Physiological Health Challenges for Human Missions to Mars

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During the next decades, manned space missions are expected to be aiming at the Lagrange points, near Earth asteroids, and Mars flyby and/or landing. The question is therefore: Are we ready to go? To answer this with a yes, we are currently using the International Space Station to develop an integrated human physiological countermeasure suite. The integrated countermeasure suite will most likely encounter: 1) Exercise devices for aerobic, dynamic and resistive exercise training; 2) sensory-motor computer training programs and anti-motion sickness medication for preparing EVAs and G-transitions; 3) lower limb bracelets for preventing and/or treating the VIIP (vision impairment and intracranial pressure) syndrome; 4) nutritional components for maintenance of bone, muscle, the cardiovascular system and preventing oxidative stress and damage and immune deficiencies (e. g. omega-3 fatty acids, PRO/K, anti-oxidants and less salt and iron); 5) bisphosphonates for preventing bone degradation.; 6) lower body compression garment and oral salt and fluid loading for landing on a planetary surface to combat orthostatic intolerance; 7) laboratory analysis equipment for individualized monitoring of biomarkers in blood, urine and saliva for estimation of health status in; 8) advanced ultrasound techniques for monitoring bone and cardiovascular health; and 9) computer modeling programs for individual health status assessments of efficiency and subsequent adjustments of countermeasures. In particular for future missions into deep space, we are concerned with the synergistic effects of weightlessness, radiation, operational constraints and other spaceflight environmental factors. Therefore, increased collaboration between physiological, behavioral, radiation and space vehicle design disciplines are strongly warranted. Another venue we are exploring in NASA's Human Research Program is the usefulness of artificial gravity for mitigating the health risks of long duration weightlessness.