



# Biomedical Results of ISS Expeditions 1-12

Presented by  
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# Acknowledgements

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The following presentation is the product of on-going work by The NASA, Johnson Space Center, Space Life Sciences Directorate (SLSD)

Laboratories, researchers, clinicians, and analysts from each division, Habitability and Environmental Factors Division; Human Adaptation and Countermeasures Division; and Space Medicine Division, within SLSD has contributed to the work presented here.



# ISS Expeditions 1-12

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- 15 Astronauts on ISS
  - 13 males
  - 2 females
- Average age 47.2 years young
- Average length of mission 175.1 days
  - Longest mission 195.8 days
  - Shortest mission 128.8 days



# Biomedical Data

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- Data Collect via Medical Requirements
- Assessments consists of:
  - Physiological
  - Performance



# Physiological Assessments

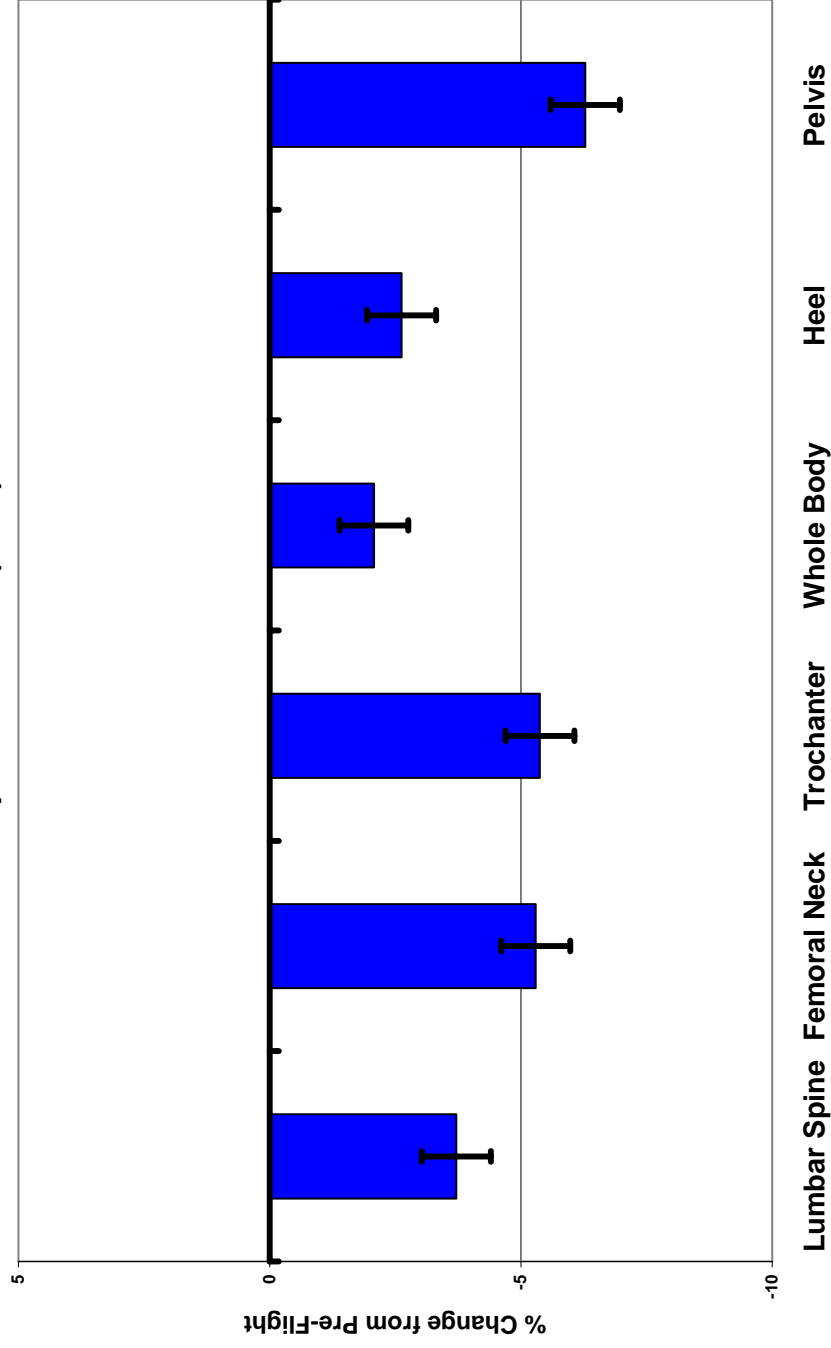
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- Skeletal
- Cardiovascular
- Neurovestibular
- Radiation Exposure



# Bone Mineral Density

BMD Percent Change from Preflight Expeditions 1-12 (n=15)





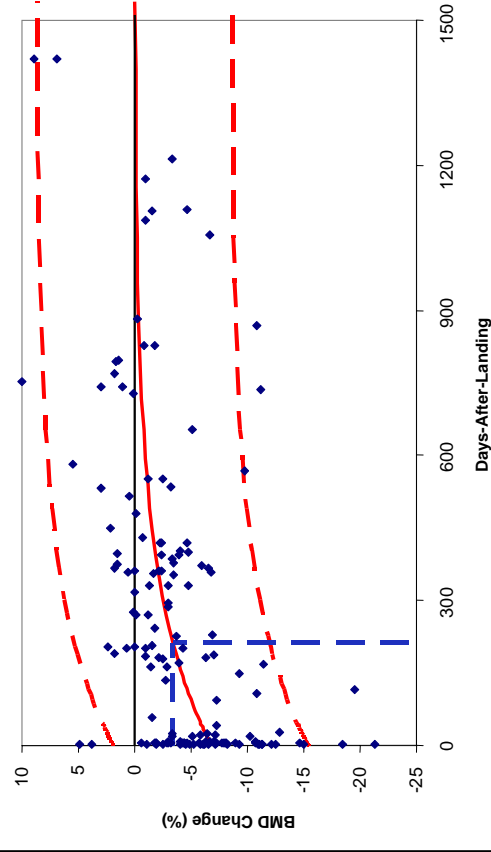
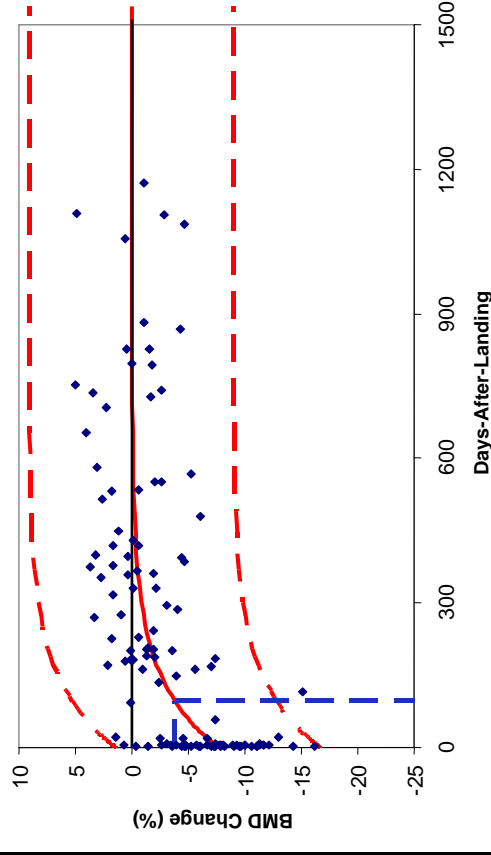
# Bone Mineral Density Recovery

Pelvis

Loss<sub>0</sub>=7.7% Recovery Half-life=97 d

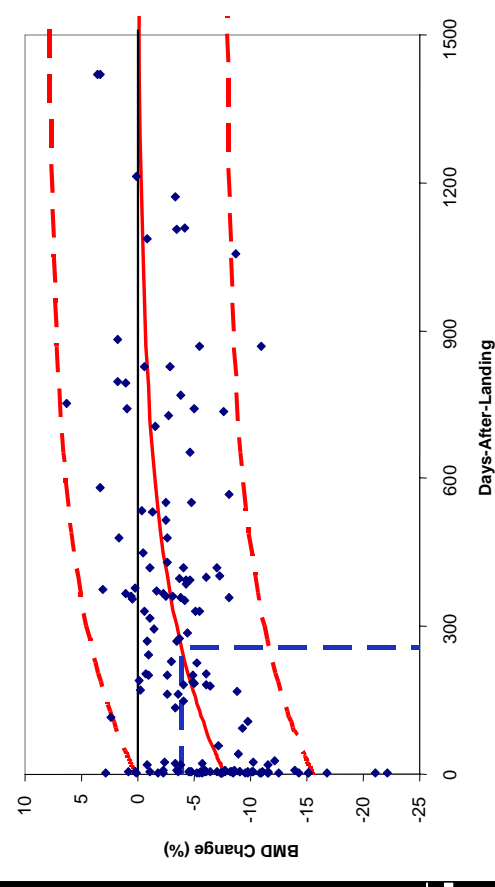
Femoral Neck

Loss<sub>0</sub>=6.8% Recovery Half-life=211 d



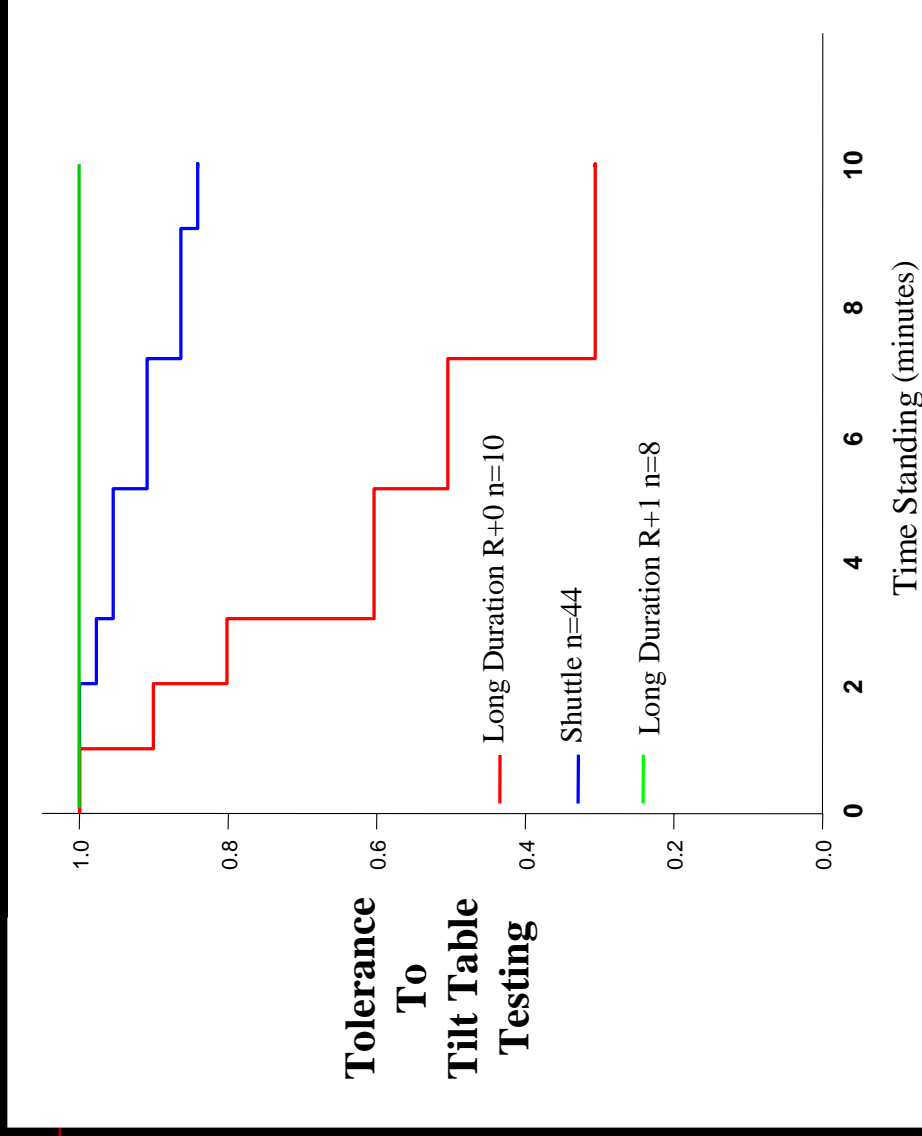
Trochanter

Loss<sub>0</sub>=7.8% Recovery Half-life=255 d





# Orthostatic Tolerance

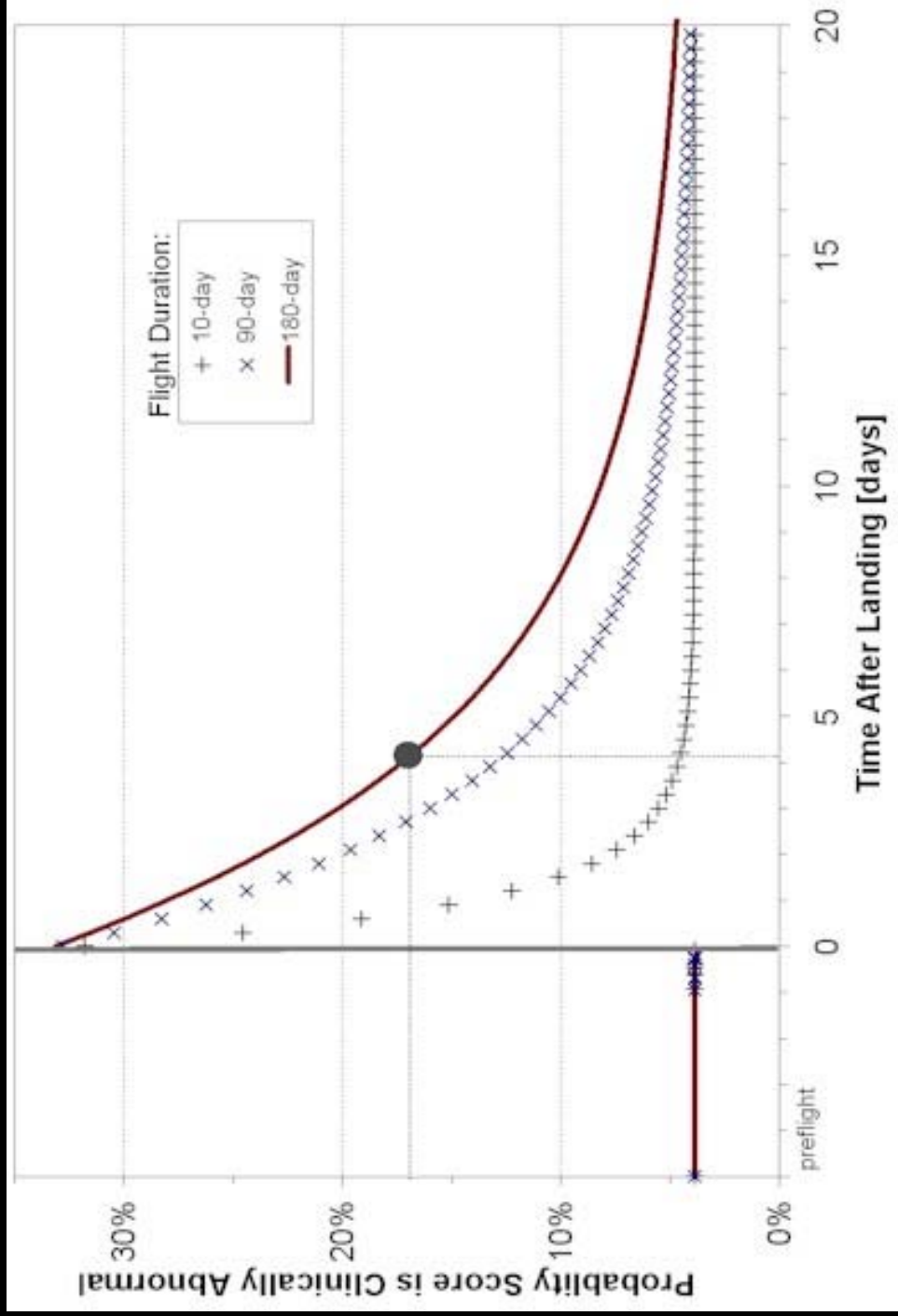


Shuttle vs. Long Duration R+0 =  $p < 0.02$   
Long Duration R+0 vs. Long Duration R+1 =  $p < 0.03$





# Postural Stability Set of Sensory Organ Test 6





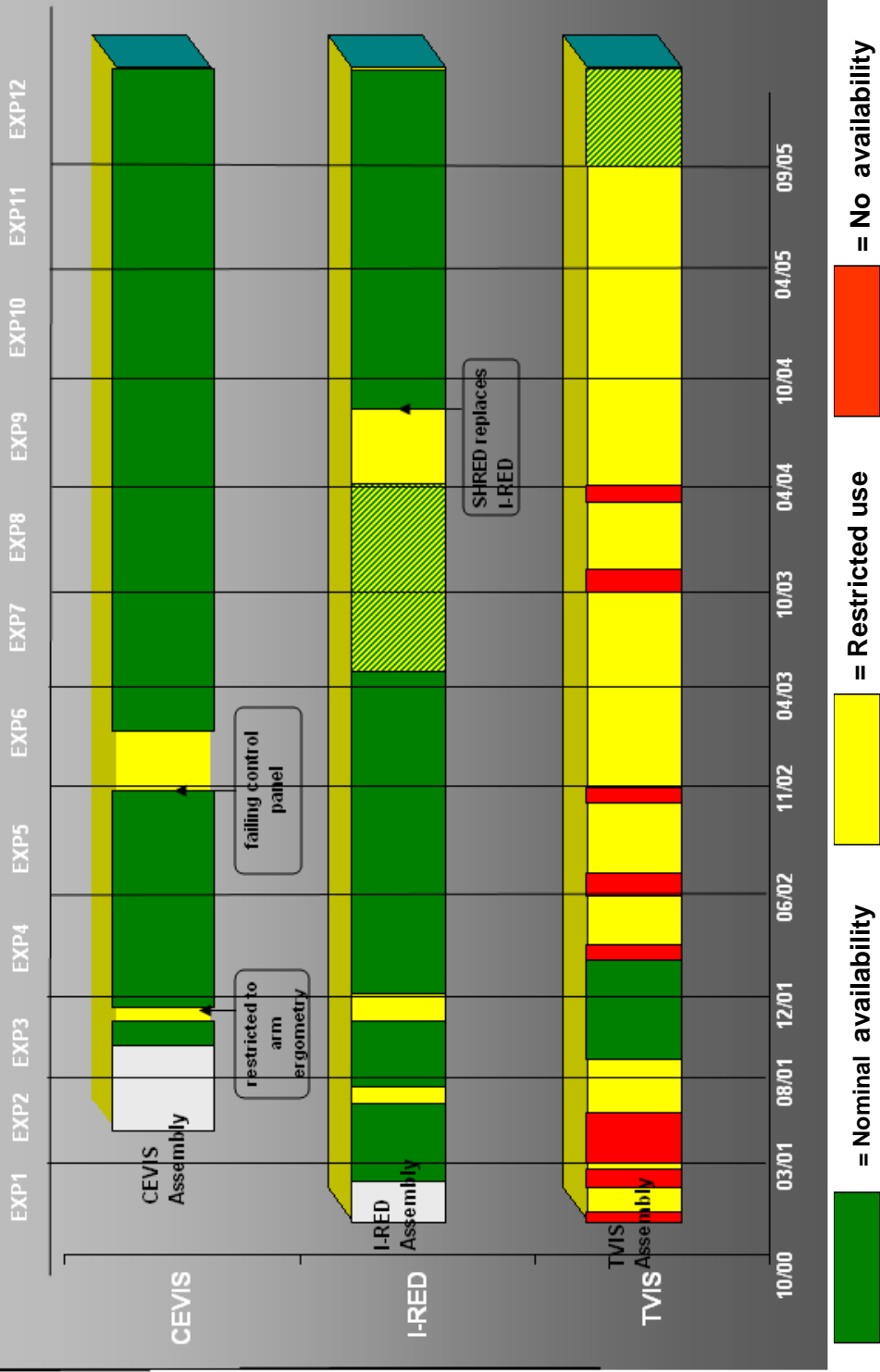
# Performance Assessment

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- Countermeasure Hardware Assessment
- Aerobic Fitness
  - General
  - Preflight
  - In-flight, Post-flight, and Recovery
- Functional Fitness
  - Strength and Endurance
  - Strength and Flexibility



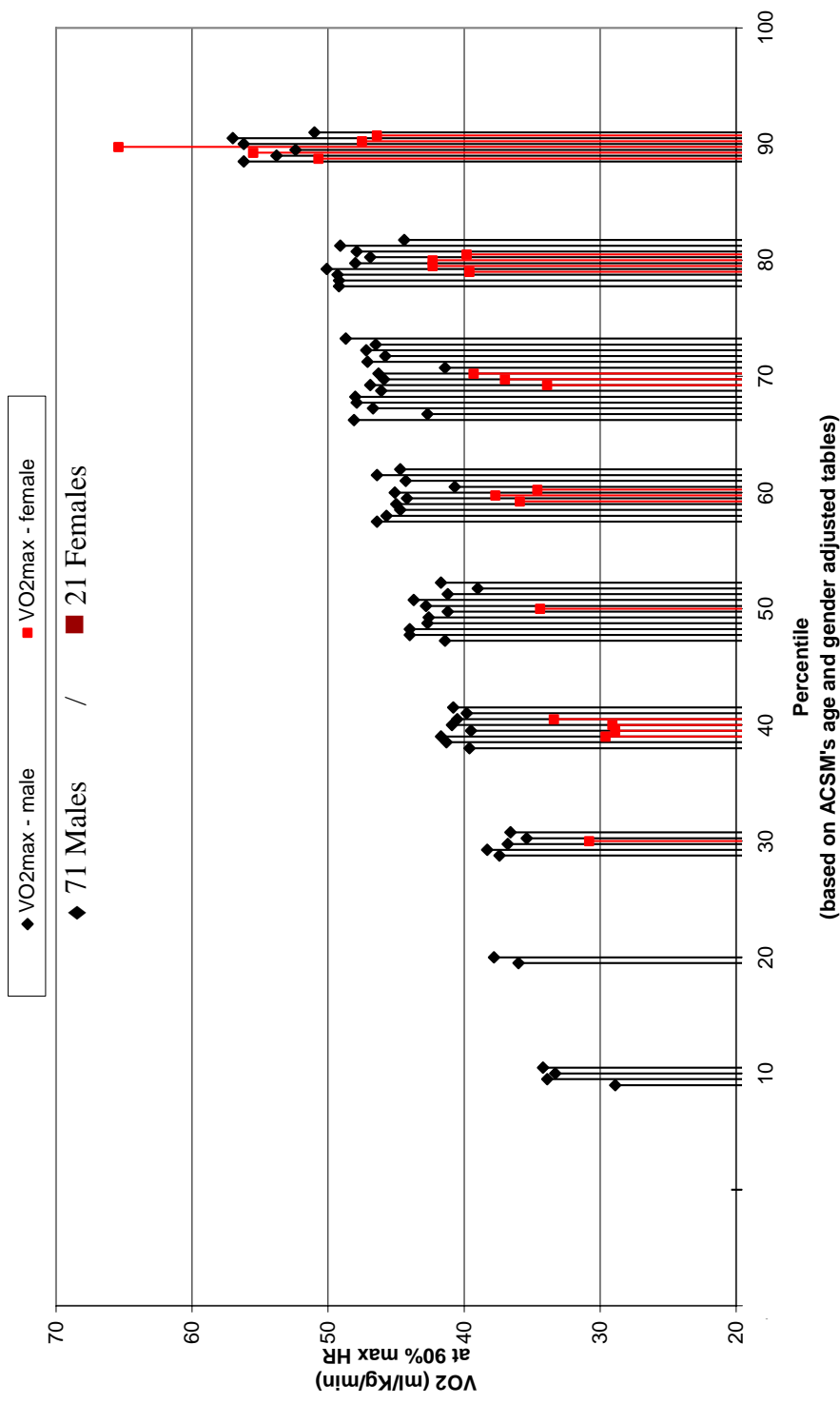
# ISS Exercise Hardware Availability Timeline





# Aerobic Capacity of the Astronaut Corps

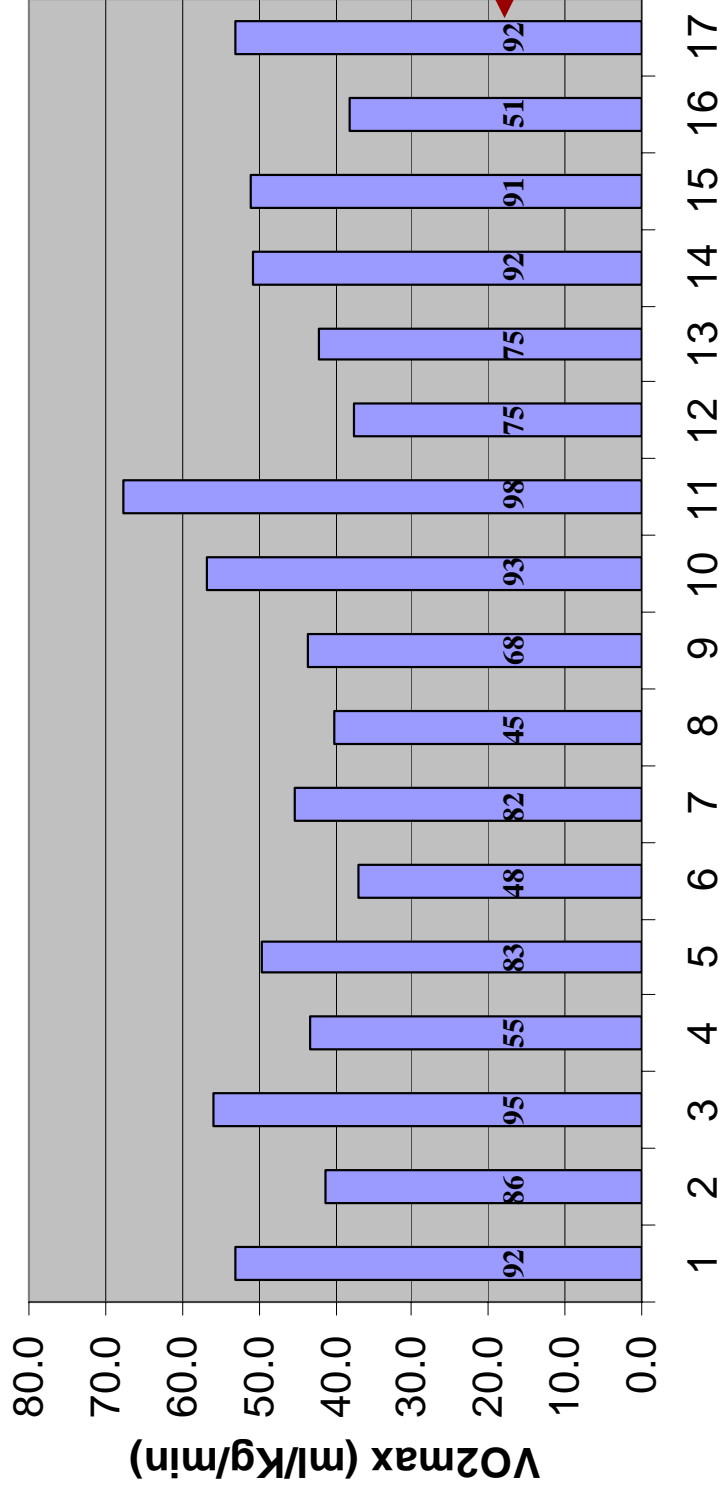
Active Astronaut Corps Aerobic Capacity  
(Data from LSAH; Annual Medical Evaluation)





# Pre-flight Aerobic Fitness of ISS Astronauts

**Pre-flight Aerobic Fitness**



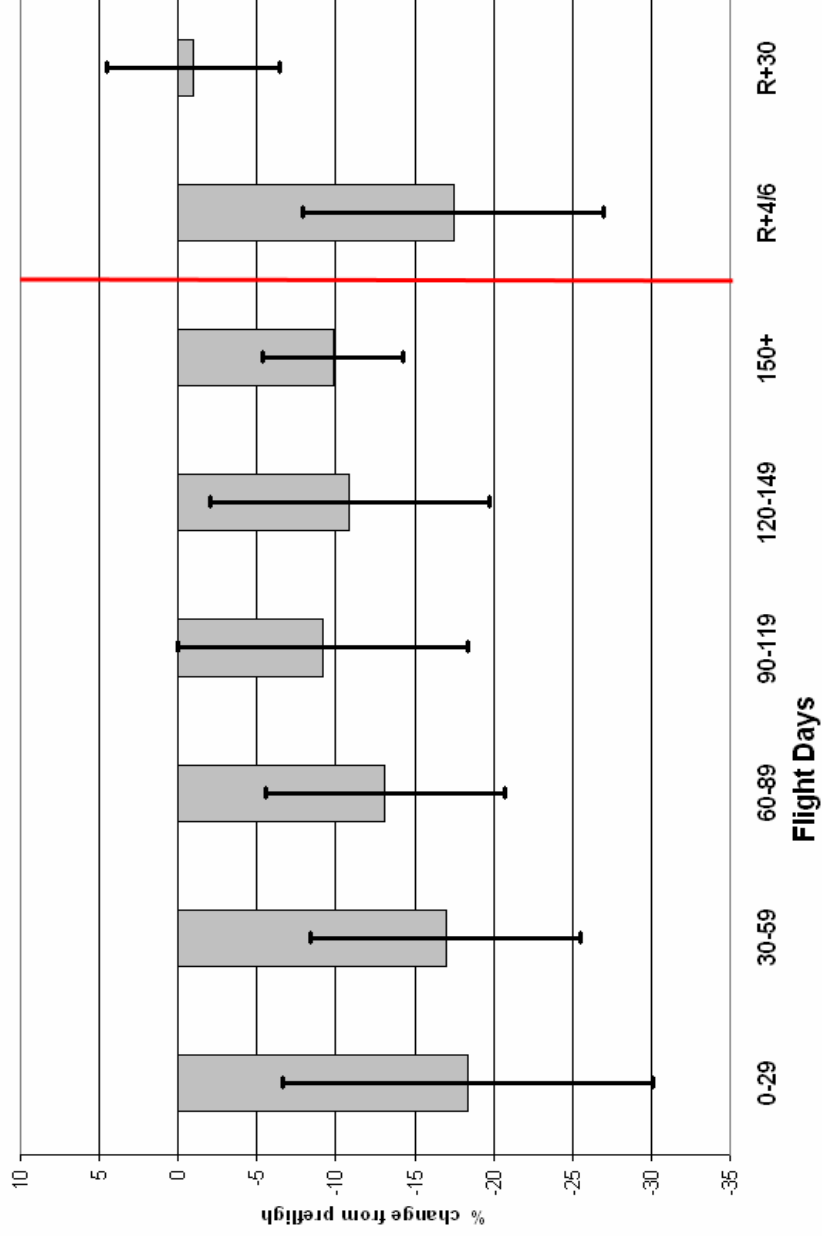
Number Represents Percentile Ranking of the Individual based on Age and Sex within the General population.

**ISS Astronauts  
Expeditions 1-14**



# In-flight and Post-flight Aerobic Capacity of the Astronaut Corps

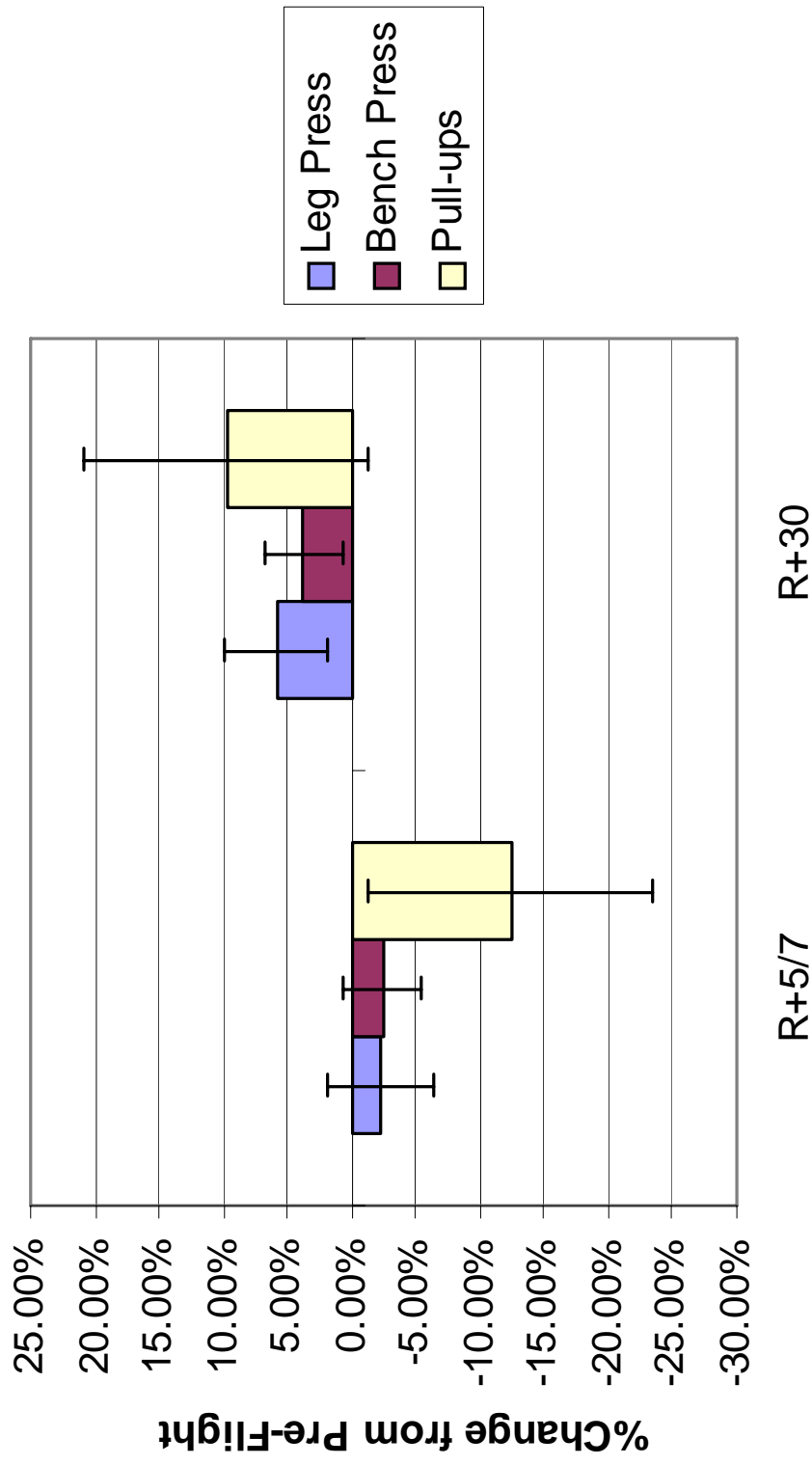
Percent Change in Estimated VO<sub>2</sub> Index from Preflight Expeditions 1-12 (n=15)





# ISS Functional Fitness Expeditions 1-12

Strength and Endurance





# ISS Functional Fitness Expeditions 1-12

## Strength and Flexibility

