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ACUTE AND CHRONIC EFFECTS OF STRESS ON BDNF: COMPARISON OF BED REST VS. ISOLATION

Abstract

Brain-derived neurotrophic factor (BDNF) plays a key role in brain plasticity by enhancing the survival and differentiation of selective populations of neurons. It has been associated with emotional regulation and the pathophysiology of various neuropsychiatric disorders and identified as a potential target for therapeutic mechanisms. To better understand the potential role of BDNF in long-duration spaceflight missions, we investigated the time course of BDNF as part of long-duration bed rest studies, short-term isolation studies in an isolated, confined, controlled (ICC) environment and long-duration isolation studies in an isolated, confined, extreme (ICE) environment. Data were collected for a total of N=48 (37 men, 11 women) as part of the 60 days head-down tilt bed rest study 'RSL' (N=23), a 30-day isolation study in the HERA isolation chamber at NASA JSC (N=16) and as part of a 14-month winter-over at Neumayer III station in Antarctica (N=9). A total of 445 blood samples were collected by venipuncture in the morning after an overnight fast once before, several times during (5 times during bed rest, 4 times in ICC at HERA, and 10 times in ICE at Antarctic station) and up to two times after each intervention, respectively. BDNF levels were quantified using enzyme-linked immunosorbent assays. Temporal profiles were analyzed by mixed models. Both isolation and bed rest revealed a fairly consistent temporal pattern. In each analog BDNF showed a remarkable spike during the first two weeks, respectively, after which it decreased during the third mission quarter, until slightly increasing again towards the end of the mission. In the long-duration ICE environment, i.e. Antarctica, BDNF gradually decreased after the third month of isolation, reaching a low around the third quarter of the mission, after which it showed slight recovery. These findings are remarkable in several ways. First, the sharp increase in BDNF was somewhat unexpected, and contradictory to our initial hypothesis. We suggest that this may be part of a compensatory mechanism to maintain neuroplastic homeostasis. It can be speculated that a similar response could be observed in Antarctica, if blood samples had been obtained early after mission onset. Second, all space analogs revealed a decrease in BDNF with increasing mission duration, and show signs of levelling off around the

third mission quarter. Because of the implication of BDNF on brain plasticity, these data underline the role of BDNF to better understand the biological basis of neurobehavioral effects during space missions.