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INVESTIGATING THE EFFECTS OF GRAVITY ON THE GENETIC REGULATION OF HUMAN TELOMERES

Abstract

Telomeres are sequences of repeat nucleotides on the end of chromosomes that function to protect against genomic degradation that comes with repeated DNA replication. Telomere length is an important biomarker that may reflect genetic and lifestyle factors contributing to aging and related diseases. While telomere length typically reduces with age, NASA's Twins Study recently showed that astronaut Scott Kelly's telomeres lengthened during his 340 days aboard the International Space Station. However, the cause of this lengthening remains unknown due to the number of confounding factors of spaceflight including microgravity, radiation, and temperature. This study aims to use a parabolic flight to isolate the microgravity variable and understand its effects on human telomere regulation.

A system that allows for time sensitive analysis of cells under short periods of microgravity was designed. This sealed and automated injection system distributes lysis solution to cells of a human T-cell line immediately prior to and after periods of microgravity during a parabolic flight, preserving their nucleic acids for post-flight analysis. Expression levels of key telomere regulating genes that contribute to extension, degradation, and regulation, including telomerase genes hTERT and TERC, will be assessed and compared to controls. Additionally, methylation of key regulatory gene promoters will be assessed via bisulfite conversion and sequencing analysis.

The system will fly on-board the National Research Council of Canada's Falcon 20 aircraft on a parabolic flight in August 2021, as part of a campaign in collaboration with the Canadian Space Agency and Students for the Exploration and Development of Space (SEDS) Canada.

The results of the flight, including an assessment of potential mechanisms of altered telomere regulation in a human T-cell model, will be presented. We hope to further both the understanding of how variable gravity impacts telomere length during spaceflight and how this may impact human health on Earth.