Influence of prenatal exposure, levels in breast milk, and duration of lactation on plasma PCB levels in 42-month-old children

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1. Introduction

Exposure to PCBs affects child development. This influence is consistently negative and well-documented. In a group of neonates, we found that a combination of a high prenatal and a high lactational exposure resulted in a less optimal neurological condition and a higher incidence of hypotonia[1]). At 18 months, perinatally high exposed children were shown to have a less optimal neurological development[2]). Adverse effects on psychomotor development up to the age of two years have been reported. Concerning child's body burden, a higher serum PCB level at four years of age has been found to be associated with a lower behavioral activity level[3]). Although reports on PCB-related effects on the human sexual development and immune status are scarce, there are indications that both are negatively affected [4,5]).

Considering the adverse effects of PCB exposure on development, factors influencing the child's body burden seem to be of special interest. In the present paper, we determine the effect of prenatal exposure, the PCB content of breast milk, and the duration of breast-feeding on the PCB levels in plasma sampled from 42-month-old children.

2.Subjects & Methods

One-hundred and four mothers who decided to breast-feed and were able to sustain this for at least six weeks, and their healthy term infants were included. These mother-infant pairs are part of a larger research project, the 'Dutch PCB/dioxin study'. All the mothers were living in Groningen and surroundings (northeastern part of The Netherlands). For each woman, the duration of full breast-feeding, the length of time during which both breast and formula milk was provided, age, body weight, parity, and formal education were recorded.

The levels of PCB congeners 118, 138, 153, and 180 were measured in blood obtained from the umbilical cord and in blood sampled from the children at 42 months of age. PCB levels in cord blood are viewed as a reflection of the prenatal exposure. In addition, the levels of these four congeners have been measured in 24-hour breast milk samples. The sum of the levels of these congeners in cord and 42-month plasma, and breast milk was calculated.

The effects of prenatal and lactational exposure on 42-month PCB levels were determined by multiple linear regression analysis. In this way, it is possible to establish whether a dose-response relationship exists between the plasma PCB level at 42 months and the variables reflecting the pre- and postnatal exposure to PCBs.

3.Results

In the perinatal period, 92 cord plasma samples and 99 breast milk samples were collected. At 42 months, blood was taken from 62 toddlers. At this age, the median sum of the levels of PCB congeners 118, 138, 153, and 180 (ΣPCB) was 0.81 μg/l (range: 0.23 - 2.2 μg/l). From birth to 42 months of age, the median increase in ΣPCB was 200% (range: 62 - 511%). A significant correlation between the ΣPCB at 42 months and the duration of full breast-feeding was found ($r=0.58$; $p<0.001$) (Fig I).

After having performed a linear regression analysis, we decided that the best fitting model explaining 42-month plasma PCB level consisted of the duration of full breast-feeding, the prenatal PCB exposure (ΣPCB in cord plasma), and the duration of partial breast-feeding. The age, the body weight, the parity, and the formal education of the mother were not significantly related to the 42-month plasma PCB level. The regression coefficients estimate the sizes of the effects of the individual variables (Table I); for example, each

additional week of breast-feeding is estimated to result in a 0.054 μg/l increase in the plasma ΣPCB at 42 months.

4. Discussion & Conclusion

In breast-fed children, from birth to 42 months of age a median increase of 200% in plasma PCB level takes place. This is so despite the fact that, during a period of fast growth, the increase in body size tends to lower the original cordblood levels. The prenatal exposure to PCBs, the duration of full breast-feeding, and the length of time during which both breast and formula milk are provided were found to be good predictors of the 42-month plasma PCB level.

In conclusion, especially in children with a high prenatal exposure who have been breast-fed for a long period, the consequences of the child's PCB body burden for the development of functional deficits should be monitored.

5. Acknowledgements

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6. References

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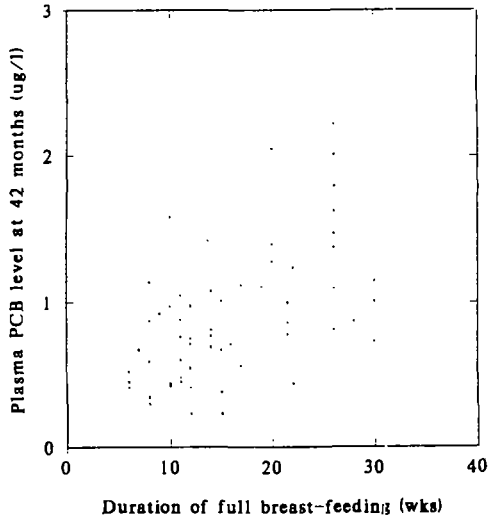

Figure I: The plasma PCB level (sum of the levels of the congeners 118, 138, 153, and 180) according to the duration of full breast-feeding (r=0.58).

Table I: Results of linear regression analysis on the logarithmical transformation of the sum of the levels of PCB 118, 138, 153, and 180 in plasma sampled at 42 months.

Variables	B (SE)	p-value
Constant	-0.54 (0.13)	
Ln(ΣPCB in cord plasma)[1]	0.73 (0.13)	<0.001
Duration of full breast-feeding	0.054 (0.0076)	<0.001
Duration of <100% breast-feeding	0.0076 (0.0037)	0.04

[1] *Logarithmical transformation of the sum of the levels of PCB congeners 118, 138, 153, and 180 in cord plasma.*