Source of Acquisition
NASA Johnson Space Center

Twins Bed Rest Project: LBNP/ Exercise Minimizes Changes in Lean Leg Mass, Strength and Endurance

Fabiano T. Amorim[1], Suzanne M. Schneider[1], Stuart M.C. Lee[2], Wanda L Boda[3], Donald E Watenpaugh[4] and Alan R Hargens[5]. [1]University of New Mexico, Albuquerque, NM; [2]Wyle Laboratories, Houston, TX; [3]Sonoma State University, Sonoma, CA; [4]Sleep Consultants Inc., Fort Worth, TX; and [5]University of California, San Diego, CA.

Decreases in muscle strength and endurance frequently are observed in non-weight-bearing conditions such as bed rest (BR), spaceflight or limb immobilization. **PURPOSE:** Our purpose was to determine if supine treadmill exercise against simulated gravity, by application of lower body negative pressure (LBNP), prevents loss of lean leg mass, strength and endurance during 30 d of 6° head-down bed rest (BR). **METHODS:** Fifteen pairs of monozygous twins (8 male, 7 female pairs; 26±4 yrs; 170±12 cm; 62.6±11.3 kg; mean±SD) were subjects in the present study. One sibling of each pair of twins was randomly assigned to either an exercise (EX) or non-exercise (CON) group. The EX twin walked/jogged on a vertical treadmill within LBNP chamber 6 d·wk^{-1} using a 40-min interval exercise protocol at 40-80% of pre-BR VO_{2peak}. LBNP was adjusted individually for each subject such that footward force was between 1.0 and 1.2 times body weight (-53±5 mmHg LBNP). The CON twin performed no exercise during BR. Subjects performed isokinetic knee (60 and 120°·s^{-1}) and ankle (60°·s^{-1}) testing to assess strength and endurance (End) before and after BR. They also had their lean leg mass (L_{mass}) evaluated by DEXA before and after BR. **RESULTS:** Changes in peak torque (T_{pk}) were smaller for flexion (flex) than for extension (ext) after BR and did not differ between groups. The CON group had larger decreases ($P<0.05$) in L_{mass}, knee and ankle ext T_{pk}, and knee ext End.

	CON	EX
Δ L_{mass} (%)†	-4.3 ± 1.2	-0.1 ± 1.0*
Knee ext T_{pk}, 60°·s^{-1}, N-m	-25 ± 7	-9 ± 5*
Ankle ext T_{pk}, 60°·s^{-1}, N-m	-10 ± 3	-1 ± 4*
Knee ext End, 120°·s^{-1}, N-m	-204 ± 67	-16 ± 48*

*mean±SE; † n = 13; * Significantly different from CON (P < 0.05); 1-tailed, non-paired t-test*

CONCLUSIONS: This LBNP/exercise countermeasure prevented losses in lean leg mass and partially counteracted the decreases in knee and ankle extensor strength and in knee extensor endurance during 30 d of BR. To completely prevent changes in lower body strength, the addition of a resistive exercise countermeasure probably will be necessary. *Supported by NASA grant NAG9-1425 to Alan R. Hargens and by NIH grant MO1 RR00827 to the UCSD GCRC.*