

## Human dioxin levels near a pentachlorophenol contaminated site in Tainan, Taiwan

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### Introduction

A pentachlorophenol (PCP) manufacturing plant in the An-Shun area of Tainan City in southern Taiwan discontinued its production of the toxic wood preservative after nearly 20 years of operation. Several studies have shown that polychlorinated dibenzo-*p*-dioxins (PCDDs) and polychlorinated dibenzofurans (PCDFs) are formed as trace byproducts during the PCP manufacturing process.<sup>1</sup> Five years after the An-Shun PCP plant ceased operation, soil and fish samples were analyzed, and both were found highly contaminated with dioxins.<sup>2</sup> The An-Shun PCP plant was situated in the aquaculture area of Tainan City. We wanted to see to what extent humans living near the contaminated site were effected by the same polluting sources that caused soil and fish contaminations.

### Materials and Methods

All the study subjects lived in the An-Nan District, four kilometers from the An-Shun PCP plant. Blood samples were drawn from volunteers living in the District. Fish and soil samples were collected from a dioxin-contaminated sea reservoir surrounding the PCP plant. Four species of fish ( $n = 29$ ) were collected and analyzed. Nine soil samples were collected from the surface sediment ( $< 15$  cm) in the sea reservoir using a ponar dredge and core sampler.

The isotope dilution high resolution gas chromatography/high resolution mass spectrometry (HRGC/HRMS) method was used to quantitatively determine the level of 17 PCDD/PCDFs in serum, fish, and soil samples. The analytical method for all samples was modified according to USEPA Method 1613.<sup>3</sup>

Principal component analysis (PCA) was used to explore and classify data. Seventeen PCDD/PCDF congeners in human serum, fish tissue, and/or soil samples were used in PCA. All values under the detection limit were treated as half of this limit. The statistical analyses were performed using JMP (version 3.2.6, SAS Institute Inc., NC, USA) software.

### Results and Discussion

We enrolled 27 volunteers (11 (41%) men and 16 (59%) women). There were no statistical differences in the average serum PCDD/PCDF levels associated with gender, age, body mass index (BMI), smoking status, or educational level. The average total level of 17 PCDD/PCDFs in serum was 1670 pg/g-lipid or 53.4 pg-WHO-TEQ/g-lipid. Figure 1 showed that the concentration distribution reported in this study was significantly higher than those obtained in five other areas in Taiwan. ( $P < 0.001$ , Mann-Whitney U test). The congeners with the highest levels were 1,2,3,4,6,7,8-HpCDD, OCDD, and OCDF (Figure 2(A)).

The mean concentration of 17 PCDD/PCDFs in the 29 fish-tissue samples collected from the sea reservoir surrounding the abandoned PCP plant was 8,626 pg/g-lipid or 985 pg-WHO-TEQ/g-lipid. The congener pattern in the fish-tissue samples was similar to the human serum samples because the congeners with the highest levels were 1,2,3,4,6,7,8-HpCDF/HpCDD, and OCDD (Figure 2(B)). The mean concentration of 17 PCDD/PCDFs in the soil samples was 606,015 pg/g-sample or 922 pg-WHO-TEQ/g-sample, and the congeners with the highest levels were 1,2,3,4,6,7,8-HpCDF/HpCDD, OCDF, and OCDD (Figure 2(C)), similar to the pattern in the human serum and fish tissue samples.

Furthermore, PCA was employed to investigate the cause of the congener profile variations. PCA is a powerful method for pattern recognition, yielding valuable information on potential sources and trends in environmental pollution.<sup>4</sup> Score plots of the human serum, fish tissue, and soil samples were shown in Figure 3(A)-(C). The subjects

plotted in those figures could be separated into two groups. It revealed that the congener pattern of Group A, samples collected from An-Nan District, Tainan, is different from the pattern of Group B, samples collected from other regions in Taiwan. Therefore, the samples collected from An-Nan District, could be contaminated by a specific source of dioxin pollution. It is likely that the PCP plant in An-Nan District was the source of dioxin pollution.

Based on the human dioxin exposure data, our investigation may have discovered a "hot spot", the first one reported the data in Taiwan. The preliminary finding has raised a public health concern in the inspected area and requires further investigations to clarify the nature of the contamination and potential impact on the local environment and human health.

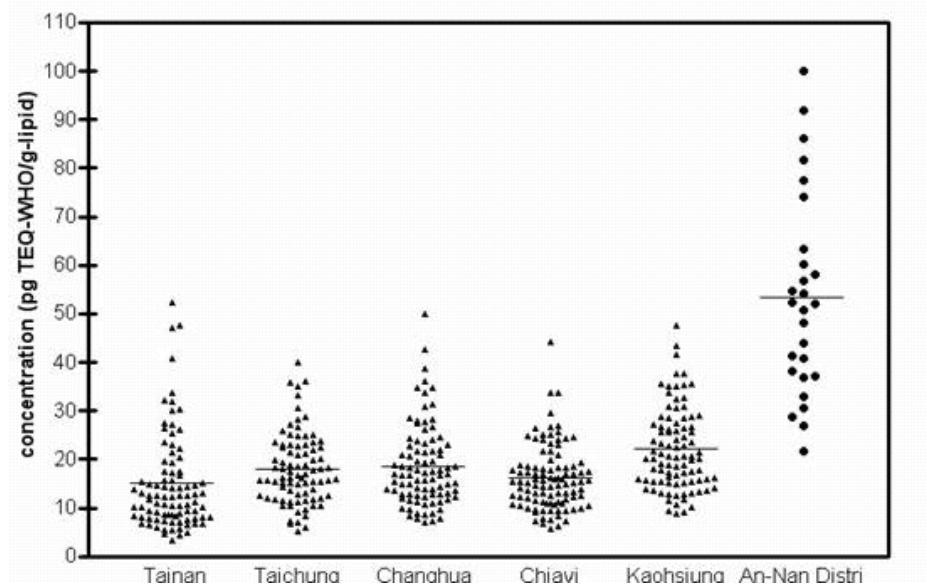
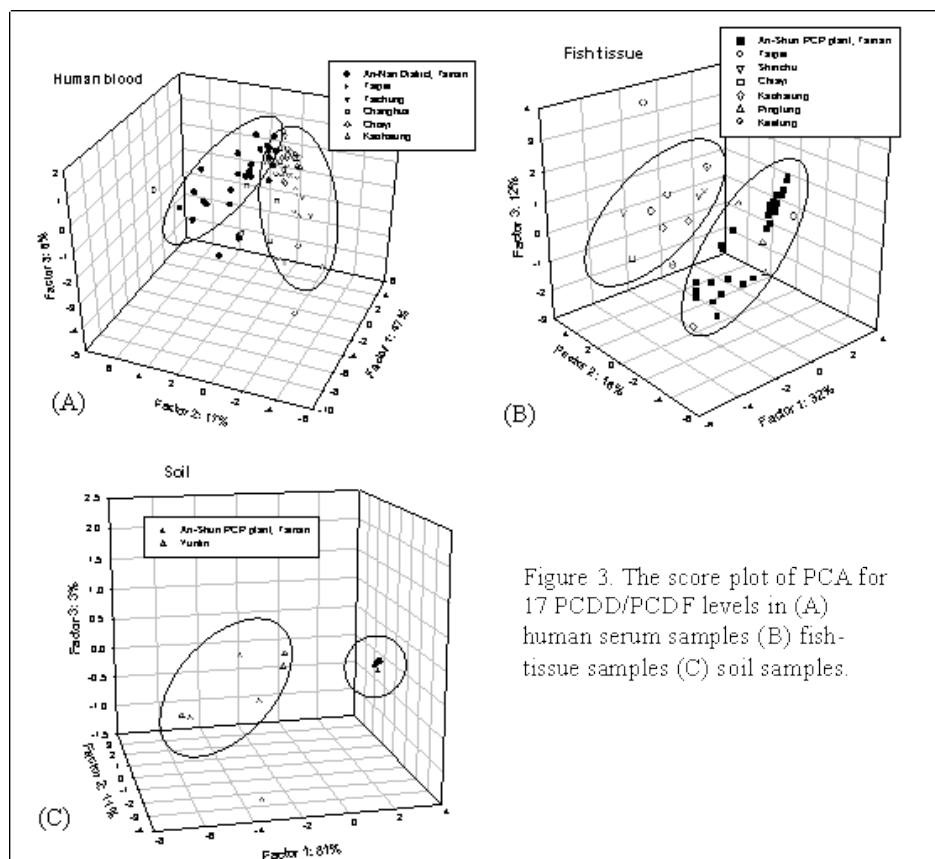
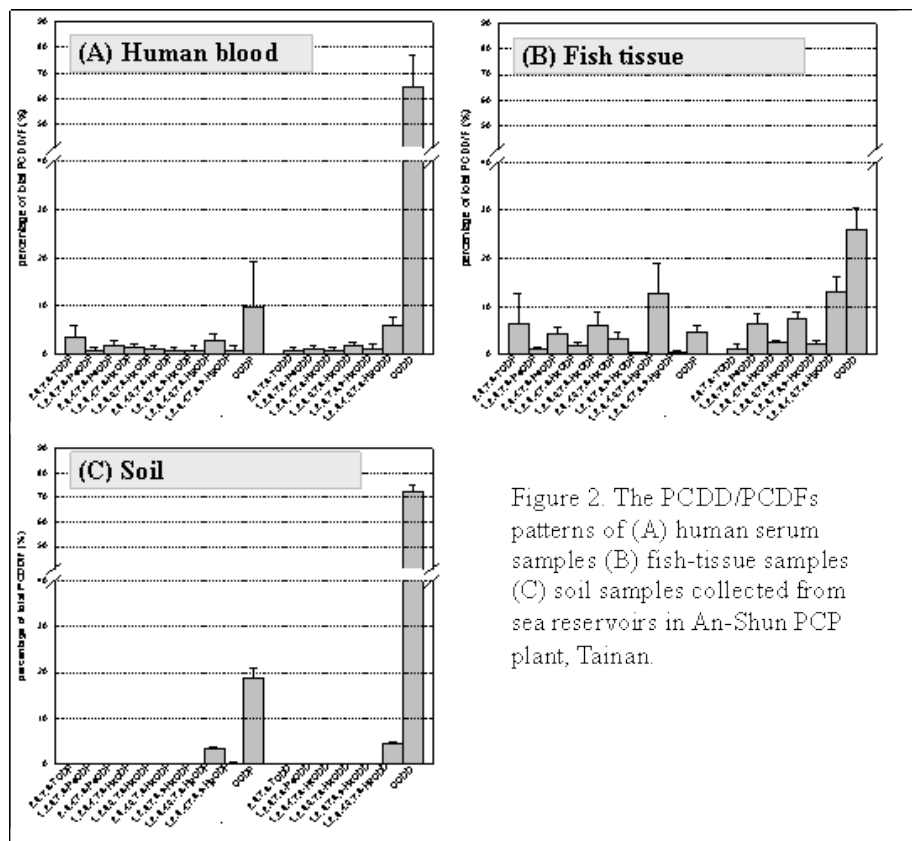


Figure 1. The serum dioxin levels measured in this study and those reported in five other areas in Taiwan.



**References**

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