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MITIGATING BONE LOSS IN ASTRONAUTS THROUGH THE APPLICATION OF THE 'AGGREGATION OF MARGINAL GAINS' APPROACH

Abstract

Extended duration spaceflight poses significant challenges to the skeletal health of astronauts, with bone loss being a critical concern due to the effects of the microgravity environment during prolonged missions. This presentation explores the application of the 'Aggregation of Marginal Gains' (AMG) approach as a novel strategy to mitigate bone loss in astronauts. The AMG concept, popularized in sports performance, particularly professional cycling, emphasizes making incremental improvements across various aspects to achieve substantial overall gains. In the context of space exploration, this approach involves integrating multiple interventions targeting bone health, ranging from modifying exercise plans, pharmacological intervention strategies, nutrition to advanced technologies such as modifying compounds regulating bone growth.

Key components of the proposed AMG strategy include personalized dietary plans rich in bone-supporting nutrients, individualized exercise regimens incorporating resistive and weight-bearing activities, and innovative technologies such as artificial gravity simulation devices. These interventions aim to address the multifaceted nature of bone loss by synergistically enhancing bone density, mineralization, and overall skeletal strength.

By aggregating these marginal gains, the AMG approach would seek to create a comprehensive and adaptable framework that can be tailored to individual astronaut profiles. The potential impact of this strategy extends beyond mitigating bone loss to promoting overall astronaut health and performance during extended space missions. As space agencies plan for future deep-space exploration, the integration of the AMG approach may contribute significantly to ensuring the long-term skeletal integrity of astronauts, thereby facilitating the success and sustainability of human space exploration.