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# Astronauts' circulation woes can cue better health for all

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A little more time on the treadmill may be just what the doctor ordered for Canada's astronauts battling microgravity's effects on circulation, according to one Western researcher.

Kevin Shoemaker, Associate Dean of Research in the Faculty of Health Sciences, said his group's new findings can improve astronauts' health – and may also help understand and prevent falls among frail elderly people on Earth.

Shoemaker was co-investigator on the Cardiovascular and Cerebrovascular Control on Return from the International Space Station (CCISS), which studied the effects of long space missions on astronauts' hearts and the blood vessels that supply the brain. The study was led by Dr. Richard Hughson of the Schlegel–University of Waterloo Research Institute for Aging.

Lack of gravity can disrupt astronauts' blood circulation, giving them puffy faces and 'bird legs as blood moves from the lower body and congests in the head and chest.

When astronauts return to Earth, the distribution reverses. Blood collects in their lower body and, if not enough oxygen-rich blood reaches the brain, some astronauts could experience dizziness, fainting or blurred vision.

Astronauts' hearts are affected by the lack of gravity when they arrive in

space and by reintroduction to gravity when they return to Earth, Shoemaker said.

"There has been a long-standing question about what the impact is of lack of gravity on cardiovascular health," said Shoemaker. "You and I are using our legs all the time, walking around campus or in the office, which translates into a metabolic load that helps us live a healthier life. In space, they (astronauts) don't use their legs. They are much less active. When they move, and the fact there is no gravity, they are pushing and pulling themselves around.

"They can be up there for six to 12 months. The analog version of that on Earth is if we put someone in bed; you still use your arms, you eat, you read. Our strength doesn't change, but our legs just shrivel. The point is, it's a rather severe version of physical inactivity – bed rest or space flight."

Our hearts and other muscles rely on the daily challenge of moving against gravity to stay strong and healthy. Long periods of sedentary behaviour – including sedentary behavior in space – are associated with higher risk of cardiovascular disorders such as high blood pressure, arrhythmia and heart failure.

The study's aim was to gain a better understanding of how astronauts' cardiovascular systems adapt to conditions aboard the International Space Station and how to maintain astronauts' health once they return to Earth.

Six astronauts took part in this study by wearing devices that measured blood pressure, heart rate and physical activity pattern during waking hours and sleep before, during and after their space missions.

Shoemaker found heart rate response and changes in blood pressure

differed significantly among astronauts. These results could point to a need for some crew members to exercise more or take other steps to help protect their blood pressure response on return to Earth.

"The fact is, when we have to work against gravity all the time, and you get this downward pull on things, our bone strength depends upon it being loaded. Every time you put weight on a bone, you are helping it remodel, in a good way, and it keeps it strong," he said. "When you don't use it, it goes away. When you don't have gravity, your bones start to get brittle, looking a lot like osteoporosis."

CCISS's results could benefit people prone to dizziness, he said; understanding the mechanisms and warning signs of drops in blood pressure could reduce the rate of fainting and falls in the elderly.

"We cannot overcome age at this point and, in older folks, we have this period of life we call frailty," he said. "So can we shorten that? Instead of creeping up on us at age 70, can we wait until we're 85? That is the goal for exercise."

While astronauts have access to top-flight exercise equipment on the space station, the question is whether they actually use it, Shoemaker said.

"You can imagine, if it takes you a long time to get ready to exercise, if you have to drive somewhere, you're less likely to do it," he said. "There are barriers to exercise in space, as well. Without gravity, you have to strap yourself into the machines to exercise, you have to strap yourself onto the bike, your treadmill is floating in the air.

"Guidelines are you should be exercising at least an hour a day. But astronauts, if you calculate the amount of time they are physically active in a meaningful way, it's about 20 minutes. They have really long days,

so incorporating it is hard. It's a significant change in lifestyle."

The experiment also discovered after exposure to the unique environment of space, arteries in the brain were less able to react to sudden changes in blood pressure. More research will take place to determine if this can be linked to reported changes in astronauts' vision.

Calcium and sodium, collecting in the arteries of astronauts, can also lead to vascular stiffness, added Shoemaker. As we get older we all get some form of hypertension, but one, vascular stiffening, has some implications for brain health and stroke.

Shoemaker hopes to generate more comprehensive imaging of the astronauts while they are on the Space Station, determining when changes to the body are occurring and to what extent, through the use of a robotic ultrasound system for remote monitoring.

In the meantime, exercise lessons learned from space have practical implications on Earth.

"There is this relationship between the amount of physical activity we get and our general health. Bone, glucose metabolism, muscle health, brain health – all of these depend on some form of physical activity," said Shoemaker. "It all links into some fundamental level of physical activity, which is easier to get on Earth than in space."

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