

Flotation Therapy: Rejuvenating the Body in a Body of Water

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Zero Gravity Nutrition

Folate, Vitamin D, Iron ferritin and DNA Repair

NASA Website Download

Too little, too much

Other nutritional issues noted in the study seem to have nothing to do with the astronauts' eating habits. Instead, they appear to result from the conditions of being in Earth orbit. For example, vitamin D is normally produced in a person's skin by a reaction that requires ultraviolet light. The Space Station, flying as it does above Earth's ozone layer, is shielded to keep out harmful amounts of ultraviolet radiation. Unfortunately, this also prevents normal vitamin D production in an astronaut's skin. Vitamin D is needed for the maintenance and growth of bones.

The astronauts take vitamin D supplements to compensate, but there is the added problem that weightless bodies seem reluctant to use the vitamin D that they have available. Smith thinks the body's shunning of vitamin D is a natural reaction to weightlessness. "The body realizes that it doesn't need the same skeleton to get itself around," Smith says, so it cuts back on bone maintenance. The loss of bone that many astronauts experience during space flight is a problem that has yet to be resolved.

One thing the astronauts have too much of is iron. The Space Station study confirmed earlier results showing that astronauts accumulate unusually high amounts of iron in a form called ferritin. The careful dietary monitoring of the new study rules out the possibility that excess iron intake is to blame. It isn't clear what the real culprit is, but previous studies have shown that in space the body scales back on some activities that require iron, such as the production of red blood cells.

The volume of blood in circulation also decreases, another phenomenon that Smith suggests may be a natural adjustment to weightlessness, which seems to make it easier for the circulatory system to route blood and oxygen through the body.

DNA damage

If the environment of space is easier on the circulatory system, it is much more stressful on other parts of the body. The NASA study found signs that the DNA-repair systems in astronaut's bodies were working overtime. These operations kick in whenever chemicals or radiation damage DNA, and the telltale sign of such action is a byproduct called 8HdG.

By the end of astronauts' missions, 8HdG-urine concentrations typically had shot up 30 percent from preflight readings. "The level of change that we see is the same that you'd see in someone who is smoking a pack of cigarettes a day," says Smith.

Radiation from space is responsible for some of the damage, but Smith says breathing pure oxygen, as astronauts occasionally do, may also be a cause. Astronauts breathe pure oxygen during takeoff and landing and when suited up for work outside the station. Breathing abnormally high concentrations of oxygen is known to damage a person's DNA through the action of types of oxygen atoms called free radicals.

The detected DNA damage is even more worrying in light of the decreased concentrations of the nutrient folate in astronauts' blood after flights. Folate helps repair damaged DNA. The good news is that folate levels improved when astronauts took supplements, which was not the case with some other nutrients.

Clearly, says Smith, space flight can be hazardous to one's health. But with NASA's new plans to build a base on the moon and to eventually send astronauts to Mars, scientists are going to have to figure out how to deal with those hazards. A typical stay aboard the Space Station lasts 4 to 6 months, but Smith says a human mission to Mars could entail a 3-year round trip. "That's where [nutrition] is going to be even more critical," he says.

Having surveyed nutrition-related changes that occur in space travelers, the NASA researchers plan further study of the potential problems from those changes. Although Smith is concerned about all of the hazards highlighted in the study, he says that radiation and cancer risks are among the "highest-priority targets" for further studies.