

## Skin diseases, tooth and gum problems, and goiter after polychlorinated biphenyl poisoning: 24 year follow-up of the Taiwan Yucheng cohort

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### Abstract

In 1979, a mass poisoning involving 2,000 people occurred in central Taiwan from ingestion of cooking oil contaminated by polychlorinated biphenyls (PCBs) and polychlorinated dibenzofurans (PCDFs). We studied the prevalence of medical conditions in the exposed individuals and in a neighborhood control group. Starting with a registry of the exposed individual from 1983, we updated the addresses of exposed individuals and identified a control group matched for age, sex, and neighborhood in 1979. In 2003, about 60 years old men and 50 years old women were interviewed by telephone. We obtained usable information from 585 exposed subjects and 547 control subjects. Unpaired Yucheng and control subjects were paired by same sex distribution and the similar age. 506 (174 men and 332 women) Yucheng subjects and control subjects were included in the follow-up study. Lifetime prevalence of chloracne, abnormal nails, hyperkeratosis, and gum swelling were observed more frequently in the PCB/PCDF-exposed men and women. The exposed women reported broken tooth, goiter and skin allergy 8.0, 3.9 and 1.8 times, respectively, more frequently than controls. There was no difference in reported prevalence of other medical conditions. We concluded that Taiwanese Yucheng people exposed to PCBs and PCDFs had increased medical conditions, including skin diseases, gum and tooth problems, and goiter in women.

### Introduction

Polychlorinated dibenzodioxins (PCDDs), polychlorinated dibenzofurans (PCDFs), and polychlorinated biphenyls (PCBs) are ubiquitous environmental pollutants found in many environmental media. In 1979, over 2000 people in central Taiwan ingested cooking rice oil contaminated with PCBs/PCDFs (Hsu et al., 1985). The victims were estimated to consume an average of 1g of PCBs and 3.8 mg of PCDFs totally during an average of nine months of exposure to the contaminated oil (Lan et al., 1981). Follow-up studies have documented that chloracne, abnormal nail, hyperkeratosis and goiter are all higher in exposed subjects 14 years after exposure (Guo et al., 1999). Besides morbidity studies, mortality studies have reported that individuals poisoned in this incident had excess mortality from nonmalignant liver disease at 13 years of follow-up (Yu et al., 1997) and systemic lupus erythematosus (SLE) for women at 24 years study (Tsai et al., 2007). Therefore, this study mainly focused on the prevalence of diseases after long period follow-up of Yucheng cohort.

### Subjects and Methods

There were 2,061 subjects based on signs and symptoms of the illness in the Yucheng registry on 1979 (Hsu et al., 1985). In 1993, we have included 1,144 exposed and 1,135 control subjects, who were required to be of the same sex, within 3 years of age. During 1993 and 2003, we had follow-up to contact 864 exposed subjects and 933 control subjects by phone. Although 279 (32.3%) of the Yucheng subjects and 386 (41.4%) of the control subjects refused to be interviewed or gave unusable responses, 585 of the exposed subjects and 547 of the control subjects completed the telephone interview. The majority of interview consisted of asking the participants questions about diseases ever diagnosed by doctors or skin and tooth lesions comparable chloracne or gum pigmentation, whether such diseases were self-reported. Interviewers were blind to exposure status. We used paired techniques (same gender and similar age) to solve the partial missing data and compare the lifetime prevalence of diseases. 120 (10.6 %) were no match and excluded in this study. Therefore, 506 (174 men and 332 women) Yucheng subjects and control subjects were included in the study.

### Results and Discussion

In this study, age, BMI, education level, smoking history and drinking history subjects have no significant differences between Yucheng and control groups. Skin, tooth diseases and gum problems are prominent in the Yucheng group (Table 1): 31% of exposed subjects described skin lesion comparable acne as compared to 1% of control subjects. Similarly, abnormal nails, hyperkeratosis, gum

swelling were all observed more often in the exposed group. Goiter, broken tooth and skin allergy were reported more often in exposed women. Although anemia, headache, and arthritis have documented that were associated with the PCB exposure (Guo et al., 1999). But no significant difference between the two groups after 24 years exposure. Other diseases including eczema, hives, gum pigmentation, diabetes mellitus, hypothyroidism, anemia, headache, liver cirrhosis, arthritis, hypertension, herniated disks and coronary diseases were not associated with PCBs/PCDFs exposure. The association between the self-report of skin lesion comparable acne and other medical conditions were documented on Table 2. The occurrence of acnelike was related to abnormal nail in Yucheng subjects and to gum swelling, hyperkeratosis, skin allergy in Yucheng women. Therefore, we concluded that Taiwanese Yucheng people exposed to PCBs and PCDFs had increased medical conditions, including skin diseases, gum and tooth problems, and goiter in women.

The study provides more information on subjects of the Yucheng cohort, who were accidentally exposed to PCBs/PCDFs contaminated rice oil and is followed-up investigation of self-reported, long-term morbidity among them. Long lasting and high morbidities were again reported among the exposed subjects. In previous study, chloracne, abnormal nails, hyperkeratosis, and skin allergy are all much higher in early exposed subjects of Yucheng (Guo et al., 1999). Similar poisoning in Japan, cases of Yusho due to ingestion of contaminated rice oil in Japan 11 years before the Yucheng episode, had acneform rash and pigment abnormalities that lasted for many years (Kuratsune et al., 1972; Nakayama et al., 1997). But the acneform rash has slowly disappeared in recent years. In this study, skin, tooth diseases and gum problems have reported again. More interesting in women, abnormal nail, hyperkeratosis, skin allergy and gum swelling were associated with skin lesion comparable acne. Further clinical studies will be warranted to confirm such findings, as well as to elucidate the mechanisms.

#### Reference

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Table 1. Prevalence (%) of reported diseases ever diagnosed by a physician or self-reported in Yucheng and control groups by gender in Taiwan, 2003

	men			women		
	Yucheng (n=174)	Control (n=174)	OR (95% CI)	Yucheng (n=332)	Control (n=332)	OR (95% CI)
Chloracne-like eruption	75 (43.6)	1 (0.6)	130.7 * (28.3-2322.2)	82 (24.9)	4 (1.2)	26.5 * (10.9-87.7)
Abnormal nail	52 (30.2)	3 (1.8)	24.1 * (8.6-100.7)	61 (18.5)	7 (2.2)	10.3 * (5.0-25.2)
Hyperkeratosis	24 (14.0)	8 (4.7)	3.3 * (1.5-8.0)	37 (11.2)	16 (4.9)	2.4 * (1.4-4.6)
Skin allergy	49 (28.5)	38 (22.4)	1.4 (0.8-2.3)	98 (29.7)	62 (19.1)	1.8 * (1.2-2.6)
-Dermatitis	1 (0.6)	0 (0.0)	-	2 (0.6)	1 (0.3)	-
-itch	30 (17.2)	22 (12.6)	-	58 (17.5)	36 (10.8)	-
Eczema	11 (6.4)	12 (7.1)	0.9 (0.4-2.1)	31 (9.4)	21 (6.4)	1.5 (0.9-2.7)
Hives	6 (3.5)	4 (2.4)	1.5 (0.4-6.0)	19 (5.8)	17 (5.2)	1.1 (0.6-2.2)
Broken tooth	4 (2.3)	2 (1.2)	2.0 (0.4-14.6)	23 (7.0)	3 (0.9)	8.0 * (2.8-34.2)
Gum swelling	30 (17.5)	12 (7.1)	2.8 * (1.4-5.9)	51 (15.5)	30 (9.2)	1.9 * (1.1-2.9)
Gum pigmentation	2 (1.2)	0 (0.0)	-	8 (2.4)	0 (0.0)	-
Goiter	0 (0.0)	0 (0.0)	-	19 (5.8)	5 (1.5)	3.9 * (1.6-11.9)
-Treated with medication or surgery	0 (0.0)	0 (0.0)	-	15 (4.6)	5 (1.5)	3.1 * (1.2-9.5)
Anemia	30 (17.4)	20 (11.8)	1.6 (0.9-3.0)	95 (28.8)	101 (31.1)	0.9 (0.6-1.3)
Headache	6 (3.5)	4 (2.4)	1.5 (0.4-6.0)	28 (8.5)	22 (6.8)	1.3 (0.7-2.3)
Liver cirrhosis	2 (1.2)	1 (0.6)	2.0 (0.2-43.0)	1 (0.3)	1 (0.3)	1.0 (0.3-5.0)
Arthritis	1 (0.6)	2 (1.2)	0.5 (0.0-5.2)	5 (1.5)	4 (1.2)	1.2 (0.3-5.0)

\* means p value &lt;0.05.

Table 2. Lifetime prevalence of diseases (%) in Yucheng individuals without (-), with (+) self-reported skin lesion comparable acne by gender

	Men			Women		
	skin lesion comparable acne			skin lesion comparable acne		
	- (n=97)	+ (n=75)	p-value	- (n=248)	+ (n=82)	p-value
Age (mean±SD)	60.6±1.2	57.7±1.4	0.1	48.0±0.8	50.1±1.4	0.2
BMI(mean±SD)	24.2±0.3	24.2±0.4	1.0	23.9±0.5	24.1±0.9	0.8
Abnormal nail	13 (13.4)	39 (52.0)		20 (8.1)	41 (50.0)	
OR	1	7.0 (3.4-15.1)	<0.0001*	1	11.4 (6.2-21.8)	<0.0001*
Hyperkeratosis	13 (13.4)	11 (14.7)		20 (8.1)	17 (20.7)	
OR	1	1.1 (0.5-2.6)	0.8	1	3.0 (1.5-6.0)	0.002*
Skin allergy	25 (25.8)	24 (32.0)		62 (25.0)	36 (43.9)	
OR	1	1.4 (0.7-2.6)	0.4	1	2.3 (1.4-4.0)	0.001*
Gum swelling	15 (15.5)	15 (20.3)		28 (11.3)	23 (28.1)	
OR	1	1.4 (0.6-3.1)	0.4	1	3.1 (1.6-5.7)	0.0004*
Broken tooth	1 (1.0)	3 (4.1)		16 (6.5)	7 (8.5)	
OR	1	4.1 (0.5-82.9)	0.2	1	1.4 (0.5-3.3)	0.5
Goiter	0 (0.0)	0 (0.0)	-	11 (4.4)	8 (9.8)	
OR	-	-		1	2.3 (0.9-6.0)	0.08
Median of PCB levels (ppb) <sup>a</sup>	53.9±9.2	95.8±10.1	0.003	81.0±10.6	113.7±17.4	0.11

a. Based on women with/without skin lesion comparable acne (n=68, 184) and men with/without skin lesion comparable acne (n=64, 77) in whom serum levels of PCBs in 1980-1982 were available; value means mean ± standard error.

b. Values shown in parentheses are percent.

c. OR means odds ratio.

d. \* means p value <0.05.