BRAIN SPECTRAL POWER ALTERATIONS ASSOCIATED WITH HEAD-DOWN TILT BED REST POSITION

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INTRODUCTION

The evaluation of whole **brain power spectral dynamics** has revealed significant alterations during spaceflight. These changes persist at modified levels for up to 20 days after astronauts return to Earth [1]. These fluctuations are thought to arise from the myriad factors encountered during space missions, such as **microgravity**.

To comprehensively investigate these neural changes on Earth, researchers have conducted experiments using the **head-down tilt bed rest position** (HDBR). The HDBR is believed to simulate the effects induced by microgravity during spaceflights [2] such as weightlessness, vestibular deprivation or cephalic fluid shift [3].

The data-driven characterization of all topological changes across anatomy and frequency of spontaneous electromagnetic activity through **electroencephalography** (EEG) recordings is paramount to understand the utility of HDBR as neurophysiological proxy for microgravity.

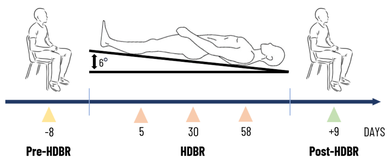
MATERIALS & METHODS

21 male participants [2]

EEG RECORDINGS

3-min resting state eyes closed

32-channel amplifier (actiCHamp)



eLORETA source reconstruction using a model with 1202 sources based on the MNI template

FREQUENCY BANDS
Alpha (8-12 Hz)

Relative power spectra in the 2-45 Hz range

BRAIN NETWORKS
Whole Brain Network (all cortical and subcortical regions mapped by the AAL atlas)

Distinction of the profiles

Power ratio calculation

$$\frac{\text{HDBR-1}}{\text{HDBR-1}} \quad \frac{\text{HDBR-2}}{\text{HDBR-1}} \quad \frac{\text{HDBR-3}}{\text{HDBR-1}}$$

STATISTICAL ANALYSIS

Student's t-test

RESULTS

NORMALIZED RELATIVE POWER IN α BAND

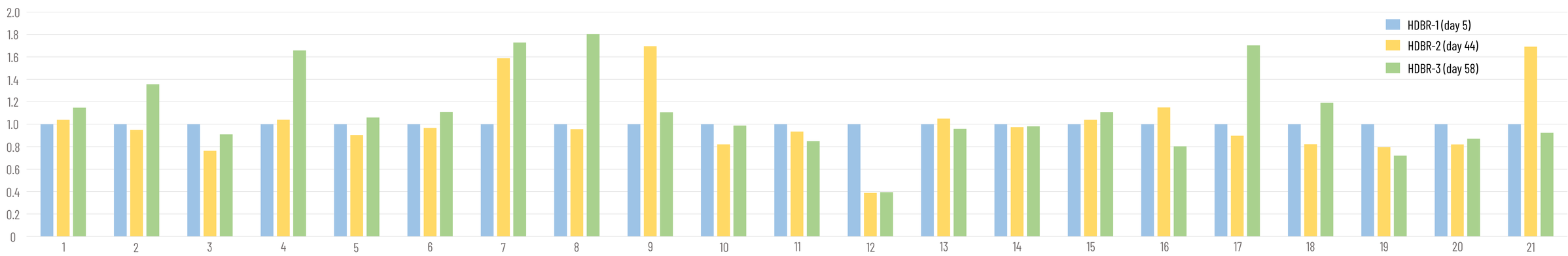


Figure 1. Normalized relative power in α band for each individual in the three HDBR conditions in the Whole Brain Network. The normalized relative power here showed was calculated by dividing each HDBR condition by its HDBR-1 (day 5) measurement.

DIFFERENT NEUROPHYSIOLOGICAL PROFILES

HDBR-2 < HDBR-1 → SUBJECTS: 2, 3, 5, 6, 8, 10, 11, 12, 14, 17, 18, 19, 20

HDBR-2 > HDBR-1 → SUBJECTS: 1, 4, 7, 9, 13, 15, 16, 21

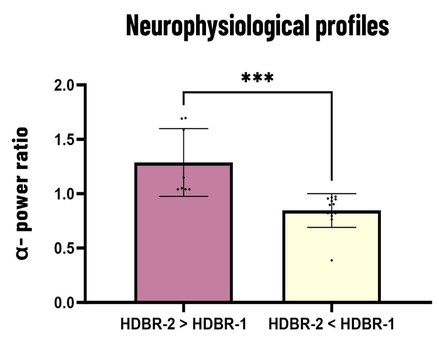


Figure 2. Statistically significant differences in the α power ratio between both neurophysiological profiles. The bar graph depicts the mean ± SEM of the HDBR-2 α power of each neurophysiological profile (***p < 0.001).

CONCLUSIONS

TWO DIFFERENT NEUROPHYSIOLOGICAL PROFILES

From the first to the second HDBR measurement, a group of subjects has shown a decrease in relative alpha power while another group has shown an increase

These disparities may be caused by different factors, such as: fitness status, nutrition, changes in intracranial fluids shifts and pressure (SANS), etc.

MORE DATA AND EXPERIMENTS ARE NEEDED

RECOMMENDATIONS FOR EEG RECORDINGS DURING HDBR STUDIES

Same body and head position for all EEG recordings, including baseline

Short EEG resting-state recordings weekly or biweeks

64 or more EEG channels (*see poster ID: 1648424*)

EEG embedded with other meta data (i.e. neuropsychology, intraocular pressure)

[1] Cheron, G. et al (2014). *PLoS ONE* 9, e82371.

[2] Brauns, K. et al (2021). *Frontiers in Physiology* , 12.

[3] Roy-O'Reilly, M., et al. (2021). *NPJ microgravity*, 7(1), 5.

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