

SUMMARY OF PARITUTU SERUM DIOXIN STUDY (2005)

In October 2001 the Ministry of Health contracted the Institute of Environmental Science and Research Ltd (ESR) to investigate non-occupational exposure to dioxins among current and former Paritutu¹ residents. Community consultation occurred resulting in majority agreement that blood serum testing was the appropriate mechanism for assessing this exposure. Following release of the report on the consultation, a protocol was prepared and ethical approval for the next phase of the study obtained in May 2003 from the Taranaki Regional Ethics Committee. An interim report based on the results of the first 24 residents who were tested was released in September 2004. Subsequently a further 28 residents were tested.

Study inclusion criteria were residence within a two kilometre radius east and one kilometre south of the former Ivon Watkins-Dow (IWD) plant for at least one year between 1962 and 1987, and no history of occupational organochlorines exposure or significant period of residence outside New Zealand.

Blood testing was undertaken in two rounds so that the results from the first round could assist in the selection of participants for the second round. This resulted in exclusion of people who lived in the area before 1974 from the second round in order to determine any temporal variation in exposure from the IWD plant.

A potentially highly exposed group of current and former residents were identified from a self-selected sample of the population based on spatial, toxicokinetic and multi-pathway exposure modelling. Exposure modelling considered the location and years of residence in relation to various time periods between 1962 and 1987.

The average age of the 52 participants (30 women, 22 men) was 58 years.

Results were compared with those obtained in a national serum study carried out by the Ministry for the Environment (MfE) in 1996-7. The TCDD results from this study were extrapolated to 2004 values using the toxicokinetic model.

Individual TCDD levels ranged from 0.85 to 33.3 pg/g (ppt) lipid. Six individuals had background levels.

The mean serum TCDD concentration was 6.5 pg/g lipid while the expected national mean for a similar group in 2004 was 1.7 pg/g lipid (i.e. 3.8 fold increase).

Mean elevations in the age-sex subgroups were up to seven times higher than those expected with greater elevations for older than younger people. The serum TCDD levels for each subgroup are given in the table below.

The overall increase in serum TCDD was less for the participants in the second round of testing due to their younger average age and shorter duration of residence in the area.

There was a non-significant mean elevation in serum PCDD/F² TEQ³ of 1.2 fold which was predominantly due to the elevation in TCDD.

¹ Paritutu is a suburb of New Plymouth.

² PCDD = polychlorinated dioxins; PCDF = polychlorinated furans

³ Dioxins differ in toxic potential and the toxicity of individual dioxins is added in order to evaluate mixtures to which people are exposed. Toxic equivalence (TEQ) is the amount of TCDD it would take to equal the combined toxic effect of all the dioxins in the mixture.

As the PCB⁴ TEQ was not significantly elevated in any subgroup of the first 24 participants tested compared to national background levels it was not included in subsequent testing.

Mean serum TCDD levels

Age group	Number	Paritutu TCDD (pg/g lipid) Mean (95% CI) ⁵	Projected TCDD (pg/g lipid) from MfE study Mean (95% CI)
Male			
25-34	2	1.7 (0.7 - 2.7)	0.6 (0.5 - 0.7)
35-49	3	1.9 (1.3 - 2.5)	1.1 (1.0 - 1.2)
50-64	12	6.1 (2.3 - 10.0)	1.5 (1.4 - 1.7)
65+	5	14.0 (4.1 - 24.0)	1.9 (1.7 - 2.1)
Total	22	6.9 (3.5 - 10.3)	
Female			
19-24	4	1.4 (0.8 - 2.1)	0.6 (0.5-0.7) ⁶
25-34	4	1.3 (1.0 - 1.6)	0.9 (0.8 - 1.1)
35-49	7	5.3 (2.3 - 8.3)	1.4 (1.3 - 1.6)
50-64	11	6.0 (3.1 - 8.9)	2.4 (1.9 - 2.8)
65+	4	17.8 (9.9 - 25.7)	4.1 (3.5 - 4.6)
Total	30	6.2 (3.8 - 8.6)	
All ages	52	6.5 (4.6 - 8.6)	1.7 (1.5 - 1.9)

Source: Fowles J, Gallagher L, Baker V, Phillips D, Marriott F, Stevenson C, Noonan M. A Study of 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD) Exposures in Paritutu, New Zealand. A Report to the New Zealand Ministry of Health. Porirua: ESR; 2005.

Duration of residence throughout the period 1962 to 1987 was important in terms of whether participants had an elevated TCDD level or not. The mean TCDD level for those with at least 15 years residence was 14.6 pg/g lipid (n=15) compared to an expected mean of 2.4 pg/g lipid, whereas for those with less than 15 years residence it was 3.2 pg/g lipid (n=37) compared to an expected mean of 1.5 pg/g lipid.

There was a statistically significant two-fold elevation in mean TEQ for those with at least 15 years residence but there was no difference from background TEQ level when TCDD was subtracted from the total TEQ.

For study participants who lived in Paritutu at least 15 years the peak increase in serum TCDD above background at the time production ceased in 1987 (or earlier if they left the area) is conservatively estimated to have been between 39 and 77pg/g lipid. For the total study group the mean past peak TCDD level is estimated to have been between 17 and 35 pg/g lipid.

No specific time periods of particular concern were detected during the production years.

⁴ PCBs = polychlorinated biphenyls

⁵ 95% CI = lower and upper 95% confidence interval around the mean

⁶ The MfE stratum was for 15-24 year olds.

There was a weak, but statistically significant, relationship between consumption of home-grown leafy vegetables and 'exposed' fruit (i.e. exposed directly to the air and usually eaten with its skin on) and serum TCDD. There was no relationship between consumption of home-grown root vegetables, 'protected' fruit (e.g. citrus), poultry/eggs, or local kaimoana.

Spatial analysis of the 2002 soil data is consistent with a plume of TCDD from the IWD plant extending to about 1 kilometre mainly to the east, and about 400 metres to the south. The highest modelled soil concentrations are outside the plant immediately east of the boundary. ESR estimates that around 500 addresses are in the area that is predicted to have soil concentrations in excess of the soil concentration (3.4 pg/g) that has been found to be associated with elevated serum TCDD levels after long-term residence during the period from 1962 to 1987.

Results suggest that the serum TCDD levels found are due to historical aerial emissions from the IWD plant throughout the production years. These emissions are most likely to have been fugitive and not as a result of incineration. It is not possible to determine from the study's findings whether these emissions were regular or episodic.

The predominant exposure was probably from inhalation of dioxin on particles and in vapour form with an additional small contribution from ingestion of home-grown 'exposed' fruit and vegetables.

The report is available from <http://www.moh.govt.nz/dioxins>.