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Developmental impacts of heavy metals and nutrition

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Background and hypothesis: A recent Lancet series highlights the enormous loss to developmental potential in young children in developing countries, from exposure to a range of socio-cultural and health risks, especially nutritional deficiencies. The adverse impact of environmental exposures to developmental toxicants such as heavy metals and pesticides has been poorly characterized in developing countries. While both arsenic and manganese exposures have known neurotoxicity in adults, systematic investigation in young children has only recently begun.

Methodology: 590 Bangladeshi 6- and 10-year-olds participated in three overlapping studies. Well water arsenic and manganese were measured from home wells; urine and blood samples were provided, and sociodemographic and household characteristics obtained. Developmental assessments at our local medical clinic employed culturally adapted variants of the WISC-III (age 10) or WPPSI-III (age 6).

Results: After adjusting for social factors, well water arsenic and manganese were both significantly associated with poorer developmental scores at age 10; associations for water arsenic at 6 years were significant, but weaker than for older children.

Implications: Millions in south Asia are exposed to naturally occurring arsenic and manganese through household wells. Exposure to high levels of manganese in drinking water occurs in the United States and worldwide. Stunting from undernutrition affects more than 25% of young children in developing countries. Developmental risks often co-occur; for example, high blood lead levels have particularly adverse consequences among undernourished Jamaican children. The combined neurocognitive loss from both heavy metals exposure and undernutrition, though rarely jointly studied, represents a substantial loss of global potential.