Recent Results from NASA Bed Rest Studies

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NASA Flight Analogs Research Unit

- NASA Flight Analogs Research Unit
  - Located at University of Texas Medical Branch (UTMB) in Galveston, TX
  - 10-bed hospital unit
  - Access to hospital facilities
  - Metabolic kitchen
  - Standardized conditions
  - Standard measures

NASA Bed Rest Studies

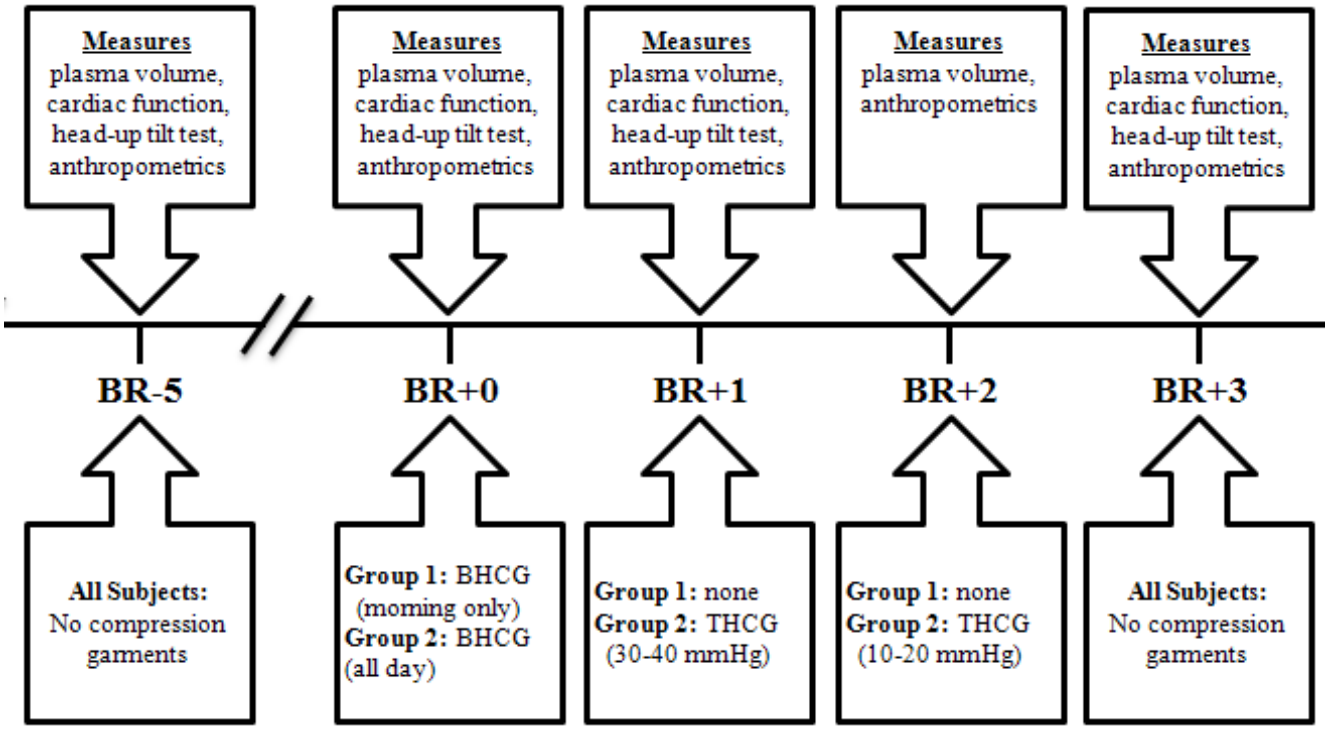
- 14-day Bed Rest Campaign
  - Efficacy of Jobst Compression Garments to Prevent Orthostatic Intolerance Following 14 Days of Bed Rest.
    - M. Stenger, Wyle
    - Examine a schedule for progressive removal of the compression garments to facilitate re-adaptation to vertical after bed rest.
  - Surveillance of Ocular Parameters in long duration bed rest subjects
    - G. Vizzeri, University of Texas Medical Branch
    - Surveillance of vision during long duration head-down tilt bed rest.
  - Standard Measures

Compression Garment Design

- Three pieces, with zippers, to ease donning
- Custom fit, graded compression
  - 55 mmHg ankle
  - 35 mmHg knee
  - 18 mmHg thigh
  - 16 mmHg abdomen

Protocol

- Bed rest protocol
  - 2 weeks pre-bed rest
  - 2 weeks 6° head-down tilt bed rest
  - 1 week post bed rest
- Subject Groups (n=16)
  - Group I (Control) - Garments worn BR+0 morning only
  - Group II (Treatment) - Garments worn BR+0, BR+1 and BR+2

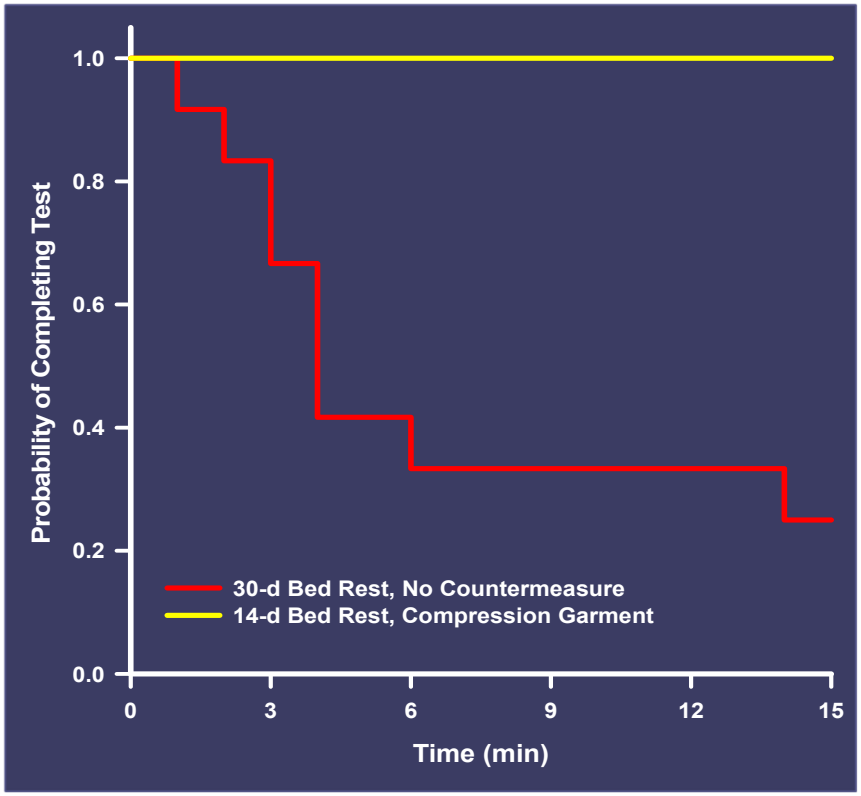


Methods (testing)

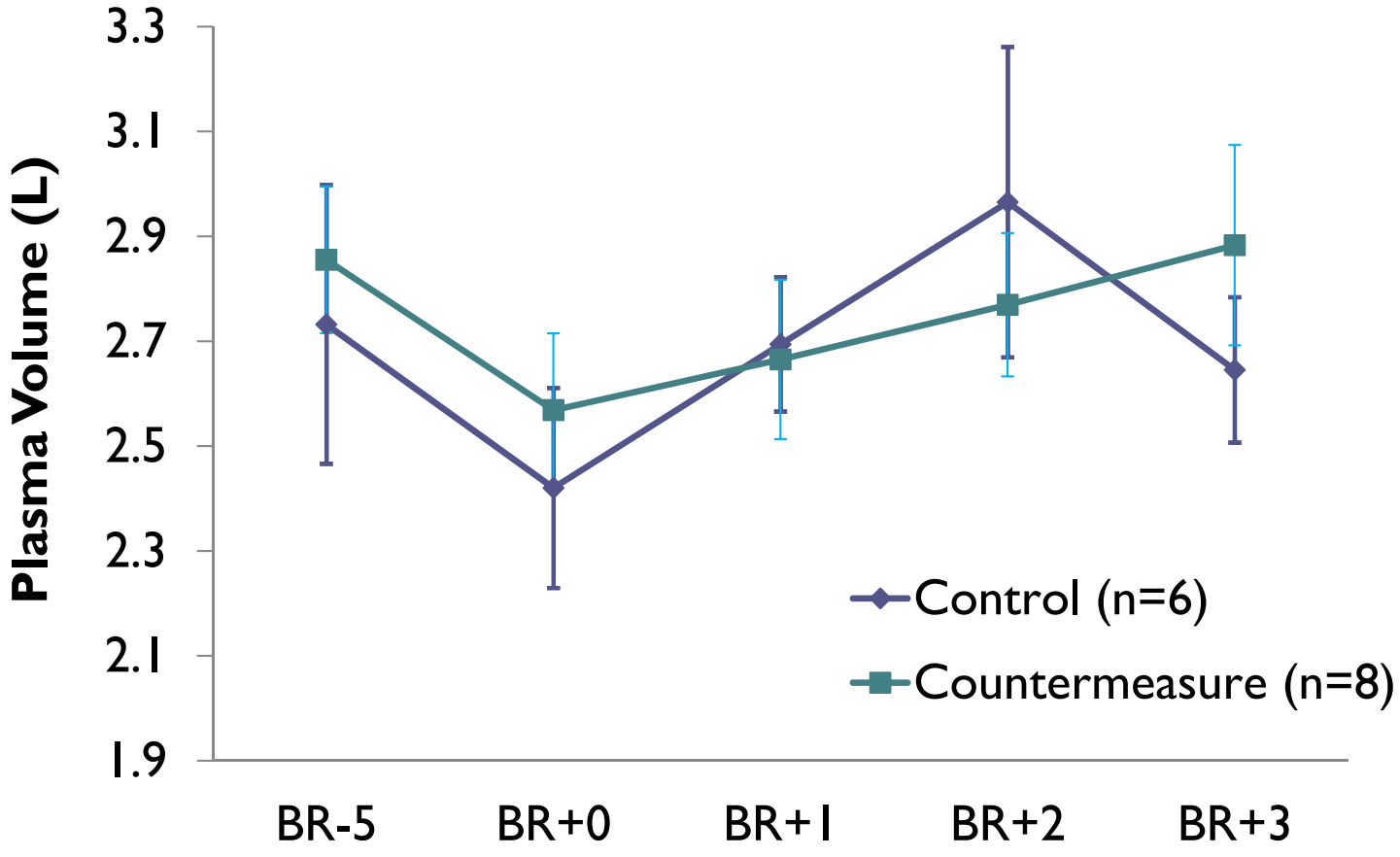
- Plasma volume (BR-5, +0, +1, +2, +3)
- Cardiac Function (BR-5, +0, +1, +3)
- Head-up tilt test (15 minutes) (BR-5, +0, +1, +3)
- Anthropometric Measures (BR-5, +0, +1, +2, +3)
- Circumference of Ankle, Calf, Thigh, Abdomen
- Comfort Logs (BR+0, +1, +2)

Results: Tilt Test

- Survival analysis
  - Typical response of subjects without garments after 30-days of bed rest (red line).
  - Garments were successful at preventing orthostatic intolerance during the tilt test on BR+0 (yellow line).

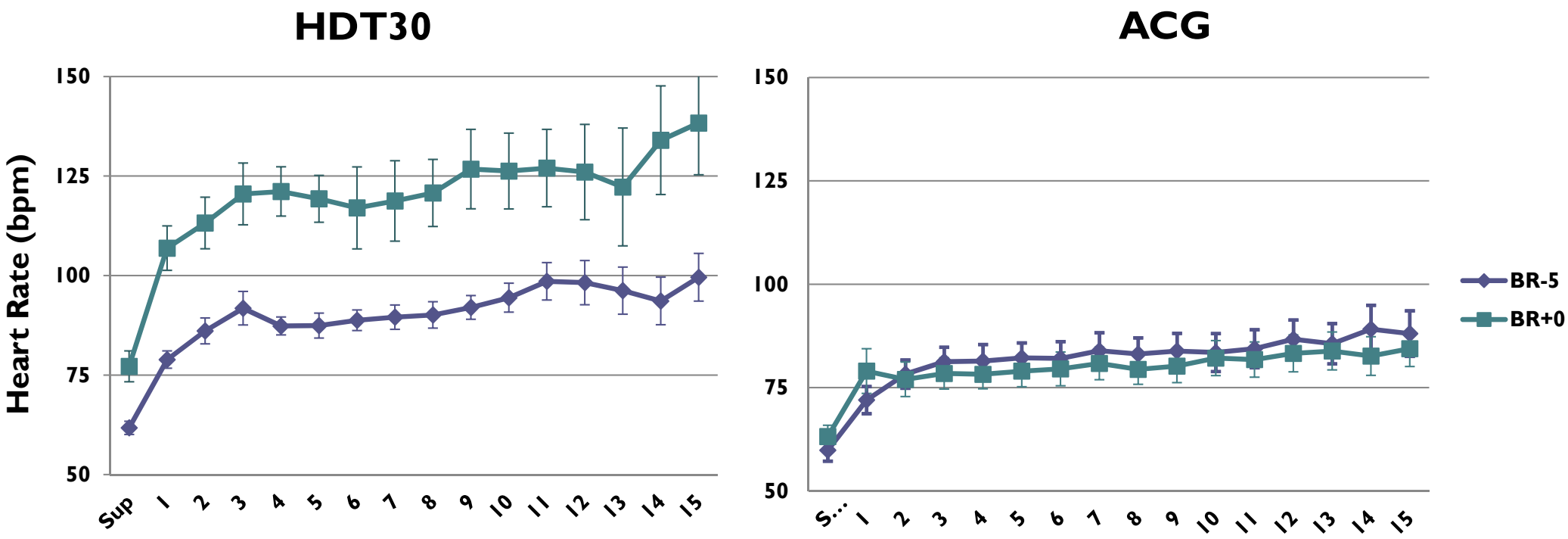


ACG: Plasma Volume



BR+0 < BR-5 (p = 0.019)

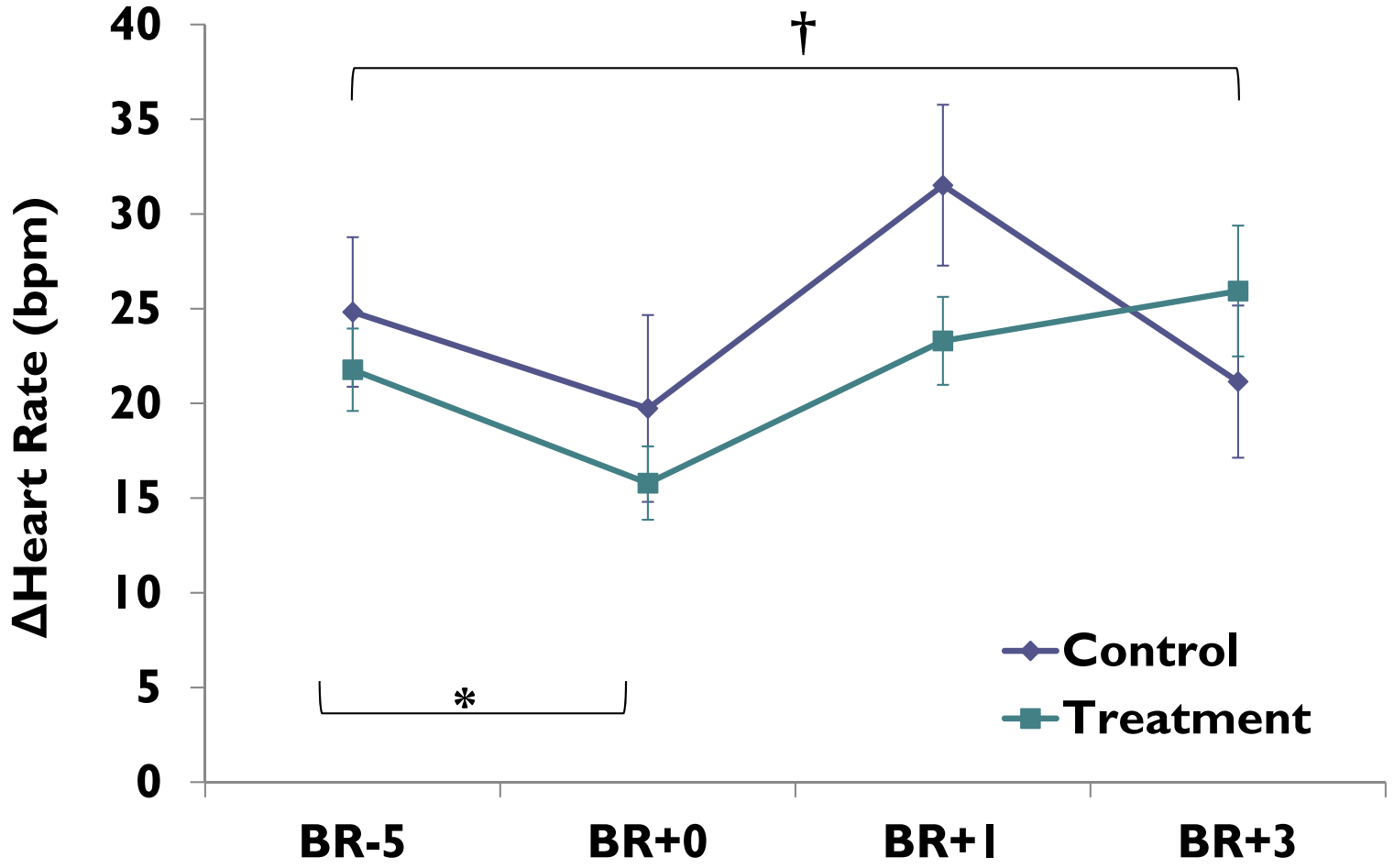
Heart Rate w/ and w/o ACG



30 day bed rest

14 day bed rest

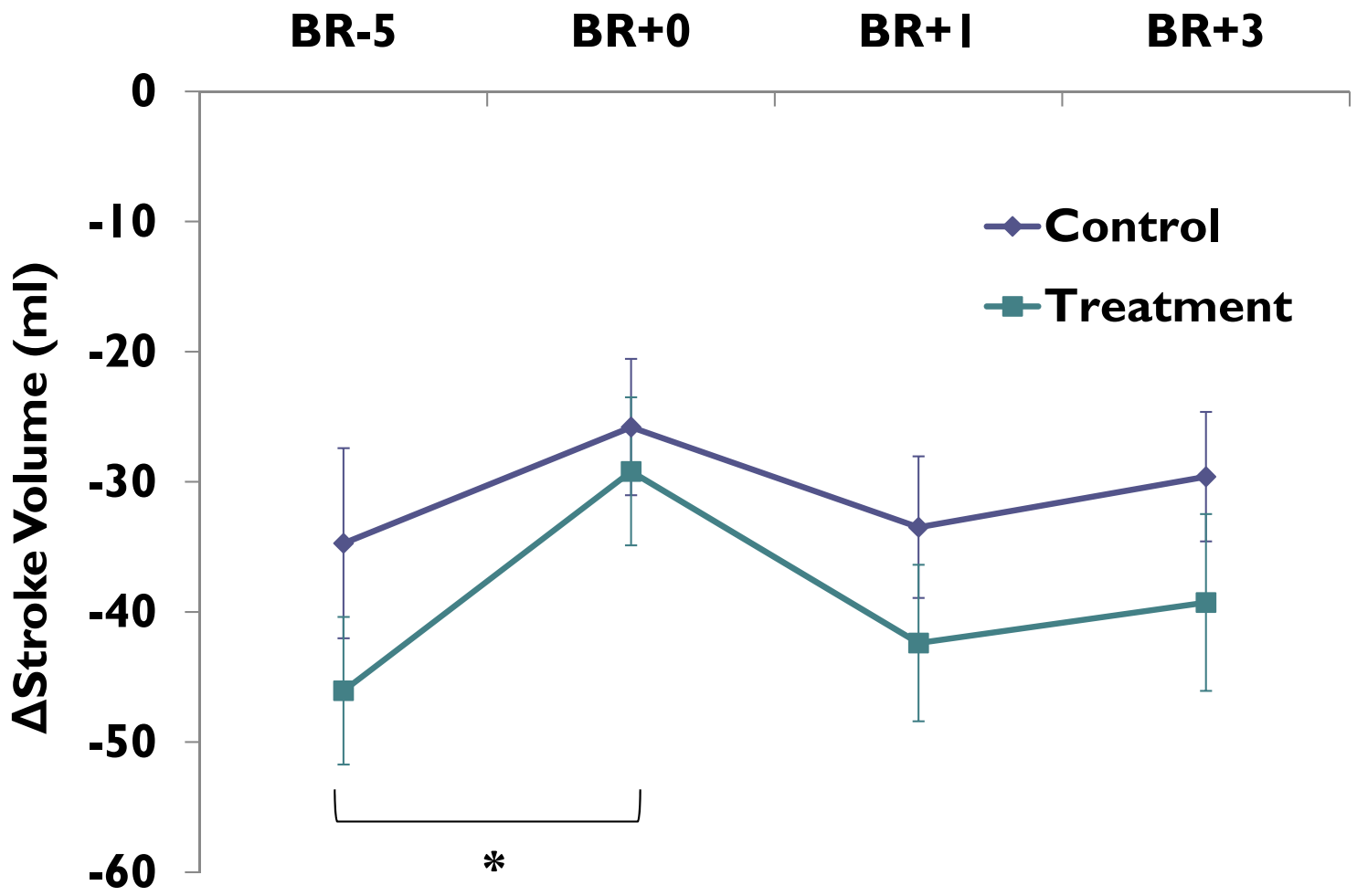
ACG: Heart Rate



* BR+0 < BR-5 (p = 0.047)

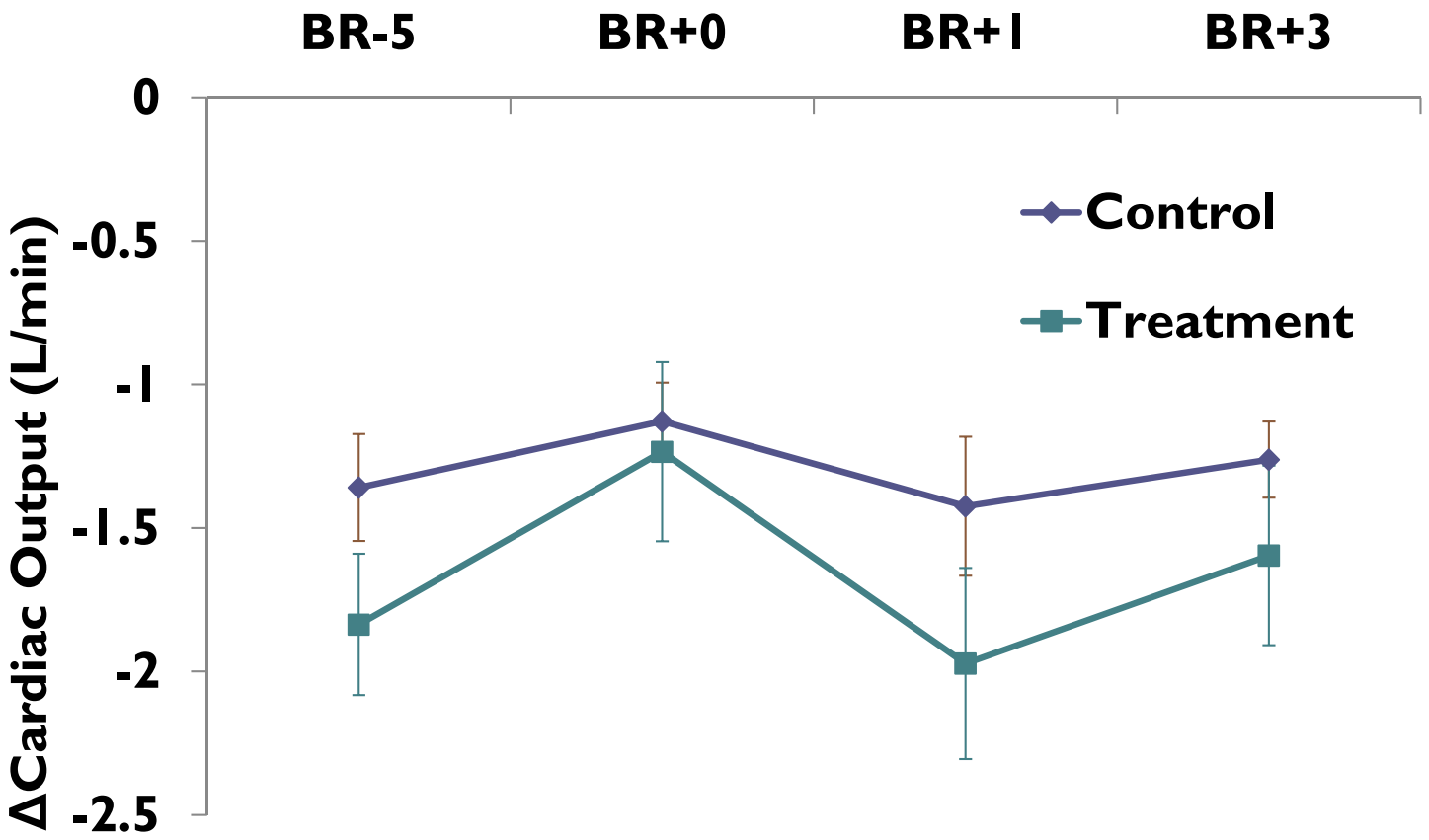
† BR+3 compared to BR-5: Treatment > Control (p = 0.021)

ACG: Stroke Volume



* BR+0 > BR-5 (p = 0.014)

Cardiac Output



No effect of Day or Treatment

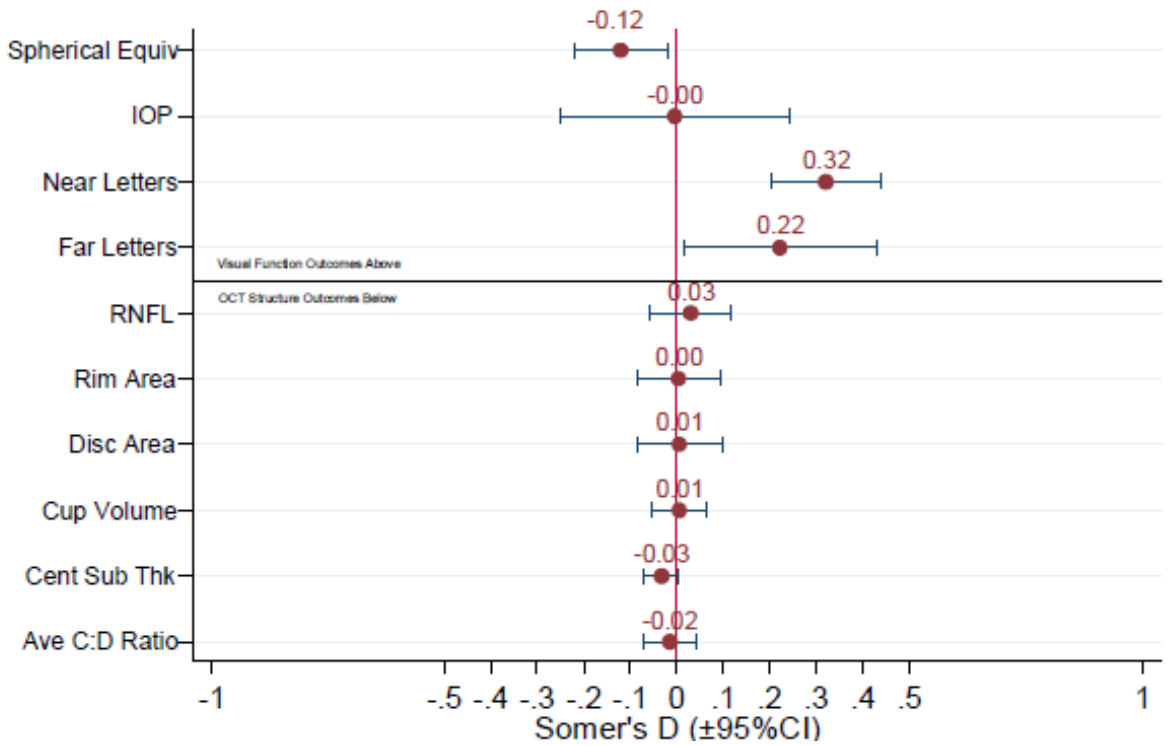
Conclusions

- While garments were successful for preventing orthostatic intolerance, continued use beyond BR+0 may inhibit efficient re-adaptation.
- Use of garments is recommended on BR+0 and only as needed on subsequent days.

Visual Surveillance

Test	BR-10	BR-3	BR4	BR11	BR+2
Best Corrected Visual Acuity	X	X	X	X	X
Cycloplegic Refraction	X	X	X	X	X
Amsler Grid Testing	X	X	X	X	X
Red Dot Testing	X	X	X	X	X
Confrontational Visual Fields	X	X	X	X	X
Color Vision Testing	X	X	X	X	X
Tonometry	X	X	X	X	X
Fundus Photography	X				X
Optical Coherence Tomography	X				X

Visual Surveillance Results

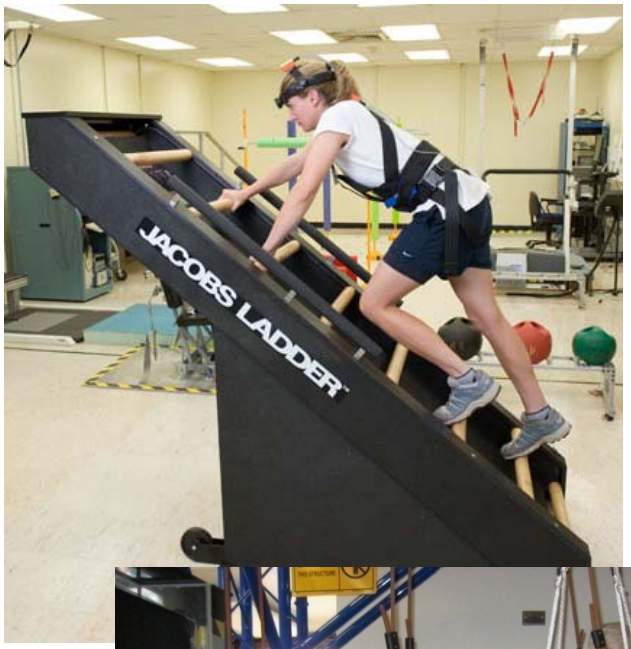


- Kolmogorov-Smirnov test was not significant for any vision tests.
- Suggesting conservatively that pre- to post distributions are not different, even though in a couple of cases the Somer's d statistic suggested increases or decreases pre/post.

- The figure summarizes the Somer's d results and the 95% confidence interval (CI) for each outcome variable balanced around a zero-reference line. This plot provides a visual representation of the direction and magnitude of association for the effect of bed rest on each outcome measure.

70-day NASA Bed Rest Studies

- Physiological Factors Contributing to Post Flight Changes in Functional Performance
  - J. Bloomberg, NASA
  - Identification of the key underlying physiological factors that contribute to performance of functional tests that are representative of critical mission tasks



- Integrated Resistance and Aerobic Training Study (iRATS)
  - L. Ploutz-Snyder, USRA
  - Evaluation of the efficacy of a new integrated resistance and aerobic training (iRAT) program designed to minimize loss of muscle, bone and cardiovascular function

70-day NASA Bed Rest Studies

- Testosterone supplementation as a countermeasure against musculoskeletal losses during space exploration
  - R. Urban, University of Texas Medical Branch
  - Examination of testosterone supplementation in conjunction with exercise (iRATS) to protect against functional loss of muscle and bone.
- Effects of retronasal smelling, variety and choice on appetite & satiety
  - J. Hunter, Cornell University
  - Examination of fluid shift effects on taste, olfaction and trigeminal response; and compare odorant acceptability ratings for pure, food-related odorants to subjects' appetite, or desire to eat a meal.
- Surveillance of Ocular Parameters in long duration bed rest subjects
  - G. Vizzeri, University of Texas Medical Branch
  - Surveillance of vision during long duration head-down tilt bed rest.

- The 70-day studies are integrated to run as a complement. Seventy days were needed due to the cycling of testosterone administration.

Questions?