

Astronauts' Children Unlikely to Inherit Cosmic Ray-Induced Genetic Defects

April 14 2005

Male astronauts exposed to cosmic rays in space are not likely to pass on possible mutations caused by the rays to their offspring, according to a new study by a collaboration that includes a scientist from the U.S. Department of Energy's Brookhaven National Laboratory. The results are published in the April 11, 2005, online issue of the Proceedings of the National Academy of Sciences.

“We concluded that one hazard to male astronauts as a result of exposure to cosmic rays - high-energy, heavy nuclei that zoom in from deep space - is probably temporary sterility, but not significant effects to their future offspring,” said biophysicist Richard Setlow, the Brookhaven scientist who participated in the research.

Cosmic-ray exposure could pose serious health risks to astronauts, who are not protected by Earth's atmosphere and magnetic field - natural defense systems that prevent most cosmic rays from reaching the ground. Compared to high-energy electromagnetic radiation, such as x-rays and gamma rays, cosmic rays may cause more severe damage to cells and are more likely to result in gene mutations or cancer. Scientists are now using animals to model the health effects of cosmic-ray exposure on humans.

To test how cosmic-ray exposure might affect the children of astronauts, Setlow and his collaborators used Medaka fish, which are small fresh-water fish native to Japan, South Korea, and China. The group exposed male Medaka to one of two types of high-energy nuclei - iron and carbon

- that simulate cosmic rays. The iron-nuclei exposures were performed at Brookhaven's Alternating Gradient Synchrotron facility, and the carbon exposures were carried out at the National Institute of Radiological Sciences in Chiba, Japan.

After exposure, the males were mated to non-exposed females. Fifteen to 20 embryos were collected daily for several months and observed under a microscope at the University of Tokyo. "Medaka fish were an excellent system to use for this study," said Setlow. "Their biggest advantage is that the covering of their embryos is clear, allowing us to visually observe mutations within a few days of fertilization."

The researchers looked for particular signs that the male Medaka - specifically, their sperm - had been damaged by the nuclei: dead embryos, which pointed to the presence of dominant lethal mutations, and color abnormalities, which indicated that a permanent, but not lethal, genetic change had occurred.

The group found that, in total, mutations resulting from exposure to iron and carbon nuclei occurred somewhat more frequently than mutations in fish exposed to gamma rays, which served as a control group. But within the total, dominant lethal mutations occurred far more frequently than color mutations. This indicates that sperm cells in male astronauts exposed to cosmic rays are more likely to die (causing temporary sterility) than undergo a non-lethal mutation that could pass on to children.

Source: Brookhaven National Laboratory

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