Sex Differences in the Force-velocity Curve and 1RM Prediction during Back Squat

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INTRODUCTION

- Velocity-based training (VBT) requires the measurement of barbell velocity during resistance exercises, and can be used to adjust external load, monitor fatigue, track progress, and predict 1-repetition maximum.
- Sex differences in the force-velocity curve may impact the application of VBT.
- While most methods VBT focus on linear velocity, measurement of angular velocity may be more appropriate.

PURPOSE

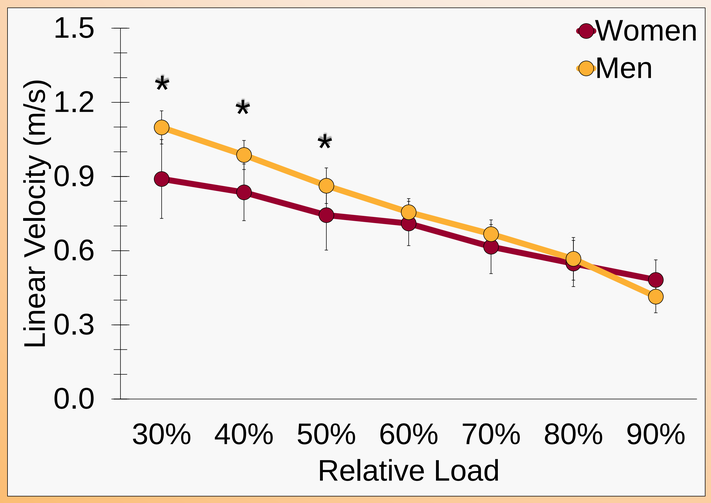
- Examine sex differences in the force-velocity curve during squat.
- Compare differences in the angular velocity between men and women during back squat exercises of various intensities.
- Assess the accuracy of the 1RM prediction from force-velocity profiling in men and women.

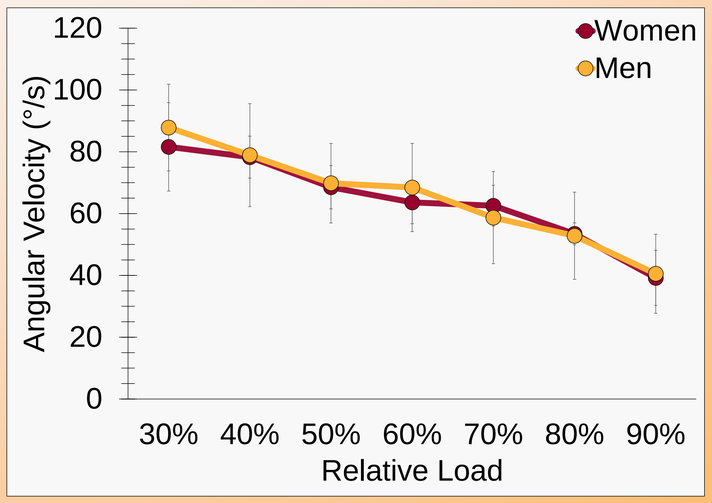
METHODS

- 12 recreationally trained men and women completed 1RM testing and submaximal testing (30-90% 1RM) of the back squat.
- Linear velocity was measured with linear position transducer, and angular velocity was measured with inertial measurement unit on the thigh.
- 1RM was predicted by individual load-velocity curve, then calculating the load at the measured 1RM velocity.

Men Produced Greater Linear Velocity than Women at 30-50% 1RM

Angular Velocity is a Better Predictor of 1RM than Linear Velocity





RESULTS

- Men had significantly greater relative 1RM than women (p=0.017, d=1.66) and a significant difference in angular velocity at 1RM (p=0.01, d=2.19).
- During submaximal sets, men produced significantly faster linear velocity at 30% (p=0.01, d=1.84), 40% (p=0.01, d=1.77), and 50% 1RM (p=0.04, d=1.13);
- Linear velocity resulted in a significant over-prediction in 1RM for men (p=0.05) and a trend for women (p=0.08).

1RM Data

Sex	Relative 1RM (kg/kg)	Linear Velocity (m/s)	Angular Velocity (°/s)
Women	1.5±0.4	0.32±0.07	44.5±5.4*
Men	1.9±0.2*	0.26±0.09	34.1±4.1

Actual vs Predicted 1RM Values (kg)

Sex	Actual 1RM	Linear Velocity Predicted	Angular Velocity Predicted
Women	97.5±30.9	113.7±37.0†	89.7±30.1
Men	176.9±31.0	187.3±29.0*	179.1±37.5

PRACTICAL APPLICATIONS

- Gender differences in linear velocity exist at loads 50% 1RM and under, which may impact how VBT is implemented.
- Differences in angular velocity at 1RM may indicate differences in technique strategies to complete maximal lifts.
- Predicting 1RM using angular velocity may be more accurate than using linear velocity.