

DOCTORAL THESIS

Prenatal exposure to organochlorine pesticides and its association with birth outcomes

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ABSTRACT

Organochlorine pesticides (OCPs) were extensively applied in agriculture, industry and public health programs for decades. Based on the persistence and the lipophilicity of OCPs, these chemicals are ubiquitous in the environment and can be accumulated in fatty tissues of animals through the food chain. Even being restricted for years, OCPs are still detected in human bodies. In this thesis, analytical methods for the determination of OCPs were developed and applied for the analysis of cord serum samples. The evaluation of prenatal exposure to OCPs and its effects on birth outcomes as well as the postnatal growth were investigated.

Due to the toxicology and carcinogenesis, biomonitoring of the OCP exposure to human is needed. Therefore, an analytical method with high sensitivity and specificity is required to detect OCPs at trace levels in serum. We compared two data acquisition modes of mass spectrometry (MS), namely selected ion monitoring (SIM) and multiple reaction monitoring (MRM). Higher sensitivity and selectivity were achieved by MRM because the background noise was reduced by lowering the matrix effects. Different ionization techniques, including electron ionization (EI), chemical ionization (CI) and atmospheric pressure chemical ionization (APCI) were evaluated. The EI source is a universal ionization technique available with the MS library for the compound identification. The negative chemical ionization (NCI) is more suitable to analyze compounds with high electronegativity. The novel ionization technique APCI was coupled to gas chromatography-tandem mass spectrometry (GC-MS/MS). The APCI source was evaluated by terms of ionization and fragmentation performance. APCI was a soft ionization technique generating molecular ions with high intensity. The selectivity and sensitivity of APCI were comparable or better than the EI source.

As one of the largest consumers and producers of OCPs, China has suffered severe OCP pollution. Previous monitoring studies reported detectable levels of OCPs in human bodies. However, studies concerning the prenatal exposure to OCPs in China are limited. Due to the vulnerability of fetuses, the effects of prenatal exposure to OCPs could be more severe than those of adults. We collected cord serum samples during the delivery period in Wuhan, China and measured the OCP concentrations to assess the prenatal exposure by using GC-MS/MS. Compared with other areas in China, the OCP levels in Wuhan were comparable in this population. The identified predominant OCPs were β -HCH and *p,p'*-DDE, with geometric means of 8.67 and 33.9 ng/g lipid, respectively. Slight positive associations were found between α -HCH and β -HCH, and between *o,p'*-DDT and *p,p'*-DDT, which indicated similar exposure source of these chemicals. The obtained results showed that HCH levels were associated with maternal age, body mass index (BMI) before pregnancy, education levels, and passive smoking.

Associations between the prenatal exposure of OCPs and birth outcomes were investigated. The sex-specific relationships between the OCP exposure and birth size were indicated. Concentrations of β -HCH were inversely associated with birth weight and ponderal index for boys, while for girls these associations were not significant. Our results suggested that the prenatal exposure to OCPs exerted negative effects on the fetal growth, and precautions should be taken even though the OCP levels were relatively low.

Keywords: organochlorine pesticides, gas chromatography tandem mass spectrometry, ionization technique, prenatal exposure, birth outcomes

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