# How being in space impairs astronauts' immune systems

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A new study led by researchers at Karolinska Institutet in Sweden has examined how T cells of the immune system are affected by weightlessness. The results, which are published in the journal *Science*

*Advances*, could explain why astronauts' T cells become less active and less effective at fighting infection.

The next steps in the exploration of space are human missions to the moon and to Mars. Space is an extremely hostile environment that poses threats to human health. One such threat is changes to the immune system that occur in astronauts while in space and that persist after their return to Earth. This immune deficiency can leave them more vulnerable to infection and lead to the reactivation of latent viruses in the body.

"If astronauts are to be able to undergo safe space missions, we need to understand how their immune systems are affected and try to find ways to counter harmful changes to it," says study leader Lisa Westerberg, principal researcher at the Department of Microbiology, Tumor and Cell Biology, Karolinska Institutet. "We've now been able to investigate what happens to T cells, which are a key component of the immune system, when exposed to weightless conditions."

In the study, the researchers have tried to simulate weightlessness in space using a method called dry immersion. This involves a custom-made waterbed that tricks the body into thinking it is in a weightless state. The researchers examined T cells in the blood of eight healthy individuals for three weeks of exposure to simulated weightlessness. Blood analyses were performed before the experiment started, at seven, 14 and 21 days after the start, and at seven days after the experiment ended.

They found that the T cells significantly changed their gene expression —that is to say, which genes were active and which were not—after seven and 14 days of weightlessness and that the cells became more immature in their genetic program. The greatest effect was seen after 14 days.

"The T cells began to resemble more so-called naïve T cells, which have not yet encountered any intruders. This could mean that they take longer to be activated and thus become less effective at fighting tumor cells and infections. Our results can pave the way for new treatments that reverse these changes to the immune cells' genetic program," says Carlos Gallardo Dodd, Ph.D. student at the Department of Microbiology, Tumor and Cell Biology, Karolinska Institutet and shared first author with researchers Christian Oertlin and Julien Record at the same department.

After 21 days, the T cells had "adapted" their gene expression to weightlessness so that it had almost returned to normal, but analyses carried out seven days after the experiment ended showed that the cells had regained some of the changes.

The researchers now plan to use Esrange Space Center's sounding rocket platform in Kiruna, Sweden, to study how T cells behave in weightless conditions and how their function is affected.

The study was conducted in close collaboration with Claudia Kutter's research group at Karolinska Institutet/SciLifeLab and collaboration partners at IBMP Moscow and New York University Abu Dhabi.

**More information:** Carlos Gallardo-Dodd et al, Exposure of volunteers to microgravity by dry immersion bed over 21 days results in gene expression changes and adaptation of T cells, *Science Advances* (2023). DOI: 10.1126/sciadv.adg1610.
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