SPACEFLIGHT MEETS GERIATRICS

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European Innovative Partnership Active & Healthy Aging
Falls Prevention Task Force

Our Life Long Fight Against Gravity

The Gravity Dilemma

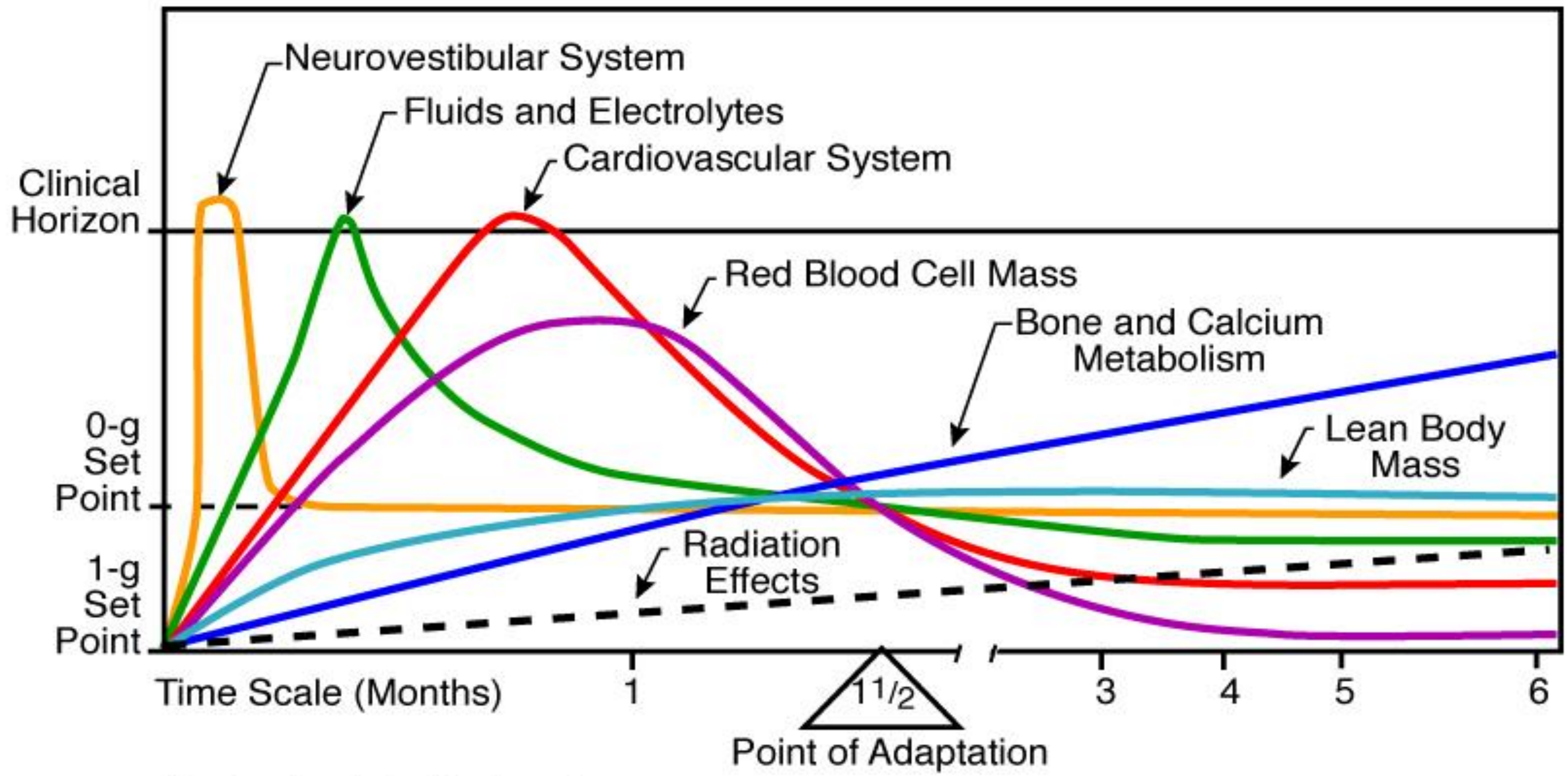
Space
(µg)

Re - entry
(1.6g)

Earth
(µrg)

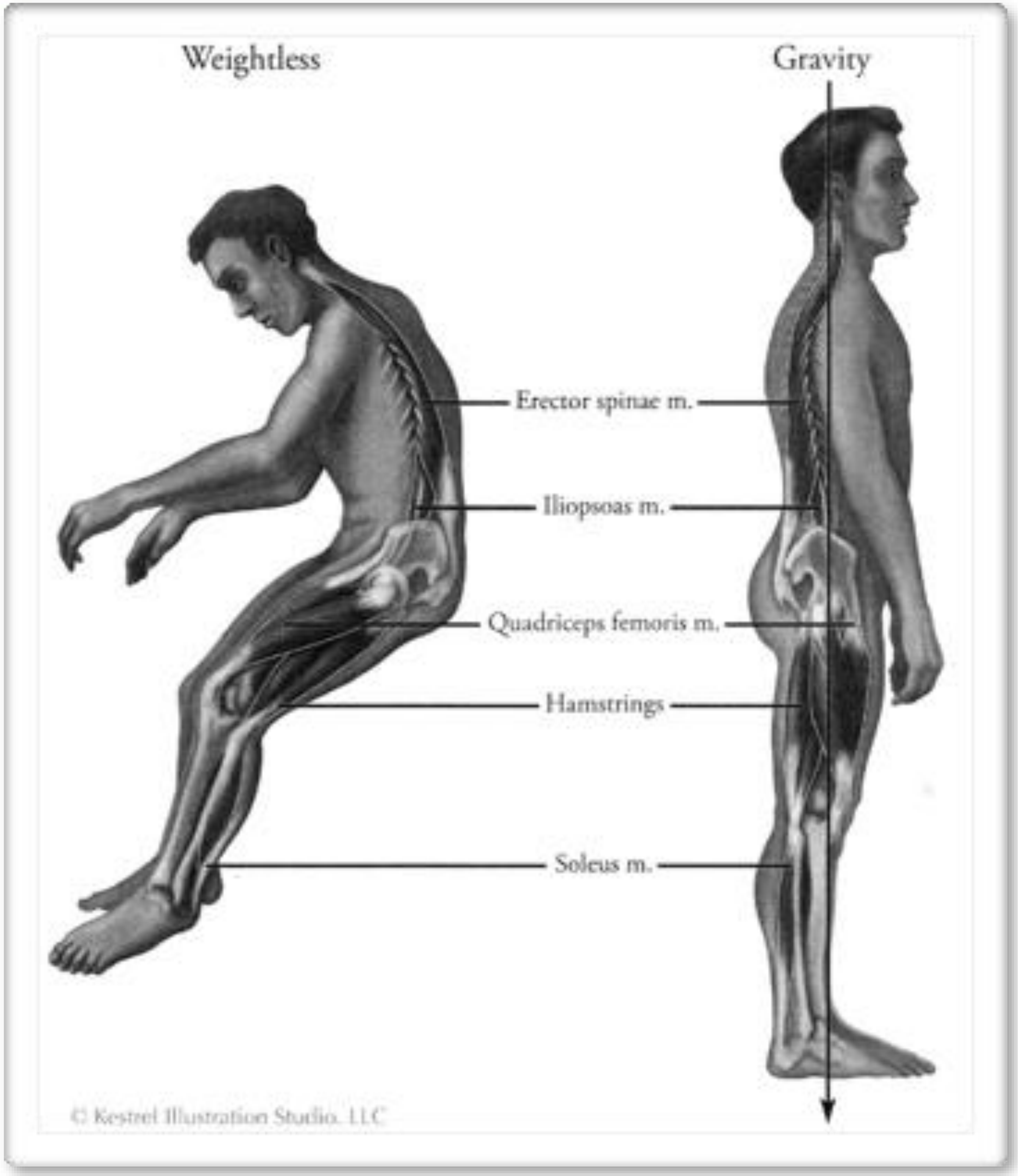
Launch
(3g)

Deconditioning Time Course

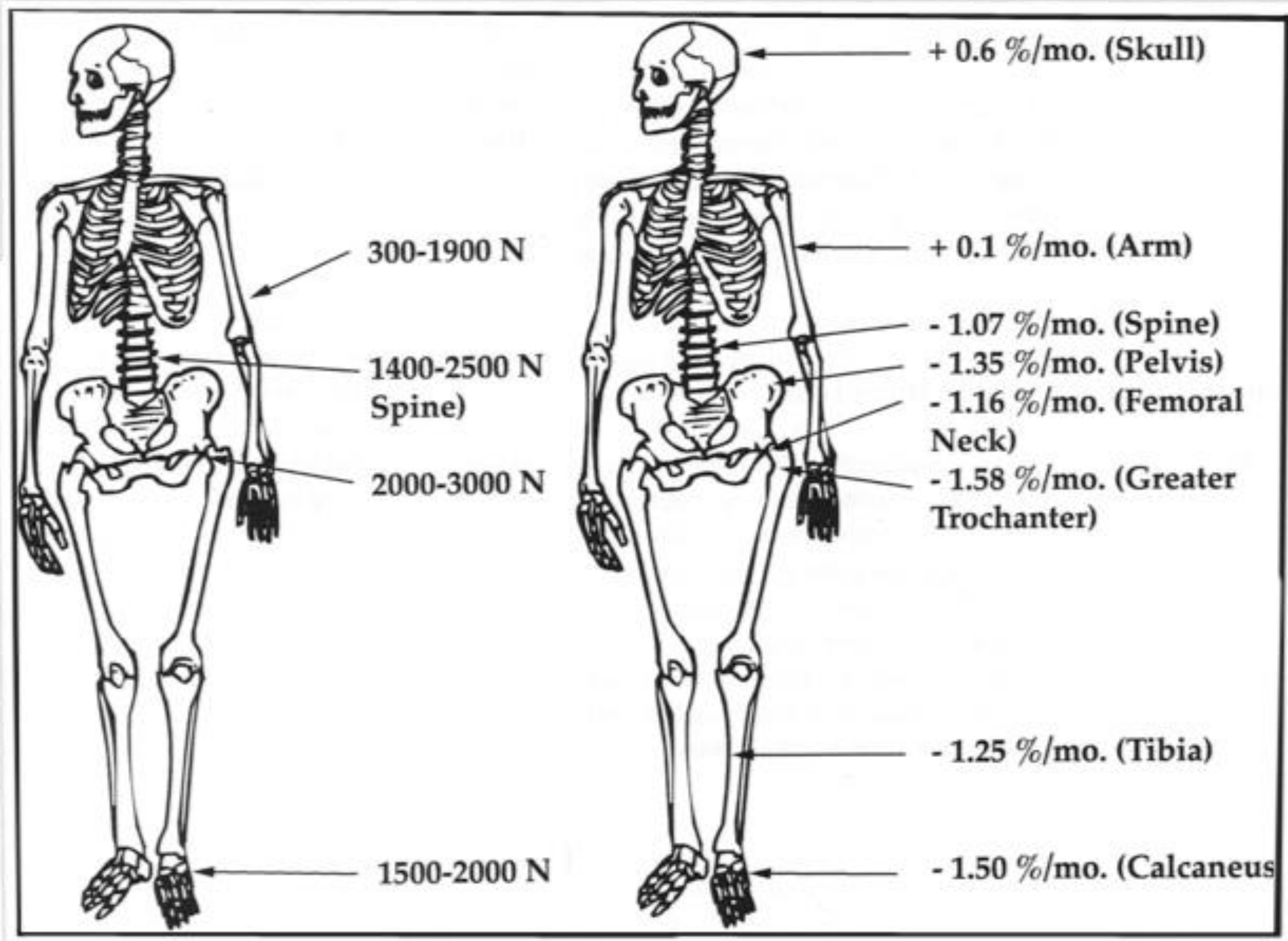


Each physiological system acclimates to microgravity at a different rate

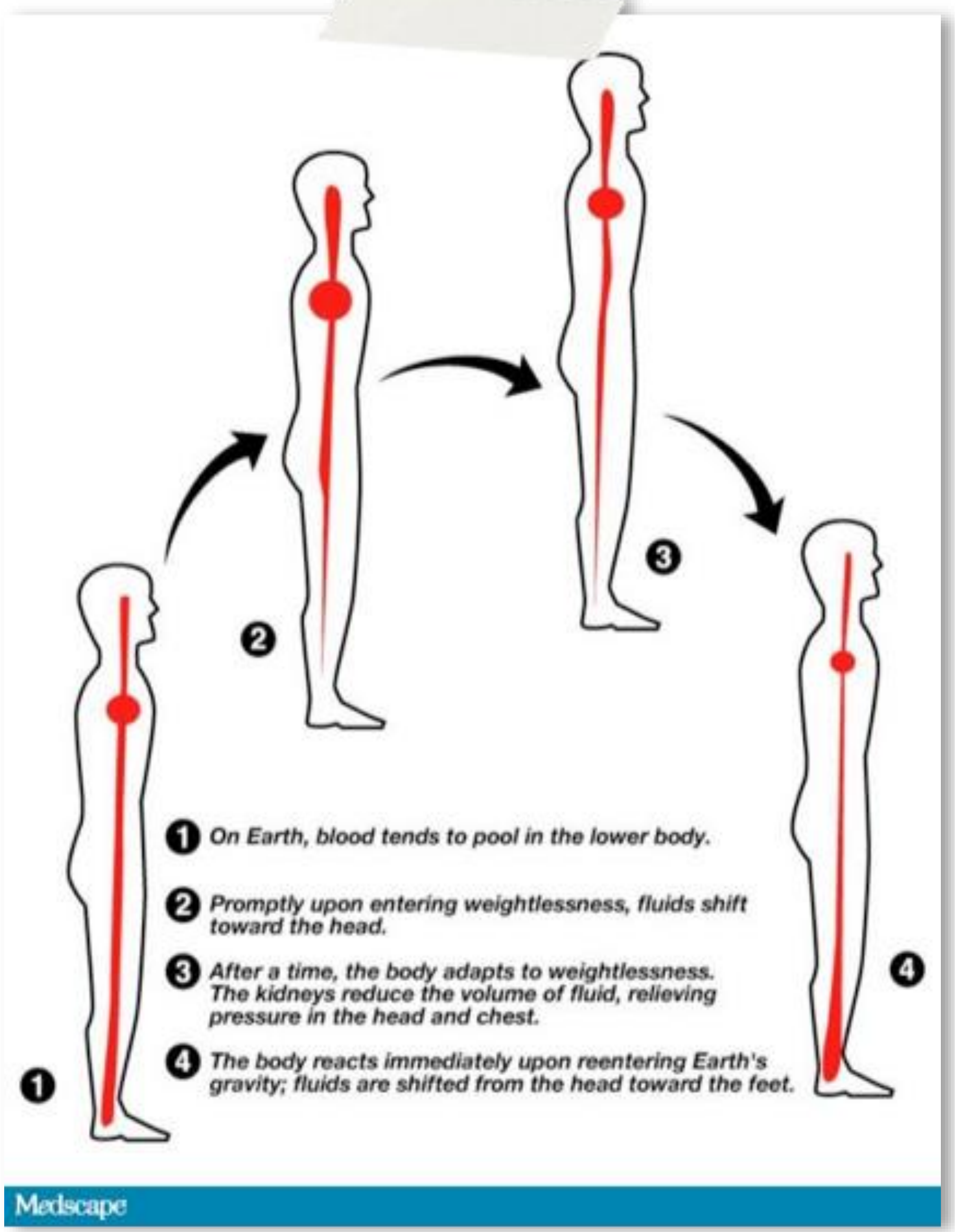
Muscles Affected in Microgravity



Bone Loss in Space



Fluid Shifts in the Body



Orthostatic Intolerance

ESA ©

Simulating Orthostatic Challenge

Head up Tilt

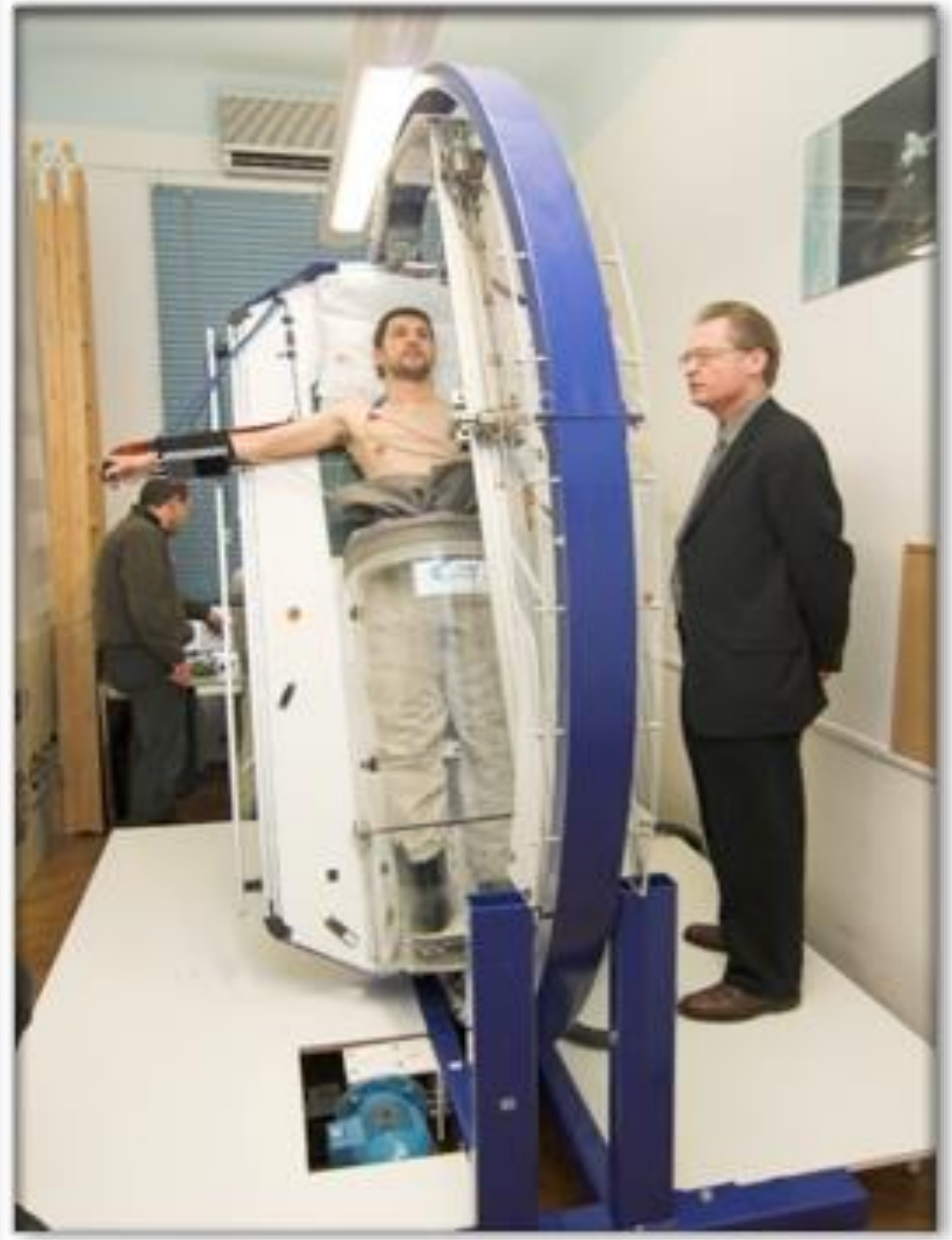
Lower body negative suction

Orthostatic Intolerance Testing

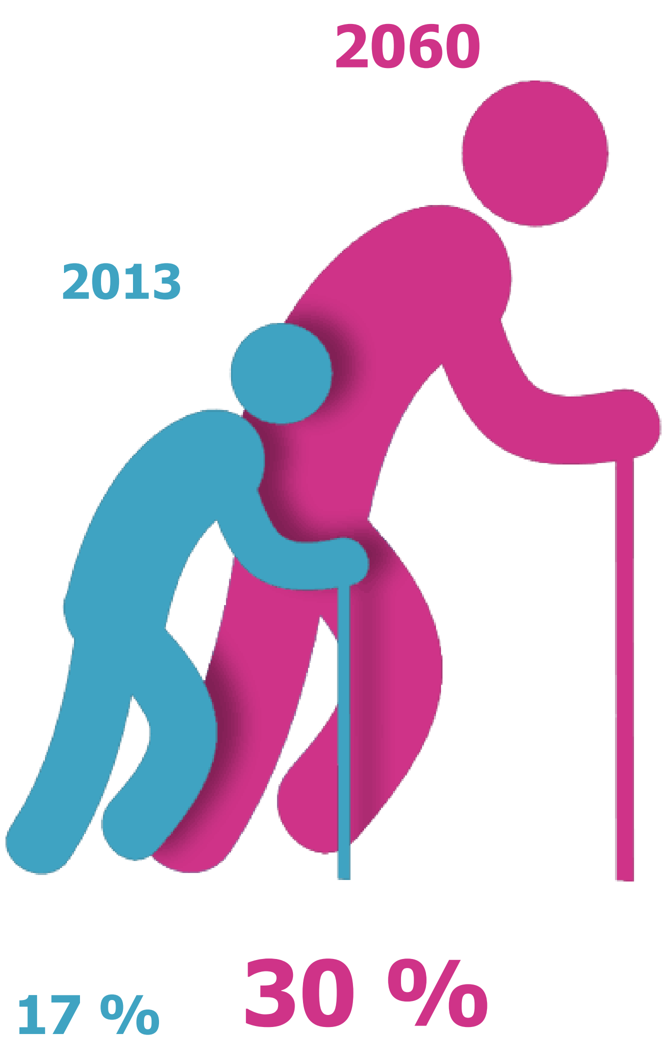
HUT

\+ ⇒ **Presyncope**

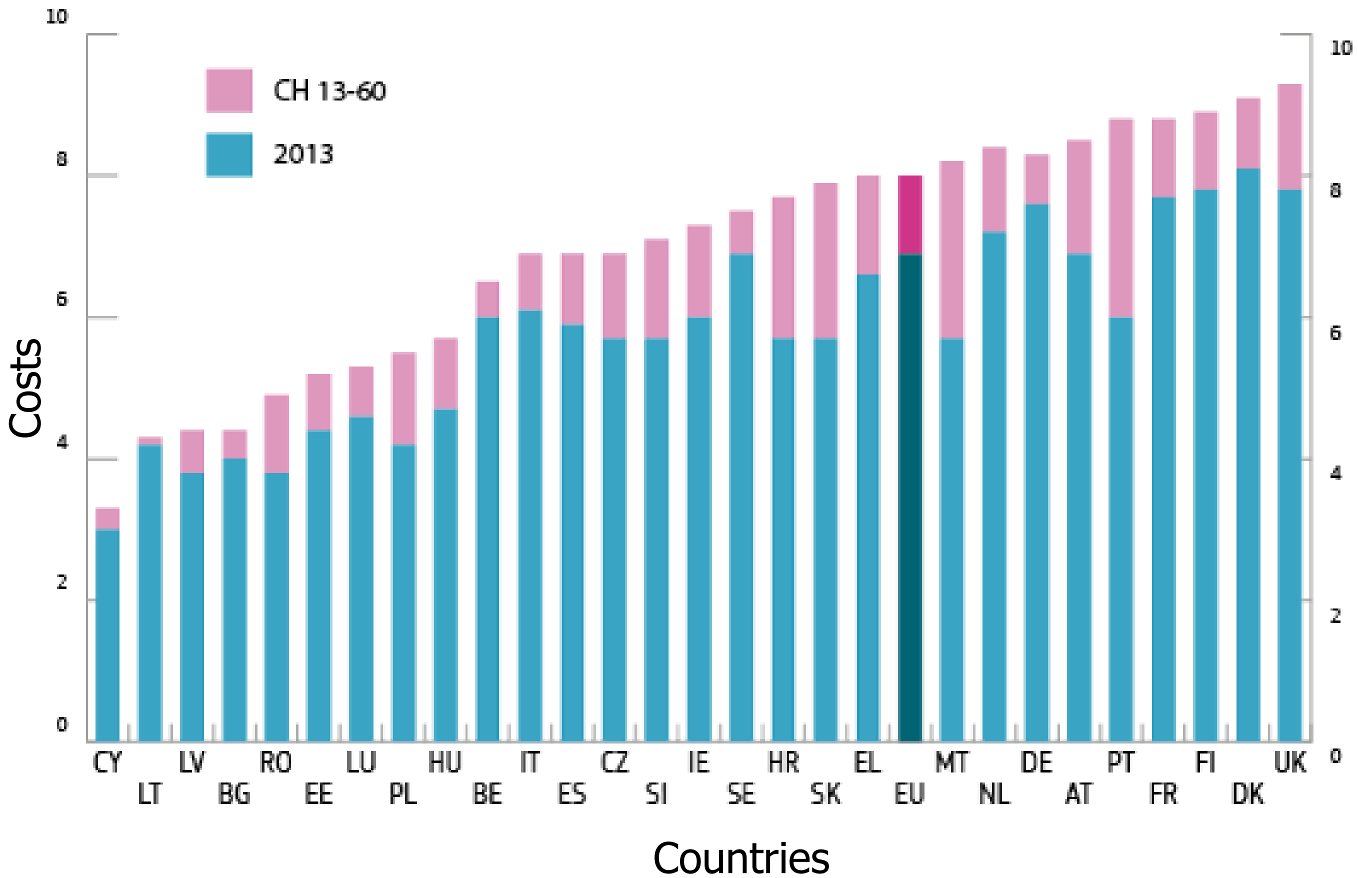
LBNP



Aging and Healthcare Costs Trends



EU Aging Report, Brussels

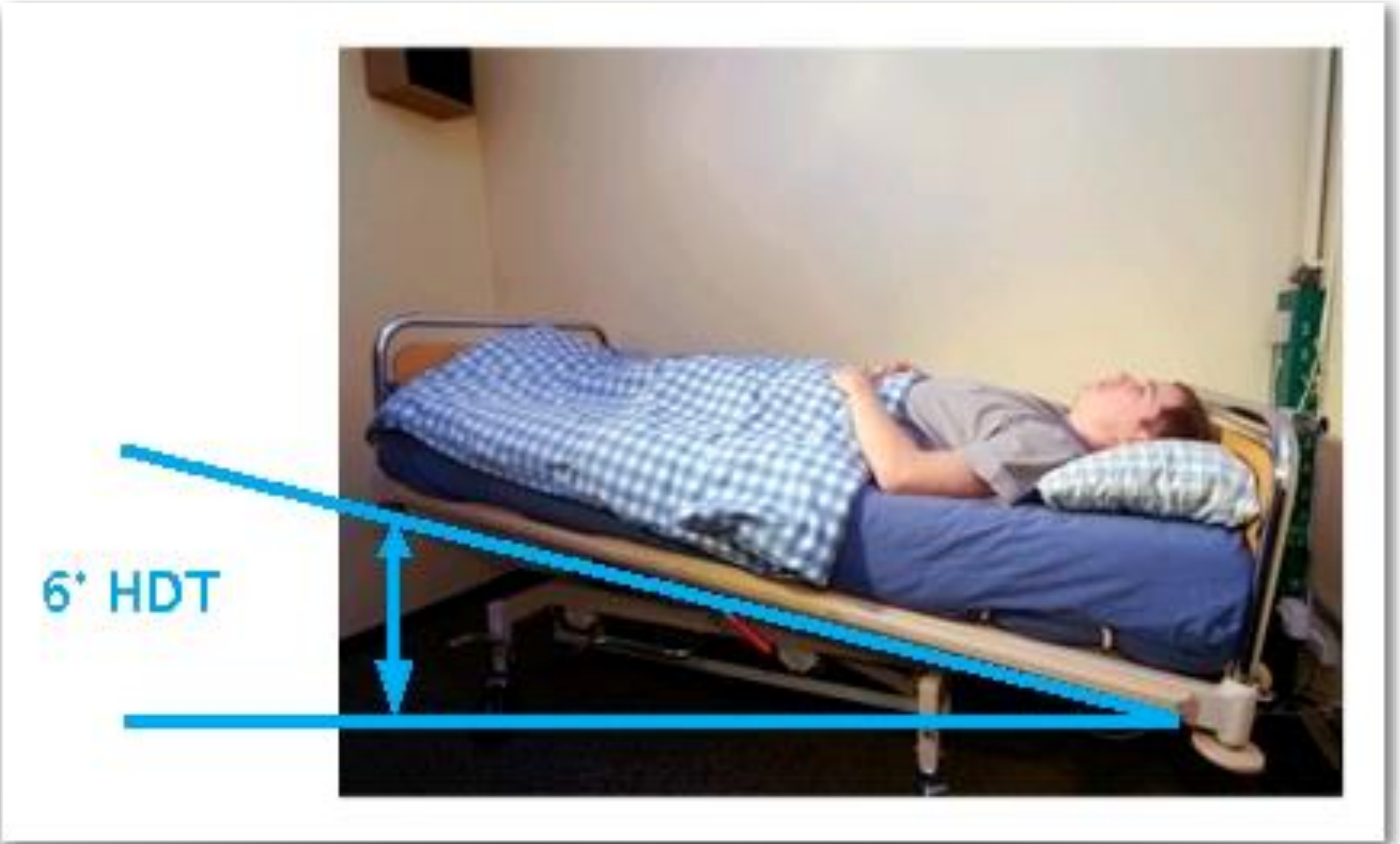


EU Aging Report, Brussels

Syncope in Older Persons

Immobilization in Older Persons

Bedrest Simulates Spaceflight Deconditioning



ESA ©

6° Head-down Bedrest Immobilization

ESA ©

Frailty: A Vicious Cycle

Immobilization

further

De-conditioning

Falls / Fear of falling

Hospitalization in Older Persons

- 65+ year old patients → 40 % acute hospitalizations
- Poor outcomes:

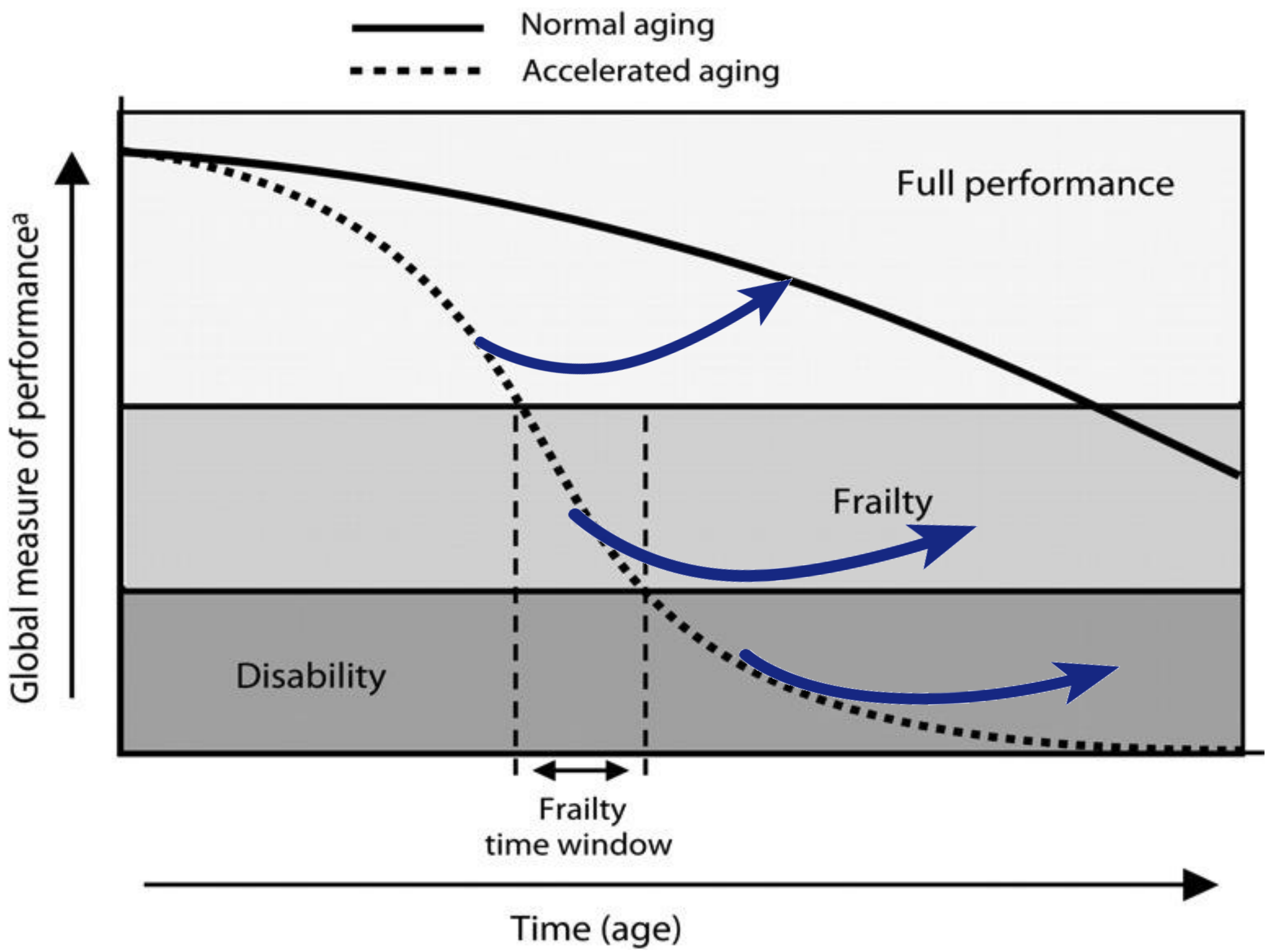
. . . high 1 year mortality

. . . 30 % functional decline

. . . high re-admission rates

. . . higher home healthcare usage

Aging, Interventions and Recovery



Singh et al. (2008). Mayo Clinic Proceedings, 83(10), 1146-1153.

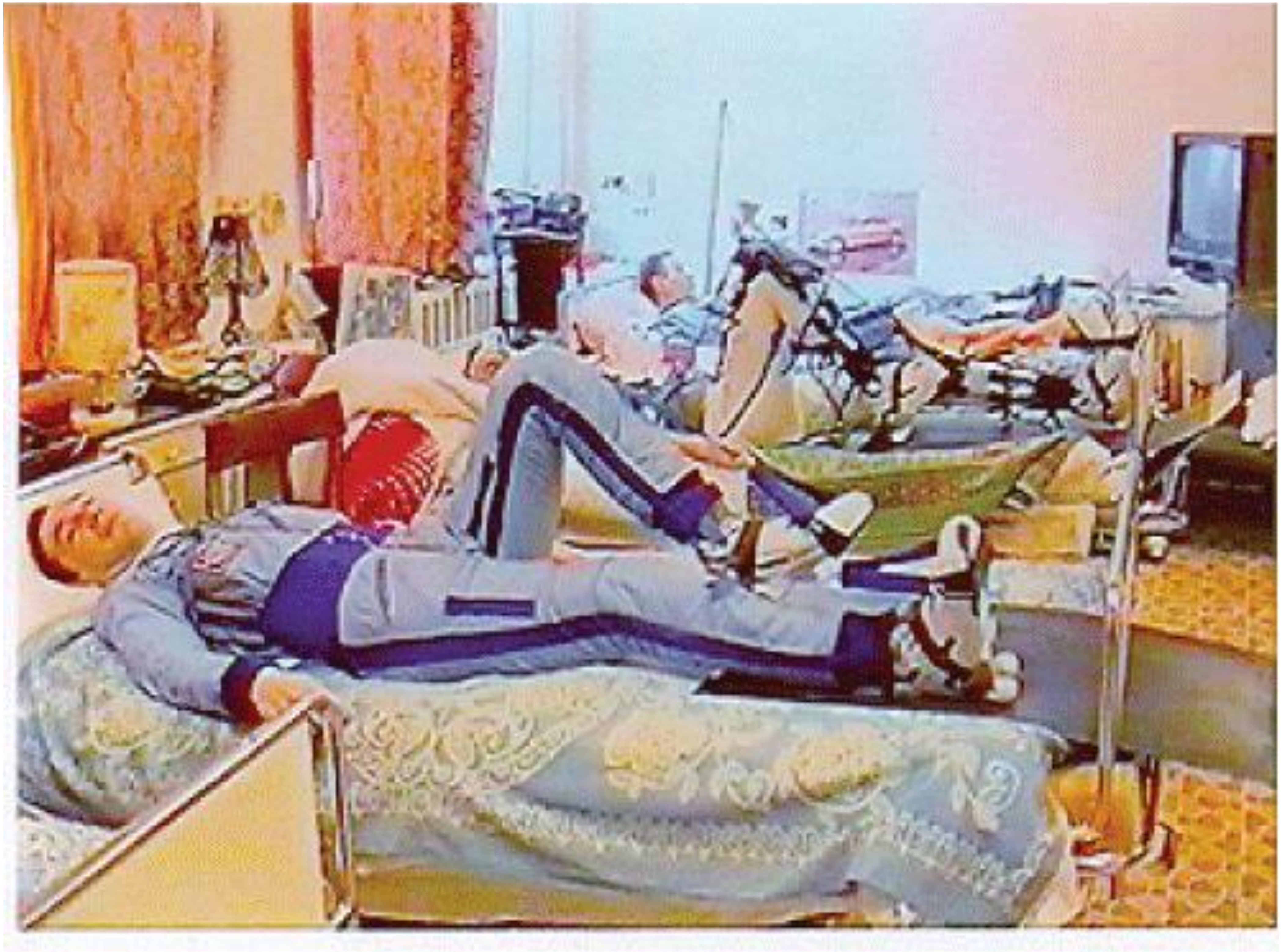
- Keeping ambulatory persons mobile
- Getting bed-confined persons re-mobilized

Scientific Research Not Balanced

Many studies: Ambulatory care

Lack of bedrest immobilization studies & care strategies in older persons

Exercising During Bedrest



Koryak YA (2015) *Int J Sports Exerc Med* 1:006

Manual Physiotherapy

Exercising in Space

NASA ©

Running while Lying Down

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

Vibration Exercise

Powerplate©)

Resistive Vibration Exercise During Bedrest

ESA©)

Resistive Vibration Exercise During Bedrest

ESA©)

Acute Immobilization ⟶ Active and Healthy Aging

Active & Healthy Aging

Immobilization Screening

Behavioral Change

Interventions

„Buddies"

Discharge Management

Impact and Outcomes

MACRO LEVEL

Improving geriatrics care

Saving in healthcare costs

MESO LEVEL

Regional Falls prevention initiaitves

Establishing community based structures

MICRO LEVEL

Falls prevention in older persons

Effectiveness of interventions

“Gravitational Physiology, Aging and Medicine” Unit

Nandu Goswami

Johann Wagner

Jerry Batzel

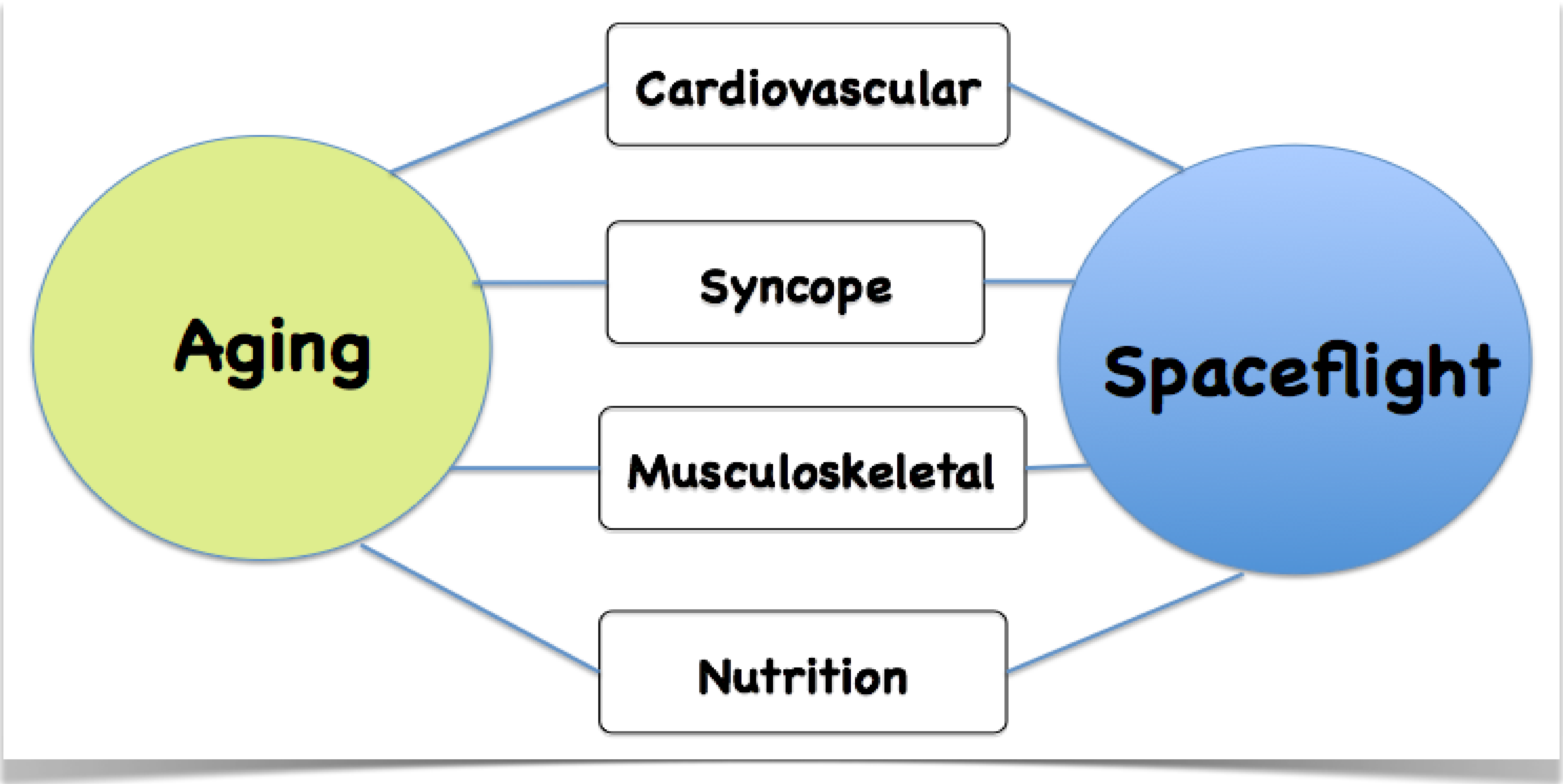
Andreas Rössler

Helmut Hinghofer-Szalkay

Andreas Jantscher

Bianca Brix

Aging and Spaceflight



“Gravitational Physiology, Aging and Medicine” Unit

Geriatric Instiutions

Space Agencies

Expertise

- **Cardiovascular regulation**
  - Hemodynamics
  - Hormones
  - Autonomic function
- **Orthostatic intolerance**
- **Vascular health & function**

Geriatric care institution
Universities
Research Centers
Communication Platforms
Companies

NASA
ESA
IBMP, Russia
DLR, Germany
MEDES, France
Simon Fraser Uniersity

Ecosystem

Social institutions

Companies & IT providers

Aging Platforms

Medical institutions

GPM

Other Stakeholders in Geriatric care

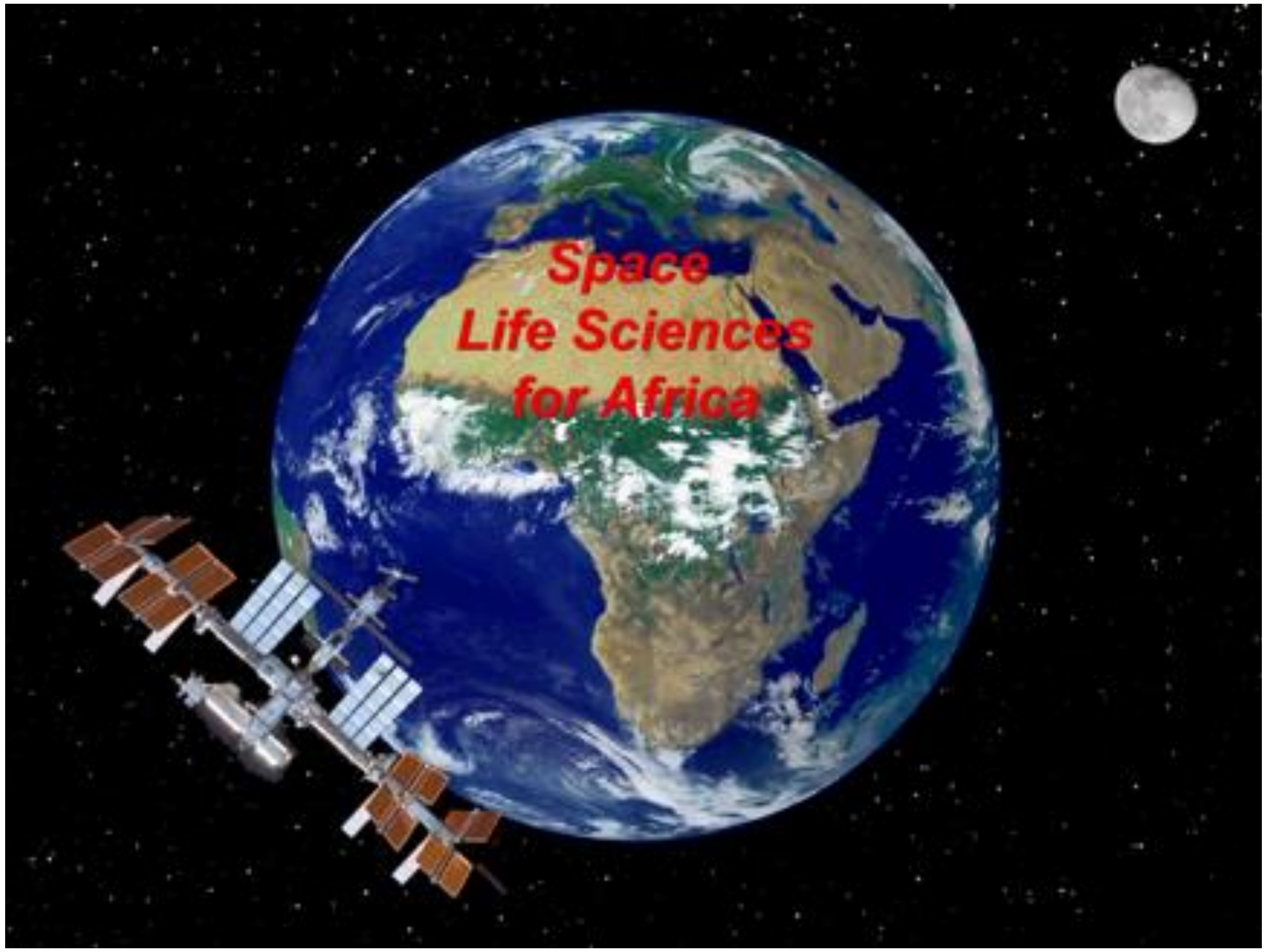
National Partners

International Partners

Selected International Collaborators

- Daniel Devigo, Ciudad Autónoma de Buenos Aires, **Argentina**
- Patrick DeBoever, VITO, Mol, **Belgium**
- Paul Dendale, University of Hasselt, **Belgium**
- Andrew Blaber, Simon Fraser Univ., Vancouver, **Canada**
- Yunfang Gao, Northwest Univ., Xian, **China**
- Ines Drenjancevic, Univ. Josip Juraj, Osijek, **Croatia**
- Jörn Rittwegger, German Space Agency (DLR), **Germany**
- Laszlo Simon, Semmelweis Univ., Budapest, **Hungary**
- Giovanna Valenti, Univ. of Bari, **Italy**
- Satoshi Iwase, Aichi Medical Univ., **Japan**
- Inessa Kozlovskaya, IBMP, Moscow, **Russia**
- Rado Pisot, Univ. of Primorska, **Slovenia**
- Hans Strijdom, Univ. of Stellenbosch, Cape Town, **South Africa**
- Benedicta Chungag, Walter Sisulu University, Mthatha, **South Africa**
- Jean-Pierre Montani, University of Fribourg, **Switzerland**
- David Green, King‘s College, London, **UK**
- Voyko Kavacic, Institute of Gerontology, Wayne State University, Michigan, **USA**
- Germaine Cornillessen, Halsberg Chronobiology Center, Minnesota, **USA**

Space Life Sciences for Africa



„Inernational co-operatiuon for Space life Sciences knowledge sharing & development in Africa"

International Academy of Astronautics (IAA):

Commission 2 – Space Life Sciences Study Group Report

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Spaceflight studies support geriatric health on Earth

Exploring the parallels between microgravity and the consequences of aging

Authors: Nandu Goswami Helmut Hinghofer-Szalkay Amal Ezzedine

Spaceflight studies support geriatric health on Earth

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Understanding the links between spaceflight physiology and the aging process can lead to improvements in human health not only for astronauts living in microgravity but also for older people living on Earth. This article provides a general overview of important physiological consequences of spaceflight, the aging process in humans on Earth, and important connections between these physiological states.

Ever since our ancestors started walking upright, the human body has adapted to the effects of gravity. For example, during standing the human heart - despite being located below the brain - is able to pump enough blood to the brain against the force of gravity to maintain proper brain function. The pooling of blood in the legs - which occurs due to gravitational forces - is counteracted by the muscle pump in the lower limbs by one-way leg venous valves as well as by the action of breathing.

Additionally, the weight-bearing bones and anti-gravity muscles have adapted during evolution to ensure adequate support during standing. Thus humans can stand up without any real problems.

The real importance of gravity on physiological systems is, however, seen when gravity is reduced or taken away, as in the microgravity environment