INFORMATION CIRCULAR: Human information in space.

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Cardiovascular

Conflicts of interests
None stated by the authors
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Preparation for and participation in spaceflight activities are associated with changes in the cardiovascular system such as decreased carotid artery distensibility and decreased ventricular mass which may lead to an increased risk of cardiovascular disease. Additionally, astronauts who travel into space multiple times or for longer durations may be at an increased risk across their lifespan.

Cardiovascular

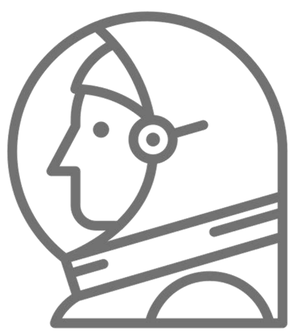
- Postflight orthostatic intolerance
- Cardiac atrophy
- Hearth rhythm disturbance

Muscle

- Muscle loss and atrophy

Bone

- Bone loss and increased fracture risk
- Increased kidney- stone formation
- Injury to soft connective tissue



Scott Kelly spent almost a year in space, which affected his body in ways expected and unexpected.
Credits - IMAGE: BILL INGALLS/NASA

NASA Sonographer David Martin simulates brachial artery ultrasound measures like those performed in the laboratory and performed by crew members aboard the International Space Station during the Cardio Ox investigation. Credits: Andrea Dunn- NASA

Recommended Reading: *NASA (Laurie J. Abadie, Charles W. Lloyd, Mark J. Shelhamer, NASA Human Research Program) - see link:* https://www.nasa.gov/hrp/bodyinspace

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Bone

During prolonged spaceflight, astronauts are exposed to both microgravity and space radiation, and are at risk for increased skeletal fragility due to bone loss. Evidence from rodent experiments demonstrates that both microgravity and ionizing radiation can cause bone loss due to increased bone-resorbing osteoclasts and decreased bone-forming osteoblasts, although the underlying molecular mechanisms for these changes are not fully understood.

It is now recognized that an unloading of the skeleton, either due to strict bed rest or in zero gravity, leads on average to a 1%-2% reduction in bone mineral density at selected skeletal sites each month. The mechanism by which unloading of the skeleton results in rapid mobilization of calcium stores from the skeleton is not fully understood, but it is thought to be related to down regulation in PTH and 1,25-dihydroxyvitamin D3 production.

Muscle

It's not a muscular disease, but a disorder caused by the absence of gravity in the International Space Station which makes it nearly impossible to maintain muscle strength. Muscular atrophy involves the weakening and degradation of muscles due to a lack of physical activity. It's not to say that astronauts aren't active (they are in great physical condition) but in space, certain muscles we use on earth require less contracting as they work in a weightless environment. Without the force of gravity causing the muscles to contract, certain muscles decrease in strength, mobility and size.

Studies have shown that astronauts experience up to a 20% loss of muscle mass on spaceflights lasting five to 11 days.

Conflicts of interests
None stated by the authors
Financing
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Koichi Wakata, Expedition 38 Flight Engineer (FE), performs ultrasound data collection for the Cardio Ox experiment, in the Columbus Module. Photo was taken during Expedition 38.
Credits: NASA

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- https://humanresearchroadmap.nasa.gov/explore/