

CALF STRENGTH LOSS DURING MECHANICAL UNLOADING: DOES IT MATTER?

KL English¹, A Mulavara², J Bloomberg³, and LL Ploutz-Snyder², FACSM

¹JES Tech, Houston, TX; ²Universities Space Research Association, Houston, TX; ³NASA Johnson Space Center, Houston, TX

During the mechanical unloading of spaceflight and its ground-based analogs, muscle mass and muscle strength of the calf are difficult to preserve despite exercise countermeasures that effectively protect these parameters in the thigh. It is unclear what effects these local losses have on balance and whole body function which will be essential for successful performance of demanding tasks during future exploration missions. **PURPOSE:** To determine the impact of bed rest-induced reductions in calf strength on changes in balance and brief functional performance. **METHODS:** Thirty-five males (35.2 y, 81.6 kg) were randomized to high intensity exercise or control conditions and completed 70 d of six degree head down tilt bed rest. Eccentric isokinetic ankle plantarflexor strength ($30^\circ \cdot s^{-1}$), balance (sway test, quantitatively scored 0-100), and brief functional performance (egress from a seat to upright, fall recovery, rock translation, and tandem walk) were assessed pre- and post-bed rest. Simple regression was performed with plantarflexor strength change (post - pre) as the predictor variable and change in balance and functional performance (post - pre) as the outcome; all subjects' data were analyzed together. **RESULTS:** Bed rest elicited a 12.5% reduction in calf strength (Pre: 196 Nm vs. Post: 168 Nm, $P < 0.0001$); balance and functional performance were also negatively affected. Calf strength change explained 11% of the increase in seat egress time (Pre: 16.4 s vs. Post: 24.7 s; $r = 0.33$, $P = 0.05$), 14% of the increase in rock translation time (Pre: 14.2 s vs. Post: 18.5 s; $r = 0.37$, $P = 0.03$), 10% of the change in tandem walk performance (Pre: 80.1% correct steps vs. Post: 50.4% correct; $r = 0.32$, $P = 0.06$), and 6% of the decrease in balance performance (Pre: 85.6 vs. Post: 71.8; $r = 0.25$, $P = 0.14$). Practically speaking, a 27 Nm decrease in calf strength (the mean loss) corresponded to a ~ 3 s and ~ 1 s increase in seat egress and rock translation time, respectively. **CONCLUSION:** Bed rest-induced losses in calf strength account for 6-14% of concomitant changes in balance and brief functional task performance. Additional work to evaluate the influence of calf strength loss on the performance of longer and more plantarflexor-intensive tasks (e.g., ladder climb and uphill ambulation) is needed.