Effects of Space Travel on Astronaut Health

Why in News?

Recent research published in 2024 reveals the effects on the health of astronauts who participated in SpaceX's Inspiration4 mission (2021), the first all-civilian team to orbit the Earth.

> *The human body evolved over millions of years to function optimally in the earth's environment, includes its gravity, atmospheric composition and relatively low levels of radiation.*

- **Physiological challenges - DNA damage-** High-energy radiation can damage DNA.
- **Increased cancer risk-** High-energy radiation can increase the risk of cancer.
- **Neurodegenerative effects-** Cosmic radiation may increase the risk of developing neurodegenerative diseases such as *Alzheimer's disease and Parkinson's disease.*
- **Gastrointestinal effects -** Without gravity to help move food through your GI tract, the intestinal system can decrease motility.
- **Vision changes -** Without gravity, bodily fluids shift upward, leading to facial swelling and increased intracranial pressure, which can affect vision.
- It can attribute to a condition called *Spaceflight Associated Neuro-Ocular Syndrome (SANS).*
    - Dysfunction in subcellular structures called mitochondria plays a role in SANS.
- **Bone density loss -** The lack of mechanical loading on bones and muscles associated with the leads to bone density loss and muscle atrophy.

> *Astronauts can lose 1-2% of their bone mass every month they spend in space and up to 10% over a six-month period (on Earth, older men and women lose bone mass at a rate of 0.5%-1% every year).*

- **Cardiovascular changes** – The heart and blood vessels struggle to adapt, complicating blood pressure regulation after return.
- Orthostatic intolerance: The changed gravity field can cause orthostatic intolerance.
- Altered heart electrical rhythm: The changed gravity field can alter heart electrical rhythm.
- **Psychological challenges - Social isolation -** The isolating nature of space travel can have profound effects on the mind.
- Long-duration missions in spaces with ***limited natural stimuli*** cause sleep disturbances, mood swings, cognitive decline and interpersonal conflicts.
- **Post-mission recovery** – Astronauts will ***undergo physical rehabilitation*** to help

them regain strength, balance and coordination after returning from space.

- **Research needed areas -** While it is known that space radiation elevates cancer risk, accelerates aging and induces cellular damage, the precise biological mechanisms of following remain unclear.
    - Limited data on lung function in space
    - Role of Mitochondria in cellular energy production and repair.
    - Effects on long-term brain function and neuroplasticity unclear.
    - Reproduction in Space embryonic development and multi-generational effects on human in space unknown.
    - Critical gap for space colonization, a potential topic in geopolitics and future human survival.

Reference

[The Hindu | Effects on Human Health Caused by Space Travel]