

Preliminary evidence of recognition memory deficits in infants born to Yu-cheng exposed women

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In 1979, over 2000 Taiwanese residents ingested cooking oil contaminated with polychlorinated biphenyls (PCBs) and dibenzofurans (PCDFs).¹ The oil in Taiwan had about 100 ppm PCBs and about 0.1 ppm PCDFs. Many developed Yu-cheng ("oil disease"), characterized by chloracne, hyperpigmentation, and related symptoms. Many among the exposed were young women, boarders at a school attached to the food processing plant where the accident occurred. Infants of pregnant women who consumed the contaminated rice oil showed elevated PCB serum levels and a set of physical characteristics, which included chloracne, brown pigmentation of the skin ("cola-colored babies"), swollen eyelids, pigmentation of the gums and nails, and eruption of teeth at birth. A number of the hyperpigmented babies were stillborn or died perinatally. Infants exposed in utero were small-for-gestational age and tended to be born prematurely.

Although PCB blood levels diminish once exposure ceases, infants born several years after the exposure of their mothers showed elevated PCB blood levels, reduced birth weight, and brown pigmentation of the skin. A 1985 follow-up of Taiwanese children born after the outbreak to Yu-cheng women found that the children were shorter and weighed less than controls; they continued to show abnormalities of the gums, skin, nails, and hair, and increased bronchitis.^{1,2} There was an increased incidence of developmental delay and poorer performance on IQ tests.

A sample of pregnant Yu-cheng exposed women is currently being recruited from a registry of Yu-cheng cases maintained by the Taiwanese Bureau of Disease Control. Public health nurses locate Yu-cheng women who are pregnant and invite them to participate in the study. This report presents preliminary findings on 11 infants recently born to Yu-cheng women and 48 non-exposed controls, who were administered the Fagan visual recognition memory (VRM) test at 6.5 months. In an earlier study of Michigan infants prenatally exposed to moderate levels of PCBs through maternal consumption of PCB-contaminated Lake Michigan fish, cord serum PCB levels were related to poorer recognition memory on the Fagan test.³

The Fagan recognition memory test⁴ consists of 10 pairs of photos. The infant is initially shown two identical target photos until he or she fixates them for a total of 20 sec. The familiar target is then paired with a novel target for two 5-sec periods, reversing left-right positions from one period to the next. The normative response at this age is to spend more time looking at the novel stimulus. Infant fixation to the stimuli is observed through a peephole and recorded on a PC computer. Mean preference for novelty is calculated by dividing the time looking at the novel stimulus by total time fixating novel and familiar stimuli and averaging percentage of novelty preference for the 10 problems.

In the present sample, control mothers were more educated than Yu-cheng mothers and more likely to be primiparous. There were no differences, however, between the two groups on other background characteristics, including alcohol, drug use, or smoking (see Table 1). There were also no differences in birth weight, length, or gestational age between the Yu-cheng and non-exposed infants in this sample (see Table 2). However, head circumference was somewhat smaller for Yu-cheng infants at birth.

Table 1. Sample Characteristics

| | Yu-Cheng (N = 11) | Controls (N = 48) | t or χ^2 |
|----------------------------|----------------------|----------------------|---------------|
| Maternal age | 28.8 (3.8) | 27.6 (2.8) | -1.24 |
| Paternal age | 30.7 (4.1) | 30.2 (3.2) | -0.47 |
| Maternal education (years) | 9.1 (2.3) | 12.0 (2.0) | 4.29* |
| Parity | 1.4 (1.0) | 0.5 (0.6) | -3.83* |
| Maternal height (cm) | 156.3 (6.5) | 158.1 (5.2) | 0.97 |
| Alcohol or drug use | | | |
| during pregnancy (% yes) | 9.1 | 10.4 | 0.02 |
| Smoking (% yes) | 0.0 | 6.3 | 0.72 |
| Alcohol problem (% yes) | 0.0 | 4.2 | 0.47 |
| Drug abuse (% yes) | 0.0 | 0.0 | 0.0 |

Values are means (SD) or percentages.

* $p < .001$.

Table 2. Infant Characteristics

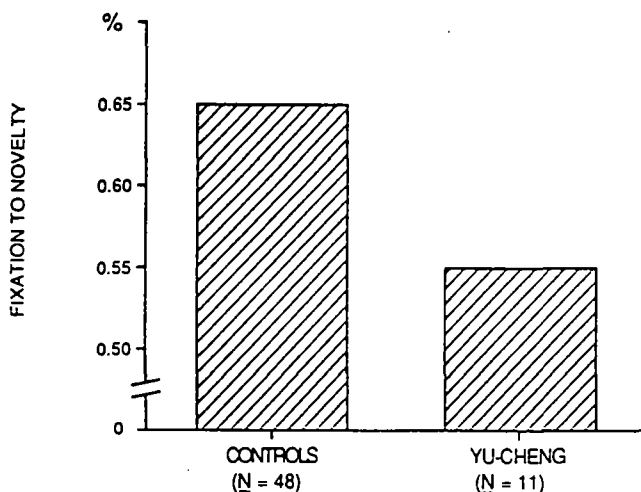
| | Yu-Cheng (N = 11) | Controls (N = 48) | t or χ^2 |
|------------------------------|----------------------|----------------------|---------------|
| Sex (% male) | 45.5 | 50.0 | 0.07 |
| Birthweight (g) | 3161.8 (404.8) | 3099.0 (433.1) | -0.44 |
| Length (cm) | 49.7 (2.3) | 49.5 (2.0) | -0.25 |
| Head circumference (cm) | 32.3 (0.9) | 33.4 (1.1) | 2.37* |
| Chest circumference (cm) | 32.1 (1.5) | 32.3 (2.0) | 0.27 |
| Gestational age (wk) | 39.2 (1.1) | 38.8 (1.7) | -0.81 |
| Apgar (1 min) | 8.8 (0.4) | 8.5 (0.9) | -0.63 |
| Apgar (5 min) | 9.8 (0.4) | 9.7 (0.5) | -0.36 |
| Age at test (wk) | 29.6 (1.6) | 29.1 (2.1) | -1.30 |
| Infant examiner | | | |
| (% examiner #1) ^a | 54.5 | 18.8 | 6.05* |

Values are means (SD) or percentages.

^aAll tests were administered by one of two examiners.

* $p < .05$.

As can be seen in the figure, Yu-cheng offspring showed significantly poorer recognition memory, as indicated by poorer novelty preference (55% for Yu-cheng-exposed vs. 65% for controls), after controlling for the potential confounders (maternal education, parity, and examiner), $F(1,54) = 13.13$, $p = .001$. A second ANCOVA indicated that the recognition memory deficit was only partially mediated by smaller head size since the main effect continued to be significant after controlling for head circumference and the three potential confounders, $F(1, 48) = 9.03$, $p < .005$.



$$F(1,54) = 13.13, p = .001$$

These preliminary data are the first to show recognition memory deficits in Yu-cheng exposed infants. These data are also the first to confirm previous findings of PCB-related deficits in novelty preference on the Fagan test, which were originally seen in Michigan infants prenatally exposed to PCBs due primarily to maternal consumption of contaminated fish.

References

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