Abstract

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Zinc Deficiency Affects DNA Damage, Oxidative Stress, Antioxidant Defenses, and DNA Repair in Rats.

Song Y, Leonard SW, Traber MG, Ho E.

Department of Nutrition and Exercise Science.

BACKGROUND: Approximately 12% of Americans do not consume the Estimated Average Requirement for zinc and could be at risk for marginal zinc deficiency. Zinc is an essential component of numerous proteins involved in the defense against oxidative stress and DNA damage repair. Studies in vitro have shown that zinc depletion causes DNA damage.

OBJECTIVE: We hypothesized that zinc deficiency in vivo causes DNA damage through increases in oxidative stress and impairments in DNA repair.

METHODS: Sprague-Dawley rats were fed zinc-adequate (ZA; 30 mg Zn/kg) or severely zinc-deficient (ZD; <1 mg Zn/kg) diets or were pair-fed zinc-adequate diet to match the mean feed intake of ZD rats for 3 wk. After zinc depletion, rats were repleted with a ZA diet for 10 d. In addition, zinc-adequate (MZA 30 mg Zn/kg) or marginally zinc-deficient (MZD; 6 mg Zn/kg) diets were given to different groups of rats for 6 wk.

RESULTS: Severe zinc depletion caused more DNA damage in peripheral blood cells than in the ZA group and this was normalized by zinc repletion. We also detected impairments in DNA repair, such as compromised p53 DNA binding and differential activation of the base excision repair proteins 8-oxoguanine glycosylase and poly ADP ribose polymerase. Importantly, MZD rats also had more DNA damage and higher plasma F(2)-isoprostane concentrations than MZA rats and had impairments in DNA repair functions. However, plasma antioxidant concentrations and erythrocyte superoxide dismutase activity were not affected by zinc depletion.

CONCLUSION: These results suggest interactions among zinc deficiency, DNA integrity, oxidative stress, and DNA repair and suggested a role for zinc in maintaining DNA integrity.

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