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How salt hate your bones: the nexus between high dietary salt intake and bone loss

Osteoporosis weaken bones making them fragile and highly susceptible to fractures due to reduction in bone mass via depletion of bone minerals. This leads to higher incidences of fractures many folds responsible for enhanced morbidity and mortality. Osteoporosis affects more than 200 million people worldwide. As per World Health Organization (WHO) osteoporosis leads to higher number of hospitalizations as compared to various other diseases like cardiovascular, diabetes etc. taken together. Osteoporosis has already been reported to weaken the economy with more than 132 billion dollars by 2050. The role of nutrition along with various minerals and vitamins have gained momentum in the recent past for enhancing bone health. Healthy or balanced diet plays an important role in maintaining normal physiology and integrity of bones, but due to changing life styles and love for junk foods the consumption of some of these ingredients have increased many folds. Unlike other nutrients the role of dietary salt (NaCl) intake on bone health has not yet been fully elucidated and with the advent of western diet style worldwide, its consumption has increased to enormous levels (12g /day as against 5g/day prescribed by WHO). Due to higher intake of salt in our daily life, WHO has already set up its goal to reduce the dietary salt intake by 30% by 2025. Excessive intake of salt has already been associated with inflammatory pathologies related to allergies, weakened immunity, cardiovascular, hypertension along with kidney impairments etc. High salt concentrations have been found impairing immune status by skewing the balance of different T cell subsets. Latest studies have depicted a close-knit relationship between high salt intake and bone health and it has been intriguingly found to be responsible for bone loss or increasing risks of osteoporosis.

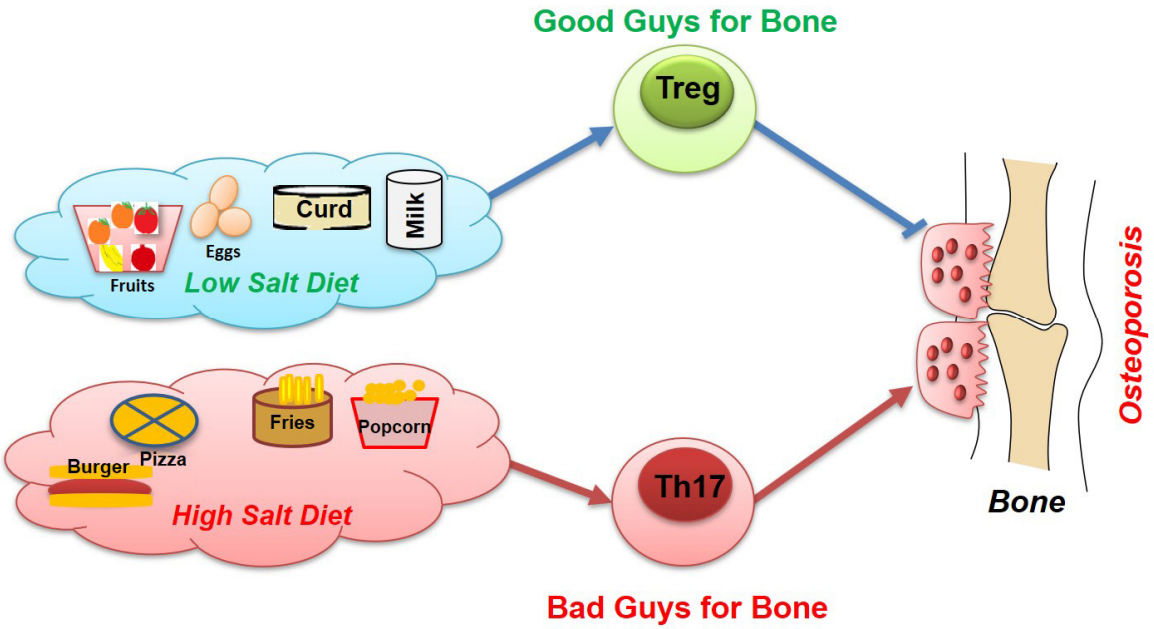

Fig. 1. High dietary salt intake induces bone loss by enhancing bone lethal Th17 cells and suppressing bone protecting Treg cells.

Immune system plays a critical role in protecting the human body from infectious, autoimmune diseases and cancer. Its two main contributors include innate and acquired immunity responses. Immune system has been at the center stage for defining bone health. A delicate balance occurs between host immune and bone systems known as osteoimmunology and any imbalance between osteoclastogenic Th17 and anti-osteoclastogenic Treg cells leads to bone loss. Thus, it becomes inevitable to explore the role of dietary salt in bone health specially in enhancing bone loss via regulating the host immunity through modulating Treg-Th17 cell axis. It has been found that high salt diet augments the bone eating osteoclastogenic cells via the help of Th17 cells by its secretion of cytokines such as IL-17, RANKL etc. On the other hand, the bone protecting regulatory T cells called as Tregs suppress bone eating osteoclasts by producing cytokines such as IL-10 etc. In the present study we for the first time report the role of high dietary salt intake in enhancing bone loss by dysregulating Treg-Th17 cell balance. In our study, we found that high salt intake decreased the Treg cell population with simultaneous increase of Th17 cells *in vivo*. It was further found that this effect of high salt intake was mediated via enhanced expression of osteoclastogenic cytokines (IL-6, IL-17, RANKL and TNF-α) and decreased expression of anti-osteoclastogenic cytokines (IL-10, IFN-γ). Our study thus for the first time establishes the pivotal role of diet, primarily high dietary salt intake on bone health; and thus opens up Pandora's box for future research in the novel field of "Nutritional Therapeutics".

Hamid Y. Dar, Leena Sapra, Surbhi Kumari, Rupesh K. Srivastava
Osteoimmunology Lab, Department of Biotechnology, All India Institute of Medical Sciences (AIIMS), New Delhi-110029, India

Publication

High dietary salt intake correlates with modulated Th17-Treg cell balance resulting in enhanced bone loss and impaired bone-microarchitecture in male mice.
Dar HY, Singh A, Shukla P, Anupam R, Mondal RK, Mishra PK, Srivastava RK.
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