

Neurotoxicants, Micronutrients, and Social Environments

Individual and Combined Effects on Children's Development

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SUMMARY—Systematic research evaluating the separate and interacting impacts of neurotoxicants, micronutrients, and social environments 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 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 social environments and interactions across the three domains. We examine the literature on lead, mercury, manganese, and cadmium in terms of dispersal, epidemiology, experimental animal studies, effects of social environments, and effects of nutrition.

Research documenting the negative impact of lead on cognition and behavior influenced reductions by the Center for Disease Control in child lead-screening guidelines from 30 micrograms per deciliter ($\mu\text{g}/\text{dL}$) in 1975 to 25 $\mu\text{g}/\text{dL}$ in 1985 and to 10 $\mu\text{g}/\text{dL}$ in 1991. A further reduction is currently being considered. Experimental animal research documents lead's alteration of glutamate-neurotransmitter (particularly *N*-methyl-*D*-aspartate) activity vital to

learning and memory. In addition, lead induces changes in cholinergic and dopaminergic activity. Elevated lead concentrations in the blood are more common among children living in poverty and there is some evidence that socioeconomic status influences associations between lead and child outcomes. Micronutrients that influence the effects of lead include iron and zinc.

Research documenting the negative impact of mercury on children (as well as adults) has resulted in a reference dose (RfD) of 0.1 microgram per kilogram of body weight per day ($\mu\text{g}/\text{kg}/\text{day}$). In animal studies, mercury interferes with glutamatergic, cholinergic, and dopaminergic activity. Although evidence for interactions of mercury with children's social contexts is minimal, researchers are examining interactions of mercury with several nutrients.

Research on the effects of cadmium and manganese on child cognition and behavior is just beginning. Experimental animal research links cadmium to learning deficits, manganese to behaviors characteristic of Parkinson's disease, and both to altered dopaminergic functioning.

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.

INTRODUCTION

The primary goal of this monograph is to inform professionals and policymakers in order to protect children who are most susceptible to the effects of neurotoxicants. To attain that goal requires identifying micronutrient deficiencies and social-environment risks linked to maternal and child neurotoxicant

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