

Renal Stone Risk During Long-Duration Spaceflight: Microgravity-Induced Urinary Changes and Countermeasures

A Narrative Literature Review, Zainab Waseem (JMDC, Pakistan)

Background:

Renal stones represent a potential health risk for long-duration spaceflight. Physiological changes related to microgravity plus dietary and fluid intake factors may contribute to stone formation risk. This can affect both astronaut health and mission operations due to limited medical resources and delayed evacuation during spaceflight.

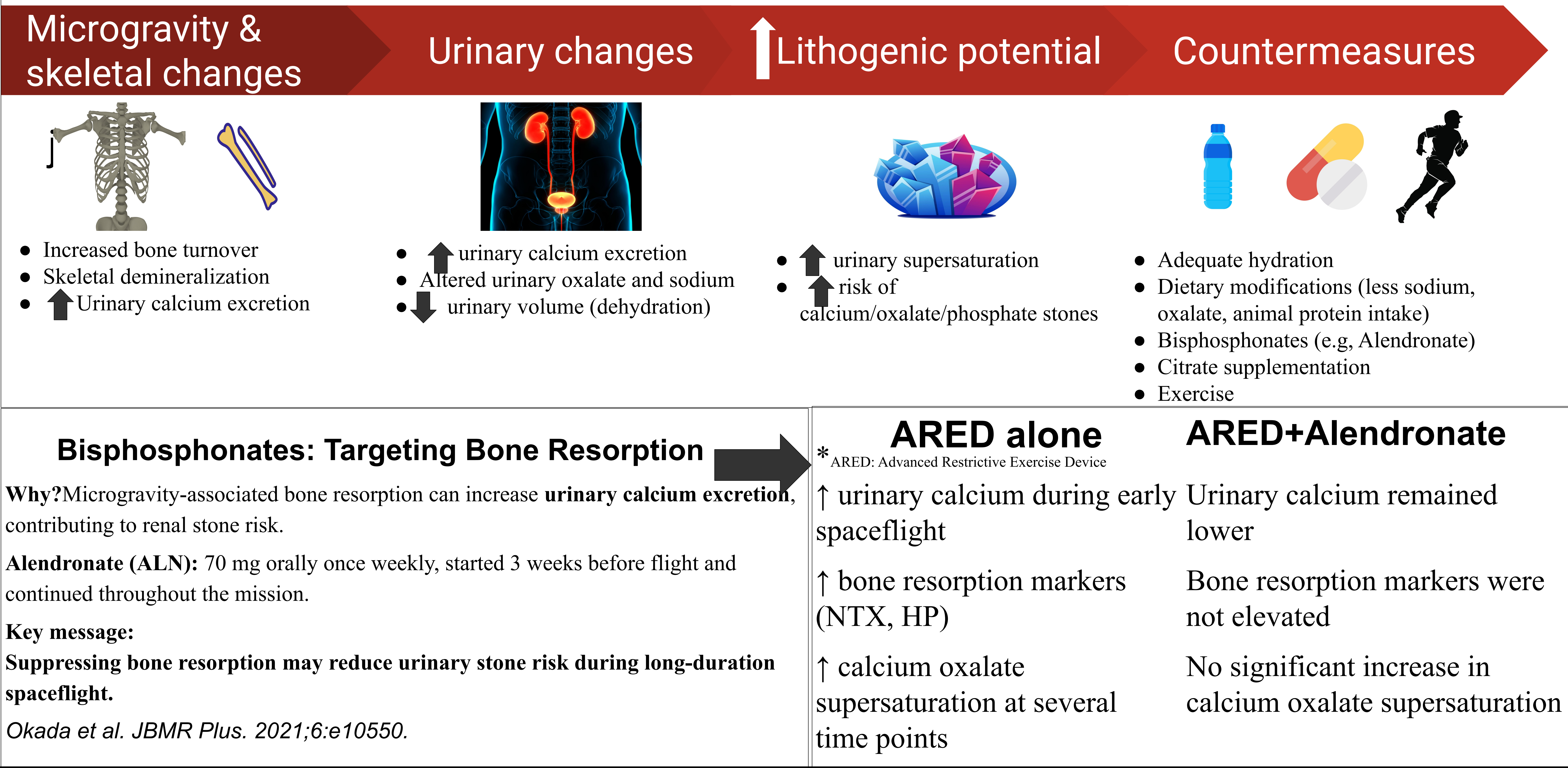
Objective:

To review the available literature on renal stone risk during long-duration spaceflight, focusing on microgravity-associated urinary and skeletal changes, risk factors and preventive countermeasures.

Methodology:

- **Study Design:** Narrative literature review (2016–2026)
- **Sources:** PubMed, Google Scholar, and NASA Technical Reports Server (NTRS).
- **Keywords:** Search combinations of *spaceflight urinary calcium*, *spaceflight renal stones*, and *microgravity renal stones*.
- **Selection Criteria:**
 - **Included:** Human spaceflight and simulated microgravity studies on renal physiology, urinary composition, stone risk factors, and preventive strategies.
 - **Excluded:** Animal studies.
- **Evidence Base:** 18 papers analyzed (including 6 core astronaut studies); human spaceflight data prioritized over simulated models.

Findings:



CONCLUSION:

Renal stone risk during long-duration spaceflight appears to be multifactorial involving skeletal, urinary, nutritional, and hydration-related factor. Evidence gaps include limited human data from long-duration missions and limited validation of findings from simulated microgravity in actual spaceflight. Further research is needed to validate risk markers, evaluate preventive strategies, and develop practical monitoring approaches for future long-duration missions.

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