

Exercise has benefits, even when it's done in space

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Astronauts have been taking part in short spaceflight missions since 1961. They have only recently begun to spend significantly longer times in space, with missions extending for months, since the days of the Russian Mir space station (1986-2001) and extended stays on the International Space Station (ISS; November 2000). Though earlier studies clearly showed that astronauts on these extended missions suffered serious deficits from lengthy times in a low-gravity environment, including dizziness when standing up, considerable loss of bone mass, and impaired muscle function, little was known about the effects of long-term space flight on the heart and vascular system.

In a new study, a research team has tested various cardiovascular measures in six astronauts on long-term missions aboard the International Space Station. These findings show that lengthy spaceflight indeed affects cardiovascular responses, but not as dramatically as the researchers predicted, suggesting that the intensive exercise routines astronauts on these long missions complete every day are doing their job.

The article is entitled "Cardiovascular Regulation During Long-Duration Spaceflights to the [International Space Station](#)." It appears in the current edition of the [Journal of Applied Physiology](#), published by the [American Physiological Society](#).

Methodology

The researchers collected data from six male astronauts, between 41 and 55 years old, who were headed to the ISS on missions ranging from 52 to 199 days. At about a month before they embarked, the research team collected a wealth of data on each subject's cardiovascular health. This data was collected during spontaneous and paced breathing, both sitting up and lying down, to reflect a variety of conditions and cardiovascular stresses. The researchers measured various factors including finger arterial blood pressure, heart rate, left ventricular ejection time, and cardiac output. The astronauts repeated these measures independently a few weeks after they arrived at the space station, then a few weeks before they returned to Earth. A final assessment took place again soon after landing on Earth.

Results

Results showed that heart rate, blood pressure, and arterial baroreflex response (the body's natural way to regulate heart rate and blood pressure based on continuous sensing of both) were unchanged from pre-flight to in-flight. Left ventricular ejection times and cardiac output both increased in-flight, while time between heartbeats, arterial pulse pressure, and the blood pumped from the heart decreased. In the post-flight testing compared to pre-flight measures, [heart rate](#) and cardiac output increased slightly, while arterial baroreflex response decreased by about a third, but only in the seated position.

Importance of the Findings

These findings suggest that long-duration spaceflight has significant effects on cardiovascular function, yet these effects are relatively small. The researchers attribute this cardiovascular stability to the intensive exercise program astronauts commit to while on lengthy spaceflight missions. On these particular missions, the six astronauts were each

allotted 2.5 hours per day to set up for exercise, complete a workout, and clean up after the session, with options to exercise on a cycle, treadmill, or doing resistance training. These exercise sessions appear to keep astronauts relatively healthy and prepared for return to Earth, despite the potentially negative effects of a low-gravity environment.

"These post-flight changes were somewhat less than expected based on short-duration flights and early reports of long-duration missions and suggest that the current countermeasures on the ISS, which include exercise training, are keeping cardiovascular control mechanisms well prepared for return to Earth," the authors say.

The ISS [astronauts](#) in the current study represent the first six-person crew, signifying the transition to greater possibilities to conduct science on this major international laboratory, they note.

More information: The study is available online at bit.ly/FQW3kG

Provided by American Physiological Society

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