Biomedical Results of 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

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

- Skeletal
- Cardiovascular
- Neurovestibular
- Radiation Exposure
Bone Mineral Density

Bone Mineral Density

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

-10
-5
0
5
Lumbar Spine Femoral Neck Trochanter Whole Body Heel Pelvis

% Change from Pre-Flight

6
Bone Mineral Density Recovery

Pelvis
Loss$_0$=7.7%  
Recovery Half-life=97 d

Femoral Neck
Loss$_0$=6.8%  
Recovery Half-life=211 d

Trochanter
Loss$_0$=7.8%  
Recovery Half-life=255 d
Orthostatic Tolerance

Survival Analysis

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

![Graph showing the probability score is clinically abnormal over time after landing for different flight durations.](image-url)
Performance Assessment

- 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

- **CEVIS**: Assembly
  - 10/00: Restricted to arm ergometer
  - 11/02: Failing control panel

- **L-RED**: Assembly
  - SHRED replaces LRED

- **TVIS**: Assembly

Legend:
- Green = Nominal availability
- Yellow = Restricted use
- Red = No availability
Aerobic Capacity of the Astronaut Corps

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

- VO2max - male
- VO2max - female

71 Males / 21 Females

VO2 (ml/Kg/min) at 90% max HR

Percentile (based on ACSM’s age and gender adjusted tables)
Pre-flight Aerobic Fitness of ISS Astronauts

Number Represents Percentile Ranking of the Individual based on Age and Sex within the General population.
In-flight and Post-flight Aerobic Capacity of the Astronaut Corps
ISS Functional Fitness Expeditions 1-12

Strength and Endurance

Legend:
- Leg Press
- Bench Press
- Pull-ups

% Change from Pre-Flight:
- R+5/7
- R+30
ISS Functional Fitness Expeditions 1-12

Strength and Flexibility

%Change from Pre-Flight

-20.00%  -15.00%  -10.00%  -5.00%  0.00%  5.00%  10.00%  15.00%  20.00%  25.00%

-20.00%  -15.00%  -10.00%  -5.00%  0.00%  5.00%  10.00%  15.00%  20.00%  25.00%

R+5/7  R+30

Push-ups  Sliding Crunches  Sit & Reach