Skeletal Adaptations to Different Levels of Eccentric Resistance Following Eight Weeks of Training

Kirk L. English¹, James A. Loehr², Stuart M. C. Lee², Mary J. Maddocks², Mitzi S. Laughlin², R. Donald Hagan³, FACSM
¹JES Tech, ²Wyle Laboratories, & ³NASA Johnson Space Center, Houston, TX

ABSTRACT
Coupled concentric-eccentric resistive exercise maintains bone mineral density (BMD) during bed rest and aging. Purpose: We hypothesized that 8 weeks of lower body resistive exercise training with higher ratios of eccentric to concentric loading would enhance hip and lumbar BMD. METHODS: Forty untrained male volunteers (34.9±7.0 yrs, 80.9±9.8 kg, 178.2±7.1 cm; mean±SD) were matched for leg press (LP) 1-Repetition Maximum (1-RM) strength and randomly assigned to one of 5 training groups. Concentric load (% 1-RM) was constant across groups, but each group trained with different levels of eccentric load (0, 33, 66, 100, or 138% of concentric) for all training sessions. Subjects performed a periodized supine LP and heel raise (HR) training program 3× wk⁻¹ for all, using a modified Agaton Fitness System (Agaton Fitness AB, Boden, Sweden). Hip and lumbar BMD (g·cm⁻²) were measured in triplicate pre- and post-training using DXA (Hologic Discovery®). Pre- and post-training means were compared using the appropriate ANOVA and Tukey post-hoc tests. Within group pre- to post-training BMD was compared using paired t-tests with a Bonferroni adjustment. RESULTS: There was a main effect of training on L1, L2, L3, L4, total lumbar, and greater trochanter BMD, but there were no differences between groups. CONCLUSION: Eight weeks of lower body resistive exercise increased greater trochanter and lumbar BMD. Inability to detect group differences may have been influenced by a potentially estrogenic situation associated with device operation in the 0, 33, and 66% groups.

METHODS
Forty males with no history of resistive exercise training in the previous six months participated in the study (Table 1). Subjects completed whole body, lumbar, and hip DXA scans (Hologic Discovery®) in triplicate before and after 8 weeks of lower body resistive exercise training. The mean of the three scans was used for statistical analysis. Pretraining BMD was measured in triplicate before and after 8 weeks of lower body resistive exercise training. Subjects completed three pre-training 1-RM tests and one post-training 1-RM. Tests were separated by at least five days. Subjects performed a periodized strength training program (3× wk⁻¹) in which the concentric load was prescribed according to 1-RM strength (% 1-RM) and the eccentric load was prescribed according to the concentric load (0, 33, 66, 100, or 138; Figure 2).

RESULTS
Total lumbar BMD increased in all groups except the 100% group. L1 and L2 BMD increased from pre to post-training in the 33 and 138% groups. L3 BMD increased in only the 33% group. L4 BMD increased from pre to post-training in the 66, 100, and 138% groups. There was no change in the 0% and 138% groups.

REFERENCES