Status report

Serum PFOA and liver function markers in the blood of adults in the Mid-Ohio Valley

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This report summarizes findings relating serum PFOA (C8) concentrations, to serum measurements of three clinical markers of liver function measured at the same time in adults from the Mid-Ohio Valley.

We have analyzed data from the questionnaires and blood tests collected in the C8 Health Project in 2005-06 for 47,092 adults. We have focused on the liver because of previously published research findings which have reported an association with relatively high concentrations of PFOA in the liver to effects of exposure such as liver enlargement in rodents and monkeys, and liver cancer in rats.

Results focused on three blood tests: bilirubin ("direct bilirubin"), ALT (alanine aminotransferase), and GGT (γ-glutamyltransferase). A disturbance in the levels of each of these can indicate liver damage: bilirubin increase can be due to liver or bile duct disease; ALT and GGT are enzymes released after liver injury. For all three, levels higher than normal indicate worse liver function. In the case of ALT, 11.2% of the study population have values above the normal range.

Statistical analyses were carried out to investigate whether these clinical makers were associated with either PFOS or PFOA concentrations at the time of blood measurement, after careful adjustment of other factors such as age, sex, reported smoking habits or obesity which might also affect the same markers.

The main finding was that serum levels of ALT increased with increasing concentrations of PFOA, and that the risk of having an 'abnormal' level of ALT (defined by levels above the normal range) also increased with increasing levels of PFOA. Neither of the other two markers, GGT or bilirubin, showed a clear relationship with PFOA.

This association with ALT is unlikely to be due to chance, as it is highly statistically significant. It is not explained by the other detailed information included in the statistical models - age, physical activity, body mass index (BMI), average household income, educational level, race, alcohol consumption and cigarette smoking.

Increases in another similar chemical called PFOS, which was not released from the Dupont plant, were associated with increased levels of two of the markers: ALT and bilirubin.

These results show a positive association between PFOA and PFOS concentrations and ALT serum levels, a marker of liver cell damage. This observed association between PFOA and PFOS with ALT is consistent both in terms of direction and magnitude with previous findings of occupational studies. Notably, these results are also consistent with data coming from a general population survey where background concentrations of PFOA are much lower compared to those reported here.

The main limitation of the present study is the cross-sectional design; both PFOA and the liver markers were measured at the same time, so we do not know whether the PFOA exposure came before any changes in markers of liver function. This makes it impossible to know whether PFOA can cause changes in liver markers.

In conclusion, a small but clear linear association between PFOA and PFOS serum concentrations and ALT, a marker of liver injury, was observed in this large population. Having higher levels of ALT does not necessarily imply a liver disease, although many liver conditions manifest themselves with increases in these markers before clinical signs are evident.