BENEFICIAL EFFECTS OF METABOLIC SUPRESSION FOR ADOPTATION AND SURVIVAL IN SPACE ENVIRONMENT.

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NASA in its plans to send humans to distant destination such as Mars faces the health and physiological performance problems caused by microgravity and space radiation. While most of the environmental conditions in spacecraft during flight can be made to mimic terrestrial conditions, microgravity cannot yet be managed. This space environmental factor has a major impact on the body's biological system forcing alterations, in order to adapt to this new environment. Most space flight and ground-based studies suggest that prolonged exposure to microgravity leads to significant skeletal muscle atrophy, bone loss, and results in suppression of total metabolism. Due to microgravity, unloaded crewmembers lose up to 1.5% of their skeletal mass and 1.8% of bone strength each month during ISS missions. Remarkably many animals, including human-size bears, which are largely inactive during the 6 to 8 months of hibernation, show no loss in bone mass and much less muscle atrophy than would be anticipated over such a prolonged period of physical inactivity. This suggests that while in a suppressed metabolic state animals have unique natural mechanisms to prevent muscle disuse and bone atrophy. The molecular mechanisms underlying these important adaptations are not yet known.

Radiation exposure is the second health hazard encountered during spaceflight that can cause radiation sickness, cancer or death. This study provides new evidence that metabolic activity levels play a critical role in radioprotection. Metabolic suppression, as an adaptive response of cells to minimize damage caused by radiation, enables cells to reduce cellular dysfunction and damage, and prolong their survival despite persistent oxidative stress. Thus mechanistic understanding of metabolism offers a means for sustaining astronauts in long-duration missions.

The ultimate goals of this study are to demonstrate that induced metabolic suppression in animals and humans will profoundly reduce their sensitivity to the damaging effects of radiation and microgravity as well as other kinds of stresses caused by spaceflight. The beneficial effects of suppressed metabolism induced by different factors such as temperature, nutrition, and medications, will not only mitigate the most detrimental hazards of spaceflight but also radically reduce mission life support requirements and spaceflight logistics.

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