



Using the centrifuge for space tourism

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DLR researchers analyse blood coagulation under increased gravity

The first tickets have already been sold to space tourists – the passengers, however, will not be as fit or healthy as astronauts, but rather people with greatly varying health conditions. This is why scientists at the German Aerospace Center (Deutsches Zentrum für Luft- und Raumfahrt; DLR) and physicians from Witten/Herdecke University have come together to analyse the prevalent risks in a pilot study. Using a long-arm centrifuge, they subject participants to 15 minutes of the forces that space tourists would encounter during takeoff and landing. The aim of the study is to determine the influence of increased gravity on blood coagulation.

Each of the 20 test subjects will be placed in a cabin attached to a six-metre arm and accelerated to 22 revolutions per minute. The male participants aged between 25 and 40 will be subjected to three times the force of gravity just 15 seconds after the start. "Breathing is more difficult, so you must get used to it," explains candidate Max Schneider after his ride in the long-arm centrifuge. Ulrich Limper and Peter Gauger from the DLR Institute of Aerospace Medicine took blood samples before the acceleration started, to be able to compare the results to afterwards. Hartmut Fredrich, the centrifuge machine operator, and physician Jürgen Wenzel monitor the test subjects' response during the phase of threefold gravity. A camera transmits images of the candidate's face to the control room. Regular measurements of blood pressure and heart rate show that the candidate is fine despite the stress. The next blood samples are taken once the 15 minutes are up and the cabin comes to a halt. "This allows us to identify the immediate repercussions of increased gravity," Ulrich Limper explains. As some responses are triggered with a certain delay, the last blood samples are taken half an hour later.

Tourists with health risks

"We have to assume that space tourists could be older, and may have previously had conditions such as a heart attack or deep vein thrombosis – but are nevertheless keen to fly to space and willing to shoulder the physical stress this entails," says Limper. Commercial providers of this kind of flight will be intent on offering these trips with several minutes of zero gravity to as broad a public as possible. "For this to happen, we need to know the risks, define precisely how we will conduct effective medical checkups before the launch or whether we may even have to introduce solutions to certain risks." For instance, whether passengers with a history of strokes or pulmonary embolism are being prescribed medication that reduces the capacity for the blood to clot, as the effectiveness of these drugs may be restricted for the duration of the flight. "We need to define this risk – so that it can be minimised," says the physician Ulrich Limper, defining the joint research project between DLR and the University of Witten/Herdecke.

Interaction between blood coagulation and the vascular system

The study has already revealed a preliminary trend: "It appears probable that increased gravity raises the capacity of the blood to clot." Until now, this effect had only been investigated on human blood cells in centrifuges or on animals. Working with human beings helps scientists perform even more precise investigations: "Among other things, blood coagulation is closely related to the human vascular system – and you can't take a look at that in a centrifuge."

To ensure that the results would be as unambiguous as possible, test subjects were selected according to strict criteria: only those who passed the check-up at the DLR Aerospace Medicine Examination Centre and whose blood coagulation results showed no abnormalities were admitted to the study. It was important that the candidate group should be as homogeneous as possible, so that the observed results of blood coagulation would be exclusively due to the ride

on the centrifuge. But there were some failures here: "We had to stop the test for some of the candidates – even with a healthy body, some people are unable to cope with the effects of increased gravity."

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Long-arm centrifuge at DLR



Candidates sit in a sealed cabin attached to a six-metre structure in the long-arm centrifuge at the German Aerospace Center (DLR)

Credit: DLR (CC-BY 3.0).

Preparing for the centrifuge ride



Peter Gauger from the German Aerospace Center (DLR) wires up the candidates before they get into the long-arm centrifuge, allowing the scientists to measure factors such as blood pressure and heart rate during the ride.

Credit: DLR (CC-BY 3.0).

Keeping an eye on the participants



In the control room, scientists and physicians monitor the candidates' response during the ride under increased gravity, helped among other things by a camera transmitting images of the candidate in the cabin.

Credit: DLR (CC-BY 3.0).

Blood samples for space tourism



Ulrich Limper, a physician from the German Aerospace Centre (DLR), draws blood from the candidates immediately after they step out of the long-arm centrifuge.

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