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OVERVIEW OF HUMAN-ENVIRONMENT INTERACTIONS STUDY IN 180-DAY INTEGRATED
 EXPERIMENT ON CONTROLLED ECOLOGICAL LIFE SUPPORT SYSTEM (CELSS)

Abstract

The exploration of deep space would be a huge challenge to human survival and health. In order

to investigate the key technology of life support and health maintenance in the deep space exploration and interplanetary mission, a controlled ecological life support system (CELSS) consist of four Plant modules, two Habitable modules, Life Support module, and Resource module was built in Shenzhen. and an integrated experiment was prepared to validate the capability of regeneration of water, air, food, and recycling of waste. These experiments would provide a scientific platform to study the human-environment interactions due to the following features: (1) The parameters of environment and rhythm could be artificially designed; (2) Precisely planned and continuous monitoring of diet, metabolites and exercise; (3) comprehensively integration of the individual's multidimensional health parameters; (4) Dynamic modeling of epigenomic patterns following the environmental exposure; (5) The methods of self-support on health monitoring and maintenance, and its combination with extravehicular medical support. Meanwhile, a cluster of research projects was integrated to explore the Human-environment Interactions in 180-day integrated experiment on CELSS: (1) study on the human adaptation and changing pattern for rhythm shuttle between Earth and Mars. Mars day (24 h 39 min) will be set during the period of the 72-108th day, and the physiological signals with wearable device and rhythm, stress related biochemical indicators by ELISA and RT-qPCR methods will be measured. (2) Research on the varying pattern of crewmembers' metabolomics and gut microbome in the condition of planed diet and exercise. (3) Study on the psychological effects of 180-day confinement to crewmembers. Try to demonstrate the physiological, biochemical and molecular parameters of omics related with psychological data. (4) Study on crew cardiovascular function adaptability and the relationship with behavior and metabolism. (5) Epigenetics research. In this experiment, we expect to access the changes of epigenetic information by gene chip, deep sequencing and mass spectrometry, meanwhile modeling the relevance of blood cell DNA methylation and environment, rhythm, diet and other health indicators, evaluating its potential values on environmental exposure monitoring and health prediction. (6) The exploration of innovative, human potential based health monitoring and maintenance technology utilizing traditional Chinese medicine (TCM), Infrared thermal imaging technology, a regular exercise of taichichuan to module on crew emotion, sleep and mental health. In this report, we will introduce the platform characteristics, objectives, research contents and methodologies on human-environment study in the 180-day integrated experiment on CELSS.