Association of Prenatal Zinc Consumption With Newborn Brain Tissue Organization and Resting Cerebral Blood Flow

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Objectives: Animal studies have shown that exposure to zinc in the prenatal and postnatal periods is essential for brain structure and functioning in rat pups. Yet, no human studies have examined whether zinc is associated with brain tissue microstructure and metabolism in infants, the basis for neurodevelopmental outcomes. The primary aim of this study was to determine associations of maternal zinc intake in pregnancy with magnetic resonance imaging (MRI) measures of brain tissue microstructure and resting cerebral blood flow (rCBF) in newborns. Our secondary aim was to examine associations of maternal zinc intake in lactation with neurodevelopmental outcomes in infants.

Methods: Mothers (N = 41) were recruited during pregnancy for a prospective cohort study. Mothers completed 24-hour dietary recalls in each trimester. Diffusion Tensor Imaging (DTI) and Arterial Spin Labeling (ASL) were performed on infants using a 3.0 Tesla MRI at 3 weeks. Maps were constructed for DTI measures, including fractional anisotropy (FA) and mean diffusivity (MD), and ASL measures of rCBF. For the secondary aim, a separate cohort of mothers (N = 125) completed 24-hour dietary recalls at 1 and 6 months, and the Bayley-III Scales were administered at 24 months to assess cognition. Linear regressions were used to examine associations.

Results: Adjusting for postmenstrual age, infant sex, infant birth weight, and total energy intake revealed that maternal zinc associated inversely and diffusely with DTI measures. Of note, maternal zinc associated inversely with infant FA toward the midbrain in each trimester (Ps < 0.01), and with infant MD in the peripheral cortex during the first and third trimesters (Ps < 0.01). Maternal zinc also correlated positively with infant rCBF toward the hindbrain ($P < 0.01$). Moreover, maternal zinc at 1 month ($B = 0.03$, $P = 0.04$), but not 6 months ($B = 0.02$, $P = 0.50$), associated positively with infant cognitive development scores at 24 months.

Conclusions: Our findings indicate that early exposure to zinc is associated with features of brain tissue microstructure, metabolism, and cognitive functioning in infants.

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