CONCENTRATIONS OF DIOXINS AND PCBS IN CORD BLOOD IN JAPANESE CHILDREN FROM THE TOHOKU STUDY OF CHILD DEVELOPMENT

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Introduction

From several cohort researches, it has been reported that the perinatal exposure to the methylmercury and persistent organic pollutants (POPs), such as polychlorinated biphenyls (PCBs), has been associated with neurobehavioral development on postnatal growth[1]. We have started a prospective cohort study to examine the effects of perinatal exposures to POPs on neurobehavioral development in Japanese children (The Tohoku Study of Child Development, TSCD)[2]. We registered 599 mother-infant pairs in this cohort study.

Measurement of PCBs in previous epidemiological researches was performed by homologue or limited isomer, but congener-specific analysis was not done. Furthermore, dioxins measurement in cord blood was not reported in many papers since this measurement required high sensitivity and a large amount of samples.

In the present study, we established a measurement procedure to simultaneously determine dioxins and all congener-specific PCBs by high resolution gas chromatograph mass spectrometer (HRGS/HRMS) using isotopic dilution method from the same sample. Then, we determined the concentration of dioxins and PCBs in whole cord blood in Japanese children.

Materials and Methods

PCDDs, PCDFs, dioxin-like PCBs and total PCBs in whole cord blood were analyzed by HRGC/HRMS. After a whole cord blood (about 20 ml) was weighed and added with the clean-up spike containing ^{13}C-labeled standard mixture of PCDDs, PCDFs, dioxin-like PCBs and PCBs, and then crude lipid in sample was extracted. This extract dissolved in *n*-hexane was purified on a multi-layer silica gel column. The purified solution was divided into two aliquots of 80 % for determination of PCDDs, PCDFs and dioxin-like PCBs (aliquot A) and 20 % for determination of congener-specific PCBs (aliquot B). The aliquot B was concentrated without further purification and measured by HRGC/HRMS. The aliquot A was fractionated on active carbon-dispersed silica gel column to PCDDs, PCDFs, *non-ortho* PCBs fraction and *mono-ortho* PCBs fraction, and measured for each fraction by

HRGC/HRMS. HRGC/HRMS analysis was conducted on a 6890 series GC (Agilent Technology, USA) equipped with Autospec-Ultima (Micromass, UK). Measurements of PCDDs , PCDFs and *non-ortho* PCBs were used with SCLV injection system (SGE, Australia).

Results and Discussion

The distribution of total PCBs concentration in whole cord blood was shown in Figure 1. The mean total PCBs concentration was 65.3ng/g-fat (SD 43.4, median 55.6, minimum 12.1, maximum 238.1, n = 163). The mean total TEQ was 13.1pg-TEQ/g-fat (SD 7.7, median 10.9, minimum 3.5, maximum 44.5, n = 84). The correlation between total PCBs and TEQ was shown in Figure 2. This correlation coefficient was 0.93 ($p < 0.01$, n = 84).

Although there are few reports on TEQ in whole cord blood in Japan, a governmental report prepared by Morita[3] is very suggestive. In that report, the TEQ values that were based on the sum of PCDDs and PCDFs were similar or slightly lower than that of our study. Fukata et al.[4] reported the PCBs concentration in cord serum in Japanese, in which the median was 63.0ng/g-fat (n=32). Our results of total PCB concentration were same level as compared with their results.

It was shown that the correlation between TEQ and total PCBs in cord blood was absolutely high in Fig 2. This suggests that it would be possible for measurement of TEQ or total PCBs to evaluate each other value. In addition, using both TEQ and total PCBs should be avoided in a multiple liner regression analysis because of multicollinearity. Consequently, measurement of both TEQ and PCBs in the same sample should be reconsidered.

The sources of dioxins and PCBs were different. In Japan, dioxins were released unintentionally into environment as an impurity of the agricultural chemicals. On the other hand, PCBs is the chemical substance which had been used intentionally for insulation oil, thermal catalyst and coating compound. As the reasons why high correlation was observed between dioxins and total PCBs in the cord blood, it would be suggested that the behavior of both chemicals in the ecosystem and the mechanism which pollutes the human body through the bioaccumulation by the food chain is similar.

Acknowledgments

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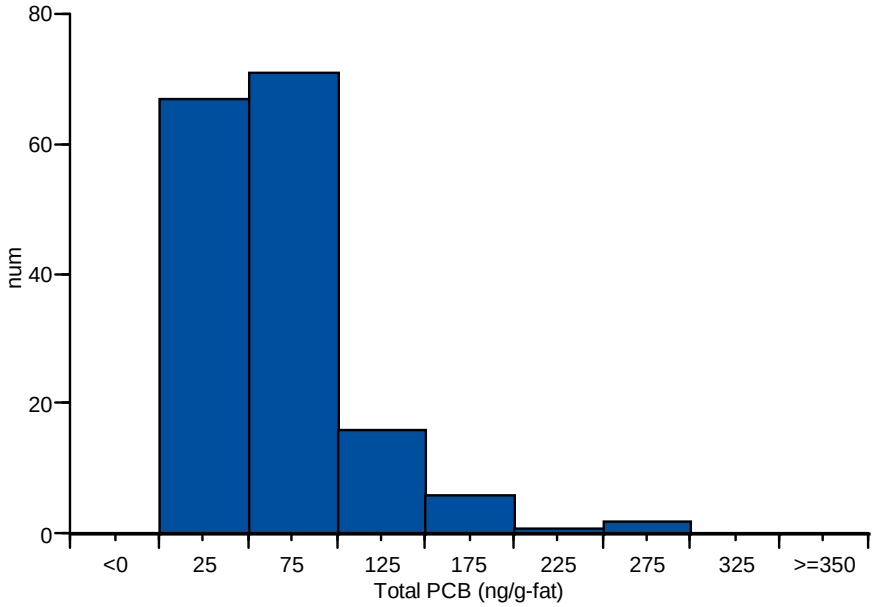

Fig 1. The distribution of total PCBs in whole cord blood

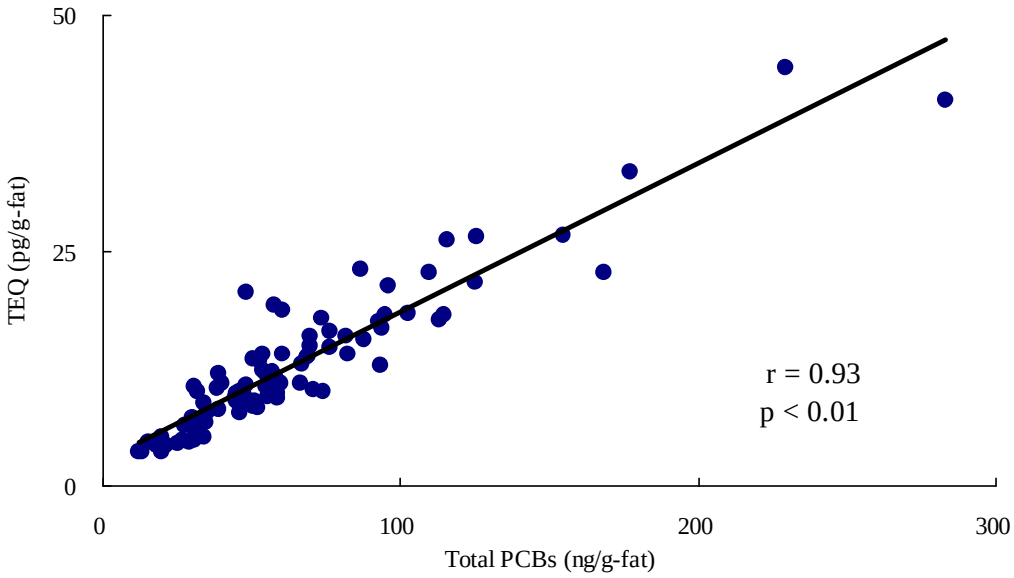

Fig 2. The correlation between total PCBs and TEQ

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