

Evaluating Disparities in Birth Outcomes and Drinking Water Quality in California

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Impaired drinking water quality remains a significant public health concern in the United States, with potential adverse effects on birth outcomes. Despite regulatory efforts, some communities face exposure to contaminants regulated under the Safe Drinking Water Act (SDWA), specifically arsenic, raising questions about the adequacy of current standards and enforcement. While studies have linked various drinking water contaminants to adverse birth outcomes, significant methodological challenges persist in arsenic research, including misclassification due to individual consumption patterns and variable susceptibility to inorganic arsenic toxicity. This study employs a difference-in-differences approach with two-way fixed effects to estimate the causal impact of arsenic exposure on birth outcomes in California from 2007 to 2022, focusing specifically on water systems serving populations of $\leq 3,300$ and those serving $\leq 10,000$ residents, where arsenic compliance challenges are particularly acute.

Our empirical strategy leverages the staggered implementation of SDWA arsenic standards, which mandated compliance by 2009 for systems serving $\leq 10,000$ residents and by 2015 for systems serving $\leq 3,300$ residents. The analysis integrates arsenic monitoring data from California's Safe Drinking Water Information System (SDWIS), utility service area boundaries, and individual birth records from the California Department of Public Health. Water quality data reflect treated water measurements collected through the state's mandated monitoring schedules, accounting for potential treatment and blending processes before service delivery. Maternal residential addresses are spatially linked to corresponding water system service areas, merged with utility-level demographic characteristics. We examine birth outcomes, including birthweight, gestational age, obstetric estimates of gestation at delivery, and APGAR scores. The model incorporates maternal residence and year-month fixed effects while controlling for maternal characteristics (age, race/ethnicity, socioeconomic status, smoking, BMI), prenatal care variables, birth characteristics, and paternal factors.

Results suggest potential differences in birth outcomes based on water system size and community characteristics, with particular attention to systems serving $\leq 3,300$ residents in unincorporated, low-income, and communities of color. These findings have important policy implications for the Environmental Protection Agency's regulatory approach to water system capacity and environmental justice concerns. Future research will extend this analysis to systems serving $> 10,000$ residents to comprehensively assess arsenic standard implementation across the full spectrum of utility sizes.