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Perinatal dioxins exposure: levels, toxic equivalents and relevance of non-dietary exposure

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Objective: We determined the congeners distribution of polychlorinated-dibenzo-p-dioxins (PCDDs) and polychlorinated dibenzofurans (PCDFs) collectively called dioxins, in the breast milk samples collected in Penang, Malaysia. Additionally, dietary intake of dioxins by breastfed infants was estimated.

Methods: An average 50 ml breast milk samples were collected from 13 lactating primiparous mothers (mean age: 33, Standard deviation = 4.3), 4-8 weeks after delivery from December 2015 to February 2017. Test subjects were healthy and lived around industrial and dumping site areas. Quantification of 17 dioxins congeners was performed according to the procedure based on the principle laid by USEPA methods 23, 1613 and 8290 using high resolution gas chromatography/high-resolution mass spectrometry (HRGC/HRMS).

Results: Toxic equivalent levels of dioxins (pg-WHO-TEQ) and concentrations of 17 congeners in breast milks were measured. The highest concentration of the most toxic congeners (TEF=1), 2,3,7,8-tetrachlorodibenzo-p-dioxin (2,3,7,8-TCDD) was 0.18 pg-WHO-TEQ. The most abundant congeners were octachlorodibenzo-p-dioxin (OCDD) (6.7-82.1%), followed by 1,2,3,4,6,7,8-heptachlorodibenzo-p-dioxin (1,2,3,4,6,7,8-HpCDD) (ND-32.3%). The mean level of dioxins was 1.5 pg-WHO-TEQ/g lipid, which is much lower than the level found in mothers from Vietnam hotspots (average 12.9 pg WHO-TEQ/g lipid) which is highly contaminated by dioxins. The total dioxins in pg-WHO-TEQ levels in breast milk were not significantly correlated with maternal age and pre-natal BMI. However, the environmental factor such as workplace and living in the industrial area contributed to the high exposure of dioxins. The average daily intake of 10.8 pg-WHO-TEQ/kg bw/day from individual breast milk was predicted for a breastfed infant at 6 months of age with assumption of 5.5 kg body weight, 640 g milk per day of consumption, 95% of dioxin absorption rate, and linear decline of dioxins during lactation.

Conclusion: Postnatal exposure to dioxins in breastfed infants occurs mainly during breastfeeding.