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POTENTIAL PREVENTION AND TREATMENT METHODS FOR DECREASED BONE MINERAL DENSITY IN SPACE CONDITIONS

Abstract

This paper has been resubmitted to the 2021 IAC after acceptance and withdrawal from the 2020 IAC due to COVID-19.

As the interest in long-duration crewed spaceflight continues to increase for space nations, the concern for prolonged extra-terrestrial effects on human physiology grows too. It is difficult to deny that society's attempt to conquer space will come with the possibility of a variety of adverse side-effects on human health. Ensuring the wellbeing of astronauts to the highest degree possible is a priority for long-duration crewed space missions. A pressing issue that astronauts have notoriously faced is the loss of bone mineral density(BMD).

Prior studies have attributed the deterioration of BMD in astronauts to the increased activity of enhanced bone reabsorbing osteoclasts, and the decreased activity in bone maintenance and growth osteocytes and osteoblasts. In microgravity conditions, BMD loss appears to occur at an accelerated rate relative to Earth conditions. Similar activity of these cells can be found in individuals that suffer from both primary and secondary osteoporosis. This similarity in cellular activity allows treatments for osteoporosis to be considered for countering and preventing BMD loss for space missions.

This paper reviews both treatment and prevention methods of decreased BMD for astronauts. Factors that make certain treatment and prevention options more favourable than others are included such as cost, effectiveness, and side-effects. Considerations made in this paper include the limitations certain pharmaceuticals may have for biological men and women. Treatment methods that are analyzed in this paper are biphosphates such as alendronic acid and ibandronic acid, selective estrogen receptor modulators (SERMS), teriparatide, exercise, vitamin D supplements, and calcium-rich diets. Prevention methods that are analyzed in this paper are biphosphates, exercise, vitamin D supplements, and diets rich in calcium.

Ultimately, substantial evidence suggests that the optimal prevention and treatment method for bone mineral density loss in space involves a calcium-rich diet, regular physical exercise, and biphosphates.