

ORGANOCHLORINE CONCENTRATIONS IN BREAST MILK AND RISK ASSESSMENT IN THE URBAN AND RURAL AREAS OF NORTHERN CHINA

Jian-Hong Zhao^{1,2}, Su-Ju Sun^{1,2}, Minoru Koga³, Yu-Xia Ma⁴, Li Li⁵, Masafumi Nakamura⁶, Jun Ge⁵, Yu-Bao Zhao⁷, Hyogo Horiguchi^{1,2}, Geroge Clark⁷, Fujio Kayama^{1,2}

¹Depart. of Environmental Medicine, Center for Community Medicine, Jichi Medical School, Tochigi 329-0498 Japan

²CREST-JST, Kawaguchi, Saitama, Japan

³Faculty of Environmental and Symbiotic Sciences, Prefectural University of Kumamoto, Japan

⁴Depart. of Hygienic Food, College of Public Health, Hebei Medical University, China

⁵Hospital of gynaecology and maternity of Shijiazhuang, Hebei Province, China

⁶Hiyoshi Corporation, Japan

⁷The Second Hospital of Luanxian, Hebei Province, China

⁸Xenobiotic Detection System International Inc., Durham, NC, U.S.A.

Introduction

In China, during the past 40 years, organochlorine pesticides (OPs) with impurity were produced and used in a large quantity¹⁻⁴. However, little is known on the OPs contamination status of the residents in mainland of China⁵. To elucidate body burden of organochlorine compounds and factors associated with organochlorine levels of the residents in North China, we performed life style questionnaire and collected breast milk specimens at Shijiazhuang urban and Tangshan rural area, Hebei Province, North China.

Materials and Methods

Human breast milk: Thirty breast milk samples were collected from breast-feeding mothers in Shijiazhuang city in November and December 2002, and 29 samples were collected in Tanshan countryside in August 2003, Hebei Province, North China. All of specimens from Shijiazhuang city and one-third specimens from rural area of Tangshan were collected within a week postpartum, and the remaining samples from Tangshan rural area were collected during more than 1-week postpartum (range 2-82 weeks).

Study design: All mothers were asked to fill out a 59-items questionnaire to evaluate the life style factors concerning physiques, past history, occupations, food consumption frequencies, exposure to pesticides, smoking habit, status of breast feeding and so on.

GC/ECD assay for OPs: OPs including p,p'-DDE, β -HCH and HCB were analyzed by GC/ECD. Three milliliter of the specimens were extracted by hexane and cleared up with Sep-Pack (florisil) and determined by GC/ECD. The lower limit quantification of the method for each chemical was 20 ng/g fat. The pesticides in the surrogate samples were identified by using GC/MS-SIM for method validation.

DIPS-CALUX Bioassay for dioxins: Dioxins including polychlorinated dibenzo-p-dioxins (PCDDs), dibenzofurans (PCDFs) and dioxin-like coplanar polychlorinated biphenyls (coPCBs) were measured by Dioxin and PCB specific Chemical-Activated LUciferase gene eXpression cell bioassay system (DIPS-CALUX[®] bioassay)⁶ at Hiyoshi Corporation (Shiga, Japan).

Statistic: The data of the pesticides and dioxins showed highly skewed distributions, so the following statistical analyses were fulfilled after natural logarithm transformation. Correlation between investigated factors and OPs level also were performed by a Spearman test.

Results and Discussions

Demographic data: There were no statistical difference of physiques of mothers and their infants from Shijiazhuang urban and Tagshan rural such as body mass index of mothers, infant sex and infant body weight. Nevertheless, the mean weight of infant in the rural area was lower than those in the urban area.

General contamination status of organochlorine: The concentration of OPs and dioxins in the breast milk from Hebei Province and the distribution of the chemicals was skewed as shown in Table 1. The concentration of p,p'-DDE in breast milk in those areas, especially Shijiazhuang urban region was relatively high compared with β -HCH or HCB. The highest one up to 12389 ng/g fat. The high concentration of p,p'-DDE might be due to the high production of DDT and deleterious past agricultural practices. We tried to trace the exposure history, the higher p,p'-DDE concentrations in the study were found in those who had lived Shijiazhuang city or outskirt for long time.

Table 1: Concentrations of organochlorine compounds in breast milk

| Organochlorine compounds | n | GM* | Median | IQ* | Range |
|--------------------------|----|------|--------|-------|-------------|
| Pesticides (ng/g fat) | | | | | |
| p,p'-DDE | 59 | 1747 | 1920 | 1874 | 137.9-12389 |
| <i>f</i> ÅHCH | 59 | 56.4 | 68.1 | 137.7 | 10-351.3 |
| HCB | 59 | 71.6 | 77.9 | 47.9 | 10-140.8 |
| Dioxins (pg TEQ/g fat) | | | | | |
| PCDDs/Fs | 58 | 12.4 | 14.1 | 11.6 | 2.1-42.5 |
| Co-PCBs | 58 | 2.6 | 2.5 | 2.5 | 0.7-15.1 |
| Total DNxS | 58 | 15.2 | 16.3 | 16.2 | 2.8-57.7 |

*GM, geometric mean; IQ, interquartile.

Treating the value under LOD (limit of detection) as 1/2 of LOD.

Geographic differences (in the urban and rural areas): Table 2 reveals that OPs were significantly higher in the specimens from Shijiazhuang than those from Tangshan. The difference might be from dietary habits and economical status. In fact, Shijiazhuang and Tangshan is located in opposite sides of the Greater Beijing District, even in the same province.

Table 2: OPs in the breast milk(<1-week) from the mothers in urban and rural area

| | Urban (n=30) | | | Rural (n=11) | | | Significance ^a |
|---------------|--------------|--------|-------|--------------|--------|------|---------------------------|
| | GM* | Median | IQ* | GM | Median | IQ | |
| | | | rang | | | rang | |
| Age(year) | 26.0 | 25.0 | 4.0 | 24.4 | 24 | 3.5 | NS |
| FAT(%) | 1.8 | 2.0 | 1.2 | 1.2 | 1.4 | 1.3 | <0.05 |
| HCB | 93.2 | 97.2 | 34.9 | 65.4 | 79.5 | 41.8 | <0.05 |
| <i>f</i> ÅHCH | 100.5 | 140.5 | 113.9 | 21.6 | 10.0 | 58.8 | <0.001 |
| p,p'-DDE | 3159 | 2771 | 3216 | 1844 | 1971 | 1652 | <0.05 |

*GM, geometric mean; IQ, interquartile; SD, standard deviation.

ng/gfat. Treating the value under LOD (limit of detection, 20ng/g fat) as 1/2 of LOD.

^a *t* -test were performed after natural log transformation except HCB.

The people live in the two areas have different dietary habits based on the geographic and economical conditions. Although some reports show that concentration of sea production is one of risk factors responsible for the high level of POPs, those mothers live in Shijiazhuang, an interior city, who consume a little amount of marine fish or freshwater fish. Instead, they consume more frequently meat, milk, egg and so on. Contrary, the people in Tangshan rural area, close to the Bohai Sea, consume less of marine fish due to lower economical condition.

Lactation period and concentrations of OPs: As seen Table 3, levels of p,p'-DDE and HCB in breast milk tended to be lower as the lactation periods increased. The tendency was found both in primiparae and multiparae.

Table 3: Lactation periods and concentrations of OPs in breast milk in rural area

| n | <1week (4, 1~6)* | | | >1week (341.3, 14~574) | | | Significance□ |
|----------------------------|-------------------|--------|------|------------------------|--------|-------|---------------|
| | 11 | | | 18 | | | |
| | GM | Median | IQ | GM | Median | IQ | |
| | rang | | | rang | | | |
| Age(year) | 29.8 | 32.0 | 6.5 | 33 | 33.0 | 4.0 | 0.41 |
| FAT(%) | 1.2 | 1.4 | 1.3 | 2.8 | 2.8 | 1.5 | <0.001 |
| HCB _q | 65.4 | 79.5 | 41.8 | 49 | 51.0 | 17.1 | <0.05 |
| <i>f</i> ÅHCH _q | 21.6 | 10.0 | 58.5 | 39 | 49.5 | 125.2 | 0.09 |
| p,p'-DDE _a | 1844 | 1971 | 1652 | 629 | 651 | 763 | <0.001 |

*Samples collection time (mean days, Rang).

GM, geometric mean; IQ, interquartile; SD, standard deviation.

μ g/gfat. Treating the value under LOD (limit of detection, 20ng/g fat) as 1/2 of LOD.

\square t-test were performed after natural log transformation except HCB.

Risk factor assessment for OPs: One of the most noteworthy findings of this study is the high correlation coefficient between higher frequency and amount of consumption of the cow's milk ($r=0.46$, $p=0.021$) and internal organs of pig and sheep ($r=0.57$, $p=0.005$) in the Shijiazhuang urban area with higher concentration of OPs. Those results are of great concern, because those foods are widely consumed in those areas.

Relation of OPs and dioxins: Fig 1 is shown the positive correlation between the p,p'-DDE and dioxins for all subjects observed. The results may infer dioxins concentration closely related to exposure of DDT or its major metabolite, p,p'-DDE in the past.

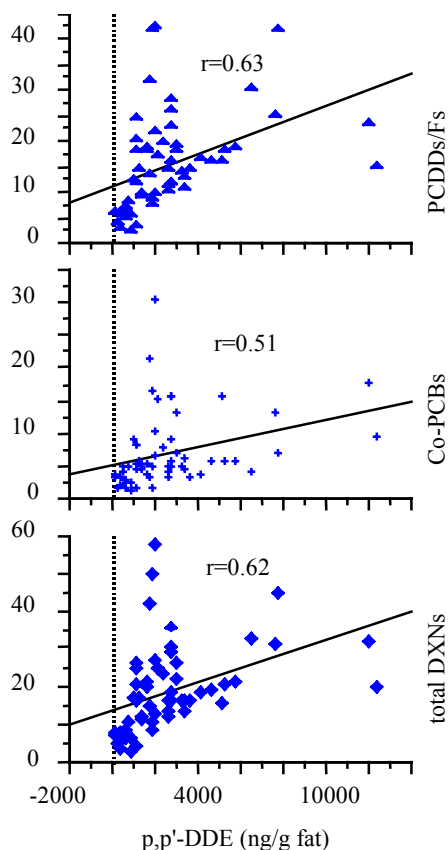


Figure 1: Correlation of p,p'-DDE level in breast milk versus dioxins level(pgTEQ/g fat).
Linear regression were performed after natural transformed. n=59.

Conclusions

1. Values of all the OPs measured were significantly higher in Shijiazhuang, an inland capital city of Hebei Province, than those in Tangshan, a rural area near the Bohai Sea in the province.
2. Consumption of cow's milk and internal organs of pig or sheep show high correlation to OPs levels in breast milk in the urban region.
3. Good correlation between the OPs and dioxins concentrations in those areas infers that dioxin concentration in those areas related closely to the exposure of OPs.

4. Although organochlorines in the breast milk were distributed in a skewed manner, those with extremely high level of p,p'-DDE or TCDDs/Fs in breast milk must be investigated in detail to elucidate the risk factors of exposure.

Comprehensive monitoring of OPs and dioxins in foodstuff is necessary in those areas to understand the status of the contaminations.

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