**Determining the Importance of In-Flight Treadmill Running Capabilities for Maintaining Astronaut Health and Performance**

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**BACKGROUND:**

Physical deconditioning induced via spaceflight is most effectively attenuated through in-flight exercise training. Throughout its evolution, NASA has implemented advancements to in-flight exercise countermeasures, culminating in the triad of devices currently used aboard the International Space Station (ISS): a treadmill (T2), cycle ergometer (CEVIS), and resistance exercise device (ARED). Despite high-quality exercise devices and prescriptions, many crewmembers experience reductions in both aerobic capacity (VO2peak pre-post mean change: -10%) and strength (knee isokinetic pre-post mean change: -15%). As NASA moves towards exploration missions, which will impose greater size, power, and time constraints on exercise systems in addition to physically demanding surface extravehicular activities (EVAs), providing robust capabilities to protect crew health and performance should be prioritized.

**OVERVIEW:**

Future missions to the Lunar and Martian surfaces will include EVAs requiring ambulation and greater physical exertion than those in Apollo missions. While the exercise device concepts planned for exploration missions include resistive and aerobic capabilities, they do not allow for ambulation. Specifically, the countermeasure planned for Artemis Lunar transit is a flywheel device, which provides both exercise modalities through a single resistive cable. While more robust than the flywheel, the devices planned for the Lunar orbital space station, and subsequent Mars habitats, will provide distinct aerobic and resistance modalities capable of achieving high intensities. However, these modalities do not include a treadmill. Recent research suggests that greater in-flight running intensity and volume attenuate decrements in aerobic capacity and strength; however, this has not been experimentally confirmed. The Exploration Exercise Treadmill Requirements study is currently underway, aiming to determine the effects of exercising without a treadmill on aerobic capacity, strength, bone density, and sensorimotor function during long-duration spaceflight.

**DISCUSSION:**

Providing running capabilities on future exploration missions may help to maintain astronaut physical ability, reduce injury, and promote health. Studies quantifying the effects of using exploration exercise devices are in progress, which will help provide critical recommendations on whether a treadmill is a necessary component of the in-flight training regime. This presentation will discuss the capabilities of exploration exercise devices and the potential implications of not having running capabilities during long-duration spaceflight.