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EFFECTS OF LOCOMOTOR GAITS UNDER SIMULATED REDUCED GRAVITY CONDITIONS ON MUSCLES AND JOINTS OF THE LEG

Abstract

Past research efforts have focused on the difference in energy expenditure between different locomotion methods in fractional gravity at varying speeds, suggesting that skipping is energetically more efficient than walking and running in these environments. While skipping may be more beneficial from an energy expenditure standpoint, the full range of reasons behind the gait transition and locomotion style selection have not yet been applied to this research. These factors include damage to the muscles of the leg, which is partially prevented by a transition from walking to running. In a space environment, these factors may play a role in astronaut health and injury prevention. For this study, subjects used 3 locomotion methods (walking, running, and skipping) on a treadmill while being physically supported by one of NASA's calibrated analogs for activity on other planets called the Active Response Gravity Offload System (ARGOS). These intervals were performed under Earth gravity conditions (1g) as a control, and under simulated reduced gravity conditions equal to that of Mars (.38g) and the moon (.17g) on intervals from 2-6 mph. Electromyography (EMG) was used to monitor muscle activation during these tests, along with the Vicon motion capture system for 3D motion analysis of ankle joint angles and forces. This study introduces a set of mean and standard deviation data for muscle activation, ankle joint angle and force measurements for simulated Martian and Lunar conditions at varying speeds as a foundation for future research. Additionally, this study employs ANOVA and t-tests to determine the significant differences between locomotion methods in the simulated environments and explores the possible long-term effects of movement in novel space environments caused by muscle activation patterns and forces exerted on the muscles and joints of the lower leg.