

Impact / Significance / Intro

The study of inter-limb asymmetry is crucial in understanding athletes' performance. However, there is a lack of longitudinal data and failure to account for individual athlete variability, hindering a comprehensive understanding of this phenomenon.

Methods

- A retrospective analysis of 17 elite level martial arts athletes (Females=8; Males=9).
- For each week of regular training, athletes performed 3 countermovement jumps with hands akimbo on two uniaxial force platforms (1,000 Hz) with self-selected rest between trials (Figure 1).
- A total of 76 weeks and 3096 trials were used for statistical analysis.
- Vertical jump height (JH) was estimated using the impulse-momentum method.
- Four interlimb asymmetry indexes were calculated to determine differences among asymmetry calculation methods.
 - Index 1=(A-B)/max(A,B)*100,
 - Index 2=(A-B)/(A+B)*100,
 - Index 3=(45-arctan(A/B))/90*100, and
 - Index 4=ln(B/A)*100
- Linear mixed models. A triple interaction of fixed effects was performed to account for training time (week), asymmetry index, and sex, while accounting for any individual variations at baseline (intercept) and any changes of the center of mass (COM depth) for each jump within each session across all of testing sessions.

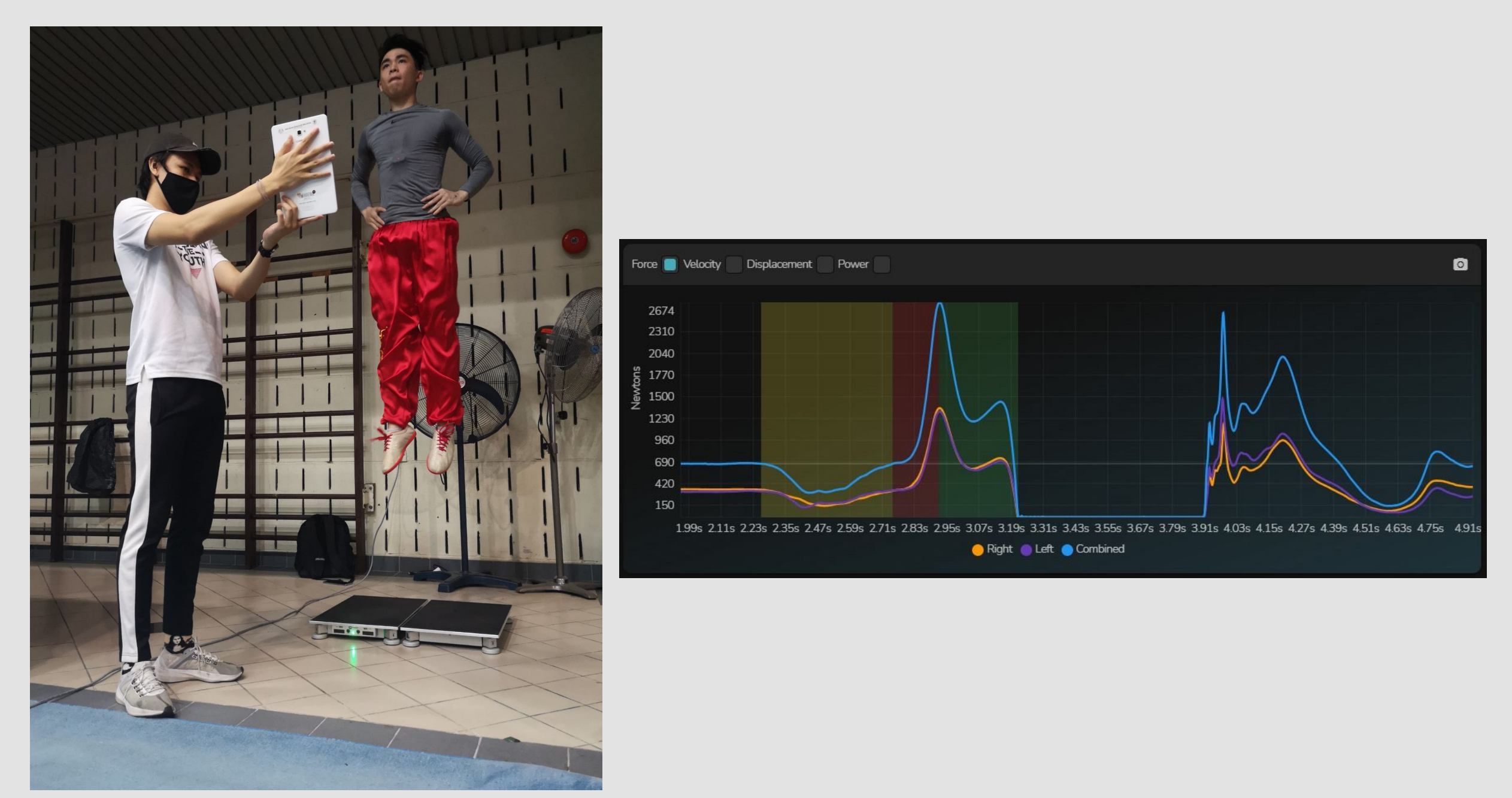


Figure 1. CMJ weekly testing set up and data collection (Left), and online data processing by the Hawkin Dynamics software (Right).

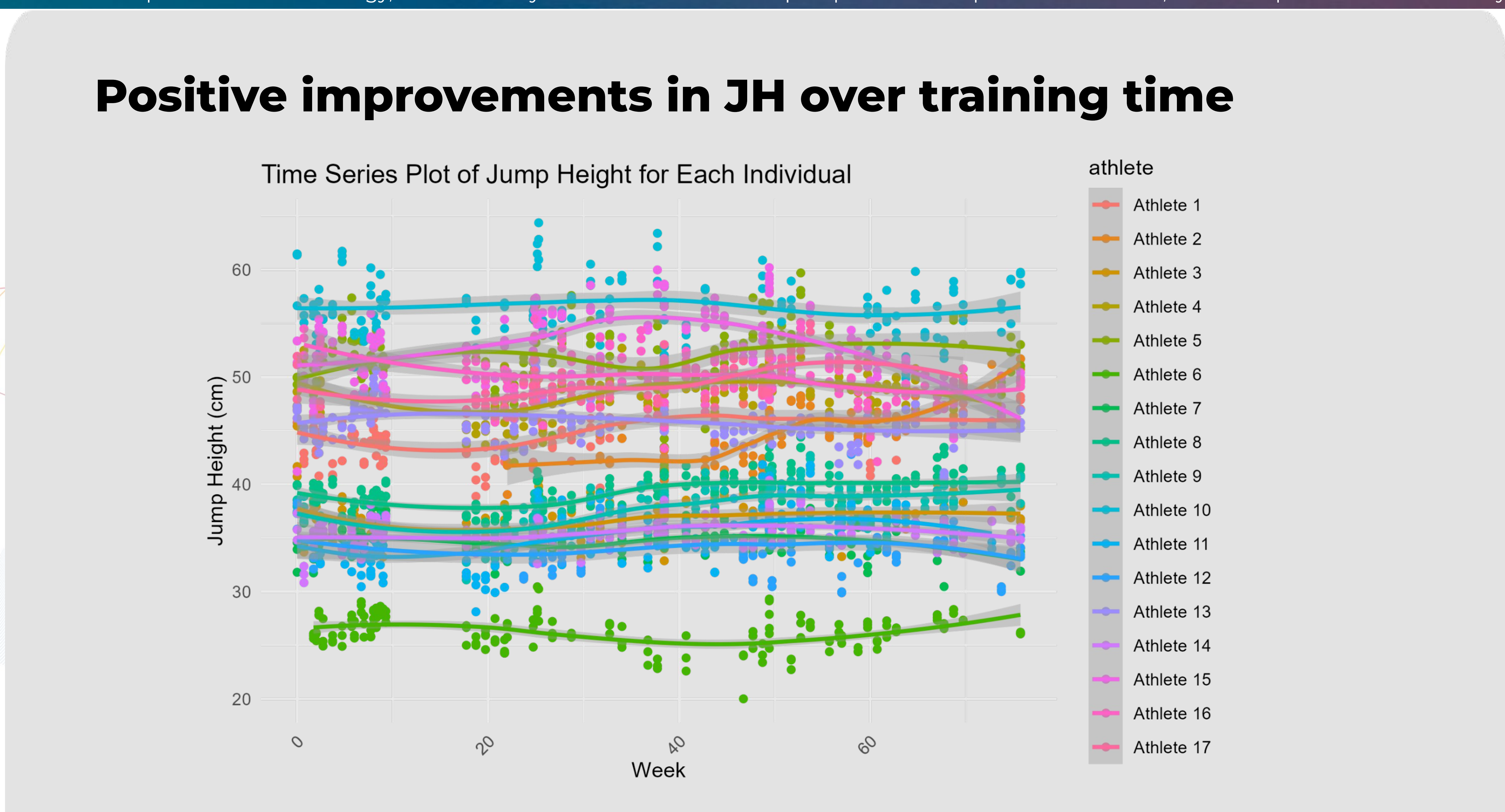


Figure 2. Jump Height responses to training time.

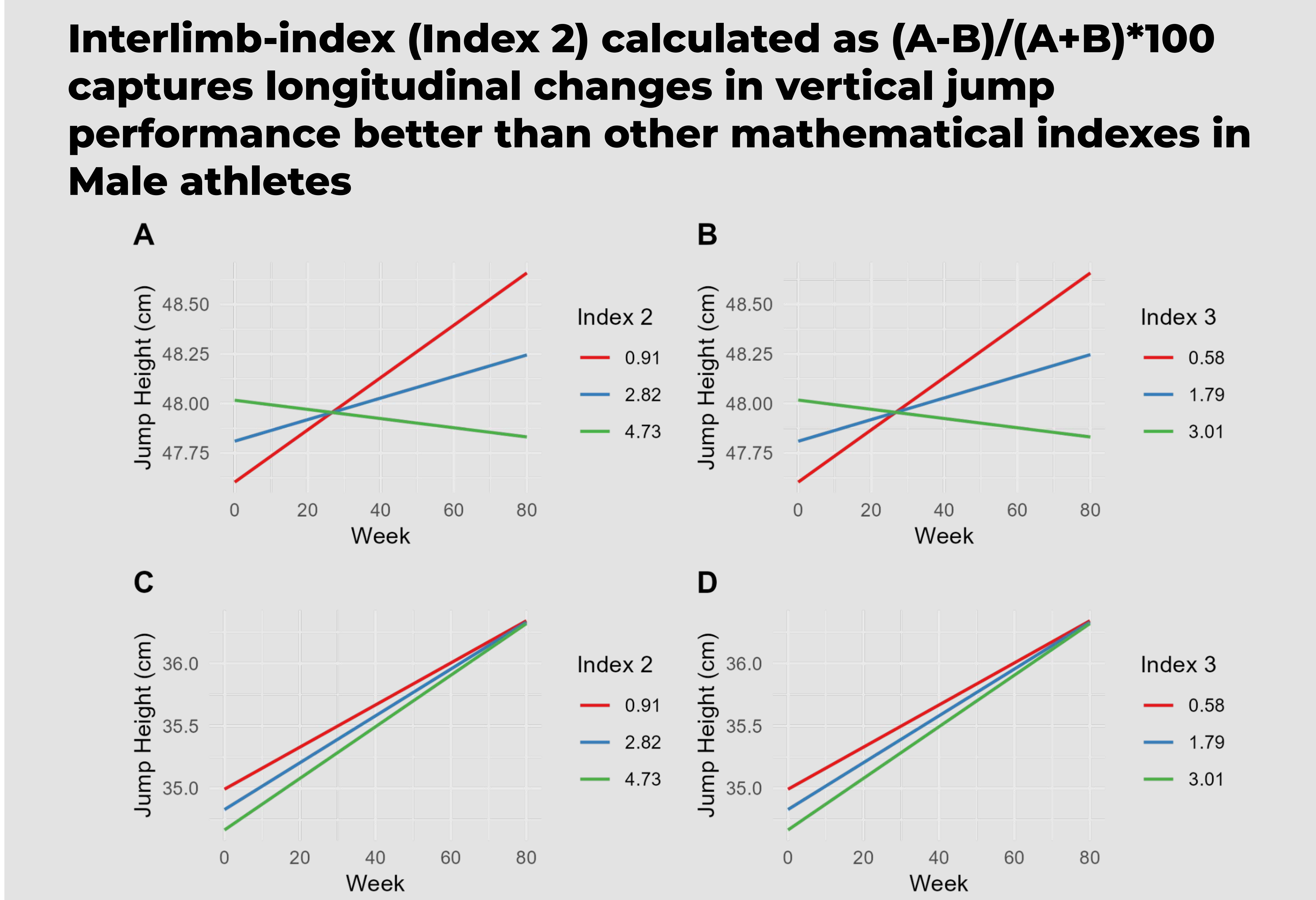


Figure 3. Predicted impact of two inter-limb asymmetry indexes (Index 2 and Index 3) on vertical jump height across time, differentiated by sex (top row [A,B] = males, bottom row [C,D] = females). The plots illustrate the trajectory of jump height predictions over a series of weeks. For both indexes, the red line represents a **low level** of inter-limb asymmetry (Index 2 = 0.91, Index 3 = 0.58), the blue line depicts a **moderate level** of asymmetry (Index 2 = 2.82, Index 3 = 1.79), and the green line signifies a **high level of asymmetry** (Index 2 = 4.73, Index 3 = 3.01).

Results

Jump Height(JH) Over Time:

- JH significantly increased over time (Estimate = 0.016, p = 0.002), indicating a positive training effect (Figure 2).

Asymmetry Indexes and Main Effects:

- No significant Main effects of the asymmetry indexes on JH were found.

Interactions with Sex:

- Interaction between asymmetry indexes and sex showed significant positive associations in male athletes.
- Asymmetry indexes may have differential effects on JH in male individuals.

Specific Interaction Effects:

- **Index 2:**
 - Interaction of Index 2 with time suggests an estimated decrease in JH of approximately 0.005 cm per unit increase in time (week) in male athletes (Figure 3A).
- **Index 3:**
 - Interaction of Index 3 with time suggests an estimated decrease in JH of approximately 0.008 cm per unit increase in time (week) in male athletes (Figure 3B).

Conclusions

Overall, these results suggest that the relationship between Index 2 and Index 3 with JH varies depending on the interaction with sex and time.

Practical Applications

Athletes and Coaches should pay attention to how interlimb asymmetry indexes are calculated and special consideration should be given to these changes over time, particularly in male athletes.

Acknowledgements

The authors would like to thank all of the athletes who participated in their weekly vertical jump monitoring testing. Additionally, Samuel Montalvo would like to thank the Wu Tsai Human Performance Alliance for their funding support.