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THE EFFECT OF MICROGRAVITY AND HIGH INTENSITY JUMPS COUNTERMEASURE ON DEFAULT MODE NETWORK ACTIVITY DURING SLEEP

Abstract

The present study investigates the effects of microgravity in the Default Mode Network (DMN) of the sleeping brain in extreme environments. The data were obtained during the RSL bed-rest study that took place in the premises of the German Aerospace Agency (ENVIHAB building) in Cologne, Germany. 23 participants were recruited for a 6 head- down tilt, bed-rest study lasting 60 days. The participants were assigned either to a control group or to an intervention (sledge) group. The latter was practiced through a sledge device for 3-4 times per week in order to alleviate the effects of microgravity. The Greek Aerospace Medical Association and Space Research (GASMA-SR) in collaboration with the Medical Physics Laboratory performed a sleep polysomnographic (PSG) study within the context of the RSL study. Each participant went through five PSGs, one 14 days before the bed-rest (BDC-14), three after the bed rest initiation (HDT), and another after the bed-rest completion. In the present study, the analysis was limited to the BDC-14 and the HDT21 experimental phases. Electroencephalographic (EEG) data recorded on 19 electrode sites according to the 10-20 International system and analyzed in order to estimate the DMN activations. The data were divided in 30-second artifact-free epochs, which were assigned by two independent sleep experts to sleep stages according to the American Academy of Sleep Medicine (AASM) criteria. The sLORETA inverse solution was employed through the Brainstorm software for estimating the cortical activity. The solution space formed by 15000 fixed dipoles covering the cerebral surface. Based on a-priori knowledge we identified 18 regions of the DMN in which the analysis was performed. Then functional connectivity analysis was performed through the estimation of the Phase-lag index (PLI), implemented by the HERMES toolbox. The produced matrices were used as inputs to both the Network Based Statistics (NBS) and the Brain Connectivity Toolbox (BCT) in order to identify statistically edges and to calculate graph-theory metrics. Finally, SPSS was used for

further statistical analysis and the results were visualized with the use of BrainNet demonstrating that microgravity results in sustained activation of specific DMN nodes (Medial Prefrontal Posterior Cingulate Cortex), while the countermeasure is partially effective.