THE EFFECT OF AN 8-WEEK HIGH- VS LOW-VELOCITY RESISTANCE EXERCISE ON THE MAXIMAL FORCE AND RATE OF FORCE DEVELOPMENT IN OLDER ADULTS

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Introduction

- Aging leads to the decline in muscle power, muscle strength, muscle size, and the loss in the ability to complete activities of daily living.[1]
- Resistance training (RT) is a form of exercise commonly utilized to mitigate the aging process. RT programs in older adults (OA) have been shown to increase muscle power, neuromuscular function, and function capacity.[2]
- The use of a load-velocity profile can be utilized to create an effective RT program that targets improvements in muscle power and strength.[3]
- The LV profile can be generated based on how much an individual can lift and how fast they can lift that load. From this data, an exercise program can be generated specific for their needs to improve functional ability and performance.[4]

Therefore, the purpose of this study was to examine the effect of an individual high- vs. low-velocity RT program on maximal isometric force and rate of force production in OA.

Methods

Resistance Training Protocol: Eighteen OA volunteered to complete an 8-week RT program and were randomly assigned into a high- (HV; n=9; Age=70±6 y) or a low-velocity RT group (LV; n=9; Age=74±7 y). Movement speed for each training repetition was assessed using a linear position transducer during belt squat movement. The HV and LV were required to move at a mean velocity above .7m/s and between .25-.3 m/s, respectively. Load was adjusted to ensure movement speed was within appropriate ranges. Participants were encouraged to move the load as quickly as possible. After baseline testing, participants trained 2 d/wk at least 48 hours apart to ensure that adequate recovery time for 8 consecutive weeks. Participants were provided biofeedback of their movement speed and encouraged to move the load as quickly as possible.

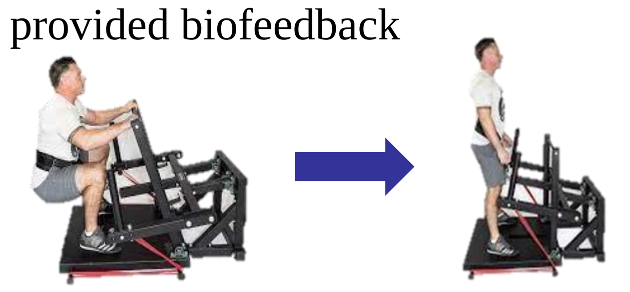

Figure 1. Example of the resistance training movement on the belt squat

Volume: Volume was assessed by examining the load lifted × number of repetitions per session. Each session was summed for each participant at each time point (PRE and POST). To equate volume (reps x load) in the LV group, repetitions were decreased to equal the estimated target volume if they were participating in the HV group. The total average volume completed was in each session by each participant was summed.

Isometric force: Force variables were collected from the knee extensors. Participants were instructed to kick out as hard as possible and as hard and fast as possible for the maximal (MVIC) and rapid (rMVIC) voluntary isometric contractions.

Peak Force (PF): The highest 500 ms epoc of force (N) achieved during maximal voluntary isometric contraction (MVIC) (Figure 2)

Peak Rate of Force Development (pRFD): The highest positive peak of the first derivative of the force-time curve collected during the rapid MVIC

RFD phases: early RFD phase is the highest slope during the first 50ms (RFD_{50}) while the late RFD phase is defined as the steepest slope during the 100-200ms ($RFD_{100-200}$) of the force-time curve of the best of the two rMVIC (Figure 2).

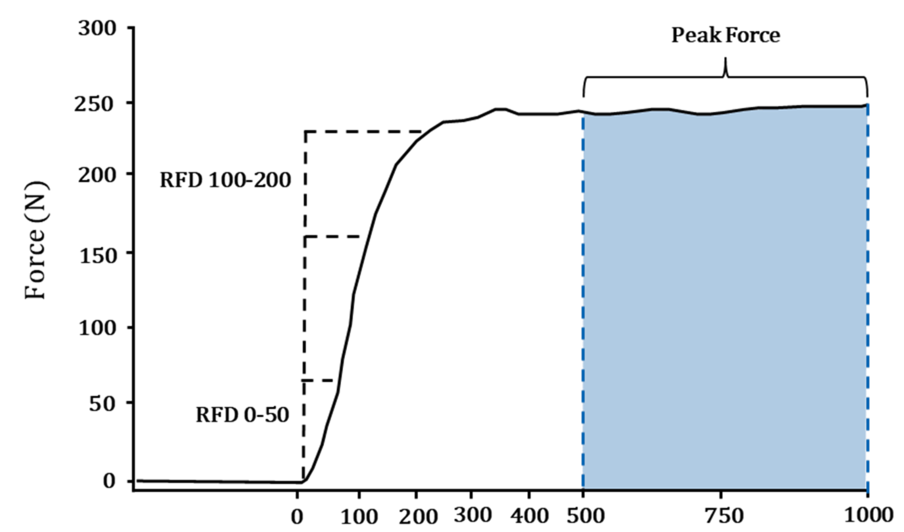

Figure 2. Depiction of rate of force development and maximal force variables

Statistical Analysis

Statistical Analysis: Separate 2 (condition)×2(time) repeated measures ANOVAs were run to examine potential differences between groups in PF, pRFD, RFD_{50}, and $RFD_{100-200}$. Independent samples t-test was run to examine the difference in exercise volume (repetitions/load) between HV vs. LV. Hedges' *g* effect size was used to estimate effect size. All data was calculated offline using custom-written software.

Results

No Condition × Time interactions or main effects for time for PF (p=.88, .95), pRFD (p=.10, .53), RFD_{50} (p=.31, .99), and $RFD_{100-200}$ (p=.25, .82), respectively. Small effect sizes were observed in PF from PRE-POST in HV (PRE: 375.46±56.93N vs. POST: 377.9±59.0N, *g*=-0.1), and LV (PRE 326.5±97.2N vs. POST 317.2±81.7N, *g*=0.2), respectively (Figure 3, A). Large effect sizes were observed in the HV and LV from PRE – POST in pRFD (PRE 2230.0±727.0N•s^{-1} vs. POST 2560.4±642.2N•s^{-1}, *g*=-1.0; LV: PRE 1808.3±660.3N•s^{-1} vs. POST 1424.2±458.2N•s^{-1}, *g*=-1.4) (Figure 3, B). Small to large effect sizes were observed in RFD_{50} from PRE-POST in HV (PRE 1312.2±902.5N•s^{-1} vs. POST 1194.4±600.2N•s^{-1}, *g*=0.3), and LV (PRE 782.8±542.8N•s^{-1} vs. POST 561.3±501.5N•s^{-1}, *g*=0.9), respectively (Figure 4, A). Small effect sizes were observed in $RFD_{100-200}$ from PRE-POST in HV (PRE 1888.3±687.4N•s^{-1} vs. POST 1813.2±452.4N•s^{-1}, *g*≤-0.3), and LV (PRE 1009.5±392.1N•s^{-1} vs. POST 955.8±369.27, *g*=.3) (Figure 4, B). There were no significant differences in average total volume between groups (p=.3, *g*=0.6) (Figure 5).

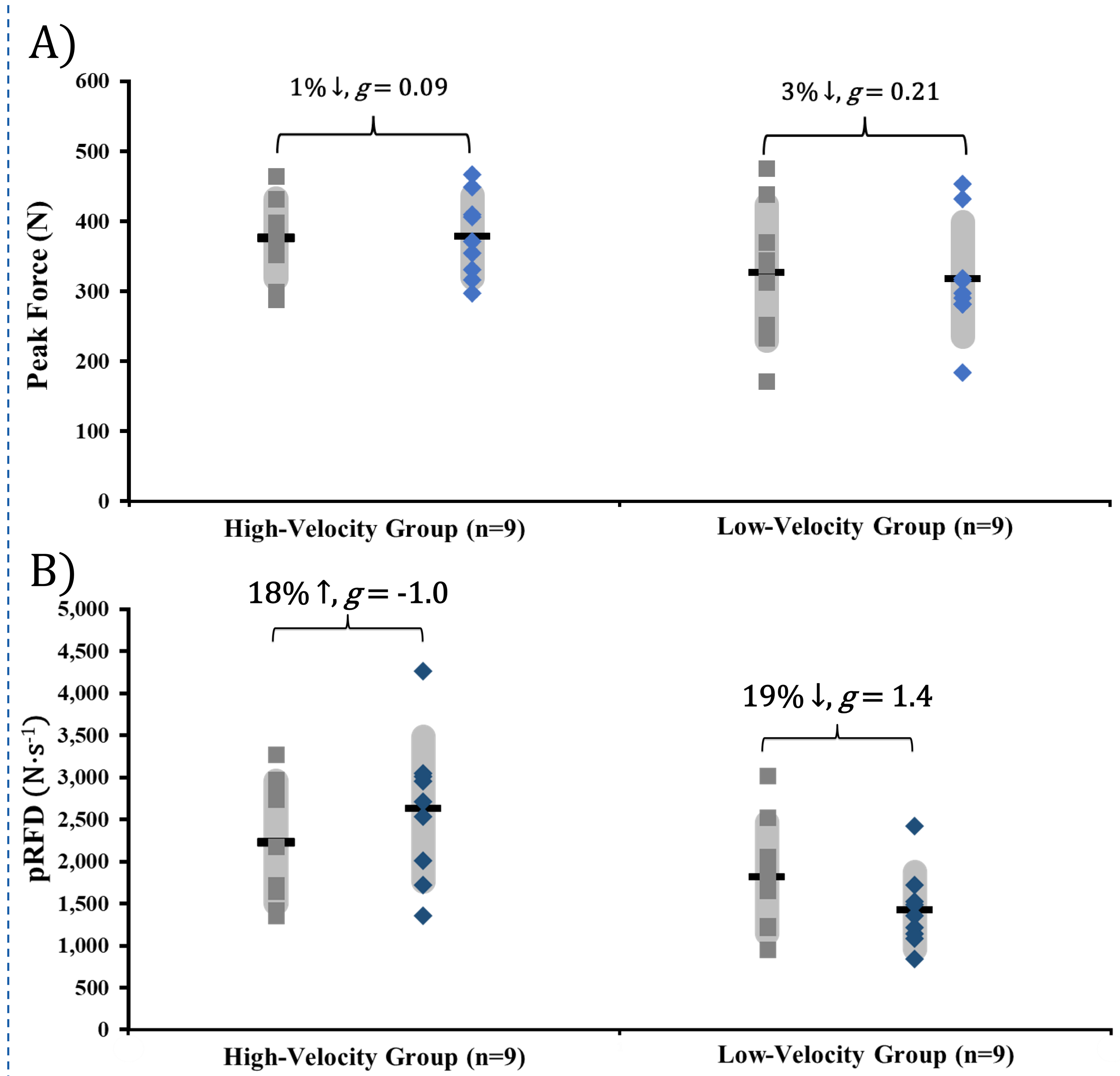

Figure 3 . Differences between HV and LV groups for **A)** peak force production and **B)** peak rate of force development from PRE (gray) to POST (blue).

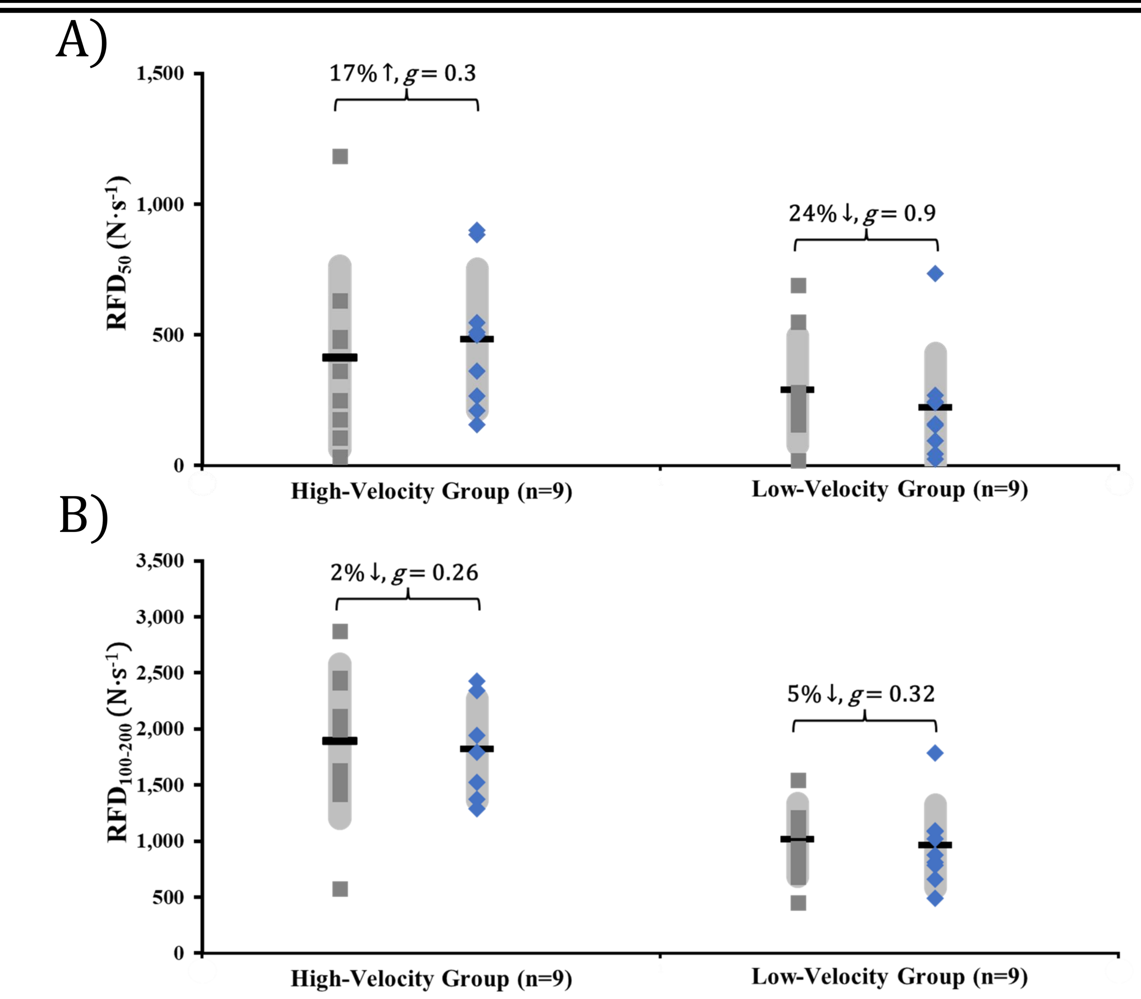

Figure 4. Differences between HV and LV groups for **A)** RFD_{50} and **B)** $RFD_{100-200}$ from PRE (gray) to POST (blue).

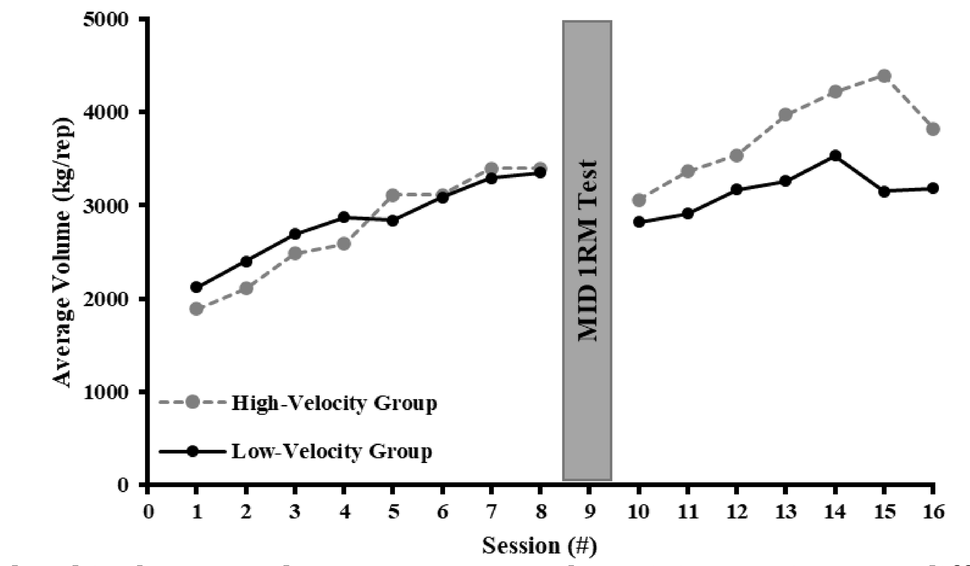

Figure 5. Volume completed in the HV and LV groups across the training sessions. No differences between average total volume between groups (p = 0.3, g = 0.6)

Conclusions

These data suggests that when total volume is matched, the large effect sizes observed in pRFD and $RFD_{100-200}$ from PRE-POST suggests that the HV improved or maintained explosive force production compared to a reduction in explosive force in the LV. However, both the HV and LV groups had a small effect size in PF suggesting both groups maintained strength. Therefore, these data then suggest that movement velocity may be influential in explosive force production adaptations following RT.

Practical Applications

These data provide practitioners and strength and conditioning professionals with additional data to design training prescription for their older adult clients.

References

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