Maternal Urinary Selenium levels and Infant Birth Size

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Abstract

Background: Selenium (Se) is an essential micronutrient, and thus is important for metabolism, growth, and normal function in humans, especially for pregnant women and fetal development. However, deficiency or overexposure of essential mineral nutrients in humans could produce adverse effects including adverse birth outcomes. For example, some studies have reported that deficiency or overexposure of Se is associated with adverse birth outcomes while others found no such association. Prenatal life is considered to be the most sensitive stage of human development to environmental exposures due to high degree of fetal cellular division and differentiation, even at virtually non-toxic levels to their mothers. Thus it is of public health interest to determine if deficiency or overexposure of Se is associated with adverse birth outcomes, and if yes, whether there exists a critical window of vulnerability of prenatal Se levels and subsequent adverse birth outcomes.

Methods: This study was based on data from a prenatal cohort of 273 mother-infant pairs recruited between 2012 and 2014 in Wuhan, Hubei Province, China. The women were aged 20 years or older and less than 16 weeks pregnant at the time of recruitment; term births (≥37 weeks of gestation) and delivered a singleton live birth without congenital malformation; and donated urine samples at each of the 3 prenatal care visits (14-18 weeks for time 1, 23-25 weeks for time 2, and 30-33 weeks for time 3 of gestation). Urinary Se concentrations were measured separately for each of the 3 urine samples, adjusted for urine creatinine levels and expressed as μg/g creatinine. Natural log transformations were applied to create a normal distribution for the creatinine-adjusted urinary Se levels. We examined the confounder-adjusted association between maternal urinary Se concentrations and birth weight (gram), birth length (cm), and Ponderal index (observed birth weight in gr/birth length in cm^3) among term births (≥37 weeks gestation) by examining Se concentrations at each measurement time in separate models and in all together in a single model. Generalized additive models were applied to test for nonlinear

relationships. Potential confounders considered in the analysis included: maternal age, gestational age, parity, and secondhand tobacco smoke (almost no women smoke or drink alcohol in this prenatal cohort).

Results: The geometric means Se concentrations were 18.6, 18.9, and 20.3 μg/g creatinine at the three measurement times, respectively. In the trimester-specific linear regression model, maternal urinary Se concentrations were not significantly associated with birth weight, birth length and Ponderal Index at each measurement time. In the multi-trimester linear regression model, we found urinary Se concentrations at the third measurement time were associated with increased Ponderal Index ($\beta = 0.073$, 95% CI: 0.008 to 0.139). Gestational age was a strong predicator of birth weight ($\beta = 64.43$, 95% CI: 16.87 to 111.99) and birth length ($\beta = 0.28$, 95% CI: 0.12 to 0.45). Secondhand smoke was inversely associated with birth weight ($\beta = -147.29$, 95% CI: -252.39 to 42.20), birth length ($\beta = -0.34$, 95% CI: -0.71 to 0.04) and Ponderal Index ($\beta = -0.07$, 95% CI: -0.13 to -0.01).

Conclusions: In this prenatal cohort study from Wuhan, China, we did not observe a linear or nonlinear association between urinary Se concentrations and adverse birth outcomes as evaluated by reduced birth weight and birth length. We did found urinary Se concentrations at the third measurement time were related to increased Ponderal Index at this point. However, it would be premature to make clinical conclusions on the basis of these data. Well-designed studies with larger sample sizes are needed to further explore the relationship.

Keywords: Selenium; birth weight; maternal urine; prenatal exposure; China