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Behaviour, Performance and Psychosocial Issues in Space (1)

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PSYCHOLOGICAL RESPONSE DURING LONG-TERM LOW METABOLISM EXPERIMENT

Abstract

Background: Astronauts' energy and nutrition need to be maintained and food supply are one of the major concerns in long-term space missions. However, carrying enough food supply will lead to extremely high economic costs, and such huge load is also a challenge for spaceship' design and rocket power. Therefore, the issue about decreasing food supply load has meaningful impact for future space explorations. One broadened acknowledged way to reduce food supply load is to build a re-generate system which is useful for normal condition. Another direction is to monitor physiological and psychological mechanisms' changes in simulating worse emergency conditions, such as fasting caused by food shortage or deviation from the landing point. The investigation on fasting in urgent situations could allow researchers to know to what extent adaptive ability could be maintained during starvation. This kind of investigations also contribute to nutritional recommendations to crewmembers for long-duration space travel. **Methods and Measurements:** In present experiment, after rigorous selection, thirteen healthy males participated the 24-day metabolism experiment, including 3-day baseline, 10-day fasting, 4-day calories restriction, and 7 day recovery. All participants signed written informed consent, and were informed to immediately report to researchers and stop fasting if they felt unwell. During experiment, questionnaires (Profile of Mood States, Standard Sleep Scale and Work Ability Index) were applied to measure the psychological responses for fasting. **Results:** Repeated ANOVA showed that fasting significantly increase negative mood states in depression, fatigue, confusion and total mood disturbance, participants also felt sleepy during fasting period (All $P < 0.05$). However, the self-report of subjective work ability was not significantly affected by fasting ($P = 0.4$). After fasting, psychological response would gradually restore to baseline in calories restriction and recovery. **Discussion:** The experiment presented a detailed profile of how psychological responses changed over the period of fasting. Evidence documented that trajectories of psychological responses followed an inverted U shape curve (negative mood, sleepiness), or a U shape curve (Work ability). With synchronous physiological tests, we found the psychological responses to fasting echo the observation from physiological changes for glucose and ketone bodies level. Negative psychological responses dropped to the bottom at the time point of shifted metabolism from glucose to ketone bodies. After adapting to fasting, participants' negative feeling decreased, even showed an improvement on mood. Our results point toward susceptible interaction between metabolism and psychological response.