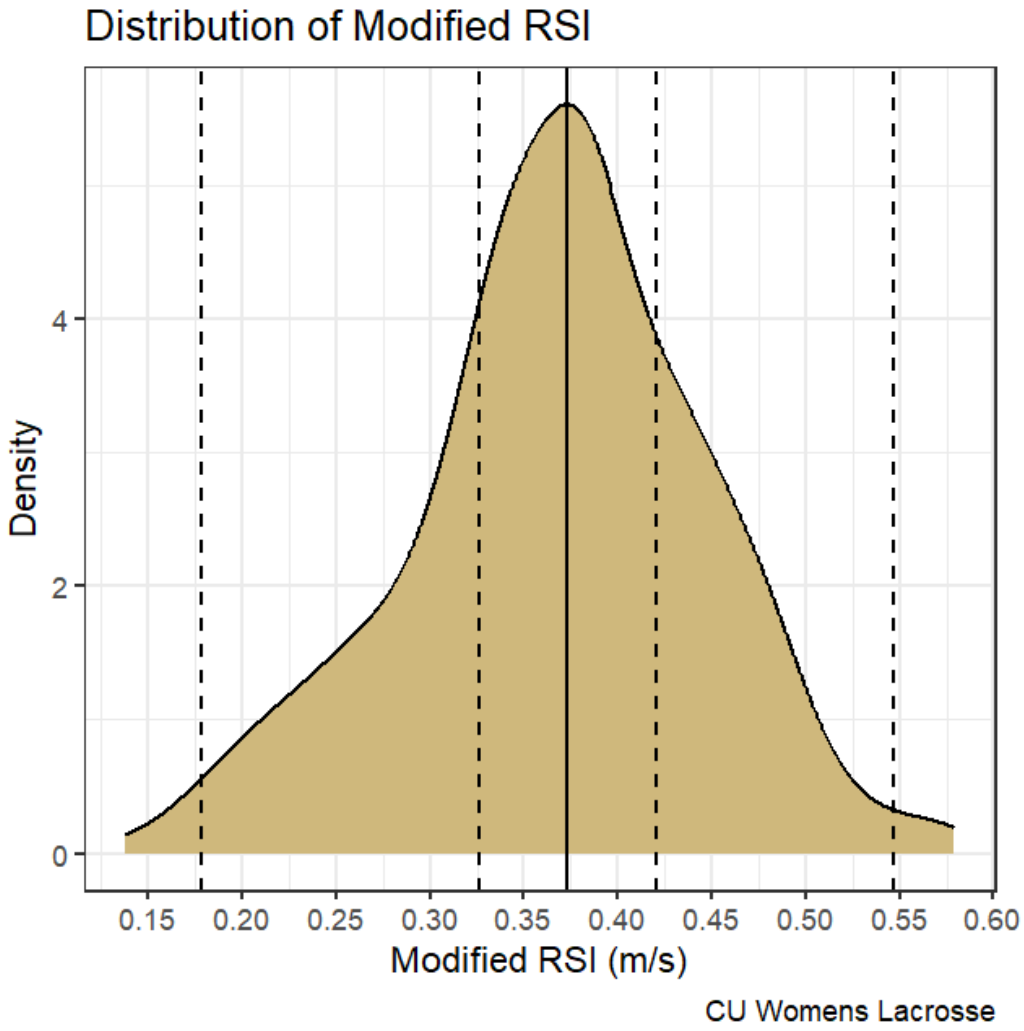
Normative Percentiles:
25th: 0.358
50th: 0.416
75th: 0.477

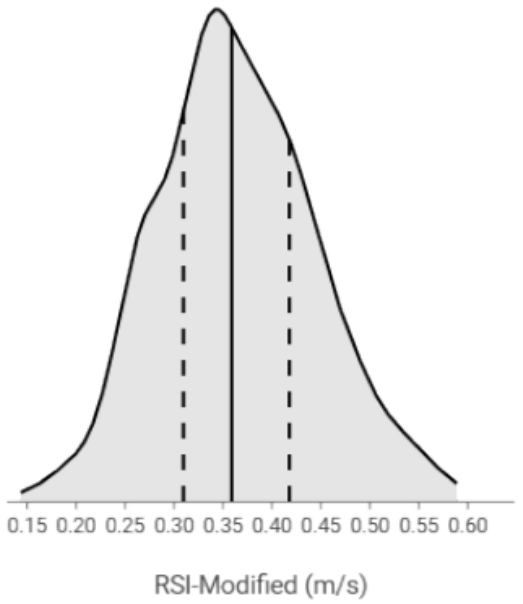
CU Data Percentiles:
25th: 0.325
50th: 0.381
75th: 0.433



Modified RSI

Women's Lacrosse

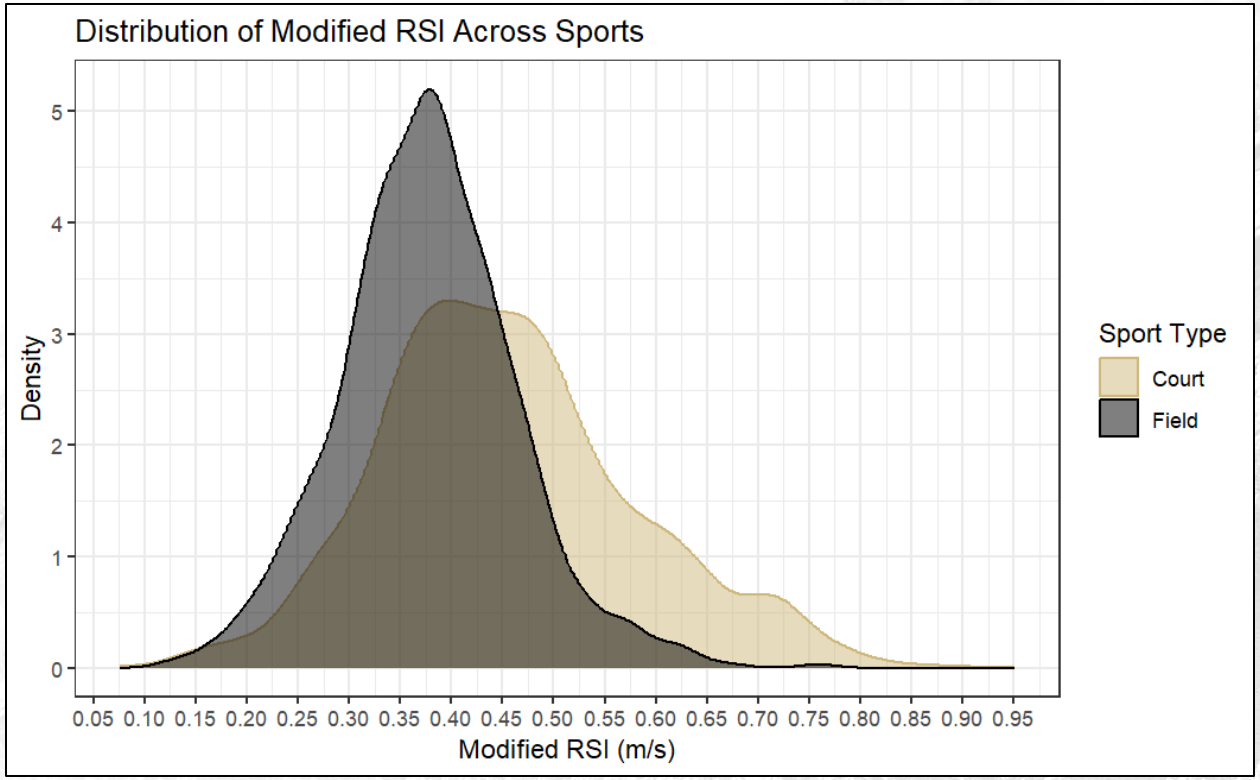




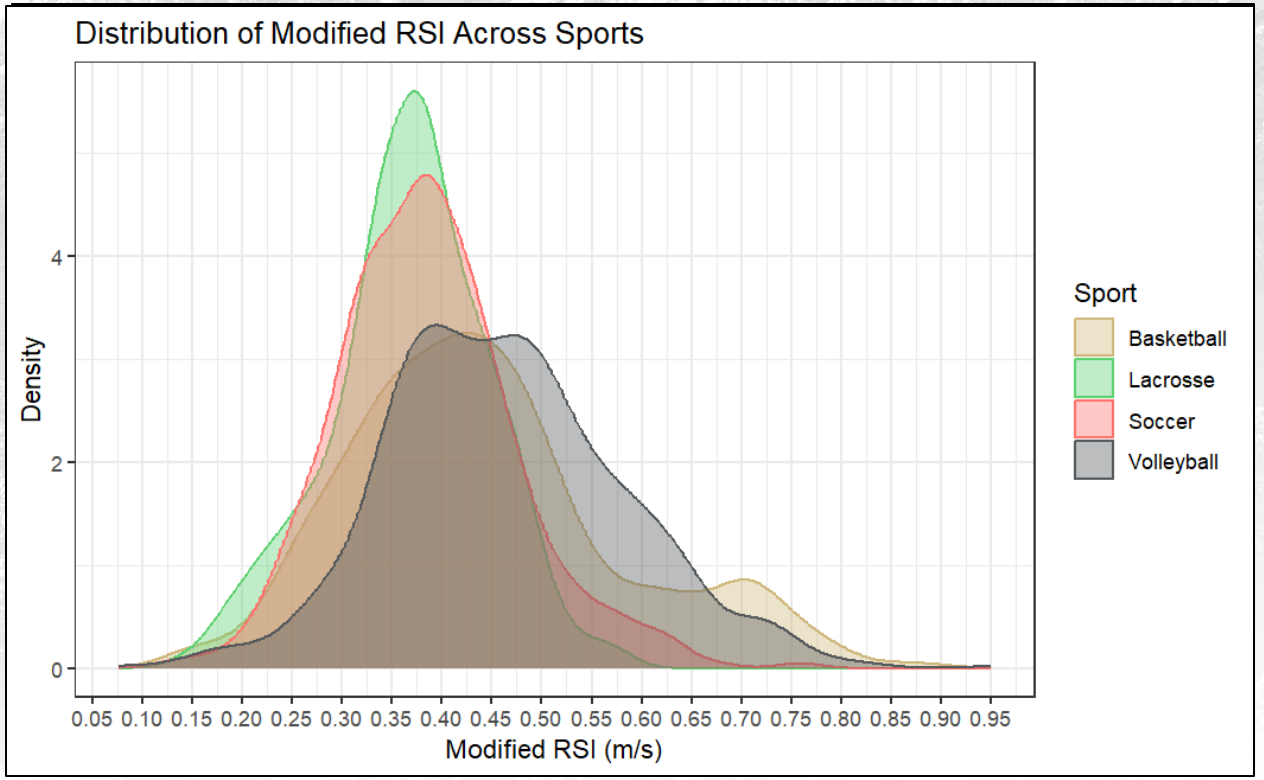
Normative Percentiles:
25th: 0.310
50th: 0.359
75th: 0.418

CU Data Percentiles:
25th: 0.327
50th: 0.373
75th: 0.420

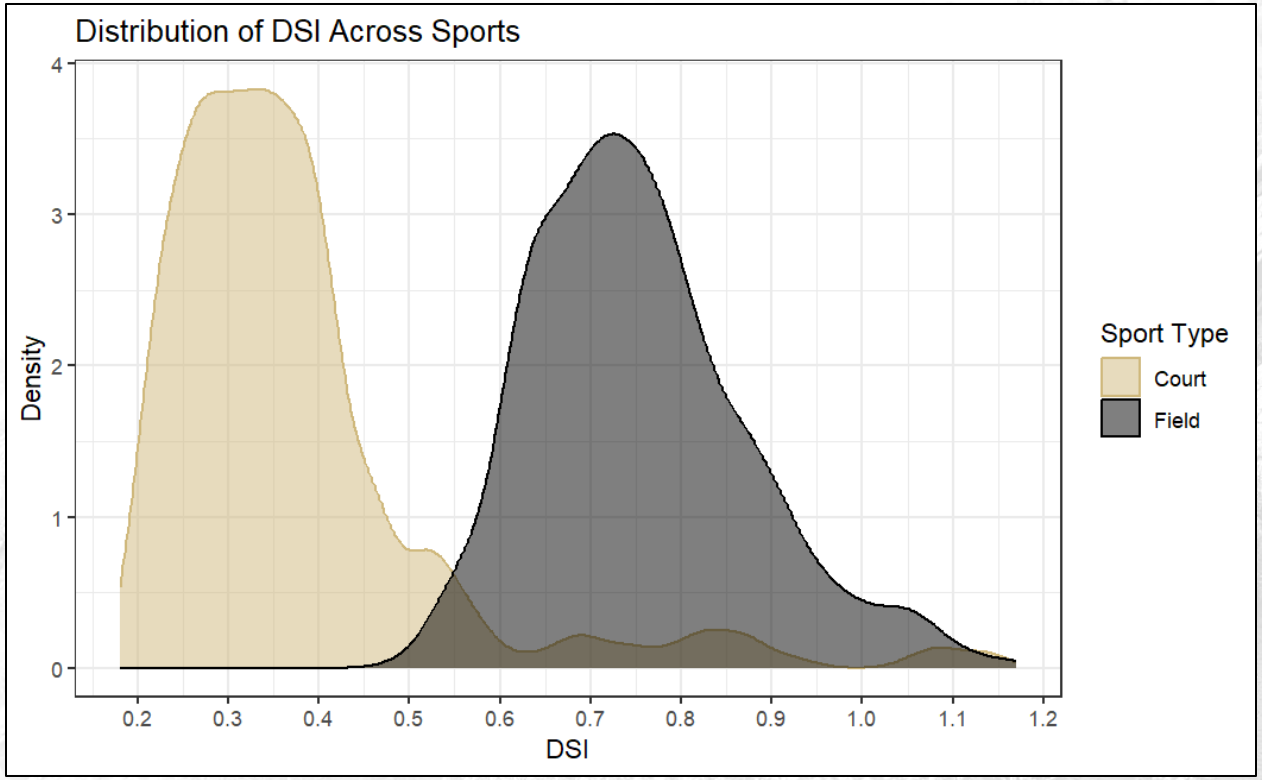
Modified RSI



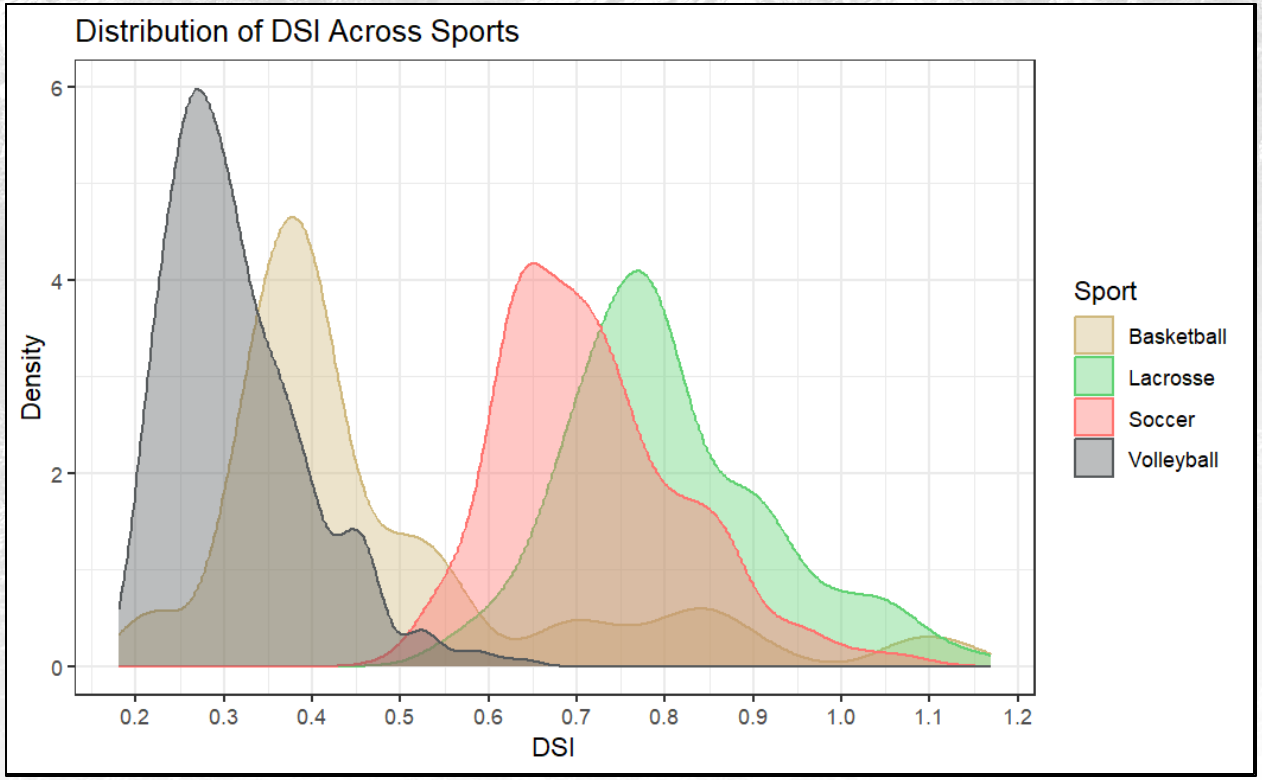
Modified RSI:
Lacrosse <<< Soccer <<< Basketball <<< Volleyball



DSI



DSI:
Volleyball <<< Basketball <<< Soccer <<< Lacrosse



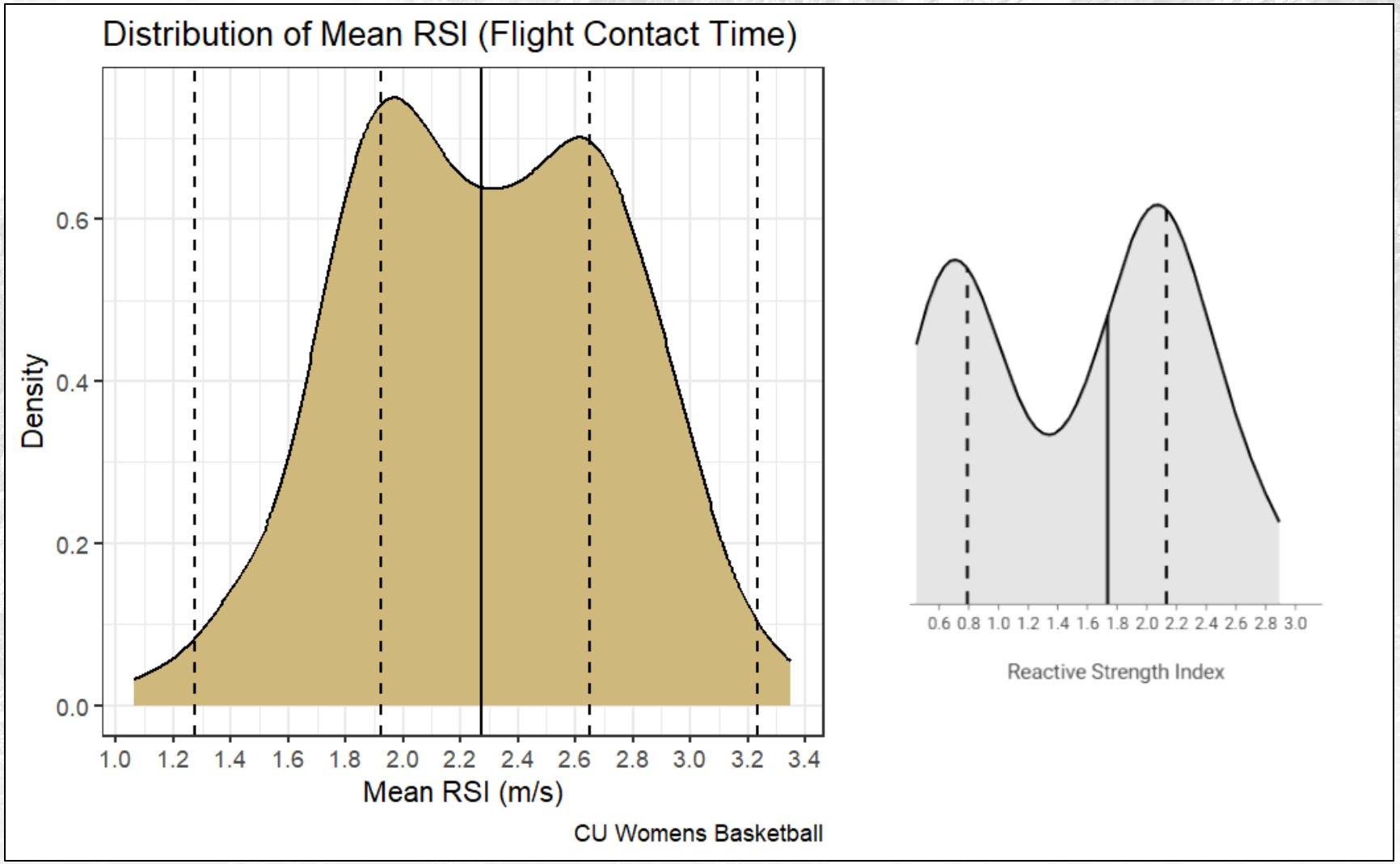

HJ Metrics

Hop Jump RSI

Women's Basketball

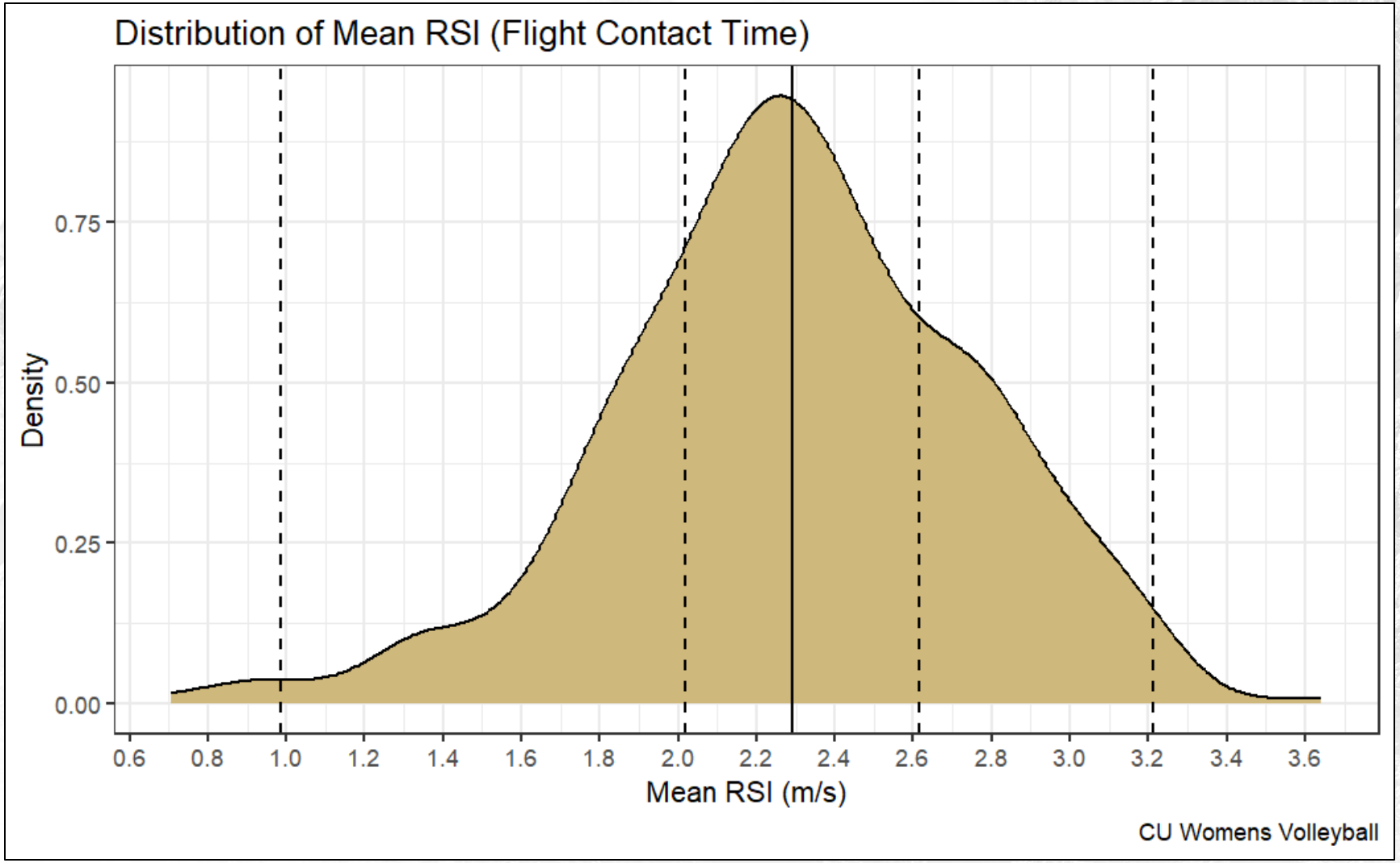
Normative Percentiles:
25th: 0.79
50th: 1.74
75th: 2.13

CU Data Percentiles:
25th: 1.925
50th: 2.273
75th: 2.650



Hop Jump RSI

Women's Volleyball



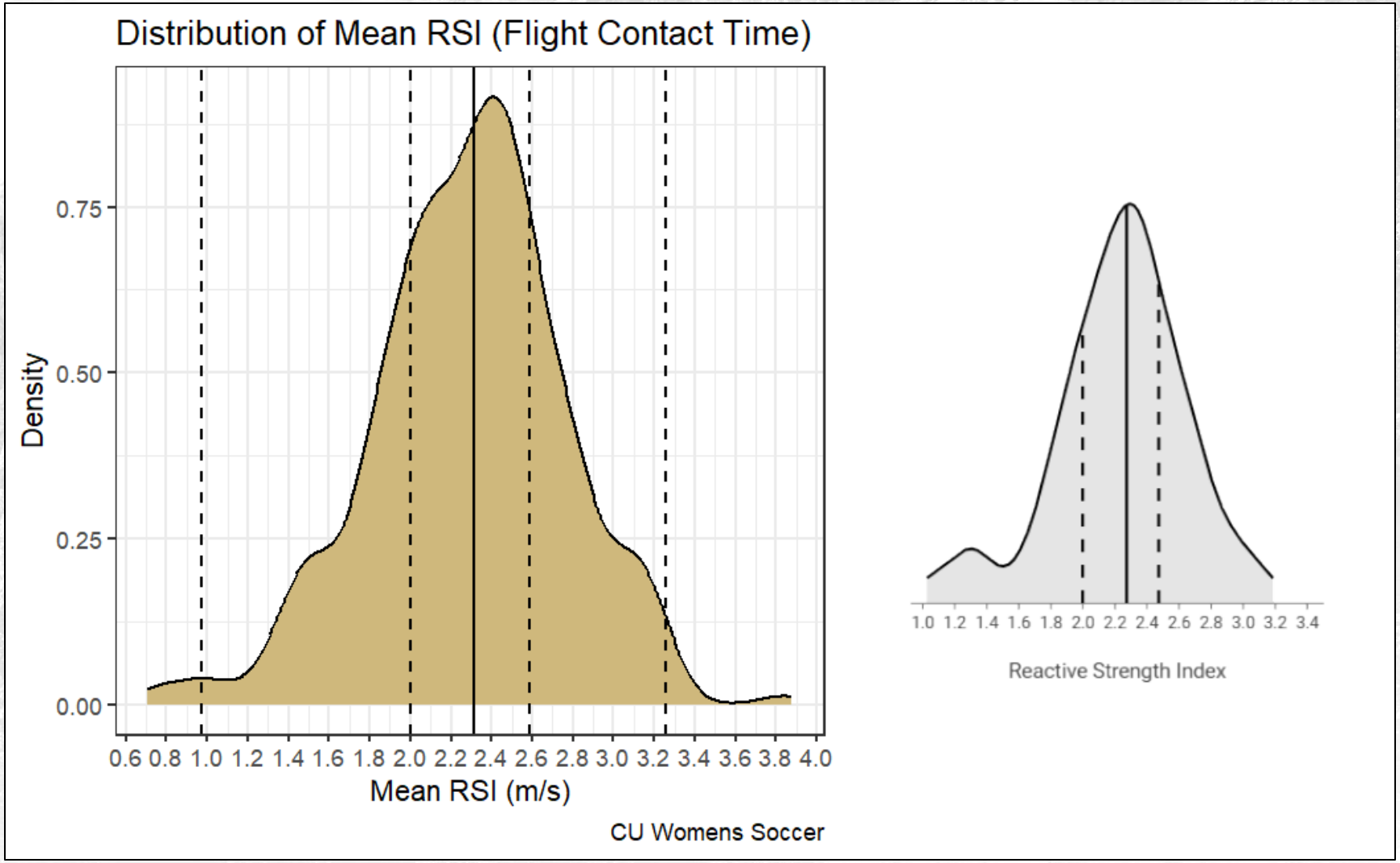
CU Data Percentiles:
25th: 2.018
50th: 2.293
75th: 2.616

Hop Jump RSI

Women's Soccer

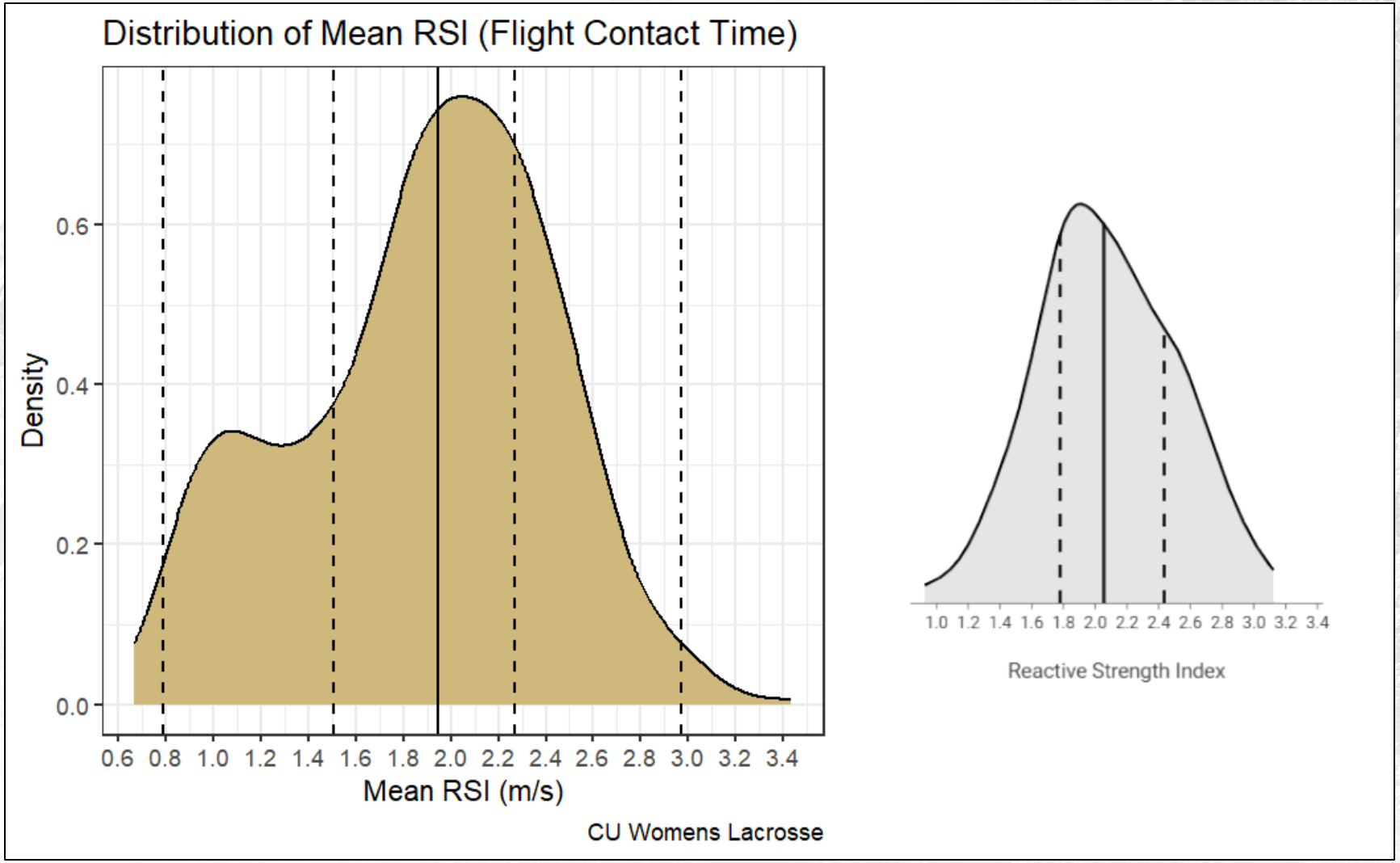
Normative Percentiles:
25th: 2.00
50th: 2.27
75th: 2.47

CU Data Percentiles:
25th: 2.001
50th: 2.315
75th: 2.586



Hop Jump RSI

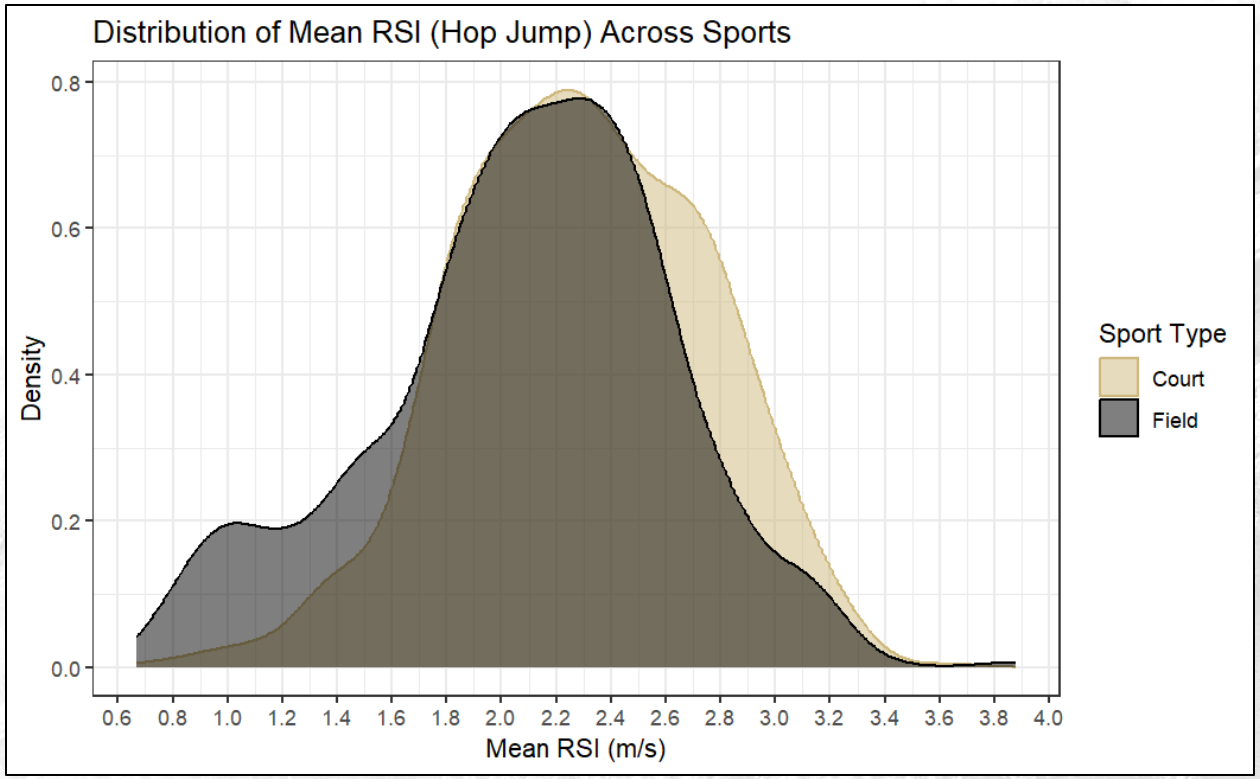
Women's Lacrosse



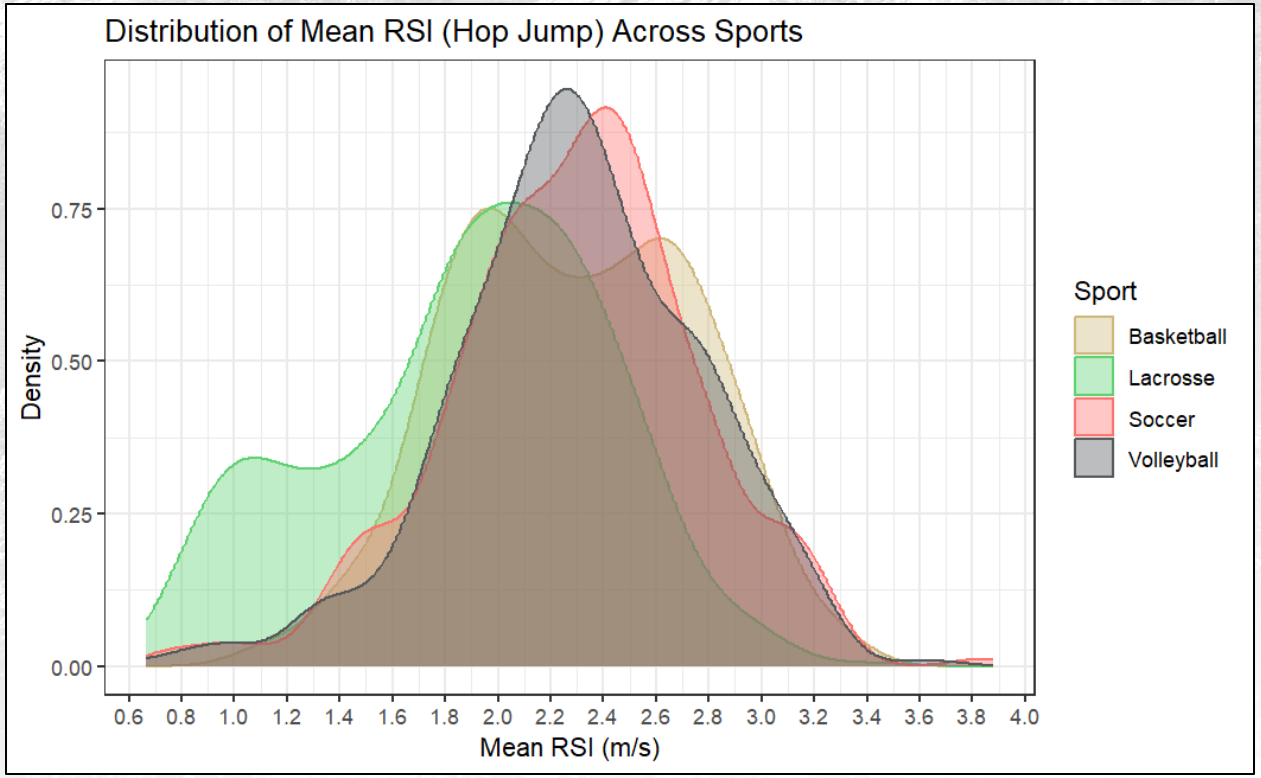
Normative Percentiles:
25th: 1.78
50th: 2.05
75th: 2.43

CU Data Percentiles:
25th: 1.506
50th: 1.948
75th: 2.267

Hop Jump RSI



Mean RSI:
Lacrosse <<< Basketball, Soccer, Volleyball



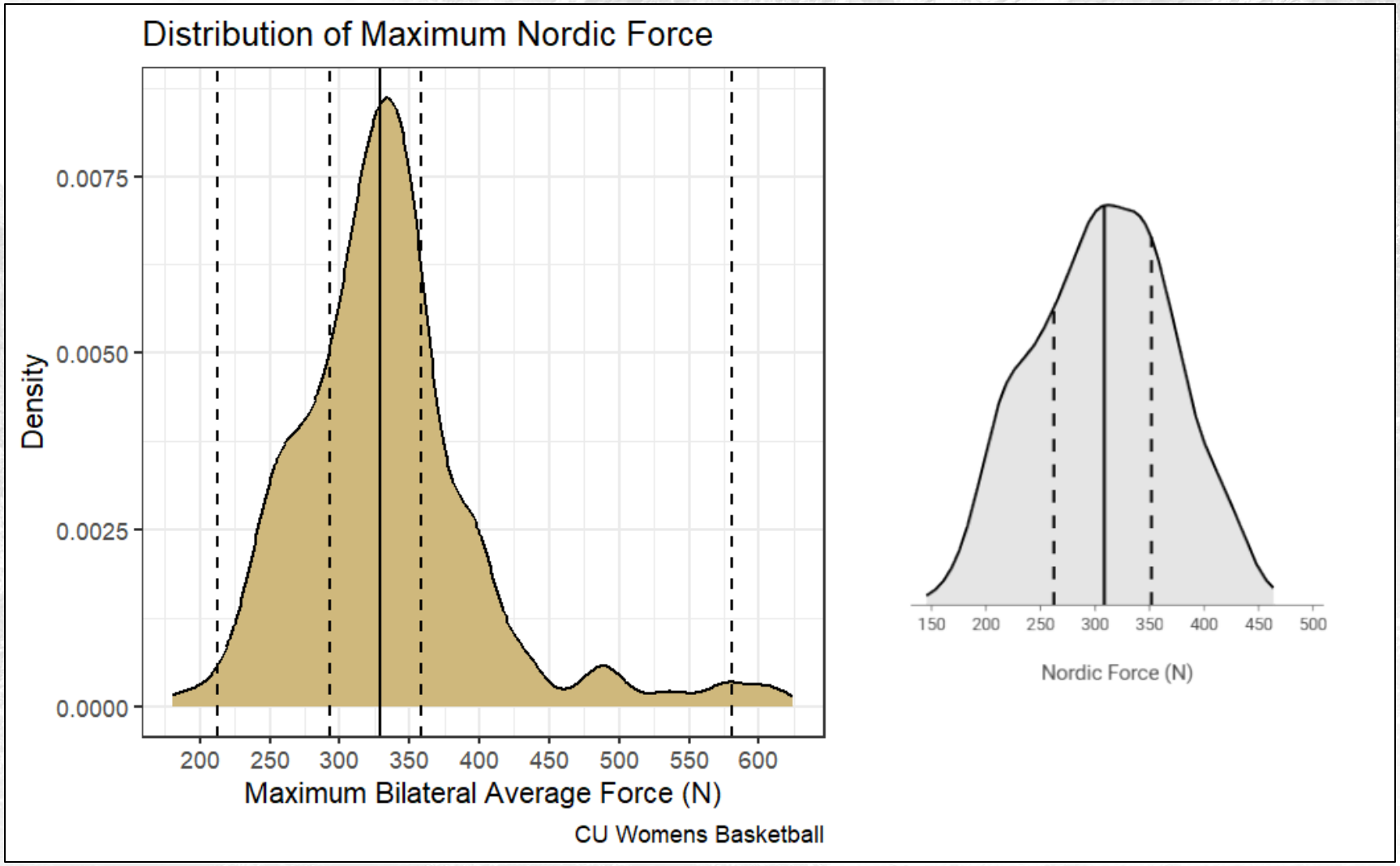

Nordic Metrics

Nordic Force

Women's Basketball

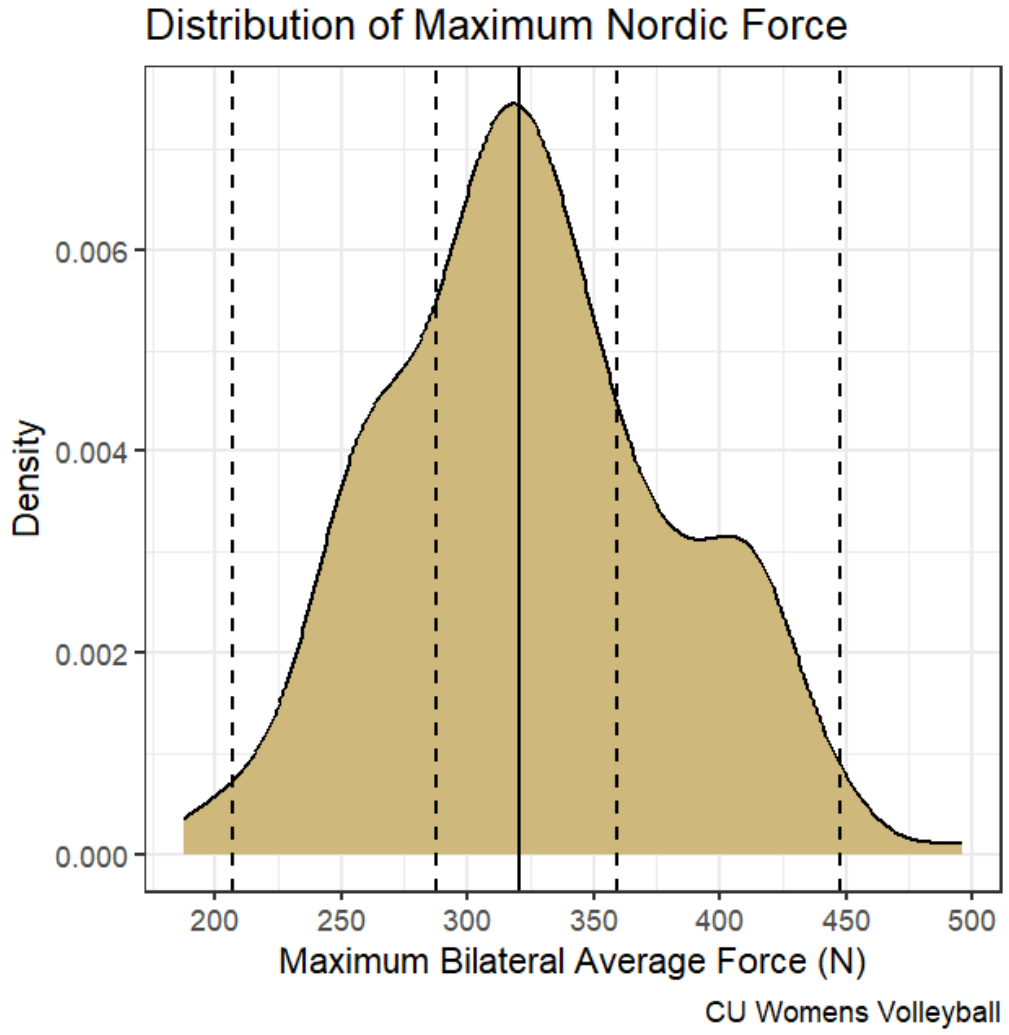
Normative Percentiles:
25th: 262
50th: 308
75th: 352

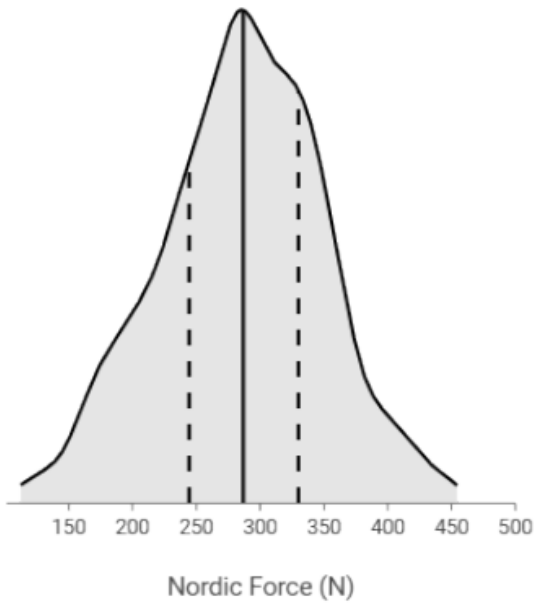
CU Data Percentiles:
25th: 293
50th: 329
75th: 358



Nordic Force

Women's Volleyball





Normative Percentiles:
25th: 244
50th: 287
75th: 330

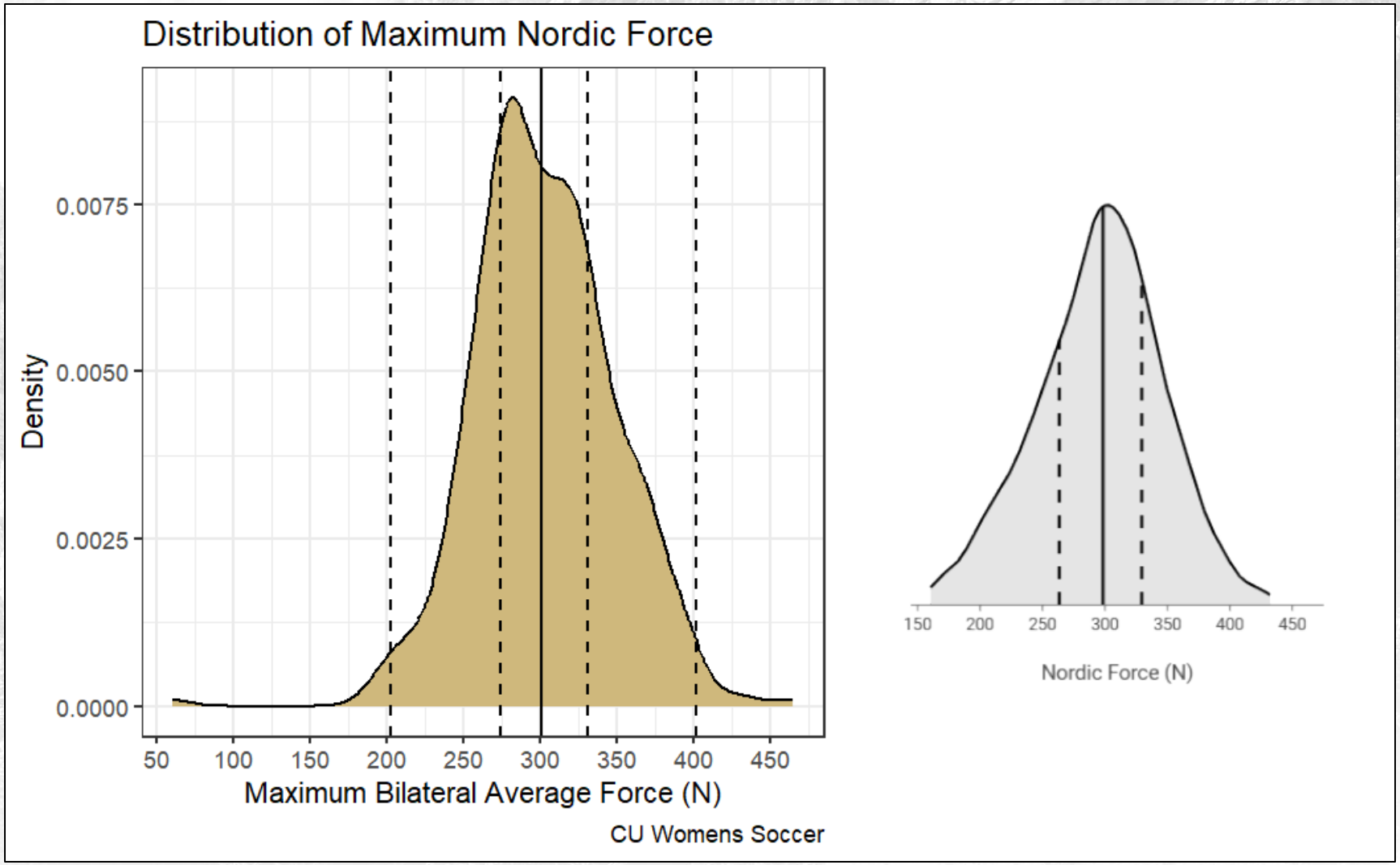
CU Data Percentiles:
25th: 288
50th: 320
75th: 359

Nordic Force

Women's Soccer

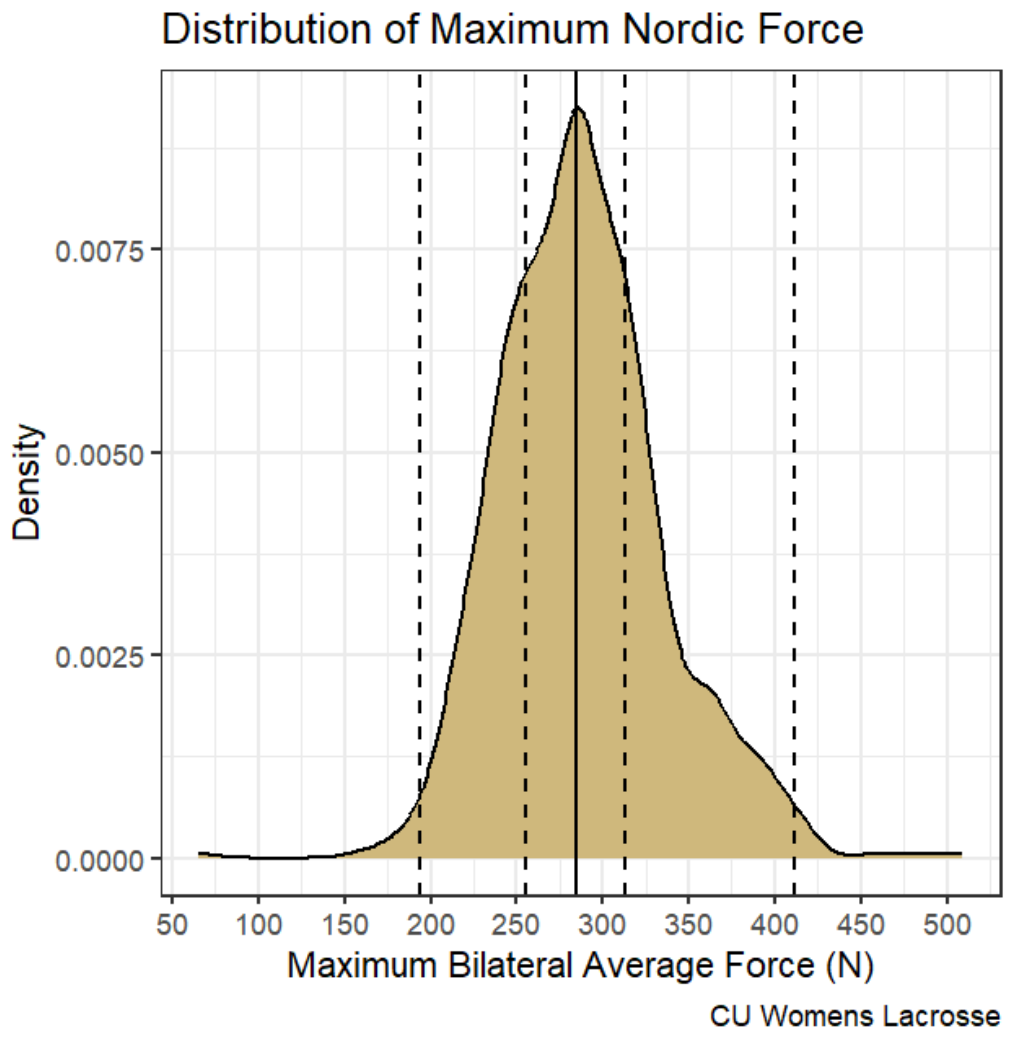
Normative Percentiles:
25th: 264
50th: 298
75th: 330

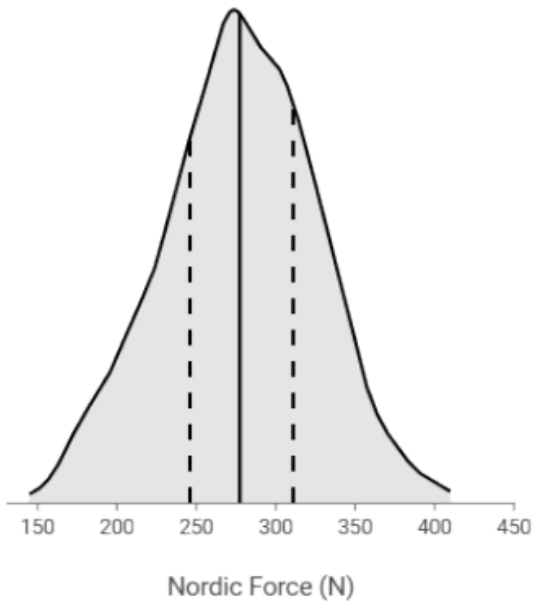
CU Data Percentiles:
25th: 274
50th: 301
75th: 331



Nordic Force

Women's Lacrosse

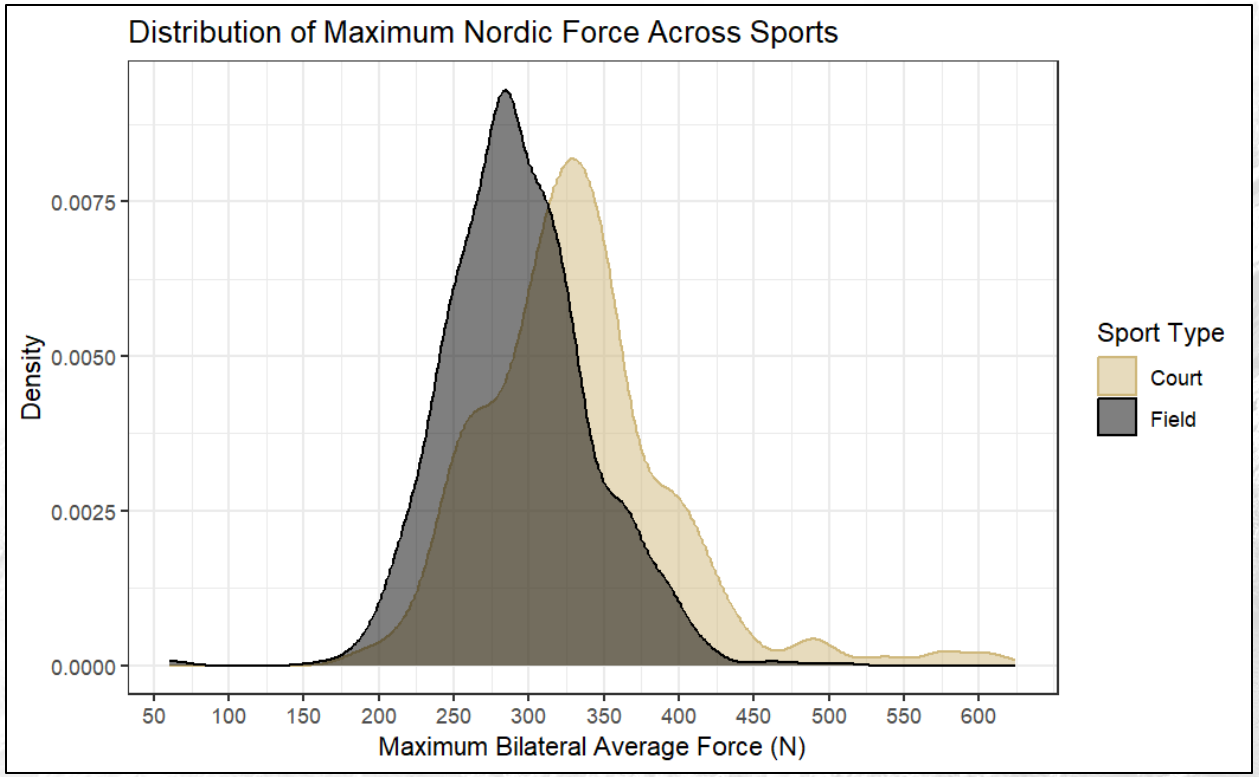




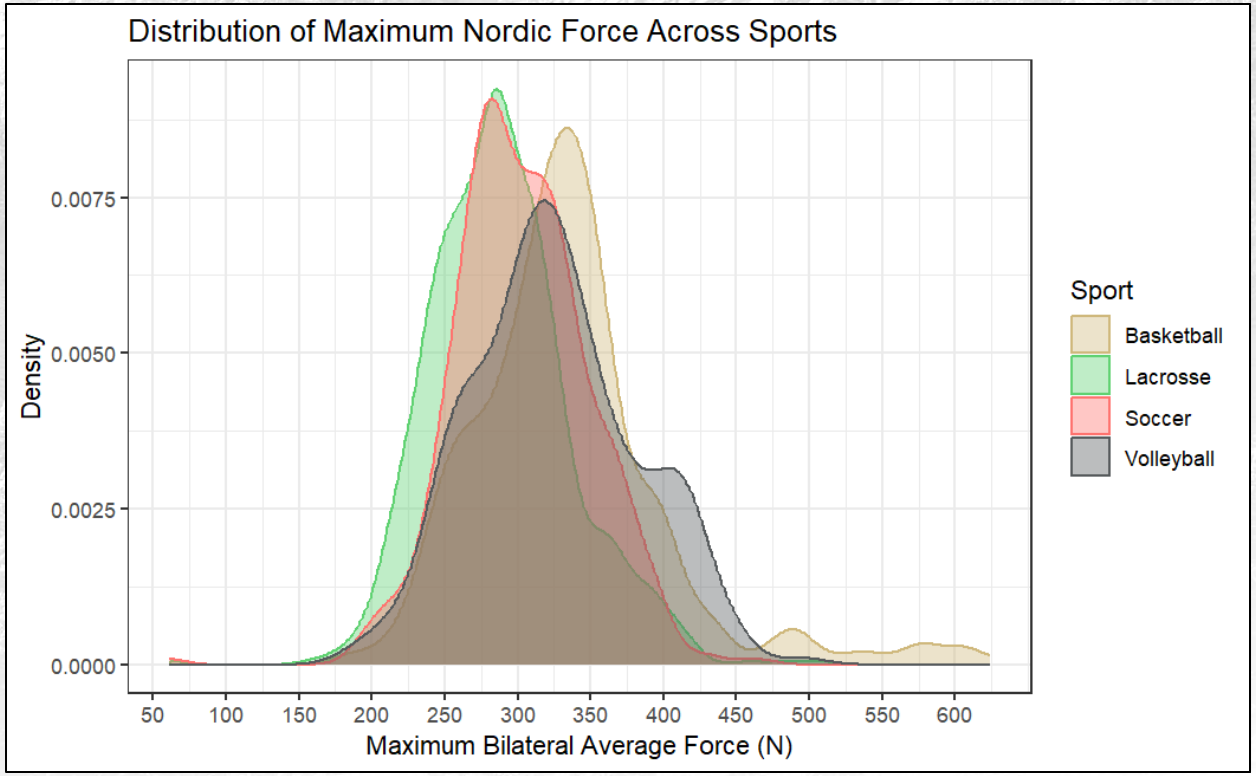
Normative Percentiles:
25th: 246
50th: 277
75th: 311

CU Data Percentiles:
25th: 255
50th: 285
75th: 313

Nordic Force



Bilateral Force:
Lacrosse <<< Soccer <<< Volleyball < Basketball



Relative Bilateral Force:
Basketball <<< Soccer <<< Volleyball, Lacrosse

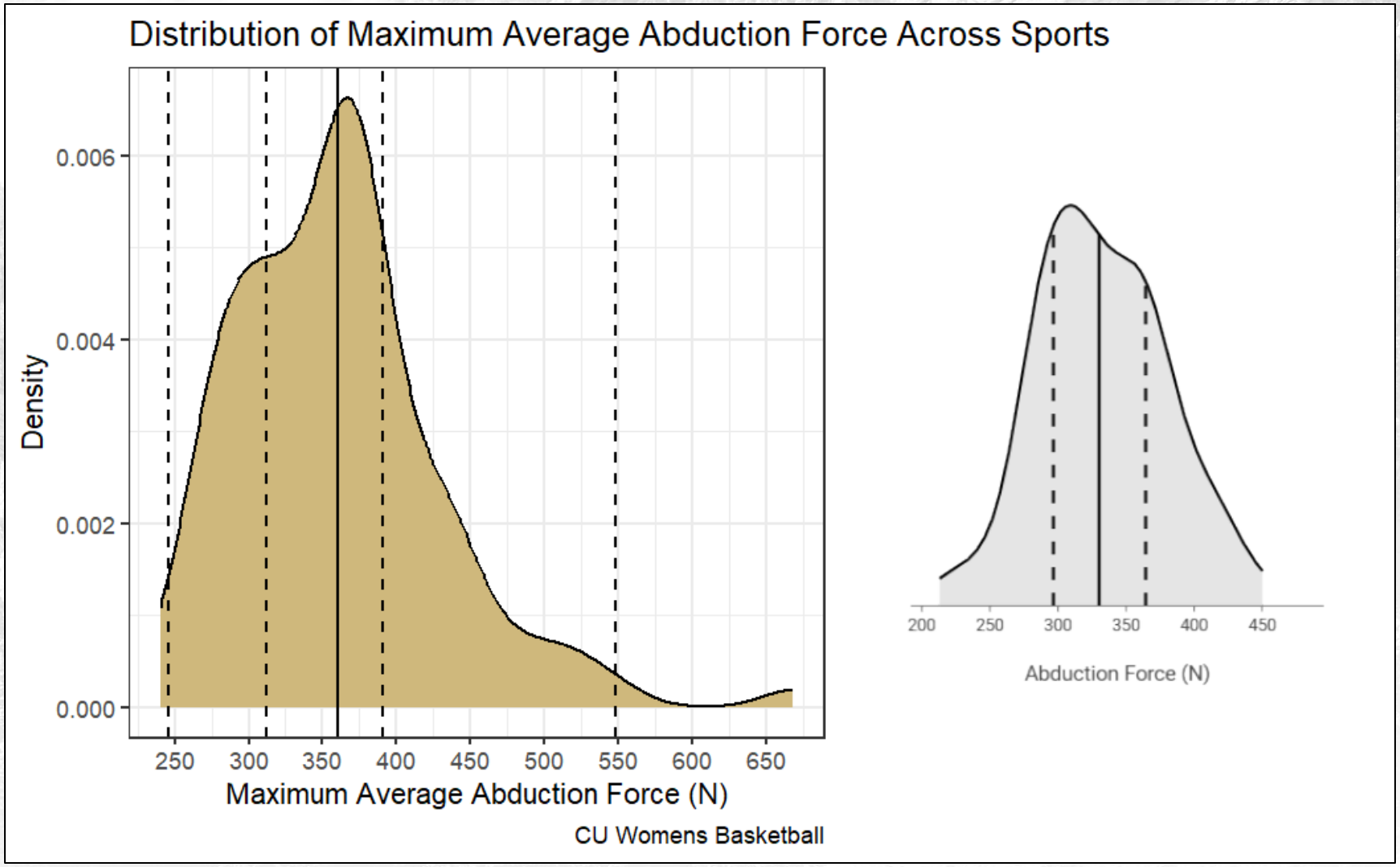
Hip Abduction/Adduction Metrics

Abduction Force

Women's Basketball

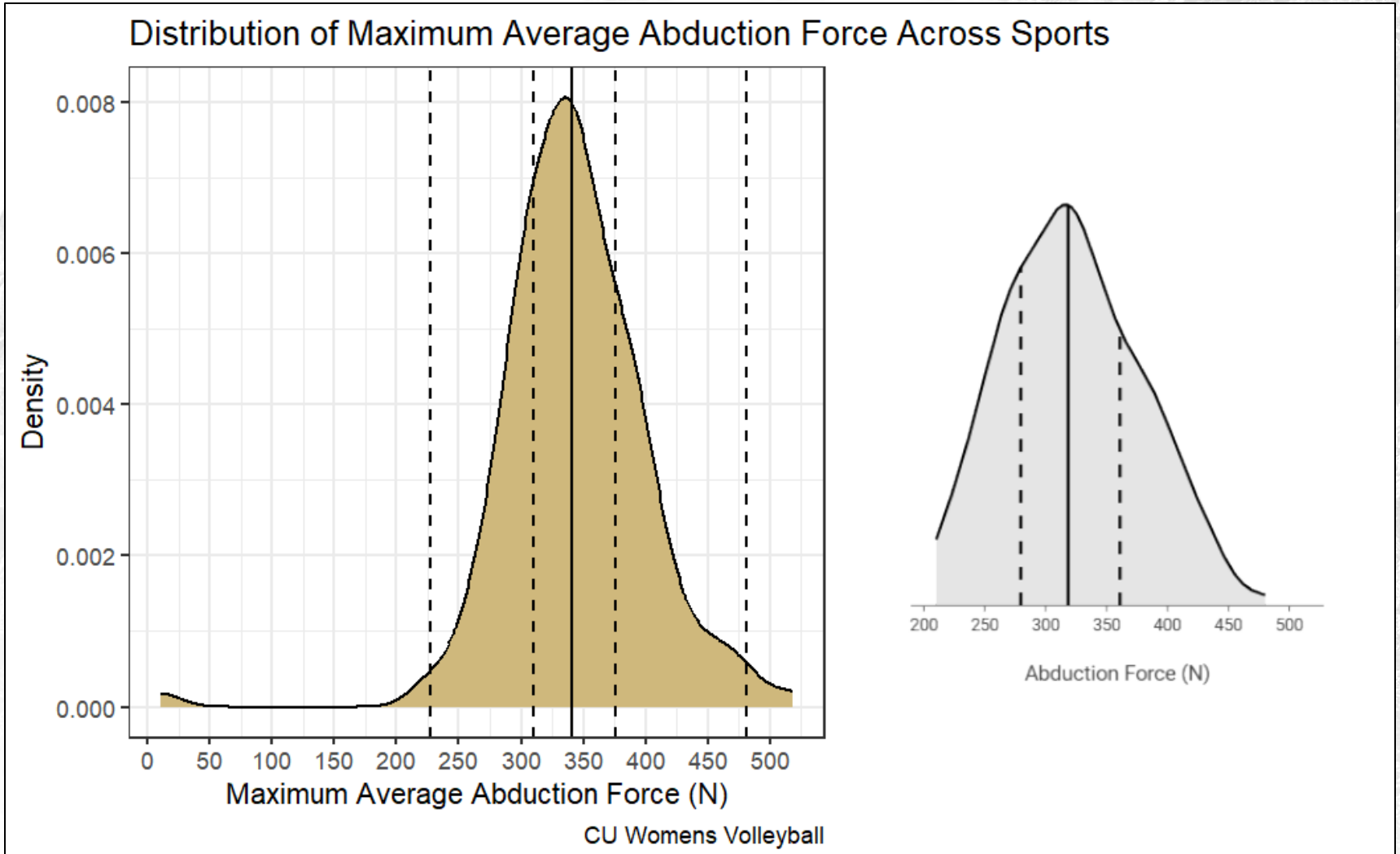
Normative Percentiles:
25th: 297
50th: 330
75th: 364

CU Data Percentiles:
25th: 312
50th: 361
75th: 390



Abduction Force

Women's Volleyball



Normative Percentiles:
25th: 280
50th: 318
75th: 361

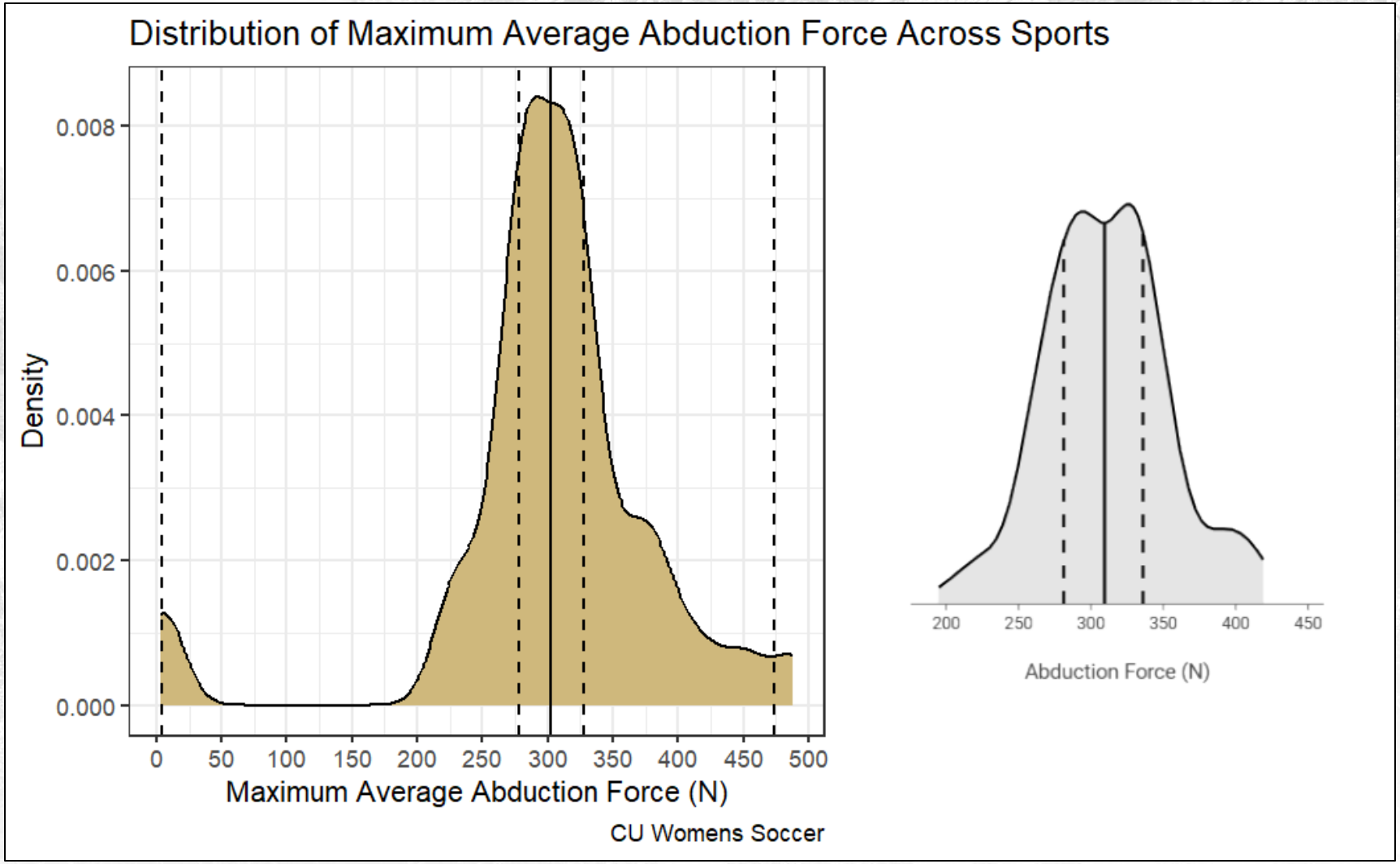
CU Data Percentiles:
25th: 310
50th: 340
75th: 376

Abduction Force

Women's Soccer

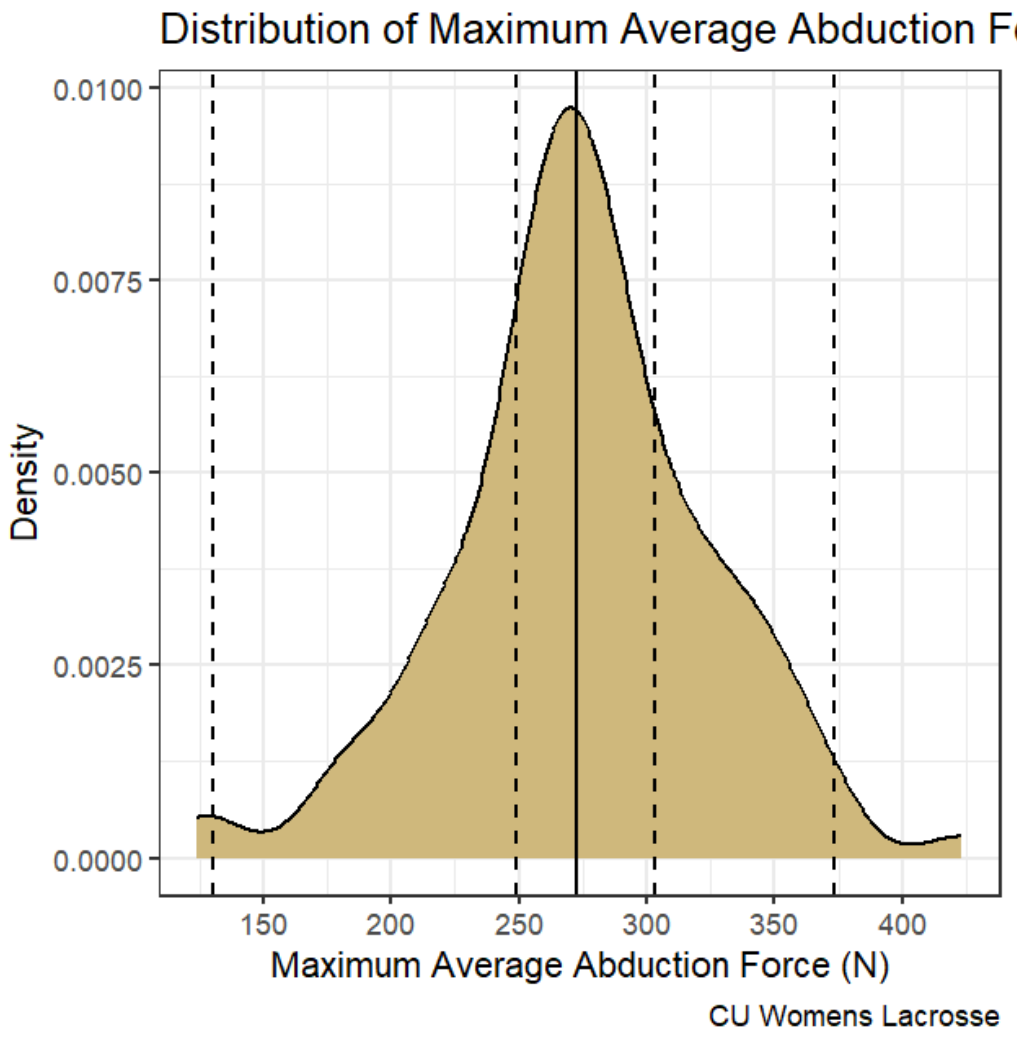
Normative Percentiles:
25th: 281
50th: 310
75th: 336

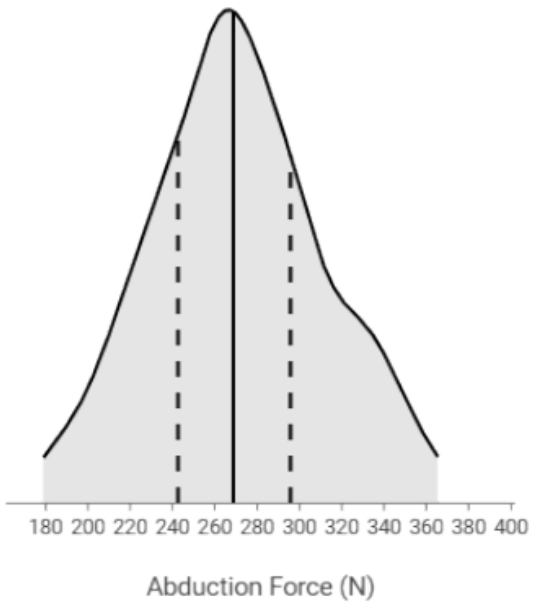
CU Data Percentiles:
25th: 278
50th: 303
75th: 328



Abduction Force

Women's Lacrosse

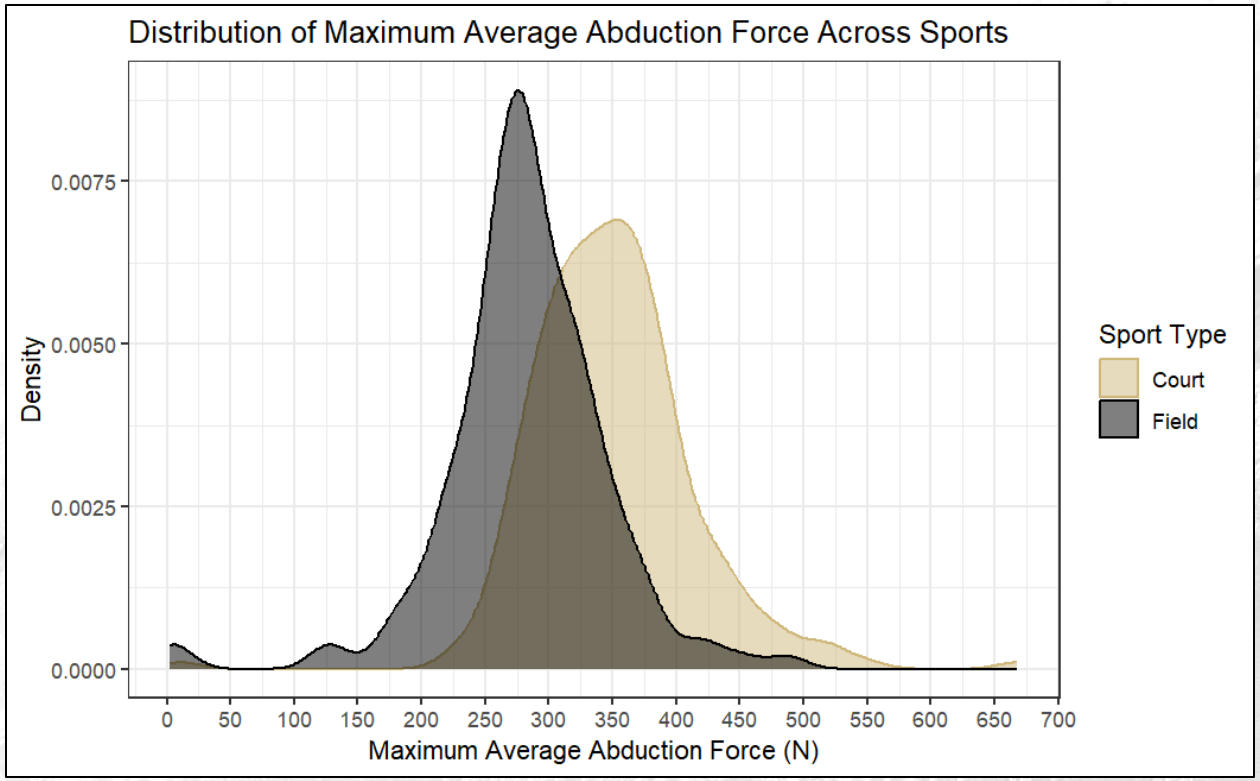




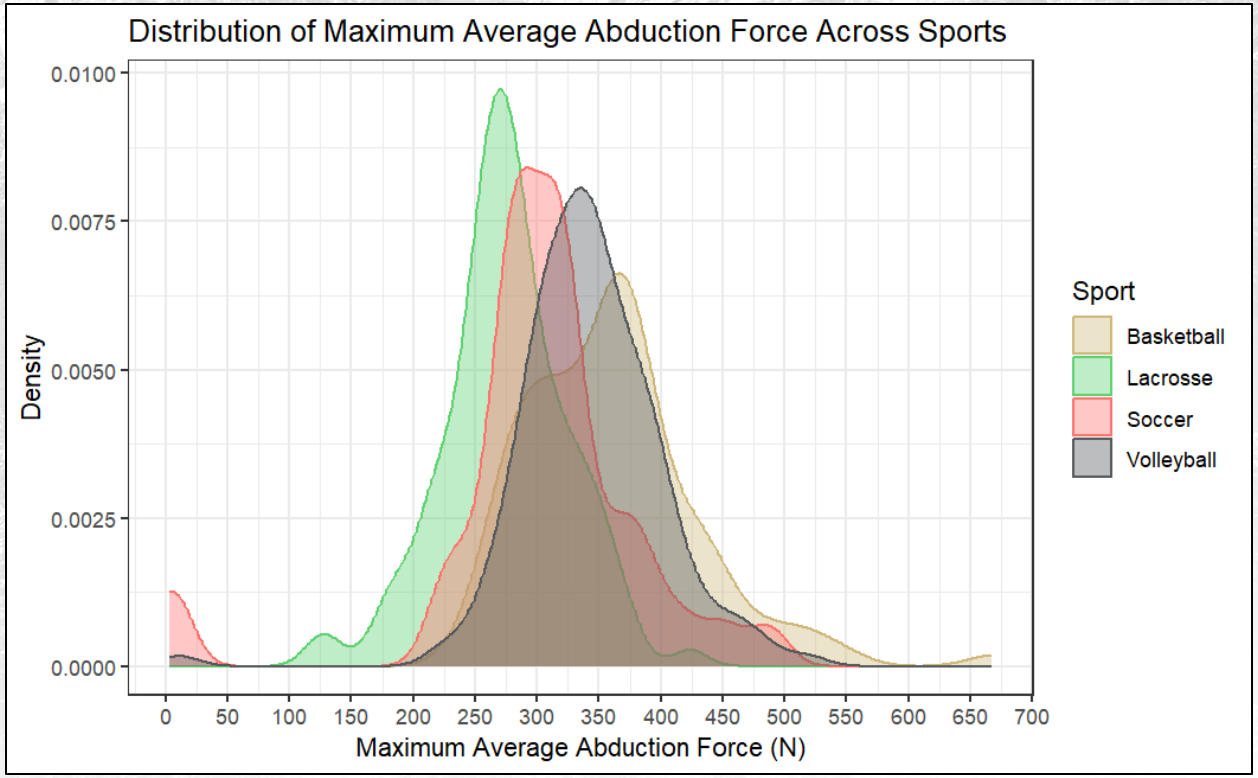
Normative Percentiles:
25th: 243
50th: 269
75th: 296

CU Data Percentiles:
25th: 249
50th: 272
75th: 303

Abduction Force



Abduction Force:
Lacrosse < Soccer <<< Volleyball <<< Basketball



Relative Abduction Force:
Soccer, Lacrosse <<< Basketball, Volleyball

Concluding Thoughts

Question 1: We found 24 meaningful thresholds for many strength metrics as they related to lower body injuries in female athletes in the CU basketball, soccer, volleyball, lacrosse population.

Question 2: For most hamstring and hip strength metrics CU women's athletes in these four sports are performing as expected or even a little higher in comparison to normative data. There is more distance from the normative data in Foredeck metrics especially for lacrosse in hop jump metrics.