

# Polychlorinated Biphenyls: Influence on Birthweight and Gestation

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**Abstract:** Fifty-one infants born to women employed at two capacitor manufacturing facilities with a history of high exposure to polychlorinated biphenyls (PCBs) had a mean birthweight of 153 grams less than that of 337 infants born to women who had worked in low-exposure areas (90 per cent confidence interval, -286 to -20 g); mean gestational age was 6.6 days shorter in the high-exposure infants (90 per cent CI, -10.3 to -2.9 days). After adjusting for gestational age, the difference in birthweight was markedly reduced, indicating that the observed reduction in birthweight was due mainly to shortening of gestational age in the high-exposure group. (*Am J Public Health* 1984; 74:1153-1154.)

## Introduction

Polychlorinated biphenyls (PCBs) are chlorinated aromatic hydrocarbons consisting of mixtures of 210 different isomers with various degrees of chlorination. Observations on the potential hazard of PCBs to the human fetus are limited to separate incidents in Japan and Taiwan where pregnant women ingested PCB-contaminated rice oil.<sup>1-4</sup> Increased eye discharge and brown staining of the skin, gingiva and/or nails were seen. In addition, several infants were small for their gestational age at birth and tended to be premature.

This report describes the findings of our study of birthweight and gestational age of infants born to women occupationally exposed to PCBs. The exposure examined here is limited to cumulative occupational PCB exposure and was designed to evaluate the potential effect of any maternal exposure prior to birth to highly chlorinated PCB congeners that persist in the body.

## Methods

Between 1946 and 1977, two facilities of the same company located in adjacent communities in upstate New York manufactured capacitors using PCBs with Aroclors 1254, 1242, and 1016 as their primary dielectric fluid. Personnel records were reviewed for information indicating leave from work for pregnancies. Between 1958 and 1975, 388 pregnancies to 354 women were determined to have resulted in live, singleton births within New York State. Birth certificates for these pregnancies were used to obtain information on birthweight, maternal age, parity, year of birth, race, sex, and date of last menses (for 1968-75) plus parental education (for 1968-75). Date of last menses (not recorded on pre-1968 birth certificates) was obtained from hospital

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and/or physician records for infants born between 1958 and 1968.

High-exposure areas were defined as those in which direct contact with PCBs occurred during the manufacturing process. For our evaluation a female worker was categorized as highly exposed if she had worked in one or more of these areas for a minimum of one year at any time prior to the birth of the infant being considered (51 births to 39 women). All locations within the plants where PCBs were not directly used were termed low-exposure areas (337 births to 280 women). Previous industrial hygiene surveys have found air concentrations of PCBs in the high-exposure areas to be approximately 10-fold greater than in the low-exposure areas.\*

## Results

The birthweights, gestational ages, and differences in means of our study population are summarized in Table 1. Birthweight adjusted for gestational age is also presented. The main effect of this adjustment was to reduce the variation about the mean in each of our study groups, most markedly in the high-exposure group.

When the low- and high-exposure groups were compared, a 153 gram difference between birthweight means was seen. This difference was reduced to 58 grams when birthweights were adjusted for gestational ages. Mean gestational age in the high-exposure group was reduced by 6.6 days compared with the low-exposure group.

When the outcomes were considered as dichotomous parameters, 7.8 per cent (4 of 51) of the high-exposure group were of low birthweight (<2501 g) compared to 5.3 per cent (18 of 337) in the low-exposure group.

Table 2 summarizes information obtained from birth certificates on other variables that can influence birthweight. On average, the workers in the high-exposure areas were older, more parous, less educated, and gave birth earlier in the study period than did the low-exposure workers.

High exposure to PCBs was associated with reduced birthweight even after adjustment for year of birth, maternal age, parity, and sex of the infant in a multiple regression analysis (difference in mean birthweights adjusted for covariables = -146.7 g, 90 per cent CI = -3 to -290 g,  $P_{(1)} = 0.046$ ). High exposure was also associated with shortened gestational age after adjustment for the same independent variables (difference in mean gestational ages = -4.8 days, 90 per cent CI = -0.8 to -8.8 days,  $P_{(1)} = 0.024$ ).

To address partially the question of autocorrelation in birthweights and gestational ages of the children of a given mother, we also conducted this same analysis for the first 39 events to the 39 high-exposure women and the first 280 events to the 280 low-exposure women. Birthweight differences were within a few grams and gestational age differences were within a fraction of a day of those reported here for all 388 births.

While there are a number of difficulties in comparing women working in a manufacturing plant to the general

\*R. Lawton, written personal communication.

TABLE 1—High- and Low-Exposure Birthweight (grams) and Gestational Age (days) Comparison

	N	Birthweight (mean ± SD)	Gestational Age (mean ± SD)	Birthweight Adjusted for Gestational Age* (mean ± SD)
Infants of workers with low-exposure	337	3346 ± 523	280.9 ± 14.2	3330 ± 490
Infants of workers with high- exposure	51	3193 ± 640	274.3 ± 20.1	3272 ± 478
Difference in means (90% CI)†		-153(-286,-20)	-6.6(-10.3,-2.9)	-58(-179,63)

\*Adjusted birthweight = birthweight - 14.43 (gestational age - 279.76)

†Confidence interval

population,<sup>5-8</sup> for completeness sake, we undertook such a comparison. A set of 388 controls matched on maternal age, parity, and year of birth was selected from the singleton live births in the two surrounding counties. The average birthweight of the infants born to the low-exposure women was 66 grams greater than their matched community controls (90 per cent CI = 1 to 177). The average birthweights in the high-exposure group were 95 grams less than their control (90 per cent CI = -283 to 93).

New York State maintains a matched birth-death file for persons up to age 5. A total of four deaths were identified from our study population utilizing this resource; all were from the low-exposure group. There were seven deaths in the community control group.

### Discussion

This study was limited to an evaluation of birthweight and its correlate, gestational age, among live births. Cumulative PCB exposure before birth was used to categorize exposure, to focus primarily on the potential fetotoxic effects of the more highly chlorinated PCBs such as Aroclor 1254, whose metabolism following exposure is minimal.<sup>9</sup>

Maternal risk factors influencing birthweights are known to include maternal age, parity, ethnicity, social class, tobacco use, underlying medical conditions, maternal height, and previous history of low birthweight.<sup>10</sup> While we were able to adjust for the effects of the first four of these

factors, we had no information on the latter four and could not account for them in our analysis.

We found small decreases in both birthweight and gestational age among infants born to women working in areas of high PCB exposure, compared to those working in areas of low PCB exposure. The observed mean birthweight difference between low- and high-exposure groups seems likely to have resulted from a shortening of gestation rather than a retardation of intrauterine growth. The small number of observations, lack of information on important influencing factors, binary exposure measure, and uncertainty in assigning biological significance to birthweight and gestational age differences of this magnitude mandate that such a conclusion be considered tentative.

### REFERENCES

- Higuchi K (ed): PCB Poisoning and Pollution. 3-7, Kodansha Ltd., Tokyo, Japan, 1976.
- Kuratsune M, Yoshimura T, Matuszaka J, Yamaguchi A: Epidemiologic study on Yusho, a poisoning caused by ingestion of rice oil contaminated with a commercial brand of polychlorinated biphenyls. *Environ Health Perspect* 1972; 1:119-128.
- Kuratsune M, Masuda Y, Nagayama J: Some of the recent findings concerning Yusho. *Proceedings of the National Conference on Polychlorinated Biphenyls*; 14-29. Washington, DC: Environmental Protection Agency, 1975.
- Wong KC, Hwang MY: Children born to PCB poisoned mothers. *Clin Med (Taipei)* 1981; 7:83-87.
- Wang JD, Miettinen OS: Occupational mortality studies: principles of validity. *Scand J Work Environ Health* 1982; 8:153-158.
- Chamberlain G, Garcia J: Pregnant women at work. *Lancet* 1983; 1:228-230.
- Saurel MJ, Kaminski M: Pregnant women at work. (letter) *Lancet* 1983; 1:475.
- Goldsmith JR: What do we expect from an occupational cohort? *JOM* 1975; 17:126-127.
- Sandstorm G, Hutzinger O: The metabolism of chlorobiphenyls—a review. *Chemosphere* 1976; 5:267-298.
- Bloom AD (ed): Guidelines for studies of human populations exposed to mutagenic and reproductive hazards. 37-110, March of Dimes Birth Defects Foundation, White Plains, NY, 1981.

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TABLE 2—Other Variables Influencing Birthweight

Variable	High-Exposure Workers		Low-Exposure Workers	
	N	mean ± SD	N	mean ± SD
Year of birth	51	1964.5 ± 4.9	337	1965.7 ± 4.5
Maternal age	51	32.4 ± 6.3	337	26.5 ± 4.9
Parity	51	2.5 ± 2.1	337	1.6 ± 1.6
Father's education (years)	12	10.6 ± 2.1	114	11.9 ± 1.9
Mother's education (years)	12	11.6 ± 1.0	114	12.1 ± 1.0
Sex of infant (% male)	51	(51)	337	(51)