Recent Results from NASA Bed Rest Studies

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- 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

<table>
<thead>
<tr>
<th>BR-5</th>
<th>BR+0</th>
<th>BR+1</th>
<th>BR+2</th>
<th>BR+3</th>
</tr>
</thead>
<tbody>
<tr>
<td>All Subjects: No compression garments</td>
<td>Group 1: BHCG (morning only)</td>
<td>Group 1: none Group 2: BHCG (30-40 mmHg)</td>
<td>Group 1: none Group 2: THCG (10-20 mmHg)</td>
<td>All Subjects: No compression garments</td>
</tr>
</tbody>
</table>

Measures:
- plasma volume, cardiac function, head-up tilt test, anthropometrics
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

HDT30

Heart Rate (bpm)

ACG

Heart Rate (bpm)

30 day bed rest

14 day bed rest
ACG: Heart Rate

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

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

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<tr>
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<th>BR-10</th>
<th>BR-3</th>
<th>BR4</th>
<th>BR11</th>
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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.
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.