Status report

Infections, obesity and clinical markers in children in relation to PFOA serum level during pregnancy in mothers in the Mid-Ohio Valley

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This report summarizes two sets of findings: firstly reported infections and asthma in children aged 4-8 years at time of interviews with their mothers in 2011, in relation to their exposures during pregnancy estimated from levels of PFOA measured in the mothers close to or during the pregnancy; and health status indicators such as lipid levels, and secondly body mass index (calculated from height and weight reported in the C8 Health Project), in relation to modelled PFOA at the time of the pregnancy, extrapolated from PFOA measured in the mothers. There is no evidence of PFOA exposure during pregnancy being associated with increased risk of adverse health indicators in these children with the possible exception of one of the lipid measurements.

In utero exposure to PFOA and risk of childhood infections

We investigated the relationship between common childhood infections and PFOA serum levels of the mother at the time of pregnancy, a proxy measure for in utero and early childhood exposure. Between 22 August and 7 November 2011, 878 women who took part in the C8 Health Project, had measured PFOA and, at the time of survey were either pregnant or had children under three years of age, were interviewed by a Computer Assisted Telephone Interview (CATI) on the extent and frequency of their child's childhood infections and reported reaction to inoculations. At the time of this interview, nearly all the children were aged between four and eight years. Exposure to infections, other factors affecting immune response or infection were considered as known risk factors and potential confounders. The study included eligible women who were still resident in West Virginia and Ohio and whose pregnancy did not end in stillbirth or infant death.

The primary exposure of interest was PFOA exposure in utero which was calculated as the estimated maternal serum level at the mid-point of the pregnancy. This was estimated using the mother's serum concentration which we have measured during or close to the pregnancy, adjusted as necessary for time between pregnancy and blood sampling in 2005/2006 and adjusting for reported breastfeeding. Maternal estimated mid-pregnancy levels of PFOA ranged around a median value of 17 ng/ml for PFOA. The risk of various infections and respiratory disease occurrence in the 12 months prior to interview along with lifetime asthma prevelance, was assessed in relation to maternal mid-pregnancy levels of PFOA, adjusted for age, socioeconomic confounders, breastfeeding and other exposure variables relating to infections.

The principle findings were that there was no evidence of prenatal PFOA exposure related increase in the risk of common infections in children or asthma since birth. There was some evidence of reduced reporting of asthma, dry cough and perhaps colds with increasing exposure to PFOA. This study has some limitations. The reports of disease in these children were provided by their mothers who were interviewed, and there was no independent verification by seeking medical records. While the exposure assessment was based on measurement of serum in the mothers, estimates of the levels in pregnancy required extrapolation over a period of up to 3 years.

In utero exposure to PFOA and risk of obesity and abnormal lipids

We investigated the relationship between childhood BMI, metabolic syndrome and some associated clinical markers and PFOA serum levels of the mother estimated at the time of pregnancy, a proxy measure for in utero and early childhood exposure. This work was prompted by some evidence from animal and epidemiologic studies which suggest that prenatal perfluoroalkyl acid exposure may affect weight or other clinical markers of metabolic syndrome. First we matched children and mothers among participants in the 2005-6 C8 Health Project who had also consented to participate in Science Panel studies, using name, address and dates of birth. The study population comprised 5584 children aged 2-19 years, with height and weight data (self-reported or reported by mother), measured blood lipids, glucose and insulin and measures of PFAAs, and successfully matched to their mothers.

Outcomes studied included Body mass index (BMI), clinical markers associated with metabolic syndrome including blood lipids, glucose and insulin and estimated metabolic syndrome. Metabolic syndrome is a combination of medical disorders that, when occurring together, increase the risk of developing cardiovascular disease and diabetes. Metabolic syndrome has various definitions and we used the definition as three or more of the following: raised BMI, raised triglycerides, decreased high density lipoproteins, raised glucose, raised insulin. In utero PFOA was estimated using the PFOA concentration measured in the mother's serum at the time of the C8 Health Project and back-extrapolated to the time of pregnancy by adjusting for individual time course in serum levels modelled in this population by the Science Panel. Both this in utero exposure measure and PFOA measured in the child were used in modelling the outcomes of interest. Potential confounders considered in the modelling were: child gender, race/ethnicity, season of sample collection, average household income, participant ever smoked cigarettes or consumed alcohol, child age at assessment, birthweight (grams), gestational age (weeks), and mother's parity relative to the index child.

This study has some limitations. Metabolic syndrome can be better estimated with data on blood pressure and waist circumference which were unavailable in this population. In utero exposure relied on modelling exposure for up to 19 years, which introduces some uncertainty in exposure assessment. However this is the largest study to date addressing this question, and overall, our results indicate that there is no increased risk of obesity or metabolic syndrome associated with in utero PFOA exposure, estimated by modeling maternal PFOA serum levels at time of the pregnancy. Analyses by specific age groups did not indicate any significant associations within these age groups. There was some evidence of a small increase in low density lipoproteins and a small decrease in insulin measured in serum, associated with in utero PFOA, but chance cannot be ruled out, and these associations were not as strong as with serum PFOA measured at survey

In conclusion, neither study suggested any evidence of an increased risk of metabolic syndrome, childhood obesity, childhood asthma nor infections, in relation to prenatal exposure to PFOA.