Neurotoxicants, micronutrients, and child development in context

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Abstract

Systematic research evaluating the separate and interacting impacts of neurotoxicants, nutrients, and developmental contexts on children’s cognition and behavior has only recently been initiated. Years of extensive human epidemiologic and animal experimental research document the deleterious impact of lead and other metals on the nervous system. However, discrepancies among human studies and between animal and human studies underscore the importance of variations in child nutrition as well as the social and behavioral aspects of children’s environments that mitigate or exacerbate the effects of neurotoxicants.

In this monograph, we review existing research on the impact of neurotoxic metals, nutrients, and developmental contexts; interactions across the three domains; and potential mediating pathways. We examine the literature on lead, mercury, manganese, and cadmium in terms of dispersal, epidemiology, experimental animal studies, effects of social and behavioral context, and effects of nutrition.

Research documenting the negative impact of lead on cognition and behavior resulted in reductions by the Center for Disease Control in child lead screening guidelines from 30 _g/dL in 1975, to 25 _g/dL in 1985, and to 10 _g/dL in 1991. A further reduction is currently being considered. Experimental animal research documents lead’s attenuation of glutamate neurotransmitter (particularly N-Methyl-D-Aspartate) activity vital to learning and memory, as well as cholinergic and dopaminergic activity. Elevated blood lead concentrations are more common among children living in poverty and there is some evidence that socioeconomic status and home environments influence lead’s toxicity. Nutrients that may influence the effects of lead include iron, zinc, and calcium.

Research documenting the negative impact of mercury on children (as well as adults) has resulted in a reference dose (RfD) of .1 _g/kg bodyweight/day. In animal studies, mercury interferes with glutamatergic, cholinergic, and dopaminergic activity. Although evidence for interactions of mercury with child social and behavior contexts is minimal,
researchers are examining interactions of mercury with several nutrients: selenium, iron, iodine, and choline.

We close our review with a discussion of policy implications, and we recommend interdisciplinary research that will enable us to bridge gaps within and across domains.