Human Space Flight to Mars

Health Risks and Social Aspects Associated to a Long Period Trip to Mars

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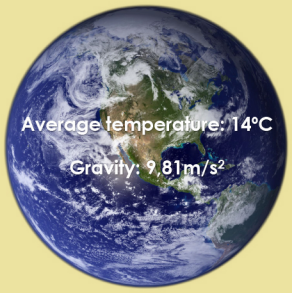
Introduction

Almost fifty years after the human landing to the Moon, space organizations fight their own way to Mars. During spaceflight, astronauts are exposed to extremely harsh conditions. Apart from them, they will face other challenges related to their stay in Mars.

The aim of this project is to identify and explain the health risks associated with a long-term human mission to Mars, as well as to give an insight into the social aspects of the mission.



Methodology

An initial Google search using the terms "manned-mission to Mars" and "health risks" followed by multiple searches in Pubmed and Google Scholar databases was performed.

The work presented hereby is the result of a literature review on the topic. Nonetheless, the project consists on a brochure under the name "**The Red Planet**: *are we ready?*" designed with Publisher 2013®.

Major hazards of the mission

1. Crew Selection. Women in Space

The aspects evaluated in crew selection are:

- Physiological adequacy
- Psychological adequacy
  - **Interpersonal compatibility**

Need for analogues of Mars' conditions

Figure 1. Mars Desert Research Station (MDRS), Utah
Mars' analogue facility built by Mars Society

Only **10%** of the astronauts sent to space by NASA were females.

Could an all-woman crew to Mars be a reasonable proposal?

2. Spaceship

Spaceship conditions
- Limited resources
- Enforced interaction within crewmembers
- Time-delayed communication with the Earth

→ **Stressful environment**
- Sleep deprivation
- Hyperactivation of HPA axis

→ **Crew response**
- Mood alteration
- Cognitive detriment

3. Radiation

The radiation experienced in outer space comprises:

- **Galactic Cosmic Rays** (GCR)
- **Solar Energetic Particles** (SEP)

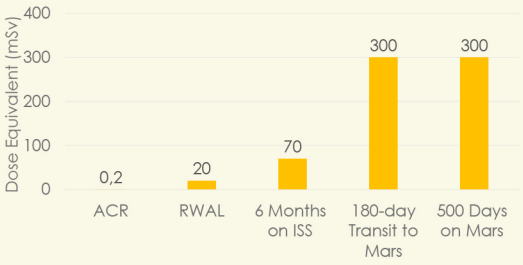


Figure 2. Comparison of dose equivalent
ACR: Annual Cosmic Radiation (sea level), RWAL: Radiation Worker Annual Limit (by DOE), ISS: International Space Station (average) (2)

Such levels of radiation could have dramatic effects in:

- **Cancer development** → DNA damage and mitochondrial dysfunction
- **Neurodegeneration** → synapsis disorganization and decrease in dendrite density

4. Microgravity

The human species has evolved in an "unchanging gravitational field", the Earth. Microgravity environment triggers changes in human physiology that are unfavorable for optimal functioning.

Some of them are listed below:

- **Muscular atrophy**
- **Spaceflight osteopenia**
- **Hearth deconditioning**

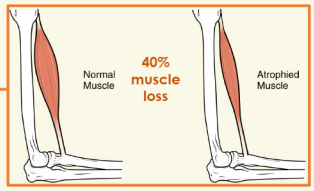


Figure 3. Comparison between normal muscle (left) and atrophied muscle (right) (3)

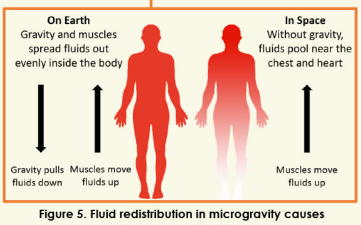


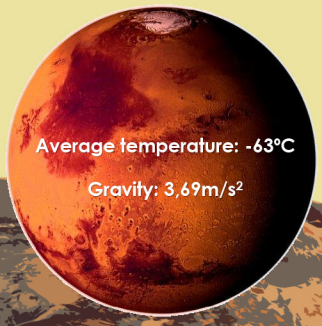
Figure 5. Fluid redistribution in microgravity causes heart deconditioning

Figure 4. Normal bone density (left) and compromised bone density (right) (4)

Countermeasures and Recovery

Although some pharmacological treatments have been studied, exercise and diet are the best options available to counteract microgravity. As for radiation, spacecraft shielding is the solution.

Upon return to the Earth, astronauts are likely to suffer some long-term effects. The most frequent one is postflight orthostatic intolerance.



Conclusions

Crew safety is a top priority in any space mission. The potential hazards have been identified but we lack the means to protect the crew against them.

The effects of spaceflight in the human body are dangerous and seem to have irreversible consequences, such as neurodegeneration.

It is important to redefine the need for such mission.

Image references

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