

Reduction in hippocampal neurogenesis and increase in depression-like behavior in zinc-deficient young rats

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Stress is one of the most potent inhibitors of hippocampal neurogenesis and reduced neurogenesis is thought to relate to pathogenesis of depression. We recently demonstrated that hippocampal neurogenesis is reduced in young rats fed zinc-deficient diet for 4 weeks and that the reduced neurogenesis is restored by feeding normal diet for 2 weeks¹. Zinc deficiency causes abnormal glucocorticoid secretion as well as exposure to stress. It is possible that abnormal glucocorticoid secretion by zinc deficiency increases depression-like behavior and reduces hippocampal neurogenesis. In the present study, serum corticosterone concentration was checked in young rats fed a zinc-deficient diet for 2 weeks.

Serum corticosterone concentration was more increased in zinc-deficient rats after exposure to forced swim stress. Immobility time in the forced swim test was significantly increased in zinc-deficient rats, but not in pair-fed rats, suggesting that the increase in depression-like behavior is due to zinc deficiency rather than decreased food intake². The increase in immobility time in zinc deficiency was restored to the control level by feeding the control diet. These results suggest that abnormal corticosterone secretion after exposure to stress is linked to the increase in depression-like behavior in zinc deficiency.

Exposure to stress and glucocorticoids facilitates the increase in extracellular glutamate in the hippocampus. Extracellular glutamate was more increased in the hippocampus of zinc-deficient rats after stimulation with 100 mM KCl. In hippocampal slices from zinc-deficient rats, the decrease in FM4-64 fluorescence (exocytosis) was more facilitated. It is likely that glutamatergic neurons in the hippocampus are more excited by zinc deficiency after exposure to acute stress. Glutamatergic neuron activity associated with abnormal glucocorticoid secretion seems to contribute to susceptibility to stress and the increase in depression-like behavior in zinc deficiency.

References

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