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Autism spectrum disorder prevalence and associations with air concentrations of lead, mercury, and arsenic

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Abstract Lead, mercury, and arsenic are neurotoxicants with known effects on neurodevelopment. Autism spectrum disorder (ASD) is a neurodevelopmental disorder apparent by early childhood. Using data on 4486 children with ASD residing in 2489 census tracts in five sites of the Centers for Disease Control and Prevention's Autism and Developmental Disabilities Monitoring (ADDM) Network, we used multi-level negative binomial models toinvestigate if ambient lead, mercury, and arsenic concen-trations, as measured by the US Environmental Protection Agency National-Scale Air Toxics Assessment (EPA-NATA), were associated with ASD prevalence. In unad-justed analyses, ambient metal concentrations were nega-tively associated with ASD prevalence. After adjusting for confounding factors, tracts with air concentrations of lead in the highest quartile had significantly higher ASD prev-alence than tracts with lead concentrations in the lowest quartile (prevalence ratio (PR) = 1.36; 95 '% CI: 1.18, 1.57). In addition, tracts with mercury concentrations above the 75th percentile (>1.7 ng/m3) and arsenic con-centrations below the 75th percentile (≤0.13 ng/m3)hada significantly higher ASD prevalence (adjusted RR = 1.20; 95 % CI: 1.03, 1.40) compared to tracts with arsenic, lead, and mercury concentrations below the 75th percentile. Our results suggest a possible association between ambient lead concentrations and ASD prevalence and demonstrate that exposure to multiple metals may have synergistic effects on ASD prevalence.

Keywords Metals . Autism spectrum disorder . Environment . Pollution . Air quality

The findings and conclusions in this report are those of the authors and do not necessarily represent the official position of the Centers for Disease Control and Prevention.

Introduction

Autism spectrum disorder

Autism spectrum disorder (ASD) is a developmental disorder characterized by impairments in social interaction, communication, and behavior evident in early development. According to the 2014 surveillance estimate from the Centers for Disease Control and Prevention (CDC), the prevalence of ASD in the USA may be approximately 1 in 45 (Zablotsky et al. 2015). To date, the etiology of ASD has been poorly defined; however, some studies have suggested that ASD may be caused by interactions of susceptible genes with the environment in which environmental triggers may alter gene expression (Volk et al. 2014; Blake et al. 2013; LaSalle 2013; Herbert et al. 2006). Therefore, several investigators have examined the relationships between ASD and exposures to pesticides (Shelton et al. 2012;