

What Do Space and Aging Have in Common?

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A Message for the International Year of Older Persons

Over 35 years ago, astronaut Wally Schirra complained of “wooziness” after returning to Earth from just 9 hours of being in the microgravity environment of space flight! Almost three quarters of our astronauts experience this symptom of feeling faint when they stand up after returning to Earth from space. We now know it is due to poor blood pressure control and reduced blood volume. In space, away from the pulling down of Earth’s gravity, the heart and blood vessels do not respond effectively when an astronaut first returns to Earth’s gravity.

As the duration of space flight missions has increased, many other symptoms related in particular to being away from gravity have been observed. They include a kind of anemia due to reduced red cell mass, muscle atrophy and reduced strength of those muscles that keep the body upright, loss of calcium from bones, reduced bone density and strength, reduced calcium absorption from the gut, disturbed sleep and a depressed immune system. These are all normal body function adaptations that occur when away from gravity. Degradation of body functions no longer needed in space is the normal adaptation to living away from gravity.

The Space Shuttle circles the Earth every 90 minutes, thus completing the normal 24 hour day/night cycle every hour and a half. Several astronauts have noted reports of sleep and body clock disturbances. Upon return to Earth’s gravity they also experience an absence of directional information normally provided by the sensation of weight in the gravity environment resulting in problems with balance control, navigation, and coordination of movements.

Our astronauts typically range in age from 30-60 years. They are very healthy men and women in excellent physical condition. Space Life Sciences research is dedicated to maintaining the health and safety of these space explorers. The research is designed to understand the causes for the symptoms that occur in space and to develop preventive or therapeutic countermeasures and rehabilitation protocols that promote a quick recovery.

You may be wondering, *“So what does aging have to do with this?”*

Or perhaps you recognize that these symptoms sound similar to those associated with the aging process.

In detailed studies focused on finding “why” and “how” these symptoms occurred in space explorers, scientists in the Soviet Union were the first to discover that healthy people confined to lying in bed continuously for several days began displaying these same symptoms.

In my bed rest research studies at the NASA Ames Research Center in California, I was struck by the similarities in the set of symptoms apparent in our young, healthy men and women volunteers and those I noticed in aging family members and friends. However, there was a significant difference. My subjects, as had astronauts, recovered quickly from these symptoms, but in the elderly it was generally assumed these same symptoms were related to the aging process and therefore irreversible. What was it about long duration bed rest that produced these results?

The answer has to do with gravity. On Earth we evolved, developed, and live our lives in gravity. Biological organisms respond to changes in gravity direction and intensity. Plants grow to align with the direction of gravity but humans, by quickly changing position with respect to gravity, change the direction that gravity acts on their bodies. The maximum effects of gravity occur when it is pulling on us in the “head-to-toe” or vertical direction. When we are lying in bed, gravity is only pulling across the chest, so we are in a position where gravity has its least effect.

We have developed sensors throughout our body that use gravity to tell us where we are relative to our environment. How we orient and re-orient ourselves relative to gravity’s pull provides signals that trigger body functions necessary for our bodies to stay “Earth healthy”.

For example, it is not just sensory stimulation that enables us to walk. Walking is actually a learned response against the pull of gravity; a response that prevents us from falling. Gravity provides loading that is countered by keeping our body weight supported by special postural muscles and bones. Actively working against the force of gravity also keeps our bones and muscles healthy. Most people call this exercising or “working out”. Changing our posture many times a day from lying to sitting, to standing stimulates upper body blood pressure sensors that automatically adjust the control of blood pressure to keep it tuned and responsive. Without this constant “head-to-toe” pull of gravity, the body systems adapt and no longer respond in the common “Earth normal” way. The results are the symptoms our astronauts experience in space flight and after they return and are similar to those previously believed to be caused by the aging process.

The conclusion I drew from the bed rest studies was that these symptoms had little to do with how old one was but rather with the circumstances associated with aging lifestyles. *Staying active and working against the pull of gravity is the secret to healthy aging and may even be the key to reversing or slowing down some of these symptoms.*

Developing ways to keep astronauts healthy in space can be applied to all of us, especially as we get older. NASA Life Sciences has been working with the National Institute on Aging and the Baltimore Longitudinal Study in planning a systematic approach to understanding and making the most of what space can teach us about the aging process. The historic return of John Glenn to space in October of 1998, brought increased awareness of the parallels of aging and space flight and how important it is to use gravity effectively here on Earth to maintain our health and youthful vigor. Only by

going into space can we understand how gravity has affected life. We have learned a great deal from space about growing old on Earth.