

Purpose

- Ankle stiffness is a crucial biomechanical factor influencing athletic performance, particularly in sprinting and jumping activities. This study examined the relationship between ankle stiffness (AS), range of motion (ROM), and physical performance in track sprinters, emphasizing gender differences in these variables and their impact on sprinting and jumping performances.

Methods

- 16 D-II collegiate track sprinters (10 males, 6 females) performed single-leg ankle hops to evaluate AS and the weight-bearing lunge test to evaluate ankle dorsiflexion ROM.
- 3D motion capture and a force plate system were used to collect biomechanical data. During the single-leg ankle hops, participants were marked with reflective markers at specific lower-limb anatomical points to measure ankle movements. Efforts were made to isolate ankle joint mechanics by minimizing knee and hip flexion/extension and minimizing ground contact time.
- Linear regression, Pearson's r correlation, and independent t-test analysis were performed on AS, ROM, and athletic performance metrics (30-m Acceleration, 30-m Fly, Vertical Jump, Broad Jump) to identify significant predictors and assess gender differences.

Results



Figure 1. Athlete performing single-leg ankle hops for stiffness assessment.

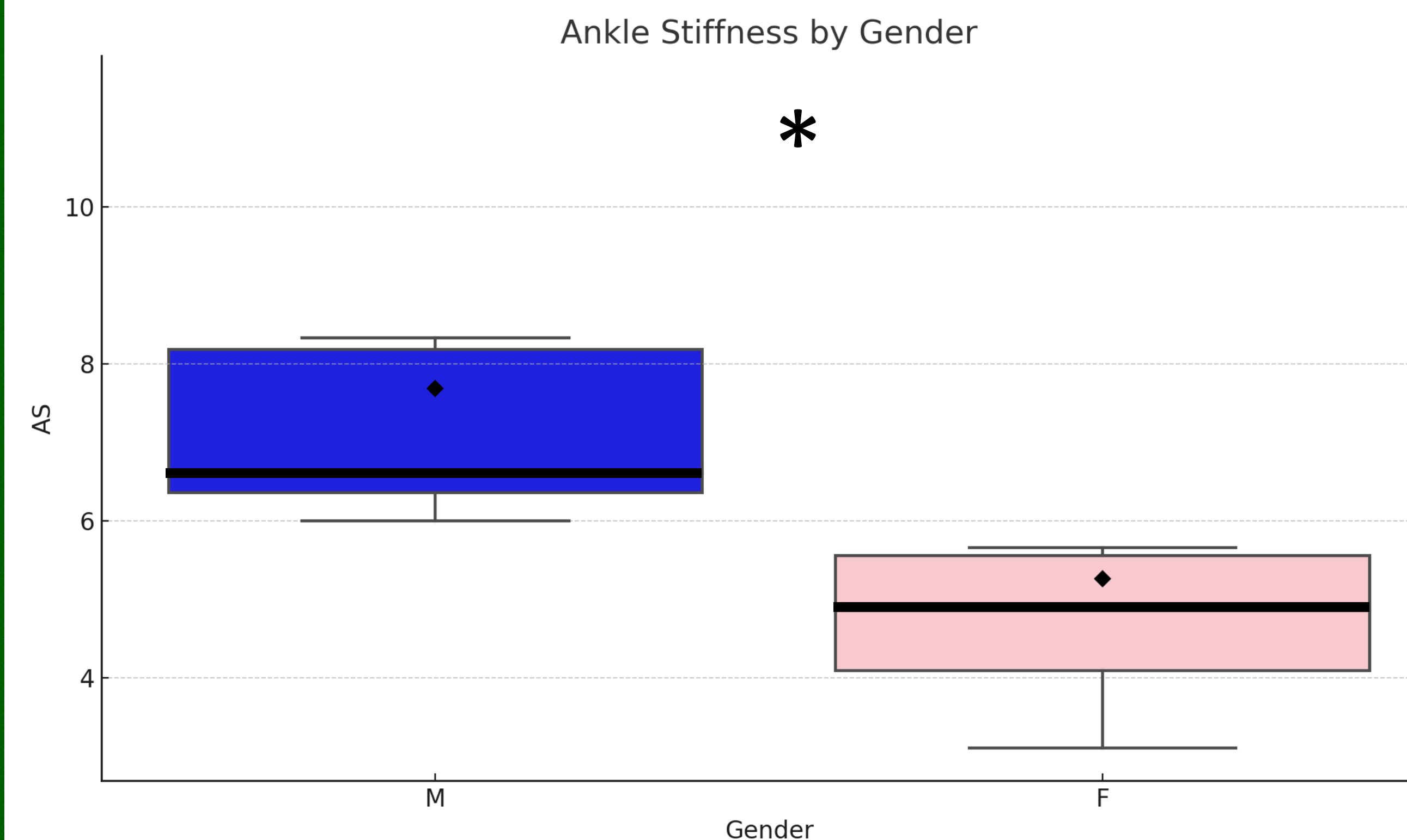


Figure 2. Ankle stiffness (AS) by gender. Box plots contain bold crossbars displaying medians, with first and third interquartile ranges. Black diamonds display means. * = significant gender difference ($p=0.040$).

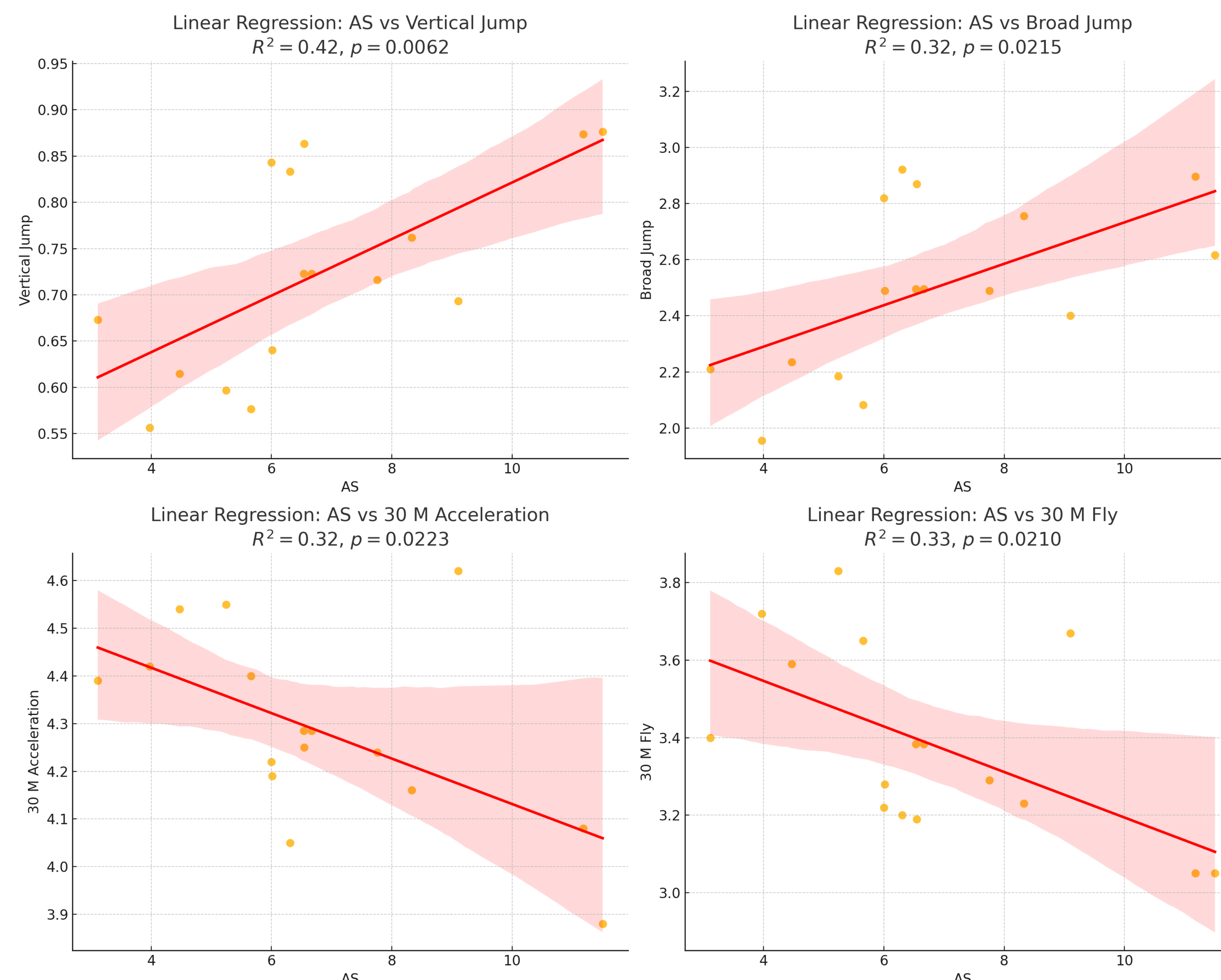


Figure 3. Linear Regression Analyses of Ankle Stiffness (AS) and Performance Metrics. The red line represents the regression line, while the shaded area denotes the 95% confidence interval. Yellow dots indicate individual data points.

Conclusions

- The significant correlations between AS and Combine testing performance metrics highlight the crucial role of ankle stiffness in athletic performance. Specifically, higher ankle stiffness is positively associated with better performance in jumping tasks and faster times in sprinting tasks. Gender differences were significant in ankle stiffness and performance, with males showing higher stiffness and better performance (p -values ranging from 0.001 to 0.005, Cohen's d -values from 0.76 to 0.82).

Practical Application

- The study found that increased ankle stiffness is beneficial for acceleration and jump performance, with males possessing higher ankle stiffness and better sprint and jump performance. These findings highlight the importance of considering ankle stiffness in training programs and the need for gender-specific approaches to optimize athletic performance. Coaches and trainers are advised to incorporate exercises aimed at optimizing ankle stiffness into training routines, with a focus on personalized strategies considering gender differences.

