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THE VIVALDI STUDY: AN INTEGRATIVE STUDY OF PHYSIOLOGICAL CHANGES INDUCED BY A 5-DAY DRY IMMERSION ON 20 HEALTHY FEMALE VOLUNTEERS

Abstract

Space agencies are actively engaged in studying the physiological adaptations to the space environment through studies on board the International Space Station (ISS), but also on the ground. Indeed, ground-based experiments simulating the effects of weightlessness are used to better understand the mechanisms of physiological adaptation, to design and validate the countermeasures. Two approaches, -6 head-down bed rest (HDBR) and dry immersion (DI) have provided possibilities for long-term exposures with findings closest to those seen in microgravity. DI is widely used in Russia, but less well known elsewhere, especially in western countries where HDBR is the gold standard model. Unlike bed rest, dry immersion provides a unique opportunity to study the physiological effects of the lack of a supporting structure for the body. Dry immersion means immersing the subject into thermoneutral water, while covered with a special elastic free floating waterproof fabric. The subject, surrounded by the tarp and "freely suspended" in the water mass, remains dry. During horizontal immersion, pressure forces are distributed nearly equally around the entire surface of the body (only the head and neck are not surrounded by water). The absence of mechanical support of specific anatomic zones during immersion creates a state akin to weightlessness called "supportlessness". As such, DI is proposed to mimic actual spaceflight in terms of a monotonous environment, posture-motion limitations, hemodynamic changes, hypokinetic effects, support unloading, and decreased proprioceptive input. Dry immersion is put forward as having a great potential to investigate detrimental effects of spaceflight and to design and validate countermeasures against changes occurring in microgravity and hypokinesia. However, to date, no controlled studies have compared the measurements obtained with DI to HDBR or spaceflight. The European Space Agency (ESA) has decided to initiate this task. As a first step, a strategic approach like the one done on the HDBR model was developed. ESA tasked a dedicated expert group and Medes to define a basic set of standard measures (Dry Immersion Core Data) and to standardize the DI study conditions. On behalf of ESA, Medes has then conducted the Vivaldi study, the first female dry immersion study in Europe. The main objective of the study was to investigate the physiological effects of 5 days of dry immersion in 20 healthy female subjects of ages 20 to 40, and to obtain a DI-in-Women Reference Dataset using a set of standardized measurements.