SPACEFLIGHT INDUCED DECONDITIONING:

PARALLELS WITH CLINICAL MEDICINE AND GERIATRICS

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Falls Prevention Task Force
Our Life Long Fight Against Gravity
The Gravity Dilemma

Launch (3g) → Space (µg) → Re-entry (1.6g)

Earth (µrg)
Each physiological system acclimates to microgravity at a different rate.
Muscles Affected in Microgravity

- Erector spinae m.
- Iliopsoas m.
- Quadriceps femoris m.
- Hamstrings
- Soleus m.
Bone Loss in Space

- 1.07 %/mo. (Spine)
- 1.35 %/mo. (Pelvis)
- 1.16 %/mo. (Femoral Neck)
- 1.58 %/mo. (Greater Trochanter)
- 1.25 %/mo. (Tibia)
- 1.50 %/mo. (Calcaneus)
Fluid Shifts in the Body

1. On Earth, blood tends to pool in the lower body.
2. Promptly upon entering weightlessness, fluids shift toward the head.
3. After a time, the body adapts to weightlessness. The kidneys reduce the volume of fluid, relieving pressure in the head and chest.
4. The body reacts immediately upon reentering Earth's gravity; fluids are shifted from the head toward the feet.
Orthostatic Intolerance
Simulating Orthostatic Challenge

Head up Tilt

Lower body negative suction
Orthostatic Intolerance Testing

HUT + ⇒ Presyncope

LBNP
Aging and Healthcare Costs Trends

EU Aging Report, Brussels

Costs

Countries

17 % 30 %

EU Aging Report, Brussels
Experiencing unexplained falls or blackouts?

One in ten falls in elderly people are caused by syncope (faints)

Prevention and treatments are available
Immobilization in Older Persons
Bedrest Simulates Spaceflight Deconditioning
6° Head-down Bedrest Immobilization
Frailty: A Vicious Cycle

- Immobilization
- Falls / Fear of falling
- De-conditioning

Further
Hospitalization in Older Persons

- 65+ year old patients → 40% acute hospitalizations
- Poor outcomes:
  - high 1 year mortality
  - 30% functional decline
  - high re-admission rates
  - higher home healthcare usage
Aging, Interventions and Recovery

- Keeping ambulatory persons mobile
- Getting bed-confined persons re-mobilized

Many studies: Ambulatory care

Lack of **bedrest immobilization** studies & **care strategies** in older persons
Manual Physiotherapy
Exercising During Bedrest

Exercising in Space

NASA ©
Prof Joern Rittweger, DLR, running in the supine position (DLR ©)
Vibration Exercise

Powerplate©)
Resistive Vibration Exercise During Bedrest
Acute Immobilization → Active and Healthy Aging

- Immobilization Screening
- Interventions
- Discharge Management
- Behavioral Change
- "Buddies"
Impact and Outcomes

MACRO LEVEL

Improving geriatrics care

Saving in healthcare costs

MESO LEVEL

Regional Falls prevention initiatives

Establishing community based structures

MICRO LEVEL

Falls prevention in older persons

Effectiveness of interventions
International co-operation for Space life Sciences knowledge sharing & development in Africa

International Academy of Astronautics (IAA): Commission 2 – Space Life Sciences Study Group Report