

**Status report: Relationship of perfluorooctanoic acid (PFOA) and perfluorooctane sulfonate (PFOS) with pregnancy outcome among women with elevated community exposure to PFOA**

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This report summarizes the findings relating PFOA (C8) and PFOS (C8S) in the serum of female participants in the C8 Health Project, which was carried out in 2005-2006 in the Mid-Ohio Valley and recent pregnancy outcome. A full report of these findings will be submitted to a peer-reviewed scientific journal.

**Background:** Perfluorooctanoic acid (PFOA, also known as C8) and perfluorooctane sulfonate (PFOS, also known as C8S) are chemicals which do not occur in nature but have been widely used in chemical production for some time and remain in the environment. They are found in the blood of most Americans at levels of around 4 ng/mL (nanogram/milliliter) for PFOA and 21 ng/mL for PFOS. PFOA has been found in the blood of pregnant women, in umbilical cord blood, and in breast milk. A few studies have looked at maternal PFOA and PFOS level and birth outcomes like gestational age and birthweight, but the studies have been limited in quality and the results were inconsistent.

**Methods:** We conducted a study of C8 Health Project participants to examine the relationship between PFOA and PFOS in serum and pregnancy outcome among community residents in Ohio and West Virginia who lived or worked in six water districts contaminated with PFOA from a chemical plant. In 2005-2006, they provided blood specimens, which were used to measure PFOA and PFOS in the serum (the clear liquid part of the blood after blood cells have been taken out) and women answered questions about their pregnancy history. We excluded twins and other multiple pregnancies, and studied miscarriages, stillbirths, and live births in the 5 years prior to C8 Health Project enrollment among women who lived within the same water district from the start of the pregnancy through the time of enrollment. We made this restriction to be sure that the PFOA level measured at C8 Health Project enrollment would be a good estimate of the level at the time of pregnancy. We compared the levels of PFOA and PFOS in pregnancies that ended in a miscarriage, preeclampsia, preterm birth, low birthweight birth, or birth defects with healthy pregnancies using multiple regression techniques that adjust for other variables which could influence pregnancy outcome. The results are presented in terms of odds ratios (ORs) that reflect the relative risk, i.e., the risk of the problem in more exposed pregnancies divided by the risk in less exposed pregnancies. An OR above 1.0 indicates an increased risk of the outcome in the more exposed group vs. the less exposed group. We also present a measure of how precise the estimates are, a 95% confidence interval, which reflects the range of plausible values taking chance into account.

**Results:** The average serum PFOA was 48.8 ng/mL and the middle value (median) was 21.2 ng/mL. The average PFOS concentration was 15.0 ng/mL and the median was 13.6 ng/mL. Among all pregnancies, 249 (13.5%) were reported to have ended in miscarriage. Among live

births, 329 (20.9%) were reported as preterm, 80 (5.0%) as low birthweight, 156 (9.8%) were complicated by preeclampsia, and 74 (7.4%) noted a birth defect.

Neither PFOA nor PFOS was related to miscarriage. Preeclampsia was modestly increased when PFOA levels were above the median compared to below the median (OR = 1.3, 95% CI = 0.9, 1.9) and when PFOS levels were above the median (OR = 1.4, 95% CI = 1.0, 2.0). Neither PFOA nor PFOS was related to preterm birth. Low birthweight did not follow any clear relationship with PFOA, except for some tendency for lower risk with higher exposure. PFOS exposures above the median were weakly related to low birthweight (OR = 1.6, 95% CI = 1.0, 2.6). Both PFOA and PFOS were weakly related to birth defects. For PFOA, there was no increase in risk for exposure above the median, but a modest, imprecise indication of an elevation in risk was above the 90<sup>th</sup> percentile (OR = 1.7, 95% CI = 0.8, 3.6) based on 12 cases in the uppermost category. For PFOS, there was an increased risk above the 75<sup>th</sup> percentile, with adjusted odds ratios of 1.8 for both 75<sup>th</sup> to 90<sup>th</sup> and >90<sup>th</sup> percentiles. Congenital heart defects were the single most common type of birth defect; however, with only 13 heart defect cases numbers were too sparse for adjusted analyses.

**Conclusion:** We found little or no support for a possible relationship between PFOA or PFOS exposure and miscarriage or preterm birth, nor between PFOA and low birthweight. PFOS above the median was associated with low birthweight, but there was no increasing risk with higher level of PFOA in the blood.. The results for preeclampsia and birth defects were more suggestive of a possible relationship for both PFOA and PFOS – slightly stronger for PFOS. Even for these outcomes, the relative risks were only modestly elevated and none showed clear increasing risk with higher exposure. Overall, the data provide little support for PFOA or PFOS being related to pregnancy outcome, with some uncertainty regarding preeclampsia and aggregated birth defects.