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LUNAR GRAVITY IS SUFFICIENT TO PREVENT SKELETAL MUSCLE ATROPHY, BUT NOT MUSCLE MYOFIBER TYPE TRANSITION IN MICE.

Abstract

Alteration in gravity influences the homeostasis of various tissues, especially weight-bearing skeletal muscle. Owing to its high plasticity to environmental change, skeletal muscle is an ideal model for studying physical responses to gravitational alteration. On the other hand, the precise role of gravitational load on skeletal muscle adaptations remains unclear. Previously, we developed a multiple artificial gravity research system (MARS), which allows us to study the effect of gravity ranging from microgravity to Earth gravity (1 g) on mice in the International Space Station. Here we show that skeletal muscle size and myofiber type are regulated by different gravitational thresholds. We studied the effects of three different gravitational levels (microgravity, lunar gravity (1/6 g), and 1 g) on skeletal muscle adaption in mice using MARS. The soleus muscle, mainly composed of slow-twitch myofibers and susceptible to gravitational change, atrophied under microgravity. Although the degree of muscle atrophy was suppressed by lunar gravity, such reduced gravity failed to prevent the slow-to-fast twitch myofiber-type transition in the soleus muscle during space flight. These results suggest that lunar gravity is sufficient to maintain a proteostasis state, whereas greater gravitational force is required for preventing the myofiber-type transition in the soleus muscle. Using space as a platform, our data is the first demonstration to indicate that different gravitational thresholds may exist for skeletal muscle adaptation. This work will be a stepping stone for elucidating the effect of gravity on the development and adaptation of various organisms.