

Title: Combined exposure to heavy metals in PM_{2.5} and pediatric asthma

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ABSTRACT

Background: Asthma is the most common chronic allergic disease in children; it affects more than 300 million people worldwide. Information on the association between exposure to ambient heavy metals and incidence of pediatric asthma is limited.

Objective: We evaluated the effects of heavy metals during pregnancy and infancy periods with asthma and identified a sensitive time window, clarifying the effect of ambient heavy metals on lung development.

Methods: A total of 171,281 children, who were born from 2004 to 2011 in Taichung City, were followed until 2014. Concentrations of ambient heavy metals such as arsenic (As), cadmium (Cd), mercury (Hg), and lead (Pb) were obtained from the Weather Research and Forecasting/Chem model, considering the top 75 emission sources in Taiwan. The distributed lag nonlinear model (DLNM) was used to investigate the relationship between combined exposure to heavy metals in 2.5 µm particulate matter and asthma in pregnant women and 1-year-old infants.

Results: We identified 31,277 new asthma cases from the birth cohort. After adjustment for socioeconomic status, maternal age, maternal atopic, maternal anemia, and maternal kidney disease, DLNM results revealed positive associations of asthma with exposure to Pb during gestational weeks of 1–14 and 32–40, and 1–3 weeks after birth. Regarding the sensitivity analyses, coexposure to Pb and As, coexposure to Pb and Cd, and coexposure to Pb and Hg were positively associated with asthma onset as well.

Conclusion: Our study suggested that combined exposure to Pb, As, Cd, and Hg during early and late gestational weeks was associated with the incidence of pediatric asthma.

Key words: heavy metals, asthma, birth cohort, sensitive windows, coexposure

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Key Messages

- Prenatal exposure to Pb is associated with later development of asthma when considering postnatal exposure.

- Combined exposure to Pb, As, Cd, and Hg during early and late gestational weeks was associated with the incidence of pediatric asthma.
- An IQR increase in Pb during gestational weeks 1–14 and 32–40, and 1–3 weeks after birth were significantly associated with asthma.

Capsule summary: Combined exposure to Pb, As, Cd, and Hg during early and late gestational weeks was associated with the incidence of pediatric asthma. The vulnerable time window may be within early and late gestational weeks.