

Abstract

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Moderate zinc deficiency negatively affects biomechanical properties of rat tibiae independently of body composition.

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BACKGROUND: To guide development of novel nutritional strategies aimed at reducing the incidence of stress fractures, we observed the effects of manipulating dietary zinc (Zn) content on bone integrity in Sprague-Dawley rats fed either a severely Zn-deficient (ZnD; 1 ppm), a moderately Zn-deficient (MZnD; 5 ppm) or a Zn-adequate (ZnAD; 30 ppm) diet for 6 weeks.

METHODS: At the completion of the diet period, body composition, bone mineral content (BMC), bone area (BA) and bone mineral density (BMD) were determined in vivo by using dual-energy X-ray absorptiometry. Following euthanasia, long bones were collected for determination of Zn content and biomechanical strength testing.

RESULTS: Despite significant positive correlations between dietary Zn and both body weight (BW) and bone Zn content for the entire cohort ($r=.77$ and $r=.83$, respectively), rats fed MZnD or ZnAD diets did not differ in feed intakes, body composition, BMC, BA, BMD or BW. Tibial bones, but not femur bones, appear to be more responsive to dietary Zn manipulation, as all bone biomechanical strength indices in the ZnAD-fed rats were significantly greater than in rats fed the ZnD diets. Rats fed either MZnD or ZnAD diets had stronger tibiae (129% increase in maximum load and stress at maximum load, $P<.01$) compared with those fed ZnD diets. The load at breakage for the tibial bones of rats fed MZnD diets was not different from the ZnD rats, but lower ($P<.05$) than that of the ZnAD rats.

CONCLUSION: These results suggest that since feed intakes, body composition, BMC, BA, BMD and BW were not significantly different between the MZnD- and ZnAD-fed animals, the reduced bone integrity observed in the MZnD-fed rats resulted from dietary Zn inadequacy, and not as a result of the reduced growth that is typically associated with Zn deficiency.

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