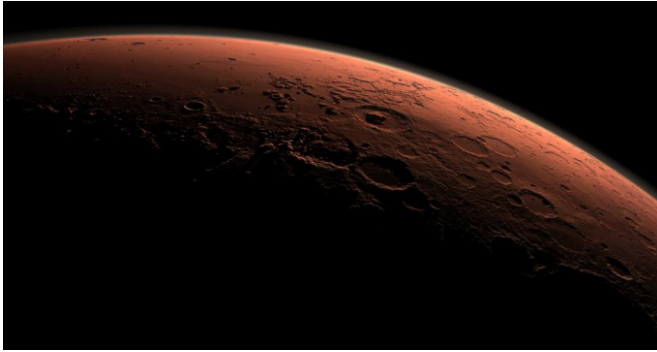


What happens to our muscles during spaceflight and when living on Mars?

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Credit: NASA

The inactivity of astronauts during spaceflights presents a significant risk to their muscles, says a new study in *The Journal of Physiology*. Scientists have simulated the impact of 21 day spaceflights on the body, and the impact of low gravity environments such as the Moon or Mars.

During spaceflights, and in future habitats on the Moon or Mars, humans are or will be exposed to a condition of "microgravity", in other words to a gravitational field much smaller compared to that present on Earth. This environmental stress has negative consequences on many organs, systems and functions of the body, including bone, muscle, plus the cardiovascular, respiratory and nervous systems. Spaceflights and reduced gravity habitats will expose astronauts also to low [oxygen](#) environments. The hypoxic stress will therefore be superimposed upon that related to reduced gravity.

Mitochondria are found in cells and they use oxygen to produce energy in a process called oxidative metabolism. People use their skeletal muscles for movement, and therefore to be active requires oxidative metabolism by these muscles. The muscles need for oxygen led researchers to think that the low oxygen ("hypoxic") environments

of [spaceflight](#) or future planetary worlds would impair function. However, they found that [inactivity](#) itself may have a more pronounced effect on [skeletal muscle](#) than a lack of oxygen.

The results demonstrated that the impairments following microgravity were not aggravated by hypoxia. Given that inactivity and hypoxia are frequently associated with several important cardiovascular and respiratory diseases there is a suggestion that for skeletal muscle, inactivity is worse compared to hypoxia. If confirmed, this finding would have obvious relevant consequences on therapeutic and rehabilitative interventions: correction of hypoxia could be less critical than correction of inactivity.

As well as for astronauts, this research could have a significant impact in patients with chronic diseases characterized by immobility and hypoxia.

The study led by physiologists from the University of Udine was carried out in conjunction with University of Pavia, Trieste, the Milano Polytechnic, University of Munich, Nottingham, German Aerospace Center, Swedish Aerospace Physiology Centre, Jožef Stefan Institute from Ljubljana, Slovenia (Coordinator of the Study) and Simon Fraser University, Burnaby. The researchers evaluated the mechanisms by which the tissue obtains energy by burning sugars and fats by the intervention of oxygen during exercise, on the knee extensors of one leg in 11 active men. Mitochondrial respiration was also evaluated on skeletal [muscle](#) fibers by biopsy.

It is important to note that another study from the research group (the PlanHab Project), looking at whole-body exercise, found that hypoxia did in fact aggravate the impairment caused by microgravity alone. This suggests that the effects of hypoxia could be more significant during whole body exercise, in which the stress on the cardiovascular system is more pronounced.

Bruno Grassi, the chief investigator on the project said:

"This research will help prepare astronauts for spaceflight and it improves our understanding of how muscles respond to long periods of inactivity in association with [hypoxia](#).

"Future studies will have to investigate in more detail the mechanisms responsible for the observed findings. The results obtained on skeletal muscles, moreover, will have to be interpreted in conjunction with those deriving from other studies of the PlanHab project, dealing with the cardiovascular, respiratory, immune and central nervous systems and metabolism."

More information: PlanHab*: hypoxia does not worsen the impairment of skeletal muscle oxidative function induced by bed rest alone, *Journal of Physiology* (2018). [physoc.onlinelibrary.wiley.com ... doi/10.1113/JP275605](https://physoc.onlinelibrary.wiley.com/doi/10.1113/JP275605)

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