The Effect of Space Travel on the Mental Health of Astronauts

Uzay Yolculuğunun Astronotların Ruh Sağlığı Üzerine Etkisi

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Dear Editor,

Human history is marked by a persistent pursuit of surpassing boundaries, notably exemplified through endeavors such as the myth of Icarus, Leonardo da Vinci's flying machines, and the Wright brothers' first airplane. The 20th century witnessed remarkable advancements in aviation, including the initiation of space exploration in 1944 with the V2 rocket, leading to Yuri Gagarin's historic space flight in 1961. This event sparked the space race, with subsequent milestones like the Mercury, Gemini, and Apollo programs by the United States, culminating in the Moon landing by Neil Armstrong and Buzz Aldrin. These events have shaped the trajectory of space exploration, defining milestones for current and future endeavors (1).

In 1998, the International Space Station (ISS) was established, and scientific research continues on this station to this day. Within the scope of Turkey's first manned space mission, astronaut Alper Gezeravcı has embarked on a space journey. SpaceX conducted the launch of the Axiom-3 mission at 00:49, with Turkey's first astronaut being Alper Gezeravcı (2). Technological advancements have been made for longer space journeys. However, the effects of these space travels on the human body are just beginning to be explored. National Aeronautics and Space Administration (NASA) has conducted medical research on astronauts who have completed space missions, aiming to reveal the effects of space missions on human bodies (systems). While space journeys are considered a significant leap for humanity in terms of discovery and progress, the focus has traditionally been on their physical impact. Nevertheless, recent studies indicate that space journeys also have substantial effects on the mental health of astronauts. This could influence the psychological well-being of astronauts participating in long-term missions, necessitating new strategies and solutions for space travel (3).

The primary differences between the space environment and Earth's environment include low gravity, radiation, circadian rhythm changes, noise, magnetic field alterations, and social isolation. The impact of microgravity includes sensory-motor problems, such as a loss of situational awareness, spatial orientation disorders, visual difficulties, and inadequate assessment of distance and speed, which can contribute to errors in coordination between the head, hands, and eyes. A study demonstrated significant deficiencies in cognitive functions, such as hand skills, dual-tasking, and motion perception, in eight astronauts after six months of exposure to microgravity on the ISS. Studies also suggest that simulated microgravity could negatively affect human emotions and cognitive functions, primarily showing a decrease in positive emotions, abnormal mood changes of fear and anxiety, and a decrease in task performance (4, 5).

Another risk in space journeys is exposure to radiation, particularly cosmic radiation caused by heavy-charged particles. Studies focusing on its effects on the brain indicate that cosmic radiation primarily affects the hippocampus and frontal cortex regions. These areas are crucial for memory, learning, and cognitive functions. For instance, research on mice exposed to ^{16}O and ^{48}Ti particle radiation at a dose rate of 0.5-1.0 Gy/minute at NASA's Space Radiation Laboratory showed a significant decline in hippocampal and prefrontal cortex functions and disruptions in synaptic integrity. Radiation has also been shown to increase amyloid plaque accumulation in models of Alzheimer's disease in rodent studies (6). Space stations are typically positioned at an altitude of 330-480 km, completing one orbit around Earth approximately every 90 minutes.

This results in the space station witnessing 16 sunrises and sunsets in a 24-hour period, significantly deviating from the familiar 24-hour daily cycle on Earth. Consequently, circadian rhythm disruption is a common occurrence during space flights and is considered a critical risk factor for long-term missions by NASA. Circadian clocks regulate the expression and function of various neurotransmitter systems, including dopaminergic, serotonergic, and cholinergic systems, which are implicated in mood regulation and cognitive functions. Circadian rhythm disruption can lead to severe effects on astronauts, including sleep disorders, decreased performance, concentration and memory loss, impairment of wakefulness, depression, and anxiety (7).

Space travel remains a significant and challenging experience with many unknowns. Low gravity and cosmic radiation stand out as the most critical risk factors. In addition to these, factors such as social isolation, immobilization, confinement, and changes in the day-night cycle constitute other stressors encountered in space. It is not possible for these factors not to affect human mental health. However, current studies indicate the limitations of our understanding and the insufficient recognition of the extent of the danger.

In conclusion, while space journeys represent an exciting frontier for expanding the boundaries of humanity, they also encompass a range of factors that can impact astronaut health. Nonetheless, ongoing technological advancements and scientific research will contribute to making space journeys safer and more sustainable in the future.

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