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Neurotoxicity of early-life manganese exposure in rats

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Background: The developing brain is believed to be particularly sensitive to the effects of metal exposure in utero and during lactation. The effects on offspring of manganese exposure to pregnant/lactating rats have not been studied extensively.

Methodology: Pregnant Sprague-Dawley rats received 10, 2.5, or 0 (control) mg/ml manganese chloride (Mn) in drinking water during pregnancy and continued until the litters were weaned (postnatal day [PND] 21). Learning and memory was evaluated at PND 35 with the Morris water-maze (MWM) task consisting of four consecutive days of acquisition, with probe and cue trials following. The elevated plus maze (EPM) was used as one index of impulsivity on PND 56. Microdialysis was used to measure dopamine and glutamate levels in prefrontal cortex and hippocampus, respectively following stimulation with high K+ (60 mM).

Results: The average daily Mn dam exposures during gestation and lactation were 479± 58 and 1328±89 mg/kg/day (10 mg/ml) and 141±5 and 327±22 mg/kg/day (2.5 mg/ml), respectively. Rats in the high Mn exposure group performed worse than controls on the MWM ($p<0.05$), but not on the EPM. These rats also evidenced retarded growth through PND 42. K+-evoked glutamate, but not dopamine, release tended to be decreased compared to control. Low Mn exposure did not produce any disturbance to growth development, MWM or EPM performance, nor evoked neurotransmitter release.

Implications: We found learning and memory, but not impulsivity, deficits in rats exposed to high Mn in utero and through lactation, as well as reductions in evoked glutamate release.