SEXUAL DEVELOPMENTS AND BIOLOGICAL FINDINGS IN YUCHENG CHILDREN

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In 1978-9, a mass poisoning occurred in central Taiwan, that was traced to the contamination of rice bran cooking oil by PCBs and their thermally degraded compounds. About 2000 persons had an illness characterized by hyperpigmentation, acne, peripheral neuropathy, and other signs and symptoms. The disorder was similar to a Japanese outbreak in 1968, and it was called Yucheng, "oil disease," in Taiwan[1]. In early 1985, we identified all living children born to women in the PCB registry maintained by the health departments. These families were interviewed in their home, and 117 Yucheng children born to 69 mothers participated for a clinical examination and follow-up[2]. One matched control child were selected for each Yu-Cheng child, matched for neighborhood, age (within 15 days for those under one year, and within one month for those older), sex, mother's age (within 3 years), parents' combined educational level (within about 3 years for the total), and occupation (within 1 class of 5 classes from unskilled laborer to professional). We have followed the development of the children since then[3].

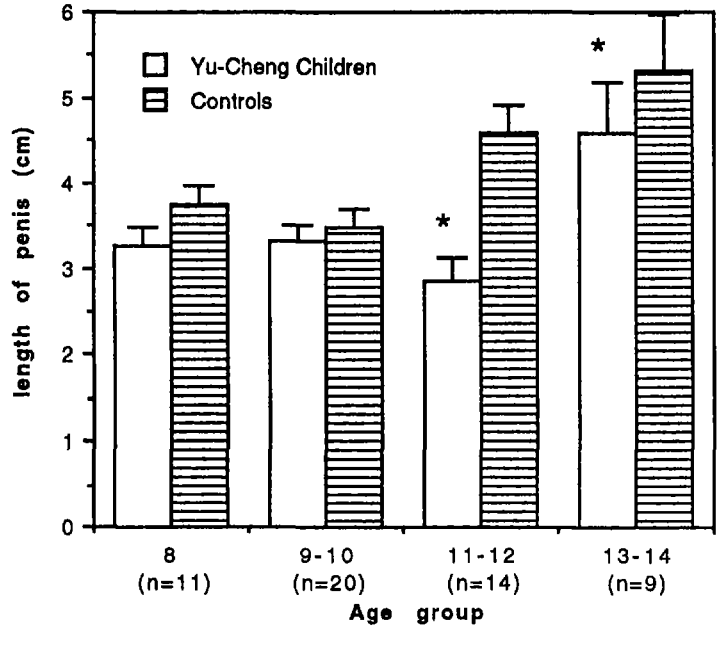
In February 1993, the children were examined in the local health departments. Each Yu-Cheng child and his or her control were examined by the same physician on the same day. The examiners were not specifically aware of the child's exposure status. Body height, weight, head circumference, arm circumference, and triceps skin thickness were measured. Tanner stage was determined by examining the following parameters: the development of breasts and female pubic hair for girls, and the development of testes, scrotum, and penis, and male pubic hair in boys. The length of penis was also measured as the distance between glans penis and root of penis.

One hundred ten Yu-Cheng children and 108 controls (total of 104 pairs) participated for examination. The findings in these 104 pairs were analyzed. The Yu-Cheng girls were significantly shorter than their controls by 2.8 cm (Table 1). The weight, head circumference, arm circumference, and triceps skin thickness were not different in the two groups. The sexual developments by Tanner stages in

Table 1. Comparisons of body height, weight, head circumference, arm circumference, and triceps skin fold thickness in Yu-Cheng and control groups by sex.

		N for each group	Yu-Cheng	Controls	Difference (Yu-Cheng minus control)	p Value
Body Height (cm)	girls	50	136.5 ± 1.8	139.3 ± 1.9	-2.8	0.02*
	boys	54	134.8 ± 1.7	136.4 ± 1.7	-1.6	0.11
Body Weight (Kg)	girls	50	32.5 ± 1.6	34.3 ± 1.5	-1.8	0.19
	boys	54	31.7 ± 1.4	31.7 ± 1.4	-0.0	0.99
Head Circumference (cm)	girls	50	52.5 ± 0.3	51.4 ± 0.7	1.0	0.12
	boys	54	52.3 ± 0.3	52.5 ± 0.3	-0.3	0.48
Arm Circumference (cm)	girls	50	19.7 ± 0.5	20.0 ± 0.4	-0.3	0.61
	boys	54	19.6 ± 0.4	19.0 ± 0.4	0.6	0.25
Triceps Skin Fold Thickness (cm)	girls	50	0.72 ± 0.03	0.72 ± 0.02	-0.00	0.91
	boys	54	0.68 ± 0.02	0.75 ± 0.09	-0.1	0.47

The length of penis in Yu-Cheng and control boys.



boys and girls were not different between Yu-Cheng and control groups (Table 2). However, in boys, the Yu-Cheng children aged 11 to 14 were shown to have significantly shorter penis compared with their matched controls, but not in boys aged 10 or younger (Figure). The shorter statue in girls and shorter penis in boys were not related to the sexual development measured by Tanner stage (Table 4).

The effects of PCBs/PCDFs on the body height and length of penis might be due to the estrogenic or antiandrogenic effects of the toxins. PCBs with less than 48 percent chlorine are associated with estrogenic activity[4]. Some polychlorinated hydroxybiphenyls interact effectively with estrogen receptor[5]. Oral administration of Aroclor-1254 markedly reduced urinary excretion of testicular steroids in boars[6]. Administration of Aroclor 1254 in the mouse reduced seminal vesicle weight, which was an androgen-dependent gland[7]. These effects could be attributed to PCBs' reported inhibition of the synthesis of testosterone by the Leydig cell in vitro[8], or increased testosterone turnover due to the induction of hepatic enzymes[9].

The authors concluded that girls with in utero exposure to PCBs and PCDFs have shorter body height than matched controls, and the exposed boys had shorter penis at 11 to 14 years of age compared with controls. These developmental effects were probably related to hormonal changes caused by toxic exposure.

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Table 2. Tanner stages in Yu-Cheng and control boys and girls. The stages were compared between Yu-Cheng children and their controls with X^2 analysis. During the two examinations in February 1992 and February 1993 respectively, the two groups had similar sexual development as measured by Tanner stage.

	Tanner Stage	Yu-Cheng Children number (percent)	Controls number (percent)	p Value
Boys 1992	1	44 (78.6%)	42 (76.4%)	0.56
	2	10 (17.9%)	10 (18.2%)	
	3	1 (1.8%)	3 (5.6%)	
	4	1 (1.8%)	0 (0%)	
Boys 1993	1	41 (78.8%)	32 (72.7%)	0.40
	2	8 (15.3%)	11 (25.0%)	
	3	2 (3.8%)	0 (0%)	
	4	1 (1.9%)	1 (2.3%)	
Girls 1992	1	31 (58.5%)	34 (64.2%)	0.22
	2	14 (26.4%)	17 (32.1%)	
	3	6 (11.3%)	2 (3.8%)	
	4	2 (3.8%)	0 (0%)	
Girls 1993	1	25 (51.0%)	19 (42.2%)	0.76
	2	13 (26.5%)	15 (33.3%)	
	3	9 (18.4%)	10 (22.2%)	
	4	2 (4.1%)	1 (2.2%)	

Table 3. Penis length in Yu-Cheng and control boys by Tanner stage. The length of penis in these two groups were compared with unpaired T-test. In Tanner stage 1, the Yu-Cheng boys had shorter penis than their matched controls. A similar trend was seen in those boys in Tanner stage 2, but without statistical significance.

Tanner Stage	Yu-Cheng Children N	Penis length (cm)	age	Controls N	Penis length (cm)	age	p Value
1	40	3.1 ± 0.14	10.32 ± 0.25	31	3.7 ± 0.19	10.07 ± 0.25	0.02
2	8	3.6 ± 0.45	12.35 ± 0.39	11	4.5 ± 0.35	11.53 ± 0.49	0.13
3	2	5.3 ± 0.25	13.68 ± 0.55	0			
4	1	9.0	14.56	1	6.5	14.24	

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