

Spinal changes after 5-day dry immersion as shown by magnetic resonance imaging (DI-5-CUFFS)

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CONTEXT

Astronauts frequently report microgravity-induced back pain, generally more pronounced in the beginning of a spaceflight. The dry-immersion (DI) model reproduces the early effects of microgravity involved in back pain pathogenesis: global support and axial unloading, flattening of spine curvature

Objectives

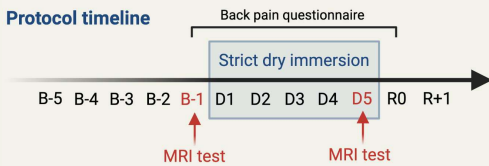
Validate DI as a model for studying spine changes induced by microgravity.



Method

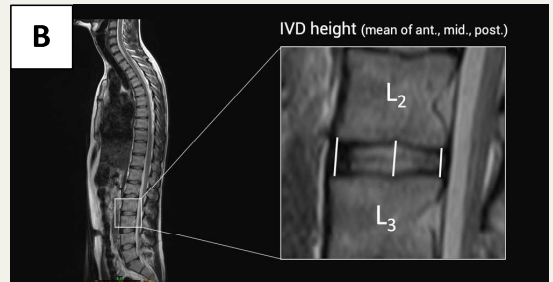
18 healthy men underwent 5-day strict DI (MEDES, Toulouse)
Upper body MRI before and on the last day of dry-immersion.

Protocol timeline



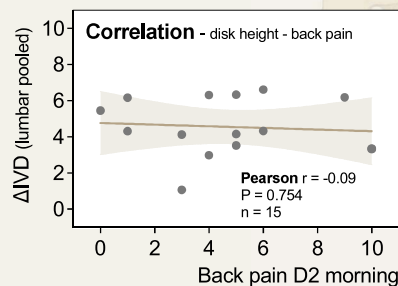
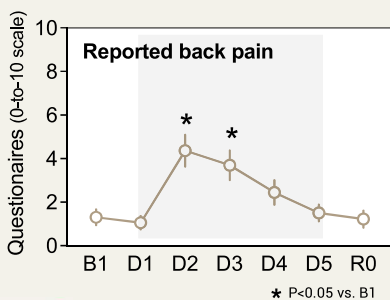
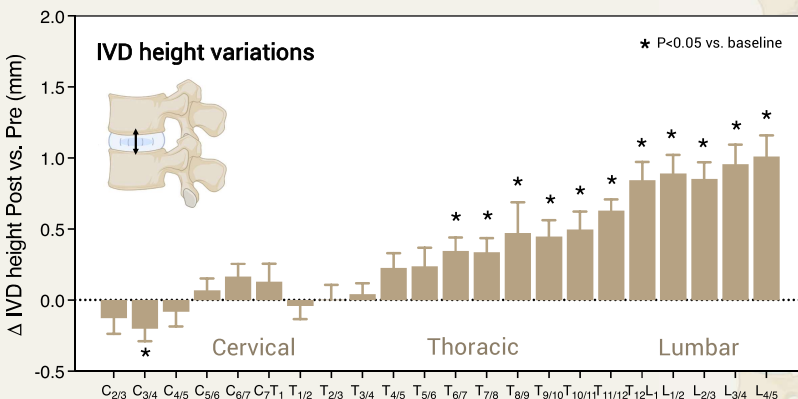
A) The dry immersion model: mimicking microgravity

B) Intervertebral disk height with MRI

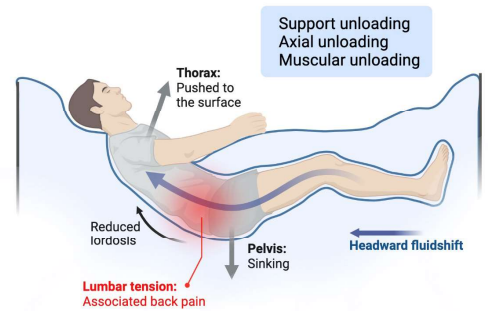


RESULTS

Intervertebral disk height increase from cervical to lumbar region, as observed in astronauts during spaceflight



CONCLUSION



5-day strict DI: IVD height increased in the thoracic and lumbar regions, and moderate back pain is maximal at the beginning of DI.

The DI model (only 2 facilities in the world: Moscow and Toulouse) provides consistent findings with data from spaceflight¹ and bedrest² concerning early spinal deconditioning (spinal flattening, increased disk height) and pathogenesis of low back pain.

DI is also promising to investigate unloading-related effects, such as cartilage³, bones⁴ and muscle tone⁵ changes.

1. Harrison et al. (2018). Preflight, In-Flight, and Postflight Imaging of the Cervical and Lumbar Spine in Astronauts. *Aerosp. med. hum. perform*
2. Belavý et al. (2011). Changes in intervertebral disc morphology persist 5 mo after 21-day bed rest. *J. Appl. Physiol*
3. Dreiner et al. (2020). Short-term Response of Serum Cartilage Oligomeric Matrix Protein to Different Types of Impact Loading Under Normal and Artificial Gravity. *Front. Physiol*
4. Linossier et al. (2017). Effects of short-term dry immersion on bone remodeling markers, insulin and adipokines. *PLoS one*
5. Amirova et al. (2021). Sharp Changes in Muscle Tone in Humans Under Simulated Microgravity. *Front. Physiol*