Improving Health Span in Space and on Earth

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Environmental Influences on Human Health

Nervous system and behavior
Musculoskeletal system
Metabolism
Cardiovascular system

Cell ↔ Human
Organ ↔ Organ
Space ↔ Earth
Research under space conditions

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Highly controlled environments at :envihab

Highend research ward
Hypobaric chamber
Shortarm centrifuge

3T PET-MR
Physiology module
Psychology module
Brainstem fMRI – interface to environment
Combating muscle and bone wasting

- Microgravity, aging, chronic disease: Muscle and bone wasting
- State-of-the-art human physiology and mathematical modeling yields stimulus-response relationship
  ➢ Rational countermeasures in space and on Earth
Combating muscle and bone wasting

Head-down bedrest as model for weightlessness

Jumps as countermeasure for bone and muscle
Train like an astronaut – pediatric orthopedic and neurologic rehabilitation

Studies in patients provide unique insight in human physiology
Volume shifts in weightlessness

Earth

Space
A patient who cannot stand
Autoimmune autonomic ganglionopathy

Continued symptoms on immunosuppressive therapy (plasma exchange + medications)
Mitigating ocular risks in space
Space associated neuroocular syndrome

- Space associated neuroocular syndrome threatens ocular health
- NASA/DLR bedrest study - 30 days -6° headdown + 0.5% ambient CO₂
- Optical coherence tomography: thickened retinal nerve fiber layer
- Future study: testing hypergravity as SANS countermeasure during bedrest (:envihab centrifuge)
Artificial gravity as countermeasure
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Exploiting gravitation as treatment?

Open angle glaucoma

Acute moutain sickness

+30°
Improving Health Span in Space and on Earth

- Extreme environmental conditions in space:
  - Weightlessness, altered circadian rhythms, confinement, altered atmosphere, radiation, scarce resources
- Physiological changes akin to premature ageing:
  - Muscle/bone loss, cardiovascular deconditioning, radiation damage
- Technology enables novel research methodologies and countermeasures
  ➢ Application on earth to improve healthspan among other societal challenges
The C.R.O.P.® laboratory at DLR
Addressing the liquid manure challenge

• Filter contains natural biofilm for waste degradation
• Urine and liqueide manure as substrate
• Produces fertilizer
• Originally developed for closed loop life support systems in space
• Upscaling for liquid manure disposal