LIVING IN SPACE HARMS YOUR BODY

(1) Have you ever dreamed of being an astronaut, or are you interested in the topic of space exploration and travel? Very few people have ever travelled into space and those who have are usually possessed with an immense curiosity for the unknown. We understand so little about space, but one thing we are beginning to grasp is that a prolonged time spent in space is actually quite harmful to the human body. Unless we figure out how to stop this damage, any thoughts of human prolonged space travel are not possible.

(2) One major cause of concern is the loss of bone mass in the absence of gravity. Bones have been designed to provide us with the support needed to counteract the force of gravity pulling down on our bodies when we're on Earth. On Earth our bone tissue is being broken down by cells called osteoclasts but cells called osteoblasts function to regenerate the bone tissue so that overall bone density remains constant in a healthy adult. When gravity is eliminated or lessoned, bones have a much lower load applied to them so they have no need to be as strong or dense. This causes osteoclast activity to increase which decreases bone tissue and it inhibits osteoblast activity which prevents bone regeneration. In space, bone tissue is lost at a rate of 1%-1.5% a month with the most dramatic losses seen in the vertebrae, hips and femur which are the primary bones that hold up most of the body's weight on Earth.

(3) This type of bone loss is called spaceflight osteopenia and it leaves bones brittle and easy to break during a fall. A six month stay in space will remove almost 10% of a person's bone mass. This might not seem like a lot, but it will take at least 3-4 years back on Earth and rehabilitation to regain this lost bone. Any trip from Earth to Mars will take 6 months of space travel and 6 months back. It will also involve a 18-20 month stay on the surface of the planet to wait for the proper planet alignment to enable the return flight to Earth. Mars also only has 1/3 of the gravity of Earth, so bone can't be regenerated properly while on Mars.

(4) Another negative impact of space travel on the body is muscle atrophy (shrinkage). Similar to bones, many of your muscles have the

responsibility of supporting your body against gravity. In space, the back and leg muscles are especially affected and start to atrophy extremely quickly. Without proper daily exercise, an astronaut loses up to 20% of their muscle mass in just 5 to 11 days! After a long stay in space, astronauts returning to Earth from the International Space Station cannot immediately stand. They need to go through medical monitoring and physiotherapy to regain their strength to first sit and then stand up. The longer an astronaut spends in space, the longer the rehabilitation needed when they return. This is the part of being an astronaut that is not so much fun or glamorous.

(5) To slow down muscle atrophy, the International Space Station is equipped with machines that aid in retaining muscle strength and mass. One machine is called the aRED which stands for Advanced Resistive Exercise Device. They also have a treadmill onto which astronauts strap themselves down using bungee cords, as well as a stationary bicycle for exercise. Astronauts have to exercise at least 2 hours a day to prevent the worst cases of muscle atrophy though it doesn't help with the bone loss. Luckily the effects of bone and muscle loss are reversible when astronauts return to Earth and are given enough time, and the proper diet and exercise.

(6) Another issue with weightlessness is that the fluids in the body, which comprise 60% of the body, get redistributed. On Earth, fluid is mostly in the lower body, but in space, the fluid moves toward the upper body. As well, a lot of the water found in the blood begins to move out into the tissues which has many negative side effects.

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(7) The water loss decreases blood volume by about 20%. This means that there is less blood for the heart to pump and this causes the heart muscle to atrophy. Once astronauts return to Earth, their hearts are weaker and sometimes are unable to pump enough blood to the brain, so astronauts are prone to fainting. As well, fluid in the upper body causes it to build up in the face causing the face to become very puffy and giving astronauts a look that is termed "moon face". The fluid in the head also causes sinus and nasal congestion that give astronauts the symptoms of a head cold that can last the entire span of the mission. The increased fluid pressure in the head also exerts a lot of pressure on the back of the eyeballs. This affects their shape and causes damage to the optic nerve. This is of huge concern to space agencies as the vision damage is hard to reverse. Even if we find solutions to bone loss and muscle atrophy, there will be no use sending astronauts on long space missions to Mars, or anywhere else, if they become blind in the process.

(8) These are just some of the major problems caused by living in space. Other problems include a disruption to your sense of balance, immune system depression, sleep disturbance, loss of taste and smell and the last one is especially disturbing…excessive flatulence (farting)! This is especially horrible when living in a small and crowded space vessel without a window to crack open.

Article Questions

1) What do osteoclasts and osteoblasts do?

2) What is spaceflight osteopenia and what causes it?

3) How does 6 months spent in the International Space Station affect an astronaut's bones?

4) Why do muscles atrophy in space, how quickly does this happen and what can be done to slow this down?

5) In 2006, Heide Stefanyshyn-Piper, an astronaut who returned from a 12 day space mission, fainted twice during a welcome home ceremony. Explain what caused this to happen.

6) Describe the vision problems that can be caused by prolonged space missions.