Dietary Exposure to Dioxins and Dioxin-Like Compounds of Babies in Greece

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The dietary exposure of infants to environmental contaminants is a crucial issue of great social impact. Of particular concern is the exposure of infants and young children to toxic substances that exhibit reproductive and developmental toxicity since these have significant impact to their still developing immunological, neurological and reproduction systems. An important group of such compounds are polychlorinated dibenzo-p-dioxins (PCDDs), polychlorinated dibenzofurans (PCDFs) and dioxin-like i.e. non-ortho and mono-ortho polychlorinated biphenyls (di-PCBs). It has been found that chronic exposure of humans to these compounds causes serious adverse health effects including chloracne, reproductive and developmental effects, neurological and behavioral effects, immunotoxicity, and carcinogenicity [1]. Specifically for infants, health effects include reduced fetal and neonatal growth, neonatal thyroid function disruption, behavioral effects in early childhood, immunologic effects in children It has been established that over 90% of human exposure to these compounds is due to food intake [2]. We undertook the task of investigating for the first time the dietary intake of these compounds in infants living in Greece. We included two age groups: 0 to 6 months, when infants are fed exclusively by breast milk and/or formula milk and 6 to 12 months, when solid food is introduced to infant nutrition. We included analytical results for PCDD/Fs and di-PCBs concentrations in the most popular infant formulae in the Greek market, previous data for breast milk concentrations of PCDD/Fs and dioxin-like PCBs from Greece, and finally analytical data for fat-containing food products from the Greek market. Samples were analyzed at the Mass Spectrometry and Dioxin Analysis Laboratory of NCSR „Demokritos“ that has been accredited according to ISO/IEC 17025. The analysis method includes sample clean-up and determination by gas chromatography coupled to high resolution mass spectrometry (GC-HRMS). The quantification of concentration and recovery was carried out by the isotopic dilution method. The burden of food products by dioxins is expressed as World Health Organization Toxic Equivalents (WHO-98 TEQs) [1]. In the first group, aged between 0 and 6 months, daily intake was separately calculated for exclusive breastfeeding, exclusive formula feeding and for feeding with a combination of human and formula milk (assuming a 50% intake of each). Total daily intake was estimated assuming an average daily oral intake of 150-200 mL milk per kg of body weight. For the calculation of dioxin and di-PCB total intake of breastfed infants for the whole breastfeeding period we applied a formula proposed by Patandin et al. [4], that takes into account the rate of intestinal absorption from breast milk and the decrease in concentrations in mother milk during breast feeding. It was found that in infants exclusively fed by breast milk, the calculated sum of PCDD/Fs and dioxin-like PCBs (45.7 - 57.2 TEQ pg /kg body weight) was significantly higher than that of infants that consume a combination of human milk and formula (23.9 - 30.0 TEQ pg /kg body weight). In the second study group, aged between 6 and 12 months, for daily intake estimations we took in consideration the quantities consumed for each food group as suggested by pediatricians. Separate daily intake estimations were performed for babies receiving human milk (estimated total daily intake 10.19 - 12.97 TEQ pg /kg body weight) and formula milk (estimated total daily intake 1.60 - 2.24 TEQ pg /kg body weight). The risks of this exposure should not be overestimated because nursing is restricted to a limited period of human life and besides, the potential consumption of higher levels of dioxin-like compounds is fully compensated by the significant health and psychological benefits of breast-feeding.

KEYWORDS: polychlorinated dibenzo-p-dioxins; polychlorinated dibenzofurans; polychlorinated biphenyls; infant exposure; human milk

REFERENCES: