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DEPARTMENT OF KINESIOLOGY

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RESISTANCE EXERCISE PERFORMANCE

The Relationships Between Bat Speed and Stride Foot Ground Reaction Forces During Baseball Swings

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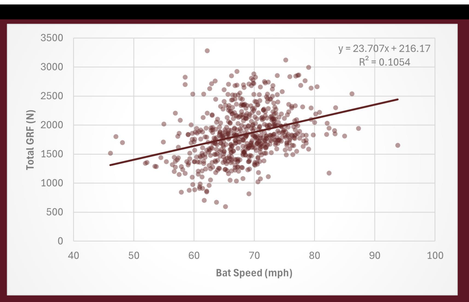
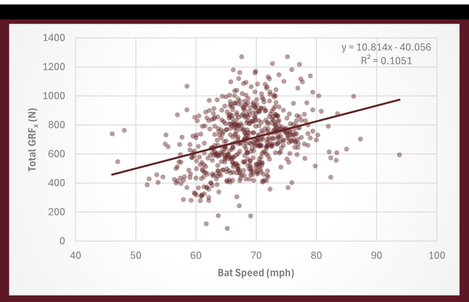
PURPOSE

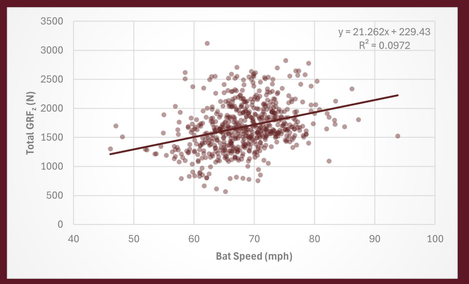
This study aimed to examine the relationships between BS and GRFs of the stride foot during baseball swings.

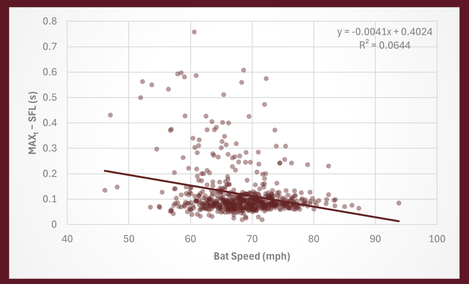
METHODS

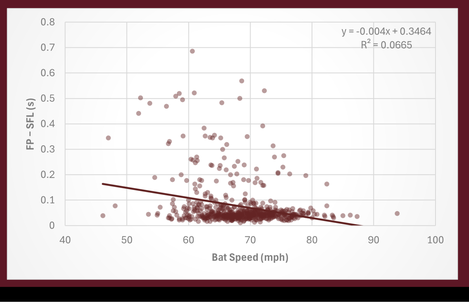
All data were collected and published freely online by The OpenBiomechanics Project performed by Driveline Baseball. Eighty-seven male participants (mean ± standard deviation, age 19.98 ± 2.11 years) of varying skill levels (12 high school, 66 college, 4 independent league, 5 minor league) performed four to nine swings, totaling 607 swings across all participants. During each swing, a Blast Baseball Swing Analyzer was attached to the knob of the bat and recorded BS, while two force plates recorded the GRFs produced by each leg in the x-, y-, and z-axes. The positive x-axis was defined as the direction towards the pitcher, the positive y-axis as the anterior direction of the hitter, and the positive z-axis as the superior direction of the hitter. The Pythagorean Theorem was applied in three dimensions using the GRF values along each axis to calculate the magnitude of total GRFs produced. Stride foot landing was defined as the instant the stride foot experienced 10% of the batter's bodyweight, foot plant as the instant GRF equaled 100% BW, and contact as the instant of collision between the bat and ball. Maximum GRFs in each axis, as well as combined, GRFs at stride foot landing and foot plant, and differences in time for the among stride foot landing, stride foot plant, maximum GRFs, and bat contact with the ball were quantified. Pearson product moment correlation coefficients assessed the relationships between BS, GRFs, and times of each phase.

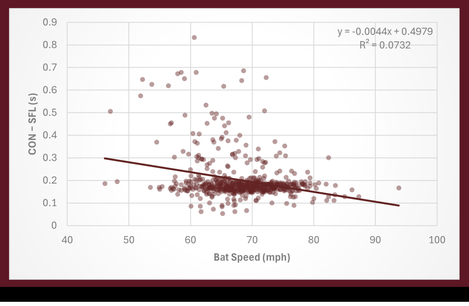












PRACTICAL APPLICATIONS

- **Hitters who can produce greater GRFs in a smaller time frame tend to have a greater bat speed during baseball swings.**
- **When designing strength and conditioning programs for baseball athletes with the goal of enhancing BS, strength and conditioning coaches may benefit from emphasizing movements and repetition schemes to enhance ground reaction force production in the x-, y-, and z-axes.**
- **Nevertheless, the low magnitudes of relationships between GRFs and BS suggest that further research in this area is needed.**

RESULTS

- Maximum GRFs for each axis and combined exhibited significant negligible to low relationships with BS ($r \geq 0.239$, $p < 0.001$).
- The difference in time between landing and contact and foot plant and contact exhibited negligible significant negative relationships with BS ($r \geq -0.109$, $p \leq 0.007$).
- The time difference between stride foot landing and total maximum GRF as well as maximum GRFs for each axis exhibited negligible significant negative relationships with BS ($r \geq -0.254$, $p < 0.001$.
- The difference in time between stride foot plant and maximum GRF along each axis exhibited negligible significant negative relationships with BS ($r \geq -0.082$, $p \leq 0.044$).
- The difference in time between stride foot landing and stride foot plant exhibited a negligible significant negative relationship with BS ($r = -0.258$, $p < 0.001$).

CONCLUSIONS

Although several statistically significant relationships existed, the magnitude of these relationships was low at best. These results suggest that the magnitude of GRFs in the x-, y-, and z-axes of the stride foot, and the timing with which they are generated, likely play at least small role in enhancing the BS of a swing. Future research should consider examining other aspects of GRFs during baseball swings to determine if any other relationships exist with BS that may aid in hitting performance.