IAF/IAA SPACE LIFE SCIENCES SYMPOSIUM (A1)
Medical Care for Humans in Space (3)

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UNDERSTANDING OF THE EFFECTS OF SPACEFLIGHT ON HUMAN HEALTH: FUTURE CONTRIBUTION OF THE ITALIAN SPACE AGENCY

Abstract

Thorough study of the effects of spaceflight on human physiology and biology is crucial in the perspective of human deep space exploration. Furthermore, human responses to spaceflight in many cases mimic the onset of health outcomes associated with aging and debilitating chronic human diseases on Earth. Thus, spaceflight offers both the opportunities to analyze these rapid physical changes and to test therapies in accelerated aging or disease models. The Italian Space Agency (ASI)'s Human Spaceflight Program started over 20 years ago, in 2000, and it is nurtured by intense collaboration with both NASA and ESA. In the framework of its national mission of promoting and fostering the culture of space across the Country, ASI promotes national research aimed at mitigating health risk from long-duration spaceflight and supporting the development of new skills. To date, ASI has performed over 80 experiments on the International Space Station (ISS), which advanced our knowledge in human research, biology and biotechnology, technology demonstration and physical sciences. We present the experiments planned for the near future by ASI on board the ISS in the field of Space Life Sciences.

Exposure to microgravity leads to a headward shift of body fluids, and it is associated with medical issues that could compromise mission safety and success of future planetary space explorations. Drain

Brain 2.0 (2024) aims to validate a cervical plethysmography system as a portable, non-invasive and easy-to-use instrument for the systematic monitoring of cardiovascular parameters of ISS crew members. This will contribute to understanding the phenomena of physiological adaptation and to identifying possible thrombosis due to physical stress in microgravity.

Monitoring astronauts' radiation exposure is key to reduce the biological risks due to excessive radiation exposure during long missions (Mars) and long-term stays in space stations (ISS, Lunar Gateway, Mars). The IRIS project (2024) foresees the implementation of crew personal dosimeters to be worn 24/7 and to monitor in real-time radiation impinging from 360.

Planning and self-sufficiency will be key to the success of future human missions beyond LEO (Low Earth Orbit). Long-term maintenance of crew health and performance mainly relies on prevention, early diagnoses, condition management, and medical interventions in situ. The APHRODITE project (2025) aims to develop a compact and versatile analytical device to measure biomarkers of immune system dysfunction from saliva samples on board the ISS. This can provide an in-flight medical diagnostic capability and support a telemedicine approach to maintaining the astronauts' health.