



# MAIN FINDINGS FROM A 14-DAY BED REST STUDY IN YOUNG AND OLDER ADULTS

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**Abstract** — Periods of physical inactivity are very often in our lives and presents high danger to our health especially in aging population. Within the scope of this work package of PANGEA project (Physical activity and nutrition for great aging) several questions were addressed: (i) what functional and cognitive decline is reached after 14-day of bed rest; (ii) is there difference between younger and older group of male participants; (iii) how nutrition and cognitive training counteracts those declines; (iv) is it reversible during 28-day of guided rehabilitation? We found functional and cognitive decline in both groups but higher in older group. Both interactions show benefits on selected functional parameters (e.g. gait, anabolism) but needs further investigation. Not all the parameters were reversed after 28-day of recovery, especially in older group. Bed rest is a suitable longitudinal approach to study functional and cognitive decline after period of physical inactivity and could be used in controlled settings to demonstrate pathways of the impact of physical inactivity and activity on our health.

**Index Terms** — BED REST, muscle atrophy, aging, rehabilitation, health decline

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The data were collected with a survey questionnaire in the frame of mass measurement – the activity undertaken within the standard PANGeA project: Physical activity and nutrition for great ageing which was co-financed by the Cross-border Cooperation Programme Slovenia – Italy 2007–2013.

## 1 BACKGROUND

The human survival in Space triggered the need for investigation of the impact of weightlessness on human organism. However, there is limited possibility to study this in a real Space environment, therefore a ground based model was proposed to simulate the microgravity environment. Interestingly, this model was rarely applied in the field of Health research, especially in the fields of aging and physical inactivity. Similar mechanisms occur after injury/disease, or when human live sedentarily, or even when aging.

## 2 OBJECTIVES

Firstly, to evaluate the impact of 14-day bed rest on older adults and compare those effects on a group of younger adults.

Secondly, to evaluate the reversibility of those effects after 28-day of supervised recovery.

Thirdly, to evaluate the effect of two countermeasures (cognitive training and high-protein diet) on those effects.

## 3 APPROACH & METHODS

### General approach

Using short term horizontal bed rest we provoked an accelerated degradation of human organism. To perform such a study ethically more acceptable, we counteracted the bed rest effects with several countermeasures. Study participants were during bed rest period supported with neutral energy balance, cognitive training, and during recovery a supervised individually developed exercise with high protein diet.

The data were collected in the frame of Bed-rest study – the activity undertaken within the standard PANGeA project: Physical activity and nutrition for great ageing which was co-financed by the Cross-border Cooperation Programme Slovenia – Italy 2007–2013.

### Methods

Altogether 23 participants (7 young and 16 older) were included in the study. Eight randomly selected older participants were involved in cognitive training during bed rest and high protein diet during recovery. Cardiovascular properties were assessed using: orthostatic intolerance protocol, daily resting heart rate and arterial pressure, and a maximal aerobic testing. Glucose, protein and bone metabolism was assessed through urinary and serum concentrations of the resorption markers. Muscle mass was evaluated in single fibers, and whole muscle level. Furthermore, functional tests were performed for motor abilities, gait and cognitive skills.

## 4 RESULTS

All participants that undergo 14-day bed rest return to the initial health throughout the 30-day guided recovery. However some parameters in cellular levels did not reverse and therefore there is a substantial need to further explore mechanisms and pathways and also to further design interventions to counteract irreversibility.

		<b>BDC</b>	<b>BR14</b>	<b>REC28</b>
Body mass [kg]	Young	74.8 ± 8.8	72.0 ± 3.0	74.2 ± 6.7
	Old	79.9 ± 12.3	77.0 ± 11.7	80.0 ± 11.7
Fat mass [%]	Young	18.0 ± 2.5	21.0 ± 2.9	
	Old	22.0 ± 5.7	24.0 ± 6.5	22.0 ± 6.0
FVC [L]	Young	5.71 ± 0.95	5.38 ± 0.49	5.59 ± 0.52
	Old	4.97 ± 0.62	4.59 ± 0.68	4.96 ± 0.69
Explosive power [W]	Young	3725 ± 380	3319 ± 464	3516 ± 385
	Old	2581 ± 524	2173 ± 510	2362 ± 575
VO <sub>2</sub> max [VO <sub>2</sub> /kg/min]	Young	39.2 ± 5.1	36.0 ± 3.2	37.3 ± 2.9
	Old	26.8 ± 4.9	22.4 ± 3.4	24.0 ± 4.4
Muscle volume [cm <sup>3</sup> ]	Young	1987 ± 270	1867 ± 204	1953 ± 210
	Old	1666 ± 234	1525 ± 211	1615 ± 188

Table 1: Main parameters of functional decline after 14-day bed rest (BR14) and recovery after 28-day of guided rehabilitation (REC28). Data are grouped for younger and older participants.

## 5 POTENTIAL NEW PRODUCTS & SERVICES

Product: New methodology we proposed for assessing electromechanical efficiency of skeletal muscles (based on tensio- and electro-myography)

Service: The upgrade of rehabilitation protocols after major surgeries (Hip, Knee, Spine, etc.)  
New knowledge about survival in Space for older adults – our study was the first of a kind.

## 6 CURRENT COLLABORATIONS

### 6.1 With other researchers

All PANGEA partner institutions and researchers in the field of health and especially gerontology for upgrade of this project – Horizon2020 calls.

## 7 CONTACT OR COLLABORATIONS NEEDED

Departments of gerontology, genetics, neuroscience, and SMEs.

## 8 COMMUNICATION TOOLS

The basic knowledge will be present in high-level papers – as a supplements and conferences in the field of kinesiology, medicine, space physiology, etc.

## 9 FUNDS NEEDED

**9.1 For basic research  
(testing protocols to reverse health decline after bed rest): 1.200.000 €**

**9.2 For applied research (sensor testing, parameter identification): 250.000 €**

**9.2 For pilot & demonstrator activities  
(sensor development for real-world problems): 125.000 €**

## 10 CONCLUSION

Bed rest is highly controllable longitudinal approach (however ethically less acceptable) to study the impact of physical inactivity, and activity as well, on functional and cognitive health. Therefore we will propose in future calls to use this approach to explain mechanisms and pathways of functional and cognitive decline in aging population (man and women), and propose interventions to counteract those declines or even to accelerate rehabilitation after physical inactivity period.

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## REFERENCES

- [1] Šimunič B., Degens H., Rittweger J., Narici M., Mekjavić IB., Pišot R. (2011). Noninvasive estimation of myosin heavy chain composition in human skeletal muscle. *Med Sci Sport Exer*, 43(9), 1619-25.
- [2] Pišot R., Narici M., Šimunič B., De Boer MD., Seynnes O., Jurdana M., Biolo G., Mekjavić IB. (2008). Whole muscle contractile parameters and thickness loss during 35-day bed rest. *Eur J Appl Physiol*, 104(2), 409-14.
- [3] Biolo G., Agostini F. Šimunič B., Sturma M., Torelli I., Preiser JC., Deby-Dupont G., Magni P., Strollo F., Prampero P, Guarnieri G., Mekjavić IB., Pišot R., Narici M. (2008). Positive energy balance is associated with accelerated muscle atrophy and increased erythrocyte glutathione turnover during 5 wk of bed rest. *Amer J Clin Nutr*, 88(4), 950-8.