

Long-duration space missions have lasting effects on spinal muscles

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Astronauts who spend several months on the International Space Station have significant reductions in the size and density of paraspinal muscles of the trunk after returning to Earth, reports a study in *Spine*.

Some changes in [muscle](#) composition are still present up to four years after long-duration spaceflight, according to the new research by Katelyn Burkhart, MS, of Massachusetts Institute of Technology and colleagues. They write, "Spaceflight-induced changes in paraspinal muscle morphology may contribute to back pain commonly reported in [astronauts](#)."

Trunk Muscles Show Decreased Area, Increased Fatty Tissue, after Months in Space

The researchers analyzed computed tomography (CT) scans of the lumbar (lower) spine in 17 astronauts and cosmonauts who flew missions on the International Space Station. Scans obtained before and after missions were analyzed to determine changes in the size and composition of the paraspinal muscles. Average time in [space](#) was six months.

Running up and down the spine, the paraspinal muscles play a key role in spinal movement and posture. Previous studies have found reduced paraspinal muscle mass after prolonged time in space, suggesting that muscle atrophy may occur without the resistance provided by gravity.

The CT scans showed reductions in the size of paraspinal muscles after spaceflight. For individual muscles, muscle size decreased by 4.6 to 8.8 percent. In follow-up scans performed one year later, size returned at least to normal for all muscles.

The scans also showed significant increases in the amount of fatty tissue present in the paraspinal muscles. Accordingly, the astronauts' muscle

density, which is inversely related to fat content, decreased by 5.9 to 8.8 percent. For most muscles, composition returned to normal by one year.

However, for two muscles—the quadratus lumborum and psoas muscles—fat content remained above pre-flight values even two to four years after the astronaut returned from space. These muscles, which connect the spinal column to the pelvis, are located lateral (alongside) to the spinal column. By comparison, paraspinal muscles located posterior to (behind) the spinal column regained normal size and density.

Changes in muscle size and composition varied between individuals. For some muscles, changes in size were at least partly related to the amount and type of exercise the astronauts performed while in zero gravity: either resistance exercise or cycling. In-flight exercise did not seem to affect changes in muscle density.

Previous studies of astronauts have linked spaceflight to muscle atrophy, especially of the muscles that maintain posture and stability while upright on Earth in normal gravity. Many astronauts experience [low back pain](#) during and immediately after space missions, and they appear to be at increased risk of spinal disc herniation.

The new study is the first to measure changes in the size and density of individual paraspinal muscles. The results show that muscle size returns to normal upon Earth recovery, but that some changes in muscle composition—particularly increased fatty infiltration—may persist for at least a few years.

Some of the paraspinal muscle changes seem to be affected by exercise, suggesting possible approaches to preventing the adverse effects of prolonged spaceflight on spinal health and functioning. Ms. Burkhart and coauthors conclude, "As NASA plans for future missions to Mars and

beyond, these results can be used to guide future countermeasures to mitigate declines in trunk muscle morphology and associated functional deficits."

More information: Katelyn Burkhart et al.
Negative Effects of Long-Duration Spaceflight on Paraspinal Muscle Morphology, *SPINE* (2019).
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