Space Flight Hazards and Human Health

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Astronaut Christina Koch will set a record for the longest single spaceflight by a woman when she completes her 11-month-long mission aboard the **International Space Station (ISS)** in February 2020. Her long stay on the ISS has to do with NASA's preparation of human missions to the Moon and Mars.

Why it is being done?

The mission became necessary as the majority of data available is on male astronauts. But male and female bodies respond differently, and health conditions occur at different rates in male and female populations. Moreover, it is being done to access the impact of long space travel, and preparation for it.

Five Hazards

NASA classifies impact of space flight on human in **5 broad criteria** known as **"5 Hazards".**

- **Radiation**
  - Any space flight is outside Earth's protective magnetic field, where radiation is much higher as compare to International space station. (International space station is just within the earth's protective atmosphere; even then radiation is 10 times higher when compared to earth.)
  - Radiation exposure increases cancer risk, damages the central nervous system, can alter cognitive function, reduce motor function and prompt behavioural changes.
- **Isolation and confinement**
  - Behavioural issues among astronauts crammed in a small space over a long period of time, are inevitable.
  - Sleep loss, circadian desynchronization, and work overload compound this issue and may lead to performance decrements, adverse health outcomes.
- **Distance from Earth**

  As distance of space flight increases from earth, communication delay increases. For example, there will be a communication delay of 20 minute in space travel to Mars.
- **Gravity**
  - Different planet have different have different gravitational pull, for example astronauts would need to live and work in three-eighths of Earth's gravitational pull on Mars. Additionally, explorers will experience total weightlessness during course of travel.
  - To further complicate the problem, when astronauts transition from one gravity field to another, it's usually quite an intense experience.
  - Blasting off from the surface of a planet or a descent through an atmosphere is many times the force of gravity.
- **Hostile/closed environments**

  NASA has learned that the ecosystem inside the spacecraft plays a big role in everyday astronaut life. Microbes can change characteristics in space, and microorganisms that naturally live on your body are transferred more easily from person to person in closed habitats like the space station

Impact Human Health

Weightlessness and osteoporosis

- According to NASA, without gravity working on your body, your bones lose minerals, with density dropping at over 1% per month. By comparison, the rate of bone loss for elderly men and women on Earth is from 1% to 1.5% per year.
- Even after returning to Earth, astronauts bone loss might not be corrected by rehabilitation, so an astronaut could be at greater risk of osteoporosis-related fractures later in life.
- The fluids in astronaut's body will shift upwards to his/her head, which could put pressure on eyes causing vision problems.

Micro-gravity and Osteoporosis

- Osteoporosis is a condition that weakens bones, making them fragile and more likely to break.
- Bone tissues are continuously remodelled in human body, by osteoblasts and osteoclasts: two types of bone-cells which constitute bone tissue. Osteoblasts are responsible for formation of bones whereas osteoclasts are responsible for breakdown of the bones.
  In micro-gravity conditions, rate of osteoclasts formation increase their rate of bone resorption , resulting in Bone loss.
- This is primary cause for Osteoporosis in astronauts.

Telomeres get longer during spaceflight

Telomeres are the caps that shield the ends of our chromosomes, protecting DNA strands from damage and degradation. Research has shown that longer telomeres are associated with fewer age-related problems

Decreased body mass and increased folate in orbit

Folate is one of the B-vitamins and is needed to make red and white blood cells in the bone marrow, convert carbohydrates into energy, and produce DNA and RNA.

Spaceflight can Trigger Gene Mutations

Stresses of space travel, which can alter the biological pathways within cells, causing them to eject DNA and RNA, which can initiate gene-mutation in human body.