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HEEL HEIGHT DOES NOT ALTER CONCENTRIC OR ECCENTRIC BARBELL VELOCITY

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INTRODUCTION

While footwear design and components vary greatly based on their intended purpose, a common design feature of contemporary athletic footwear is a heel-to-toe height differential (e.g., elevated heel height). Prior research has indicated that moderate heel height differentials can lead to altered lower extremity joint kinetics, muscle activity, and reduced lifting capacity (1-3). There have also been indications that even a small heel height differential leads towards less hip flexion during the squat, with an individual displaying a more upright posture, during the execution of a squat; however, minimal information is available on the impact of elevated heel heights on the influence of barbell velocity during the lift (3,4). As the use of velocity-based intensity prescription has increased in its over the years, as opposed to traditional percentage of 1RM based prescription, understanding the potential influence of elevated heel heights on barbell velocity is of importance to sport performance experts (5). PURPOSE: The purpose of the present study was to examine the influence of elevated heel heights on concentric and eccentric barbell velocity during a back squat at 75% of a participants 1RM.

METHODS

Twenty (age = 22.3±4.1 years) resistance trained participants (males, n = 10; females, n = 10) took part in a randomized protocol of three repetitions at 75% of their maximal effort barbell squat (1RM) at a 0, 5, 10, or 15 degree incline. Participants performed three successive repetitions per condition, with zero inter-repetition rest, and 5 minutes of rest between conditions. Participants were instructed to complete a full squat; however, participants were not provided external feedback as to the squat depth. Heel height was adjusted to the designated heel height through custom-made wooden-lifting platforms set to specific incline levels (0%, 5%, 10%, and 15%) while all participants utilized a standard, zero-drop (e.g. flat) athletic shoe. This led to a relative heel height differential based on the foot size of the individual, based on prototypical footwear design specifications. Sagittal plane kinematics were collected through a single Basler Scout camera recording at 100 Hz and processed through MaxTRAQ2D. A custom Matlab program was utilized to determine the average barbell velocity during the eccentric and concentric portion of each repetition, with velocities averaged across the three repetitions. Separate repeated measures ANOVA's were completed to examine the influence of heel height (0, 5, 10, 15 degree) on barbell velocity during each phase.

Elevated heel heights do not alter concentric or eccentric barbell velocity during heavy back squats.

PRACTICAL APPLICATIONS

Strength and conditioning coaches are well aware of the variation in footwear design and the implications for resistance training technique for their athletes; however, the influence of heel height on barbell velocity has not been previously reported. The present study suggests that heel-to-height differentials, a common component of most athletic footwear, will not alter barbell velocities during a barbell back squat. As such, Strength & Conditioning Coaches that utilize velocity-based exercise prescription may not need to adjust training zones based on varying footwear utilized by athletes during training sessions.

Lift Condition & Muscle Action	75 - 0 Ecc	75 - 5 Ecc	75 - 10 Ecc	75 - 15 Ecc	75 - 0 Con	75 - 5 Con	75 - 10 con	75 - 15 Con
Average Velocity (ms-1)	-0.464	-0.433	-0.435	-0.375	0.410	0.392	0.383	0.386
St. Deviation	0.227	0.222	0.199	0.302	0.184	0.172	0.152	0.166

RESULTS

While descriptive statistics indicated that barbell velocity tended to slow during the concentric and eccentric portions of the movement as heel height increased, statistical analyses indicated no significant differences in either concentric or eccentric barbell velocity as heel height was increased.

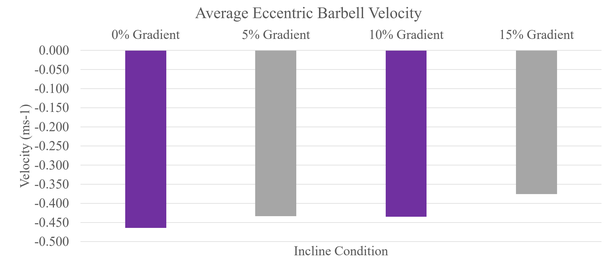

Figure1. Average Eccentric Barbell Velocity
No significant differences were observed in concentric barbell velocity.

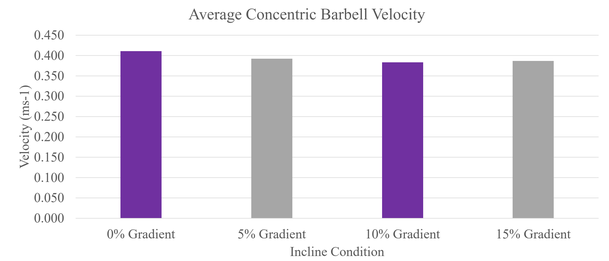

Figure2. Average Concentric Barbell Velocity
No significant differences in were observed in eccentric barbell velocity

CONCLUSIONS

There has been much discussion about how the footwear utilized by athletes may affect their ability to perform during a strength training session with previous research indicating that alterations in footwear design or components may indeed alter joint kinematics and joint kinetics during certain resistance training exercises (1-4). While the present study only looked at barbell velocity during a squat, results indicate that altering heel height would not alter barbell velocity during a barbell back squat.

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