Twenty-One Days of Lunar Environment Alters Muscle Fiber Areas in Mouse Gastrocnemius

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ABSTRACT

Currently, astronauts that work in space are vulnerable to the detrimental effects the environment can have on their body, and measures should be taken to help prevent and protect the well-being of those who may be susceptible. As NASA strives to someday return to the Moon, it is abundantly clear that we know little about the long-term effects of habitation on the Lunar surface. The effects of Lunar gravity (approximately 1/6th of our own) paired with potential exposure to galactic cosmic radiation (GCR) on skeletal muscle is relatively unknown, and may have serious implications on the success of future Lunar missions and astronaut health. The key point in this study was to analyze the effects of simulated lunar gravity, through partial loading, on muscle fiber size with GCR, using either ^{28}Si or ^{56}Fe. **Methods:** Female BalbC/ByJ mice (4 months) were separated into weight bearing (CC) or partial suspension with a load equal to 1/6th body weight (G/6). Groups were further divided by radiation species, receiving either 50cGy of 300 MeV ^{28}Si, 1 GeV ^{56}Fe, or a sham exposure. A single whole-body irradiation was carried out at Brookhaven National Laboratory on Day 0, and immediately followed by 21 days of full or partial loading. At the end of the study period, the gastrocnemius muscles in each of the mice were collected and prepared for histology, cut in 10 **μm** cross sections, underwent hematoxylin & eosin staining, photographed, and analyzed for average fiber area. **Results**: Compared to control values, average fiber area in partially loaded animals was significantly reduced ($p<0.05$). In the presence of ^{28}Si or ^{56}Fe exposure, average muscle fiber diameters were significantly greater in the G/6 groups compared to their non-irradiated controls, but exposure did not contribute to additional gains in diameter for irradiated CC animals. **Conclusion:** These works are the first known data to demonstrate that simulated Lunar gravity reduces average fiber area in muscle, and whole-body exposure to heavy ion doses similar to those present in GCR during partial loading appears to mitigate some of losses seen by partial loading alone. But as there were no discernable alterations in fiber area in irradiated loaded controls, we feel that further studies are needed to explain why GCR exposure, regardless of ion species, results in increased fiber diameter in partially loaded muscle.

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