The Relationship between Ground Reaction Force and Softball Pitch Velocity

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Introduction

- The only external contact a pitcher has is with the ground. Therefore, ground reaction force is theorized to be important in determining pitch velocity.[2]
- Limited previous research suggests a positive relationship between ground reaction force (GRF) and softball pitch velocity.[1]
- Pitch velocity may be associated with the rate of force generation, or the peak slope of the force-time curve, of the stride leg.[3]

Purpose

- To examine the relationship between the GRF of the stride leg and softball pitch velocity.

Methods

- Three right-hand dominant female Division III intercollegiate softball pitchers (18.3 ±0.6 years; 72.1 ±1.6 kg; 168.0 ±7.9 cm).
- Following a typical pregame warm-up, 15 maximal velocity pitches were thrown from a wood platform into a net, positioned approximately 10 feet in front of the platform, on two occasions separated by one week.
- The pitchers landed with their stride leg on an Accupower force plate which was embedded in a wood platform; GRFs were recorded at 600Hz.
- Peak vertical and braking GRFs were normalized to body weight (BW).
- Ball velocity was measured to the tenth of one mile/hour using a Stryker radar gun and converted to meters/second.
- Rate of vertical and braking GRF generation were calculated by the peak force over the time to peak force (F/t).
- Time to peak force was defined as the time from the first upward deflection in GRF greater than 5% body weight to time of peak force.

Results

- A Pearson correlation was used to examine the relationship between GRF variables and ball velocity for all 90 pitches.
- A significant positive correlation was found between ball velocity (23.5 ±0.9 m/sec) and vertical GRF (168 ±48.6% BW; r(90) = .696, p < .001).
- A significant positive correlation was found between ball velocity (23.5 ±0.9 m/sec) and braking GRF (109.6 ±23.1% BW; r(90) = .854, p < .001).

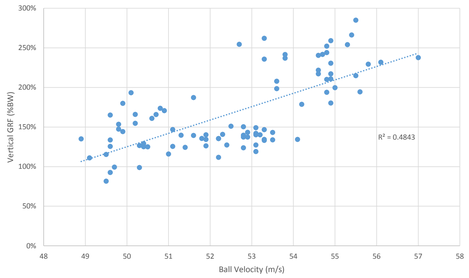

Figure 1. Relationship Between Ball Velocity and Vertical GRF

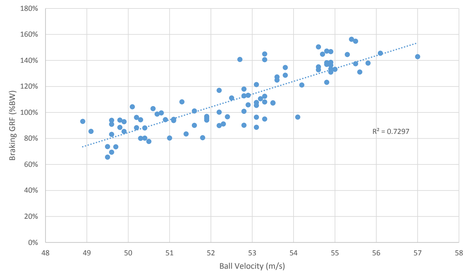

Figure 2. Relationship Between Ball Velocity and Braking GRF

- A significant positive correlation was found between ball velocity (23.5 ±0.9 m/sec) and slope of the vertical GRF (31066 ±15952 N/s; r(90) = .294, p = .005).
- A significant positive correlation was found between ball velocity (23.5 ±0.9 m/sec) and slope of the braking GRF (12296 ±5457 N/s; r(90) = .535, p < .001) of the stride leg.

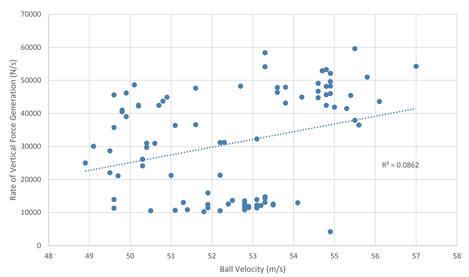

Figure 3. Relationship Between Ball Velocity and Rate of Vertical GRF

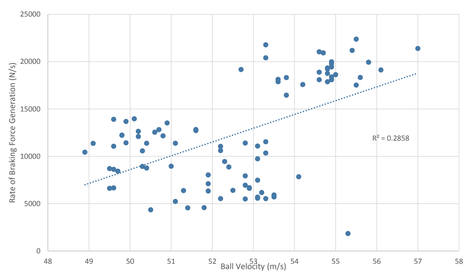

Figure 4. Relationship Between Ball Velocity and Rate of Braking GRF

Discussion

- Participants that generated large braking and vertical GRFs tended to generate greater ball velocity, which is consistent with previous research.[1]
- Positive, but less robust, correlations were found between the rate of GRF generation in both the vertical and braking directions and ball velocity, which is consistent with previous research.[2]
- Normalized vertical GRF was consistent with previous research using a similar population.[1]

Future Research

- Future research should utilize a larger sample size, measure stride length, and measure drive leg GRFs in addition to stride leg GRFs.

Conclusions

- There is a positive relationship between GRF variables and ball velocity. However, additional research is needed to establish a cause and effect relationship.
- The peak vertical and braking force are more strongly related to pitch velocity than the rate of GRF generation in those directions.

Literature Cited

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