



SPACEFLIGHT MEETS GERIATRICS

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*European Innovative Partnership Active & Healthy Aging
Falls Prevention Task Force*



The Gravity Dilemma



Space
(μ g)



Launch
(3g)

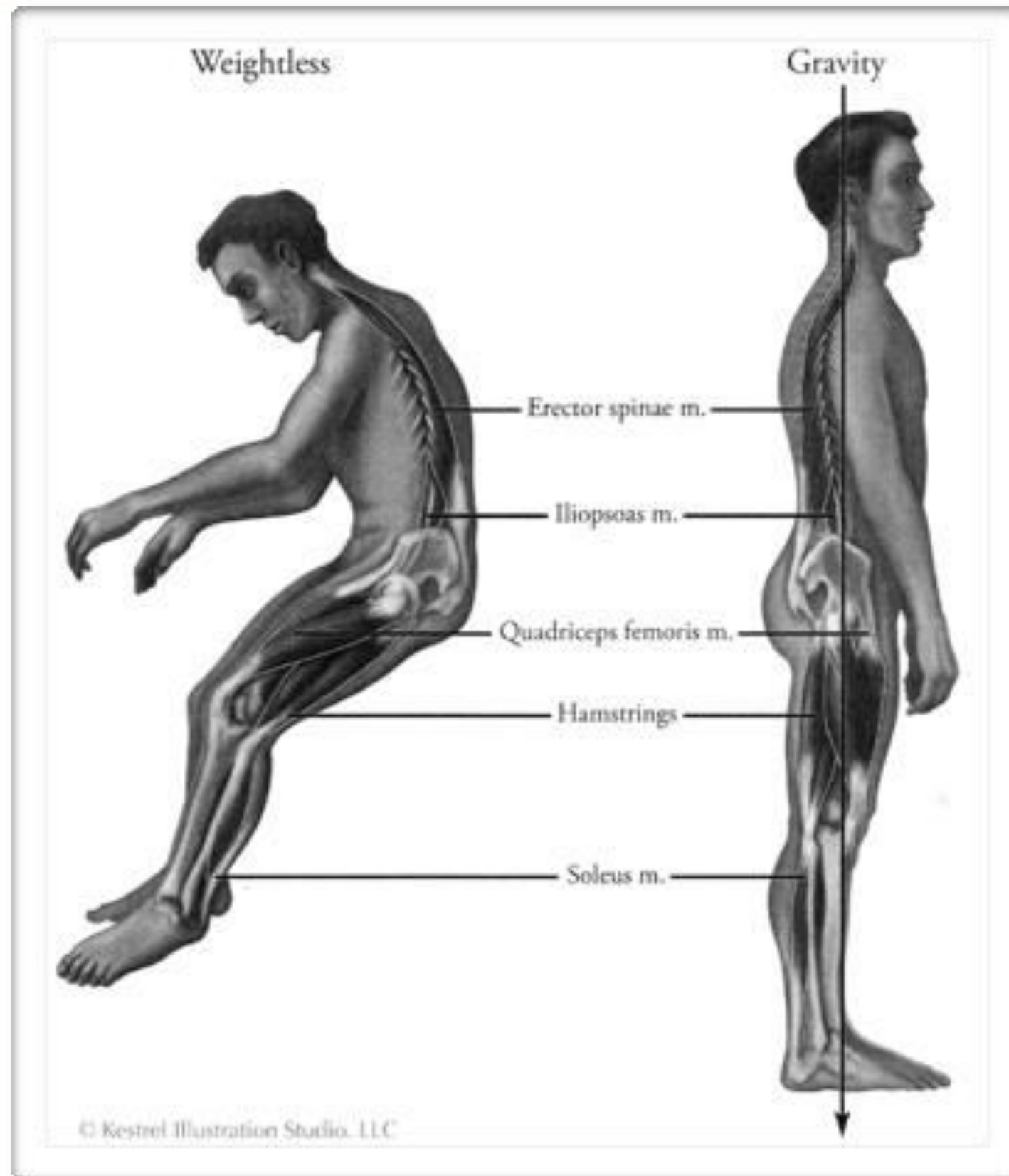


Re - entry
(1.6g)

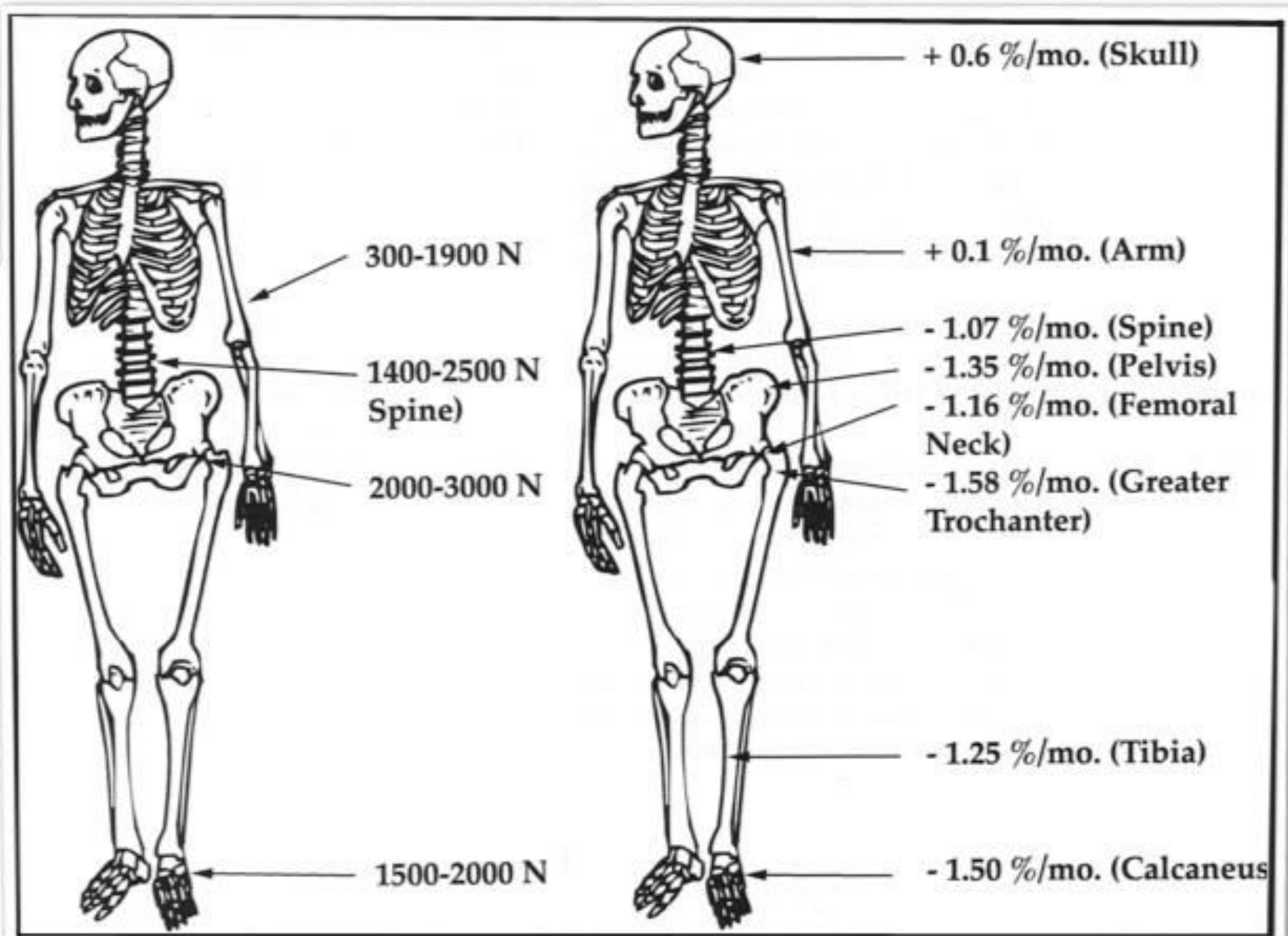


Earth
(μ rg)

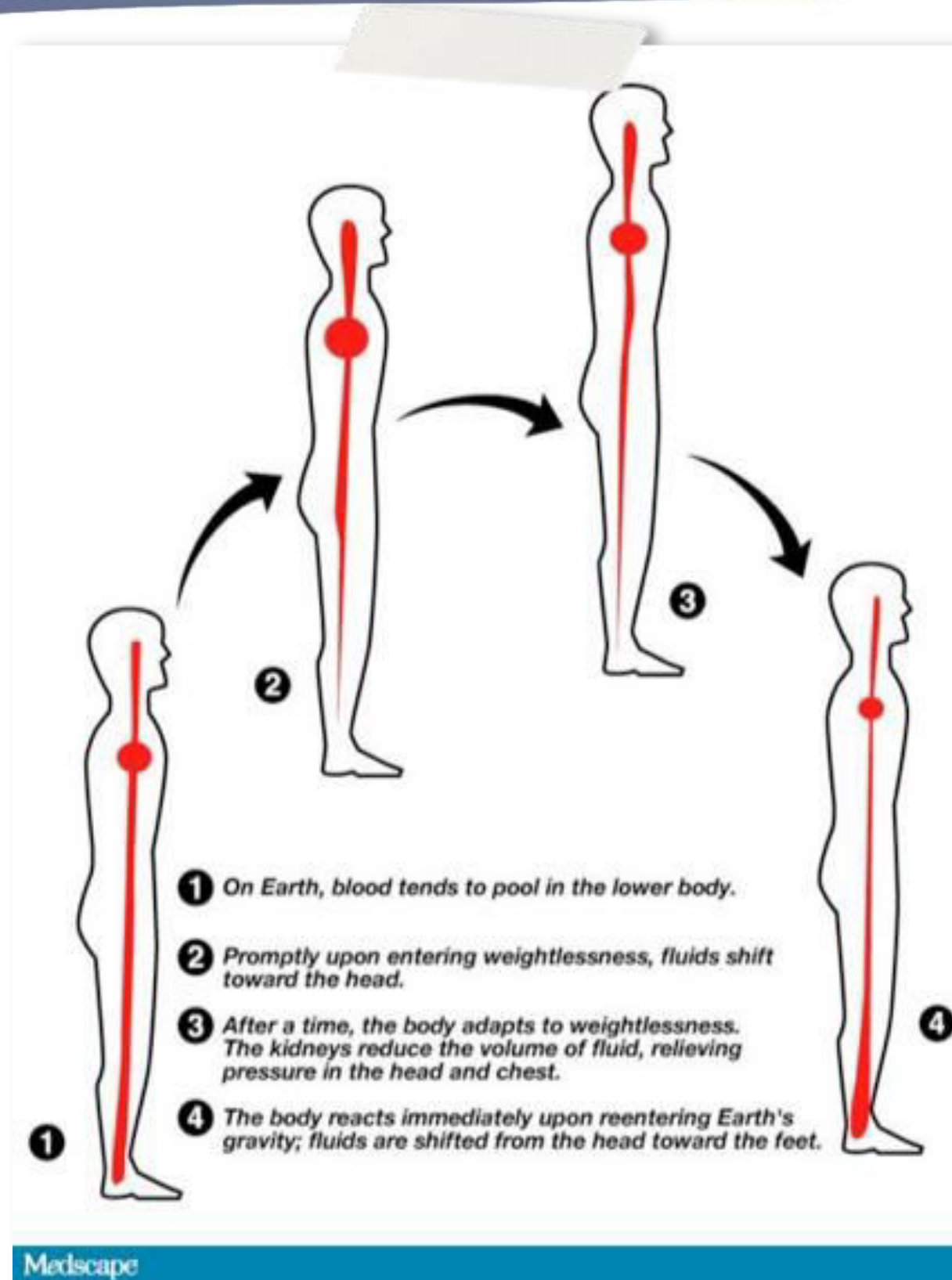
Muscles Affected in Microgravity



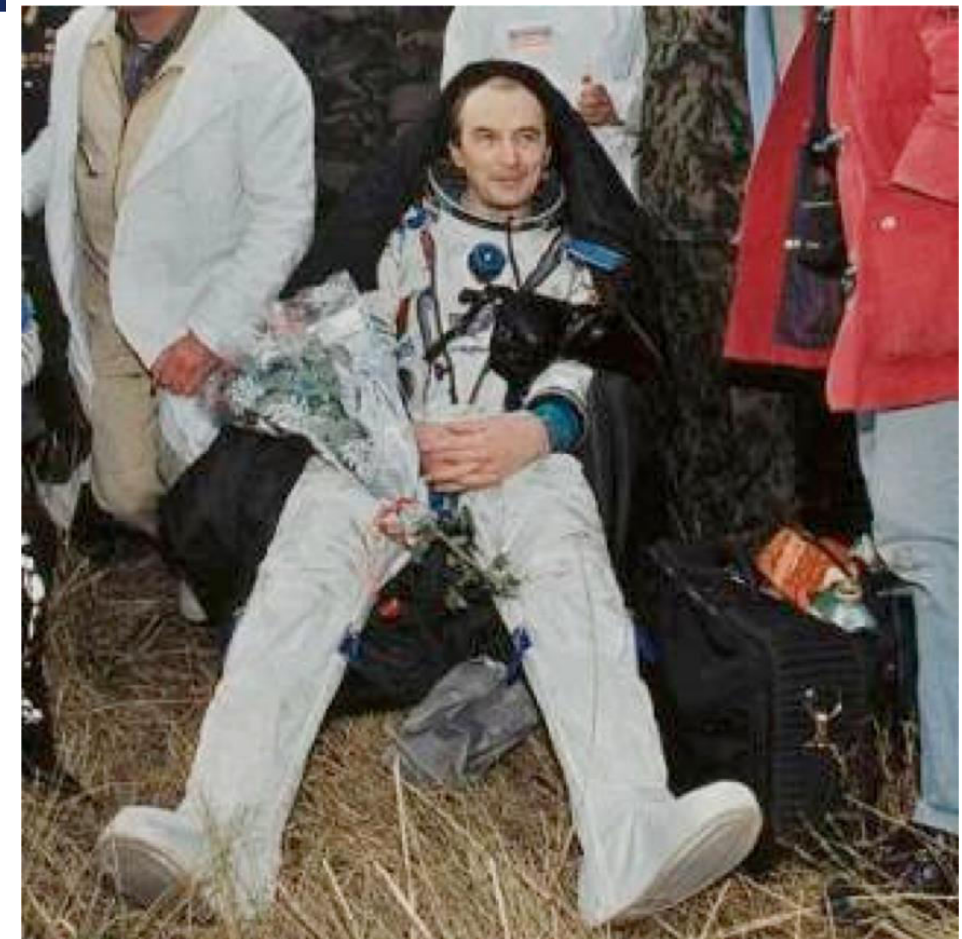
Bone Loss in Space



Fluid Shifts in the Body



Orthostatic Intolerance



Simulating Orthostatic Challenge

Head up Tilt



Lower body negative suction



Orthostatic Intolerance Testing

HUT

+

⇒ **Presyncope**

LBNP

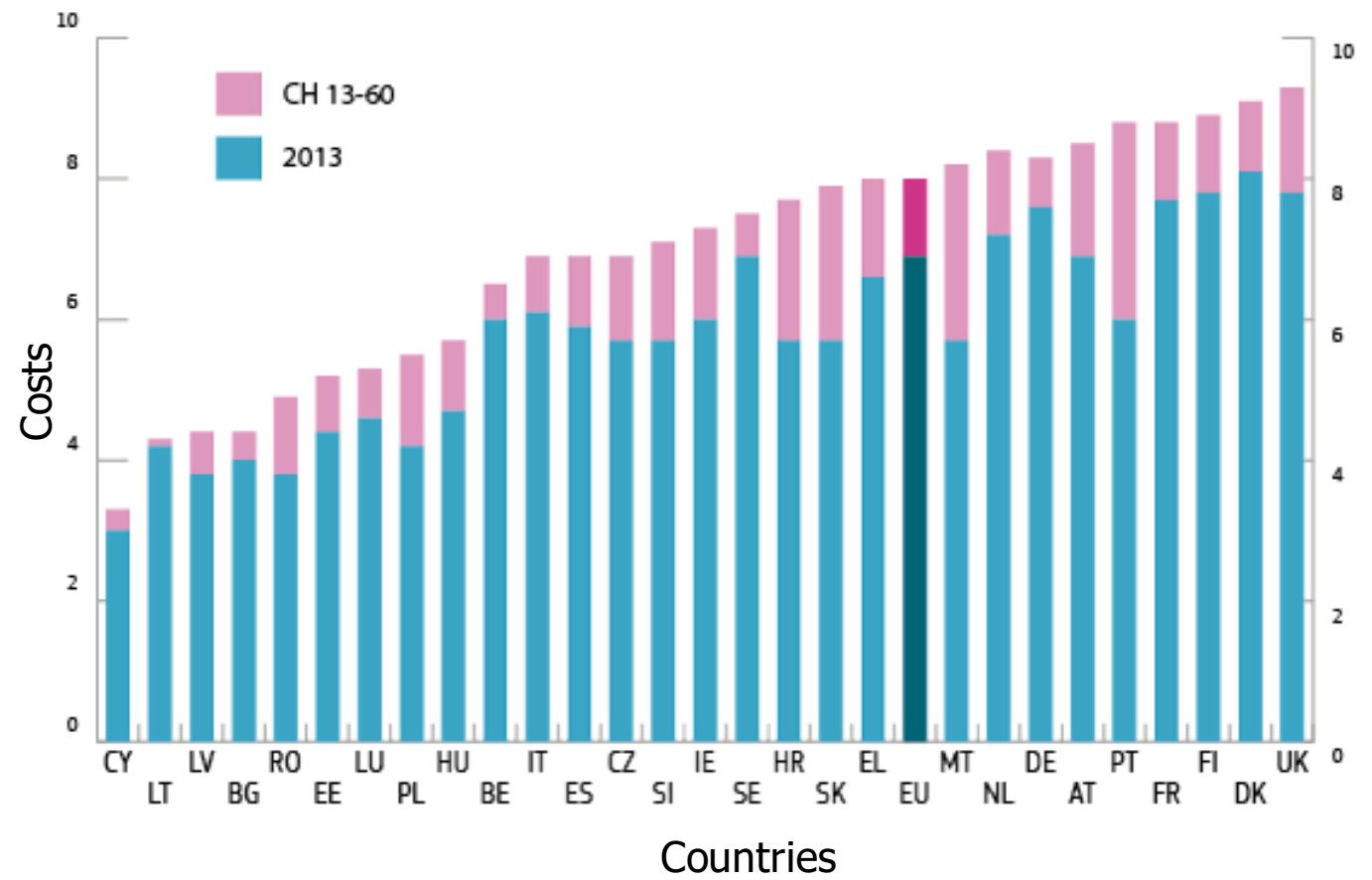




Aging and Healthcare Costs Trends



EU Aging Report, Brussels



EU Aging Report, Brussels

Syncope in Older Persons

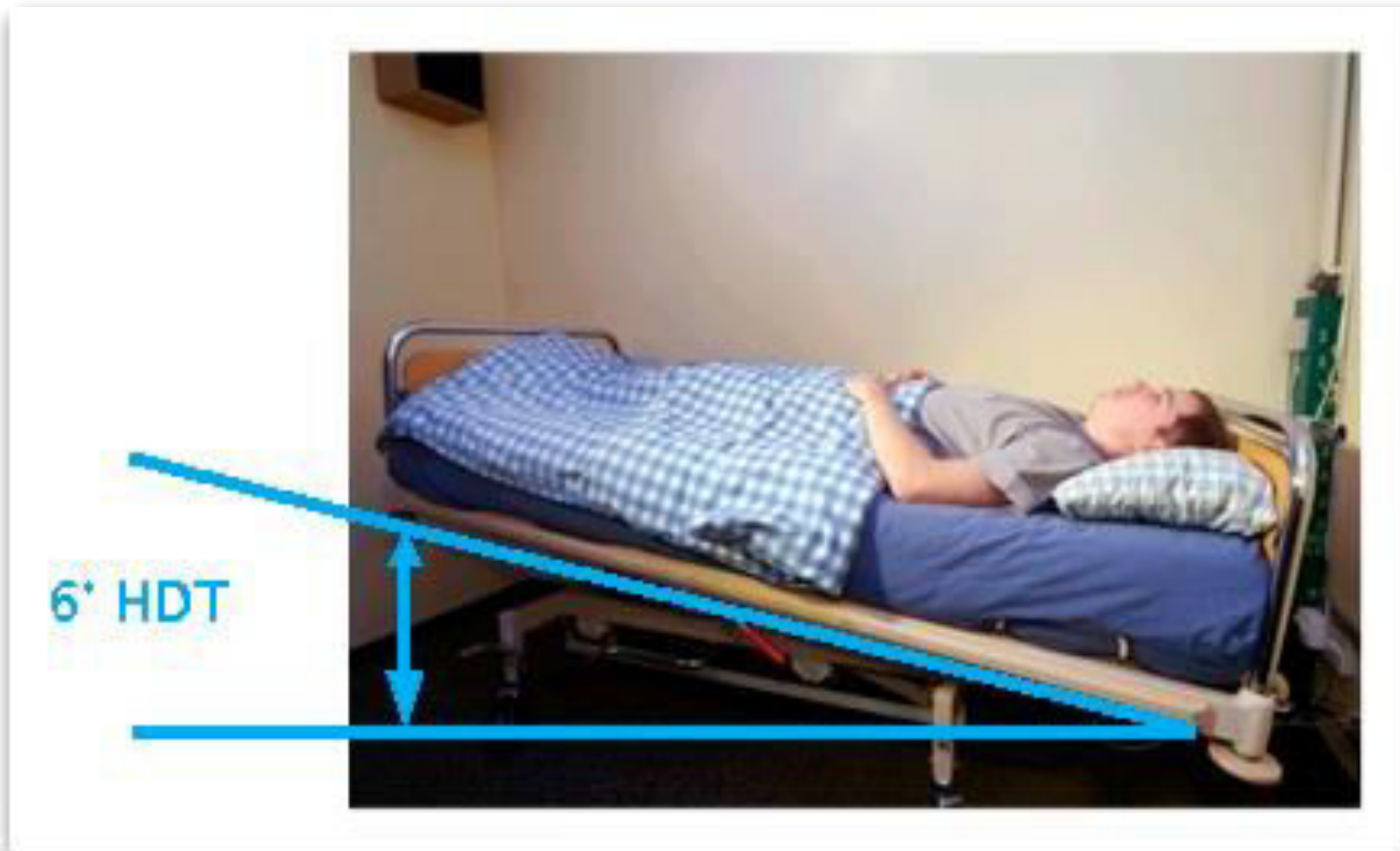


Immobilization in Older Persons





Bedrest Simulates Spaceflight Deconditioning



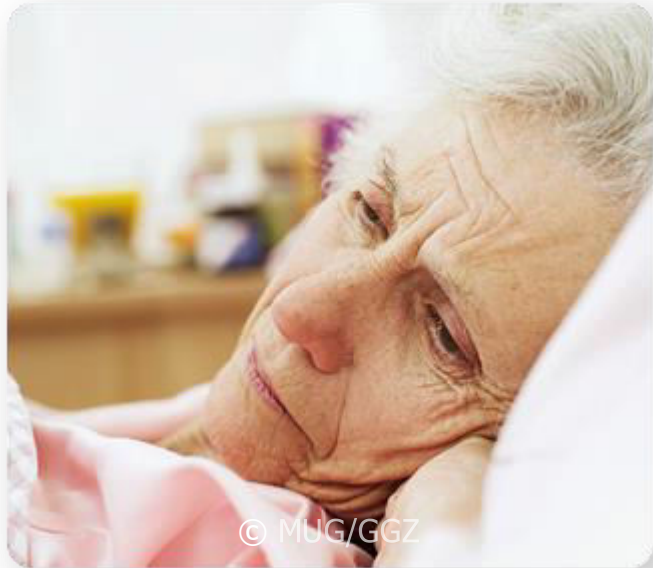


6° Head-down Bedrest Immobilization



ESA ©

Frailty: A Vicious Cycle



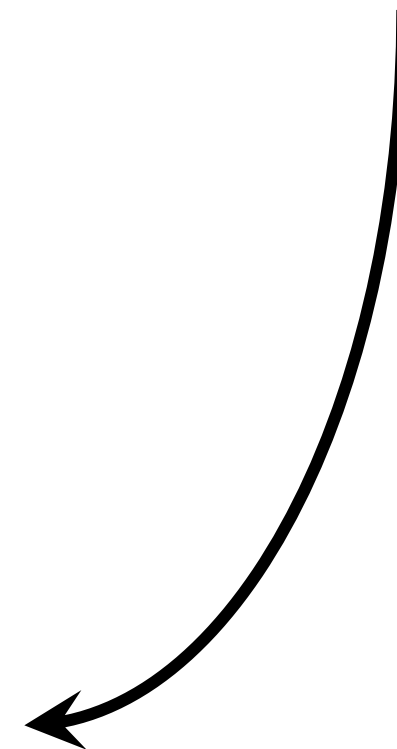
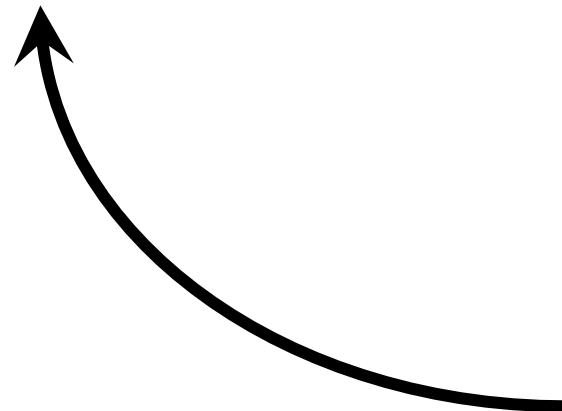
Immobilization

further



De-conditioning

Falls / Fear of falling

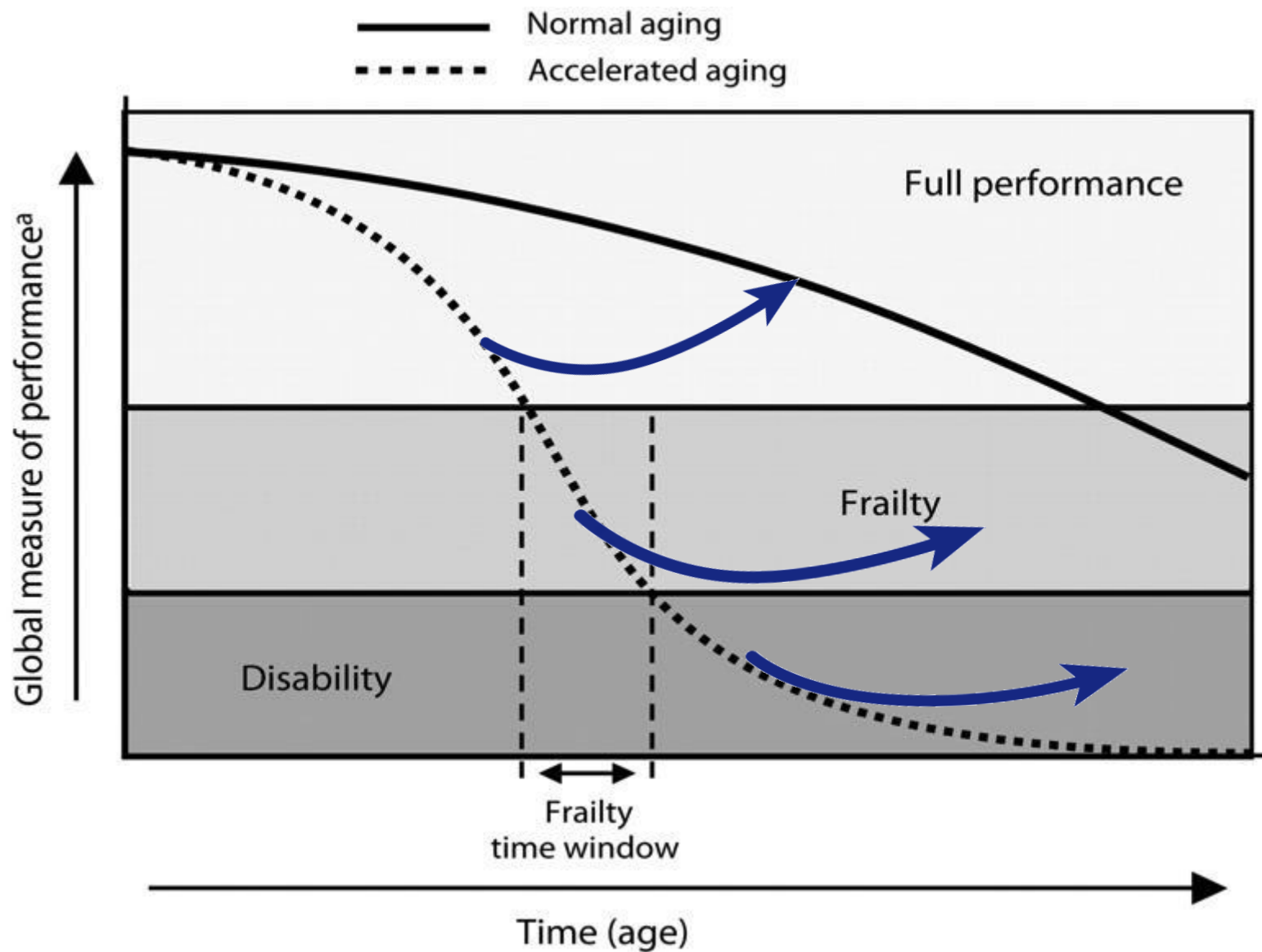




Hospitalization in Older Persons

- 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



Exercising During Bedrest



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



Manual Physiotherapy



Exercising in Space



?

NASA ©

Vibration Exercise



Powerplate©)

Resistive Vibration Exercise During Bedrest



ESA©)



Resistive Vibration Exercise During Bedrest



ESA©)



Acute Immobilization → Active and Healthy Aging



Immobilization Screening



Active & Healthy Aging



Behavioral Change



Interventions



Discharge Management



„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



"Gravitational Physiology, Aging and Medicine" Unit

**Johann
Wagner**



**Nandu
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**Jerry
Batzel**



**Andreas
Rössler**



**Helmut
Hinghofer-Szalkay**



**Andreas
Jantscher**

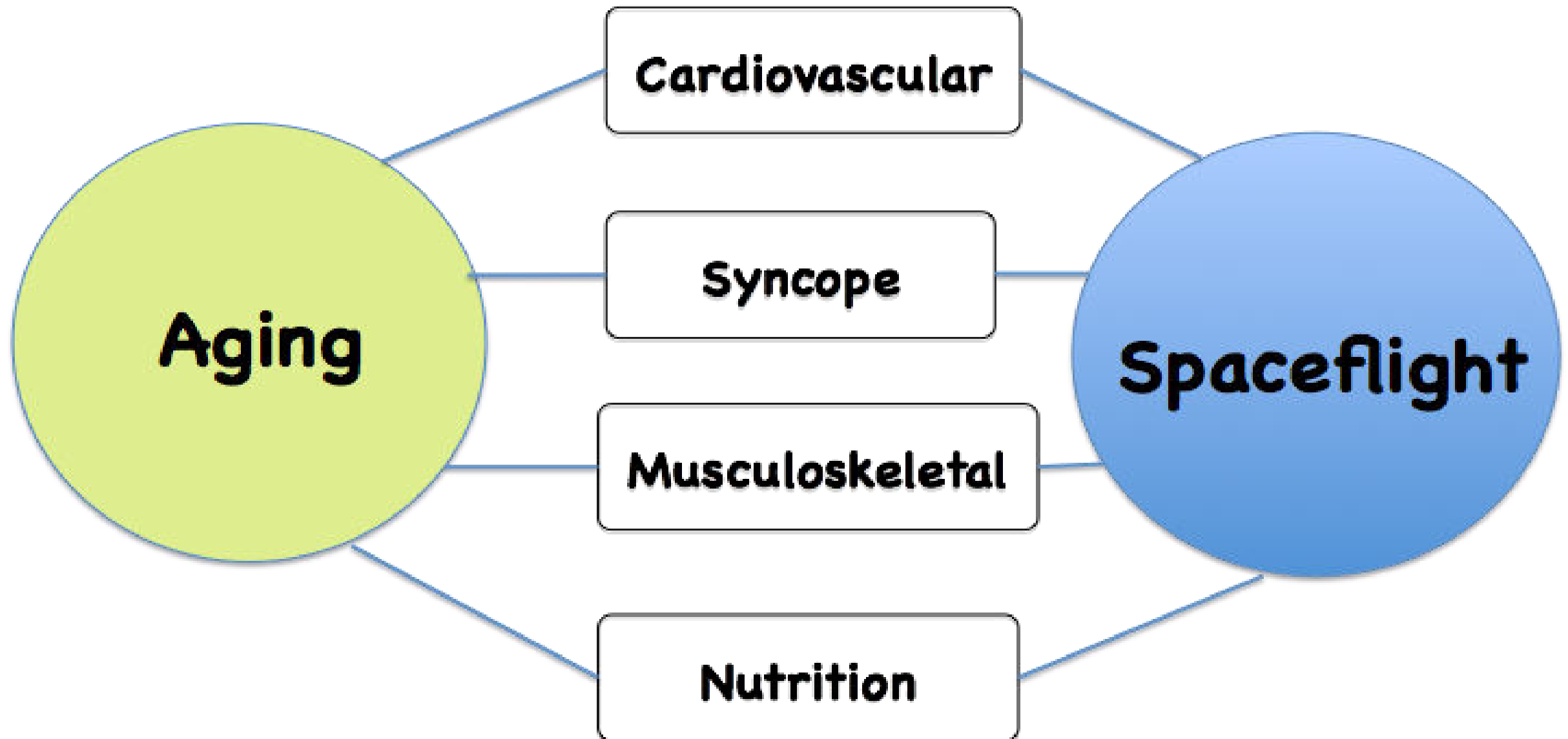


**Bianca
Brix**





Aging and Spaceflight





"Gravitational Physiology, Aging and Medicine" Unit

Geriatric Institutions

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 University



Ecosystem

**Social
institutions**

**Companies
&
IT providers**

**Aging
Platforms**

**Medical
institutions**



**Other
Stakeholders in
Geriatric care**

National Partners

International Partners

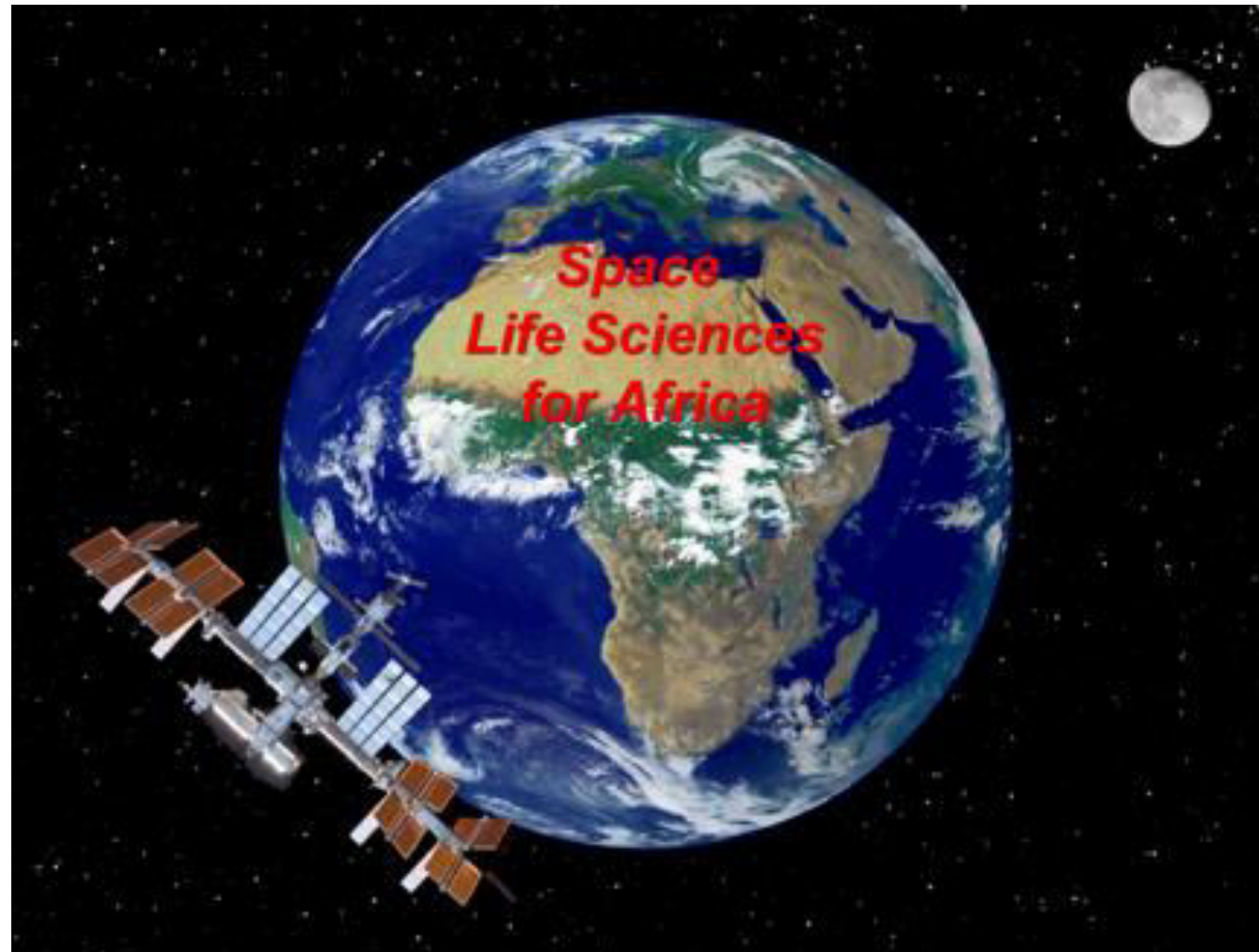


Selected International Collaborators

- 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**

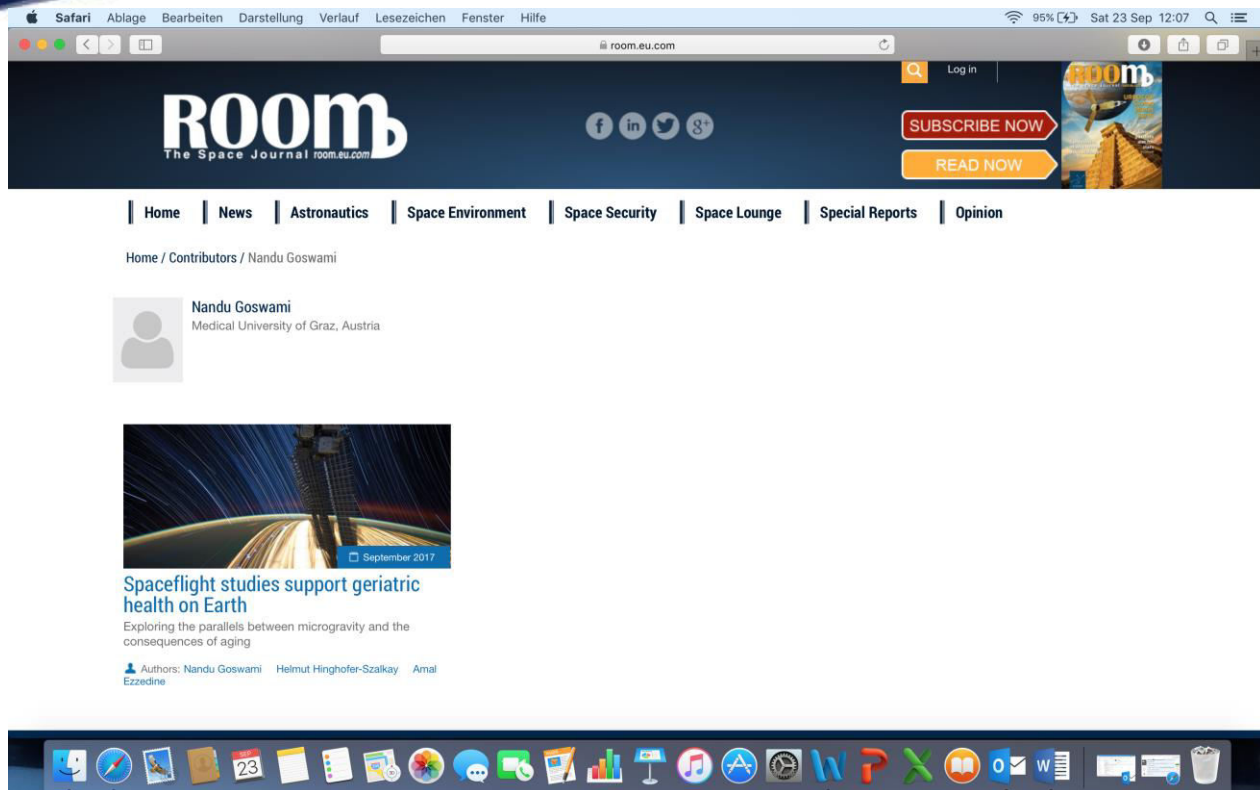


Space Life Sciences for Africa

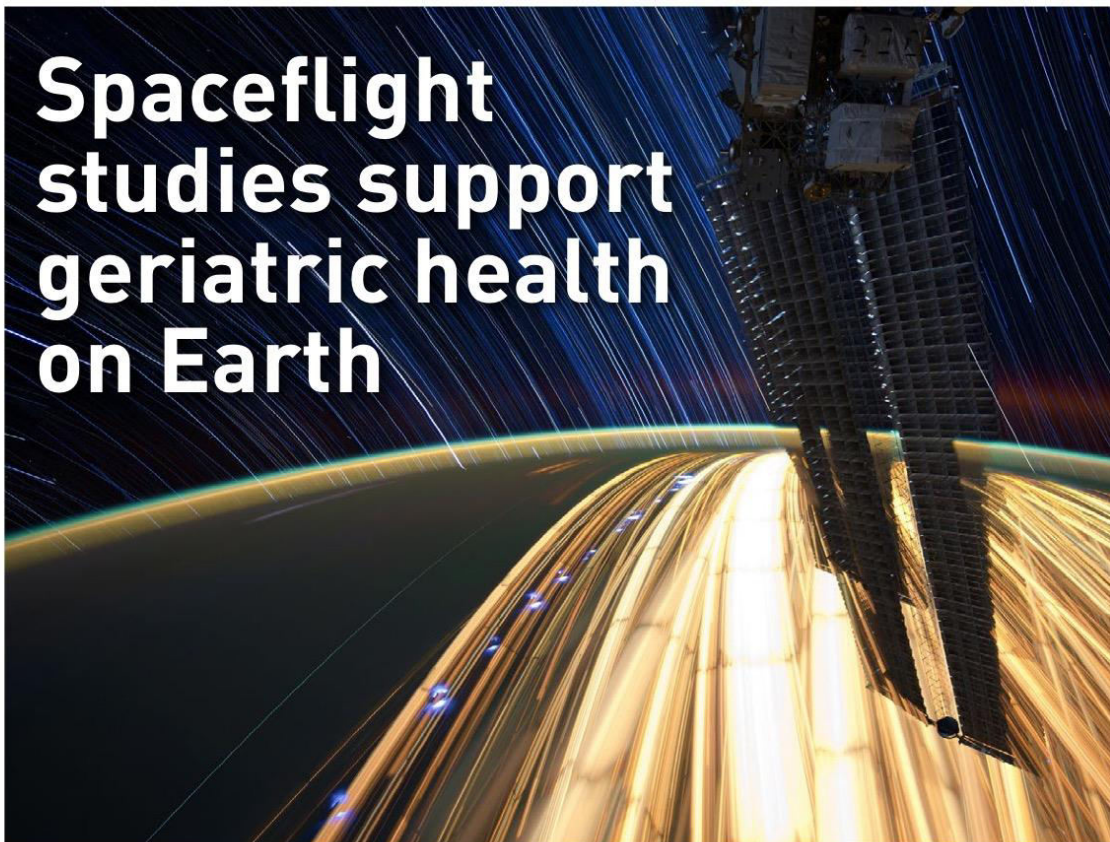


„International co-operation for Space life Sciences knowledge sharing & development in Africa“

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



Astronautics



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