WEIGHT-BEARING SPEED OF MOVEMENT: THE EFFECTS OF A HIGH-VELOCITY RESISTANCE TRAINING PROGRAM IN OLDER ADULTS

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INTRODUCTION

Speed of postural adjustment and mobility are important functional components for older adults. Ample strength alone is not enough to enable older adults to recover from a trip; the speed of the stepping reaction is also important to recovery (Pavol et al., 2001; van den Bogert et al., 2002). High-velocity resistance training (HVRT) (Fielding et al., 2002) was utilized in this study of people over 65 yrs old to train rapid leg muscular actions, and to assess relationships between power and rapid stepping.

METHODS

Healthy older males (M, n=20) and females (F, n=28) aged 65-82 were randomized into one of two 12-week, three days/week exercise programs. Thirty-four subjects performed HVRT for bilateral leg press (LP), calf raise (CR), hip abduction (ABD) and hip adduction (ADD), and unilateral hip flexion (HF). Fourteen subjects completed a program of whole-body flexibility and upper-body resistance training (FUBT). Three rapid stepping tests were performed pre- and post-intervention (PRE, POST): a rapid lateral step, a rapid step up (SU, rapid foot placement on a step), and a lateral destabilization (LD) recovery step test. For LD, a lateral waist-pull was delivered to the subject using a weight-dropping system (Luchies et al. 1999). Reaction time (RT), stepping speed (SPD for LS and LD; ST for SU) and weight shift time (WST, the difference between movement onset and start of step) were measured. Strength (one-repetition maximum, 1RM) and power tests were performed both PRE and POST for each leg exercise. Peak power (PWR) was calculated using displacement vs. time measurements of the weight stacks (Ballistic Measurement System, Innervations, Muncie, IN, USA) while the subjects completed the concentric motion as fast as possible at three loads (30, 50 and 70% of 1RM). Repeated measures analysis of variance was used to determine differences in the power and speed parameters due to exercise group, sex and time (PRE vs. POST). Regression analyses were used to identify factors that predicted changes in the stepping parameters.

RESULTS

HVRT improved PWR for all exercises (e.g., ADD in Figure 1), however FUBT F also improved on LP and CR PWR. Many stepping parameters improved for both HVRT *and* FUBT subjects. Initial performance on the stepping tests was a strong independent predictor of the improvements on the stepping tests with exercise (for example, step time during SU in Figure 2). Changes in PWR and 1RM with exercise predicted changes in step parameters in multiple regression models, but were not independent predictors. For example, sex, PRE LD SPD, changes in HF, ABD and ADD PWR, and changes in LP, ADD and HF 1RM best predicted the changes in LD SPD (R^2-adj=56.1%, $p<0.001$).

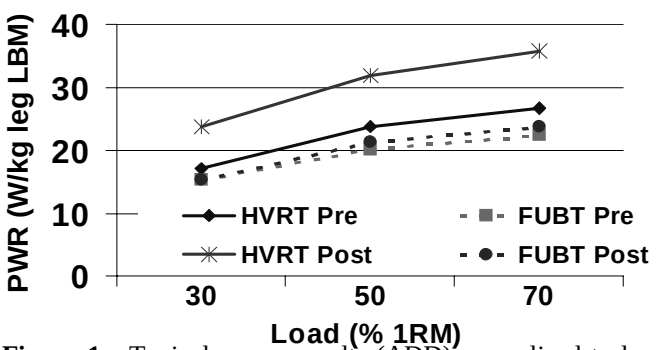

Figure 1: Typical power results (ADD) normalized to leg lean body mass (LBM)

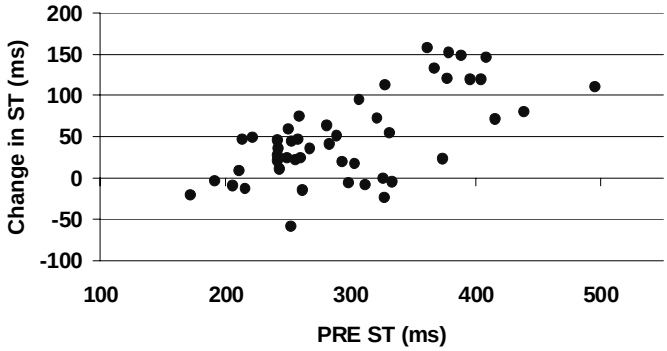

Figure 2: Relationship between PRE intervention step time

SUMMARY

HVRT was effective at improving PWR in older adults for all exercises tested, but this did not result in the HVRT group improving more on the stepping tests than the FUBT group. A surprising result of this study was that the FUBT group also showed improvements in LP and CR PWR and many stepping speed parameters. Since there is no known physiological reason for FUBT to improve leg PWR and stepping speed, other explanations must be sought. One possibility is a placebo effect; FUBT subjects also anecdotally reported feeling "healthier" as a result of the exercise program, which may have increased their activity level outside of the study, therefore improving their PWR and thus movement speed through other activities. Similarly, the FUBT subjects may have felt more confident in their mobility as a result of feeling healthier, which could have affected their performance on the power and stepping tests. As activity and confidence level were not assessed in this study, these explanations cannot be verified. Initial performance on the stepping tests independently predicted the change in those speed parameters, thus revealing a ceiling effect for these rapid stepping tests - the fastest subjects in the study improved little while the slowest subjects improved the most. Since changes in 1RM and PWR were consistent predictors of improvements on the stepping tests, methods of improving these attributes, such as HVRT, may hold promise for improving movement speed in older adults with speed deficits.

REFERENCES

Fielding, R.A. et al., (2002). *JAGS*, 50(4):655-62
Luchies et al. (1999). *J Gerontol*, 54A(3):M140-44
Pavol M.J. et al. (2001). *J Gerontol*, 56A(7):M428-37
van den Bogert A.J. et al. (2002). *J Biomech*, 35:199-205