HEALTH

Constructing an atlas of human biology in space: Q&A with Christopher Mason

By Nicholas St. Fleur July 5, 2024

Reprints

Weill Cornell Medicine geneticist Christopher Mason, who studies the effects of space on human health.
THOS ROBINSON/GETTY IMAGES FOR WEILL CORNELL MEDICINE

After several delays, the highly anticipated first commercial spacewalk is set to launch later this summer as part of SpaceX's Polaris Dawn mission, propelling four civilian astronauts more than 430 miles above Earth. Among those eagerly awaiting the mission's findings is Christopher Mason, a geneticist and computational biologist who studies the effects of space on the human body. He previously helped lead the NASA Twins Study that compared physiological, molecular, and cognitive measures for astronauts Scott and Mark Kelly.

Last month, Mason and researchers from more than 100 institutions released the Space Omics and Medical Atlas, the largest collection yet of health data gathered from astronauts and other civilians in space. The package, which consists of 44 published papers, includes data from the Inspiration4 mission, which was the first all-civilian space orbit, the Twins Study, and others. Data on human space biology from the Polaris Dawn mission, as well as from future lunar missions, are slated to be added to the repository.

Mason, who is a professor of genomics, physiology, and biophysics at Weill Cornell Medicine and also a scientific advisory board member of Seer, a biotechnology company whose tools were used to study the data, spoke with STAT about the release of the spaceflight atlas, creating a baseline for human health in space, and his thoughts on the "second Space Age." This interview has been edited for length and clarity.

What is "Space Omics"?

"Space Omics" is everything from the way you measure astronauts and biology in space, to the ways you quantify what's happening in space. When people say "-omics," it's just a broad term to define all sorts of technologies that look at cells, genes, and molecules. Genomics is all of the genes, transcriptomics is all of the transcripts, proteomics is all the protein. "Space omics" is all those technologies, metrics and medical measurements done with astronauts before and when they get back from space.

Related: Q&A: Solving astronauts' health challenges in deep space could have payoffs on Earth

See More Reports ›

What is the Space Omics and Medical Atlas (SOMA)?

The Space Omics and Medical Atlas is the compendium of [data on] almost every astronaut we've ever measured anything from in the past 10 years, including the Twins Study. It's in atlas form so people can query it, they can look at specific genes, and they can test some of their own hypotheses and compare it to their own data.

How many astronauts' data does it have?

It includes 64 astronauts that have some cytokine data, which is not that big of a number, but it's about 10% of everyone who's ever been to space, so it's actually decently large. Cytokines are a kind of metabolomics or proteomics measure, particularly proteins that come out when you're stressed or inflamed. We're able to measure different cytokines and how they change in spaceflight. There are 13 astronauts in the atlas with transcriptome and genomics data. The atlas spans short missions, long missions, males and females.

But the important thing is that this is also open. We have an open consent form. Anyone who's going to space is welcome to join the studies and contribute their data. It's the first release of the atlas, but we want it to grow.

What's the point of the spaceflight atlas?

When you go to the doctor and you get bloodwork done and you're looking for, say, how much glucose you have in your blood, you always have a normal range. When you get your bloodwork, you'll want to know, "Am I normal? Am I high? Am I low?" This is the first atlas of what a normal human body looks like in space. Before this we really had no metrics. We had individuals. We looked at one, two, or four people. But this is the first time we can begin to say what is a nominal range of blood, genes, proteins, and cellular responses for being in space. The atlas gives us that baseline.

How is the data in the spaceflight atlas collected?

Some are through basic blood work like when people go to the doctor. Some are from things like the Seer's technology, or with sequencing assays, instruments built by Illumina and Element. We've used a large battery of technology. It's not just one tube of blood, we actually take about 14 tubes of blood.

What surprised you the most from collecting and analyzing all of this data?

One of the interesting things is the telomeres that we saw get longer in the twins study, we also saw that for Inspiration4. The telomeres get a little bit longer even within just a couple of days of being in space. I was surprised at how fast that occurred. We see what we believe to be a rapid response to radiation.

Also the most surprising thing was just how quickly we got the crew trained and ready to go and do science in space. The Inspiration4 crew, which were selected, trained, and were in space within five months of being trained, were collecting ultrasounds and bloodwork, and doing microbiome testing. And they're all civilians.

You mentioned that the telomere lengthening was surprising. Why is that surprising, and why is that important to know?

It's surprising because of how fast it occurs. I thought it would take more than a few days. It also seems to be somewhat dose-dependent. Like many of the changes we saw, the telomeres got a little bit longer, but not as much as if you've been in space for a month. We see some evidence of the cells in the body measuring the dose of their time in space, if you will. If you think of a dose of a drug, if you take a lot of something, it'll affect you more than if you take a little. We're beginning to see that there is somewhat of a dose-dependent effect, that the more time you spend in space, we think you'll see these changes. Telomeres will get longer, the longer in space. The cytokines we see change, will have a bigger change the longer you spend in space.

Related: NASA twins study explores body's response to long space travel

What does that mean? Is it cause for concern?

Telomeres are basically the caps at the end of your chromosomes that keep your DNA intact. Normally they shrink as you get older, so the fact they get longer in space is a sign of youthfulness and more longevity. But it's not like the fountain of youth is in space. It just indicates that there is a surprising feature that we see now in almost every crew, that is the lengthening of telomeres.

It doesn't mean you'll live forever if you go to space. It just means that the body's having a reaction to the radiation that is akin to, like, what you might do if you have a really strong workout where your muscles are sore for a day, but then it builds the muscle. We think it's what's called hormesis, which is a stress on the body, but may actually have some function. It may be a good thing, for a short burst of the radiation.

One of your papers discusses "spaceflight dermatology." What was that about?

For the first time ever we did skin biopsies for the Inspiration4 crew, right before and right after their mission, about a month before and then within three days of landing.

We could actually see the inflammation in the skin. Scott Kelly had reported that he had a rash when he got back from space. A lot of astronauts report rashes and discomfort in the skin, so it's something that's been discussed a lot. But this was the first time we got to do a biopsy to see what's changing. And we can actually see different immune cells getting closer to the skin and moving. The structure of the skin is almost a bit different, and there's inflammation.

What does the atlas tell us might be points of concern when it comes to putting people in space or space travel?

One good thing is we don't see any red flags or showstoppers that say civilians and crews should not be going to space. Over 95% of the genes and the proteins that changed did come back to normal. The vast majority of the molecular and cellular changes in the body revert back to baseline pretty quickly within about a month. But one of the things we did see that was intriguing, we see evidence that maybe there's a stress on the brain that is on probably the blood-brain barrier. It's not necessarily bad. It's just different from what we see on Earth. It's something we're just going to keep an eye on to see.

How do you see the spaceflight atlas being utilized for future lunar missions?

I've been chatting with some of the people that are doing training right now for going to the moon. Some of the astronauts will participate in some of these same studies. The goal would be to add all of this so the atlas keeps expanding.

The lunar radiation will be much higher because you don't have the protection of the magnetosphere or the Van Allen belts. We're expecting that the radiation that will be absorbed on the way to the moon will be significantly higher.

Related: Q&A: Meet Catriona Jamieson, the scientist sending tumors into space

We think that if some of the changes really are linear — we see a little bit of change in a few days and a lot more in a few months — you might accelerate some of these changes when you're going to the moon, which is a much harsher environment with more radiation. That helps us find what genes could be targeted by drugs for countermeasures, and what you could use for radioprotection. The changes that happened in the blood work will help us pinpoint what we could potentially target for countermeasures.

What role do the SOMA studies play pertaining to pharmaceuticals in space?

We did some whole-genome sequencing for the crews and made a pharmacogenomics report. We see that some of the genes that regulate metabolism of drugs also change in space. … It's the beginning of the work of pharmacogenomics for astronauts. We do this for patients on Earth, but now we're starting to do this for astronauts. It's helpful because then you don't have to bring every drug with you. You could bring only the ones that you know will work for your genome.

What further research do we need to better understand the long-term health impacts of space on the human body?

The simplest thing is more data, because we have just 64 total astronauts for one measure and we have handfuls for other astronauts for these other broad measures. We also have to get more data on males versus females.

We see some evidence that females might recover faster from spaceflight, which is interesting. But we don't have the statistical power to know that for certain yet. We're in the early stage of seeing interesting trends, but now we really need to validate them across multiple missions.

What's your main message for the general public?

Space is open! It's still expensive, but space seems safe for regular people. They can get trained, they can contribute to science. They can donate samples, tissues, blood, sweat, and tears — quite literally — to our studies. It's a second Space Age!

About the Author

Reprints

Nicholas St. Fleur

General Assignment Reporter, Associate Editorial Director of Events

Nicholas St. Fleur covers the intersection of race, medicine, and the life sciences. He hosts STAT's health equity podcast, Color Code.

nicholas.stfleur@statnews.com

@SciFleur

Tags

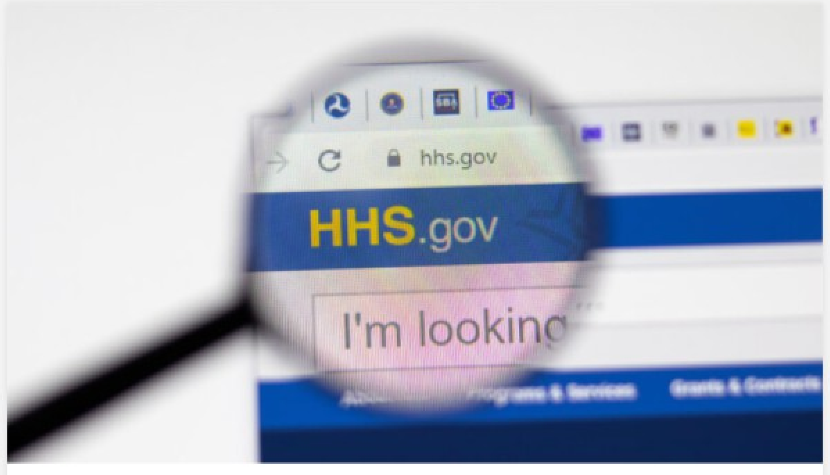
BIOTECHNOLOGY RESEARCH

To submit a correction request, please visit our Contact Us page.

Recommended Stories

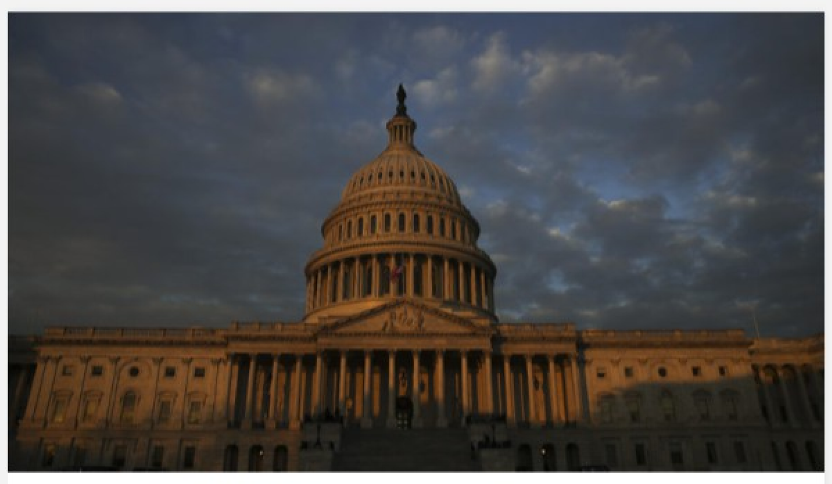
HEALTH HELEN BRANSWELL

CDC confirms first known severe case of H5N1 bird flu in the U.S.



HEALTH TECH NEWSLETTER BRITTANY TRANG

How federal health agency HHS uses AI, telehealth wins and BD's sins



POLITICS RACHEL COHRS ZHANG

S+ **Congress strikes deal to rein in PBMs after years of debate**

BIOTECH JASON MAST

S+ **Editas Medicine lays off 65% of staff and shelves lead gene-editing program**

A STAT INVESTIGATION CASEY ROSS AND BOB HERMAN

S+ **UnitedHealth pushed employees to follow an algorithm to cut off Medicare patients' rehab care**

STAT

Reporting from the frontiers of health and medicine

COMPANY
- About
- Our Team
- Contact Us
- Careers
- Diversity & Inclusion
- Our Awards
- Advertise With Us
- STAT Brand Studio
- Supporters
- Licensing Stories

ACCOUNT
- STAT+
- Group Subscriptions
- FAQ
- My Account
- Log In
- Subscribe

MORE
- Events
- Newsletters
- Reports
- App
- Podcasts
- Community

PRIVACY COMMENT POLICY TERMS DO NOT SELL MY DATA