

## THE “SCIENCE FOR BED REST” STUDY 2025

In 2025, our consortium was awarded the “Science for Bed Rest” project by the Italian Space Agency (ASI) through a competitive call to conduct a 21-day, 6-degree head-down tilt bed rest (HDTBR) campaign.

The study focused on the deterioration of multiple physiological systems induced by prolonged inactivity in young men and women. It also investigated recovery after a 21-day, supervised, and tailored retraining programme. An advantage of the HDTBR is in the standardization of experimental conditions across studies and the collection of a standard set of “core” measurements from every study. Such standardization allows for the comparison of different studies, of varying lengths, participants, and interventions, and facilitates data pooling across studies for greater statistical power.

The Bed Rest Centre at the Science and Research Centre Koper is led by the Institute for Kinesiology Research. Since 2006, we have organized seven bed rest studies, involving 14 cohorts, including 126 participants, who remained in bed for 10 to 35 days. The latest study, conducted in 2025, was of particular significance as it was one of the few studies to include women for comparison with their male counterparts. Specifically, the study included three groups:

- Group A: Eleven young males (18–35 years) who underwent a 21-day HDTBR period, without interventions, followed by a 21-day recovery period.
- Group B: Nine young females (18–35 years) who underwent a 21-day HDTBR period, without interventions, followed by a 21-day recovery period.
- Group 21A: One young male (18–35 years) who underwent a 21-day HDTBR period, with a daily intervention consisting of adaptive neuromuscular electrical stimulation., without a recovery period.

More specifically, the volunteer in Group 21A wore a sensorized wearable device on the right side of the body, with the left side serving as the control, for 3.5 hours per day under both resting and exercise conditions. The device provided adaptive neuromuscular electrical stimulation and was designed to monitor and prevent inactivity-induced muscle atrophy. It represents a precursor technology for the development of a specialized intravehicular space suit. The device also applied controlled tissue compression and activated the underlying muscles through multiple electrical stimulation electrodes.

The study was conducted following ethical approval from the National Medical Ethics Committee of the Republic of Slovenia (Reference No.: 0120-161/2025-2711-7, issued on 14 July 2025). The first two participants joined

the study on 18 August 2025, and the last two participants completed the study on 4 November 2025. As in our previous studies, all participants successfully completed all examinations.

A total of 90 researchers participated in the study, which was coordinated by the Institute for Kinesiology Research (IKR), Science and Research Centre Koper (ZRS Koper), in collaboration with representatives of the Italian Space Agency (ASI). On 4 March 2026, we organized a scientific meeting within the framework of the Padua Muscle Days, where we presented the main findings of the study, which will be published in scientific journals.

The study was conducted within the framework of the Italian Space Agency Contract No. 2025-83-I.0 “Support Services (Medical, Clinical, and Administrative) for the Implementation of a 21-Day Bed Rest Campaign”.

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*Fig. 1: The bed rest ends with supine-to-stand test where participant stands under medical supervision as approx. 60% of them experience syncope.*

*Slika 1: Bed rest se zaključí s testom prehoda iz ležečega v stoječi položaj pod zdravniškim nadzorom, saj pri približno 60 % preiskovancev pride do sinkopije.*

## ŠTUDIJA ZNANOST ZA BED REST 2025

Leta 2025 je bil naš konzorcij uspešen na mednarodnem razpisu Italijanske vesoljske agencije ASI in je pridobil projekt **Science for Bed Rest**. Študija je bila usmerjena v raziskovanje poslabšanja delovanja različnih funkcionalnih sistemov organizma pri mladih moških in ženskah med 21-dnevnim ležanjem v postelji s 6-stopinjskim nagibom glave navzdol (6° Head-Down Tilt Bed Rest – HDTBR). Posebna pozornost je bila namenjena tudi procesu okrevanja in spremljanju stanja po 21-dnevnem nadzorovanem in individualno prilagojenem programu rehabilitacije.

Pomembna prednost modela HDTBR je visoka stopnja standardizacije raziskovalnih pogojev med posameznimi študijami, vključno z uporabo standardiziranega nabora temeljnih meritev v vseh raziskavah. Taka standardizacija omogoča neposredno primerjavo študij z različnim trajanjem, različnimi skupinami preiskovancev in različnimi intervencijami in združevanje podatkov iz več raziskav, kar prispeva k večji statistični moči analiz.

Center za raziskave vpliva dolgoročne popolne gibane neaktivnosti ali (simulirane) breztežnosti na človekov organizem (Bed Rest Centre) Znanstveno-raziskovalnega središča Koper deluje pod okriljem Inštituta za kineziološke



*Fig. 2: The team behind the 2025 bed-rest study: 11 organisations, countless hours, and 10 future PhDs.*

*Slika 2: Ekipo, ki stoji za študijo ležanja v postelji iz leta 2025: 11 organizacij, nešteto ur in 10 bodočih doktorjev znanosti.*

raziskave. Od leta 2006 smo izvedli sedem raziskav ležanja v postelji, ki so vključevale 14 raziskovalnih kohort in skupno 126 preiskovancev, izpostavljenih ležanju v postelji od 10 do 35 dni.

Zadnja raziskava, izvedena leta 2025, je bila še posebej pomembna, saj je spadala med redke tovrstne raziskave, ki so poleg moških vključevale tudi ženske, kar je omogočilo neposredno primerjavo odzivov obeh spolov. Študija je vključevala štiri raziskovalne skupine:

- **Skupina A:** enajst mladih moških (18–35 let), ki so opravili 21-dnevni HDTBR brez intervencij, ki mu je sledilo 21-dnevno okrevanje.
- **Skupina B:** devet mladih žensk (18–35 let), ki so opravile 21-dnevni počitek v postelji brez intervencij, ki mu je sledilo 21-dnevno okrevanje.
- **Skupina 21A:** mlad moški (18–35 let), ki je opravil 21-dnevni počitek v postelji z vsakodnevno uporabo vesoljske obleke kot intervencije brez obdobja okrevanja.

Udeleženec **skupine 21A** je vsak dan uporabljal »vesoljsko obleko« na desni strani telesa, medtem ko je leva stran služila kot kontrola. Obleka se je uporabljala 3,5 ure dnevno med mirovanjem in izvajanjem vadbe. Z mehansko kompresijo in sistemom več elektrod za električno stimulacijo je posebej za to oblikovana obleka, omogočala aktivacijo mišic.

Raziskava je bila izvedena na podlagi soglasja Nacionalne medicinske etične komisije Republike Slovenije (št. 0120-161/2025-2711-7 z dne 14. julija 2025). Prva preiskovanca sta se raziskavi pridružila 18. avgusta 2025, zadnja pa sta jo uspešno končala 4. novembra 2025. Tako kot v vseh naših dosedanjih raziskavah so tudi tokrat vsi preiskovanci uspešno končali celoten raziskovalni protokol in opravili vse predvidene preiskave.

V raziskavi je sodelovalo skupno **90 raziskovalcev iz 11 institucij**. Raziskavo je vodil in koordiniral Inštitut za kineziološke raziskave Znanstveno-raziskovalnega središča Koper (ZRS Koper) ob tesnem strokovnem nadzoru predstavnikov ASI.

4. marca 2026 smo v okviru mednarodnega znanstvenega srečanja Padua Muscle Days organizirali satelitski simpozij, namenjen predstavitvi prvih ključnih rezultatov in znanstvenih spoznanj, pridobljenih v okviru raziskave. Rezultati bodo postopoma objavljeni v mednarodnih znanstvenih revijah.

Študija je bila izvedena v okviru pogodbe z ASI št. 2025-83-I.0 Support Services (Medical, Clinical, and Administrative) for the Implementation of a 21-Day Bed Rest Campaign.

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