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# An Epidemiologic Investigation of Clinical Chemistries, Hematology and Hormones in Relation to Serum Levels of Perfluorooctane Sulfonate in Male Fluorochemical Production Employees

Following reports of the finding of organic fluorine in sera samples, a fluorochemical medical surveillance program began at 3M's Decatur manufacturing facility in the late 1970's. The surveillance program has generally consisted of annual or biannual tests of clinical chemistries, pulmonary function, blood counts and a biomonitor of fluorochemical exposure. A total organic fluorine measurement was routinely done until 1993. This measures the amount of fluorine that was covalently bound to carbon in the serum sample. When test data were available, a company physician reviewed each employee's results. These physicians did not, and have not, found abnormalities in individuals that they felt were related to fluorochemical exposure. That is, medical conditions, medications and lifestyle factors adequately explained the laboratory abnormalities (which one expects to find in this type of program.)

Beginning in 1994, the 3M Decatur (Alabama) plant medical surveillance program incorporated a serum measurement of perfluorooctane sulfonate (PFOS) and perfluorooctanoate (PFOA). Total organic fluorine was not measured. A formal report was written of the aggregate analyses conducted of the medical surveillance clinical program data for the Decatur (Alabama) and Antwerp (Belgium) employees who voluntarily participated in 1994, 1995 and 1997. The findings from this aggregate

analysis suggested that, among these participating Antwerp and Decatur male fluorochemical production employees, significant hematological, clinical chemistry and hormonal abnormalities were not associated with serum PFOS levels up to 6 ppm. It was not possible to derive inferences from the few employees with serum PFOS levels > 6 ppm. Limitations of this study include its cross-sectional design, the voluntary participation rates, the few subjects exposed at the highest levels, and the lower levels of serum PFOS measured among these employees compared to those estimated to cause effects in laboratory animals. Results of the hepatic and lipid clinical chemistry tests were published in *the Journal of Occupational and Environmental Medicine* (1999;41:799-806). In the Spring of 2000, medical surveillance will again be offered to 3M fluorochemical production employees at the Antwerp and Decatur manufacturing sites.

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# An Epidemiologic Investigation of Clinical Chemistries, Hematology and Hormones in Relation to Serum Levels of Perfluorooctane Sulfonate in Male Fluorochemical Production Employees

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ABSTRACT

3M manufactures products which contain chemical compounds, either as intentional components or residual impurities, that have as a parent molecule, perfluorooctane sulfonyl fluoride. These chemicals include: perfluorooctane sulfonate (PFOS), N-ethyl perfluorooctanesulfonamide, N-ethyl perfluorooctanesulfonamido ethanol, N-methyl perfluoroctanesulfonamido ethanol and chemicals derived from it, and the mixture of mono-, di- and tri [N-ethyl perfluorooctane sulfonamidoethyl] phosphates. There may be other precursors in the workplace. These molecules enter a number of product applications (e.g., surfactants, food packaging additives, polymers). These compounds may be expected to transform metabolically, to an undetermined degree, to PFOS as an end-stage metabolite. Potassium perfluorooctane sulfonate ($C_8F_{17}OSO_2K^+$) is, itself, a surfactant used as a wetting and foaming agent in industrial and commercial processes.

Subchronic studies in rats and primates suggest there may be a potential for cumulative toxicity with PFOS over time with the primary effect related to metabolic wasting. Although the mechanism of toxicity is not fully understood, toxicity may be due to an effect on peroxisome proliferation, fatty acid metabolism, membrane function, protein synthesis and/or mitochondrial bioenergetics.

Medical surveillance has been routinely performed on 3M fluorochemical production workers (in Decatur, Alabama and Antwerp, Belgium) with potential exposure to PFOS and/or to perfluorinated precursors that may metabolically degrade to PFOS. The purpose of this study was to provide an analysis of the hematology (hematocrit, hemoglobin, red blood cells, white blood cells and platelet count), clinical chemistries

(alkaline phosphatase, gamma glutamyl transferase, aspartate aminotransferase, alanine aminotransferase, total and direct bilirubin, blood urea nitrogen, creatinine, glucose, cholesterol, low density lipoproteins, high density lipoproteins and triglycerides) and hormonal parameters (cortisol, dehydroepiandrosterone sulfate, estradiol, follicle stimulating hormone, 17-alpha hydroxyprogesterone, luteinizing hormone, prolactin, sex hormone binding globulin, free testosterone, bound testosterone, and thyroid stimulating hormone) in relation to serum PFOS as determined by high performance liquid chromatography mass spectrometry methods. These relationships were assessed in fluorochemical production employees from two time periods, 1995 (N = 178) and 1997 (N = 149).

Descriptive simple and stratified analyses, Pearson correlation coefficients, analysis of variance and multivariable regression were used to evaluate for possible associations between PFOS and each hematological and clinical chemistry test and hormonal assay. Age, body mass index, current alcohol consumption (drinks per day) and cigarette use (cigarettes smoked per day) were potential confounding factors that were considered in the analyses. Multivariable regression models were fitted with PFOS analyzed as a continuous variable using linear as well as non-linear transformations in order to maximize the possibility of finding associations between PFOS and the parameters of interest.

Four categorizations of serum PFOS levels were assessed in relation to the response variables: 0 - < 1 ppm; 1 - < 3 ppm; 3 - < 6 ppm; and $\geq$ 6 ppm. In 1995, mean serum PFOS levels by category were 0.49 ppm, 1.82 ppm, 4.12 ppm and 8.17 ppm, respectively. In 1997, mean serum PFOS levels by category were 0.52 ppm, 1.78 ppm,

3.87 ppm and 7.20 ppm, respectively. For both years, 95 percent of the employees' serum PFOS levels were below 6 ppm. Although the two plant populations differed by age, body mass index and alcohol consumption, no consistent associations, by both plant locations and year, were observed between the clinical chemistries, hematology and hormone parameters and the employees' serum PFOS levels.

The findings from this study suggest that, among these Antwerp and Decatur male fluorochemical production employees, significant hematological, clinical chemistry and hormonal abnormalities are not associated with serum PFOS levels up to 6 ppm. It is not possible to derive inferences from the few employees with serum PFOS levels $\geq$ 6 ppm. Limitations of this study include its cross-sectional design, the voluntary participation rates, the few subjects exposed at the highest levels, and the lower levels of serum PFOS measured among these employees compared to those that caused effects in laboratory animals.

INTRODUCTION

3M manufactures products which contain chemical compounds, either as intentional components or residual impurities, that have as a parent molecule, perfluorooctane sulfonyl fluoride. These chemicals include: perfluorooctane sulfonate (PFOS), N-ethyl perfluorooctanesulfonamide, N-ethyl perfluorooctanesulfonamido ethanol, N-methyl perfluoroctanesulfonamido ethanol and chemicals derived from it, and the mixture of mono-, di- and tri [N-ethyl perfluorooctane sulfonamidoethyl] phosphates. There may be other precursors in the workplace. These molecules enter a number of product applications (e.g., surfactants, food packaging additives, polymers). These compounds can be expected to be transformed metabolically, to an undetermined degree, to PFOS as an end-stage metabolite [Gibson et al., 1983]. Potassium perfluorooctane sulfonate ($C_8F_{17}OSO_2K^+$) is, itself, a surfactant used as a wetting and foaming agent in industrial and commercial processes.

Potassium perfluorooctane sulfonate is readily absorbed by ingestion [Johnson and Ober, 1979; O'Malley and Ebbens, 1980]. Ninety five percent of a single oral dose of [$^{14}C$] PFOS administered to male rats was absorbed within 24 hours [Johnson and Ober, 1979].

After a single, 24-hour occluded dermal exposure to PFOS at a dose of 5000 mg/kg, total serum organic fluorine concentrations were 10.3 and 0.9 ppm for male and female albino rabbits, respectively [O'Malley and Ebbens, 1980]. Twenty eight days after dosing, total serum organic fluorine concentrations had risen to 130.2 and 128.0 ppm for male and female albino rabbits, respectively. On the other hand, no quantifiable

organic fluorine could be detected 28 days after a single, 24 hour occluded dermal exposure to a 0.06% solution of PFOS in water at doses of 0, 0.003, 0.06, and 0.3 mg PFOS solution/kg, respectively, to 3 male and 3 female albino rabbits per dose group [Glaza, 1995].

Once in the body, PFOS concentrates primarily in the liver of rats [Johnson et al., 1979]. Eighty-nine days after a single intravenous dose (mean 4.2 mg/kg) of radiolabeled PFOS, mean tissue concentrations (μg PFOS equivalent/g tissue) were: liver, 20.56; plasma, 2.21; kidney, 1.09; lung, 1.06; spleen, 0.51; bone marrow, 0.46; red blood cells, 0.45; adrenals, 0.41; testes, 0.36; skin, 0.35; muscle, 0.29; subcutaneous fat, 0.20; eye, 0.16; abdominal fat, $\leq$ 0.08; and brain, < 0.05. Johnson et al. [1979] observed that 30.2 percent of the dose 89 days after administration had been excreted in the urine and 12.6 percent in the feces. Analyses of the urine, feces and tissues have suggested that PFOS is not metabolized [Johnson et al., 1984]. The plasma half-life was calculated to be 7.5 days after a single oral dose of radiolabeled PFOS (mean dose, 4.2 mg/kg) in solution to three male rats [Johnson and Ober, 1979].

There appears to be significant enterohepatic circulation of PFOS with both urinary and fecal excretion [Johnson et al., 1979; 1980; 1984]. In male rats, cholestyramine administered in the feed decreased the retention of radiolabeled PFOS in liver, plasma, and red blood cells, 3.8, 7.7 and 6.0 fold, respectively, and increased its elimination via feces 9.5 fold after the rats were given intravenous radiolabeled PFOS (mean dose, 3.4 mg/kg) [Johnson et al., 1980; 1984]. There was a lower clearance rate of $^{14}C$ in the urine compared to control animals because of the increased rate of fecal elimination. Cholestyramine is a bile acid sequestrant that acts by binding bile acids in

the intestinal tract. This reduces bile acid resorption and its return to the liver. Decreased flow of bile acids in the enterohepatic circulation results in increased conversion of hepatic cholesterol into bile acids. This results in a decline in hepatic cholesterol concentration and the stimulation of low density lipoprotein (LDL) receptor synthesis, which subsequently produces a decline in serum LDL cholesterol levels.

Upon acute exposure, PFOS was moderately toxic by oral administration [Gabriel, 1976; Dean et al., 1978; Rusch and Rinehart, 1979], but not dermal [O'Malley and Ebbens, 1980]. There have been two acute oral toxicity studies reported [Gabriel, 1976; Dean et al., 1978]. In the more recent study PFOS was suspended in a 20% acetone/80% corn oil mixture and administered orally by gavage levels to 5 male and 5 female rats per group at the following dosages: 100, 215, 464 and 1000 mg/kg [Dean et al., 1978]. Animals were observed for 14 days. The acute oral LD50 values (95% confidence limits in parentheses) were male rats, 233 (160 - 339) mg/kg; female rats 271 (200 -369) mg/kg; combined male and female rats; 251 (199 - 318) mg/kg. Clinical signs included diarrhea, hypoactivity, decreased limb tone, ataxia, corneal opacity, ptosis, piloerection, prostration and tremors. In the previous study, PFOS was administered in water and the LD50 in the rat was determined to be 1.25 - 2.50 g/kg [Gabriel, 1976]. Gabriel's results appear to be inconsistent with subsequent toxicity studies.

In an acute inhalation toxicity study [Rusch and Rinehart, 1979], a series of one-hour inhalation exposures in rats at exposure concentrations of PFOS at 24.09, 7.05, 6.49, 4.88, 2.86, 1.89 and 0.0 mg/L produced 100 percent mortality at the highest level and partial mortality (10 - 80%) at all other PFOS levels. Observations included dyspnea, tremors, convulsions, hypersensitivity, hypoactivity, excessive salivation and lacrimation

and general poor condition. The LC50 was determined to be 5.2 mg/L (95% CI = 4.4 - 6.4 mg/L).

PFOS has been shown to be a potent inducer of hepatic peroxisomes and fatty acid beta-oxidation in the rat [Ikeda et al., 1987] and mouse [Sohlenius et al., 1993]. After feeding male rats for two weeks with a powdered chow containing 0.02% PFOS, hepatic catalase, fatty acyl-CoA, carnitine acetyl transferase and carnitine palmitoyl transferase increased by 1.74, 4.90, 6.84 and 1.69 fold, respectively, compared to control animals [Ikeda et al., 1987]. PFOS also induced cytochrome P-450 activity. Male mice administered perfluorooctane sulfonic acid at a concentration of 0.05% weight/weight in the diet for 5 days resulted in weight loss and increased peroxisomal fatty acid beta-oxidation, peroxisomal catalase activity, Ω-hydroxylation of lauric acid, cytosolic epoxide hydrolase activity and cytosolic DT-diaphorase activity [Sohlenius et al., 1993].

Haughom and Spydevold [1992] fed 0.02% perfluorooctane sulfonic acid in the diet for 7 - 14 days to male Wistar rats which resulted in increased liver weight, liver triacylglycerol, liver free cholesterol and decreased liver cholesterol ester as well as decreased serum cholesterol and triacylglycerol levels. There was reduced cholesterol synthesis from acetate, pyruvate and hydroxymethyl glutarate but no reduction in synthesis from mevalonic acid in the hepatocytes from the treated rats. The activity of liver hydroxymethyl glutaric acid-Co-A reductase (HMG-CoA) and acyl-CoA cholesterol acyltransferase (ACAT) was reduced. Haughom and Spydevold [1992] suggested that the hypolipidemic effect of perfluorooctane sulfonic acid may be due to downregulation of HMG-CoA reductase and ACAT with enhanced fatty acid oxidation in the liver. This would subsequently reduce very low density lipoprotein (VLDL) production by the liver.

Recently, Nabbefeld et al. [1998] tested the hypothesis that PFOS and other fluorocompounds may act as peroxisome proliferators by displacing fatty acids from liver fatty acid binding protein (L-FABP). 10 μM PFOS caused a 66 percent reduction of the fluorescently labeled fatty acid analog 11-(5-dimethylaminonapthalenesulfphonyl)-undecanoic acid from L-FABP *in vitro*. Comparable results were observed for bovine serum albumin. These findings demonstrated that PFOS has a high affinity for fatty acid carrier proteins and can displace the endogenous ligand.

Results from three subchronic studies have been reported [Goldenthal et al., 1978a; 1978b; 1979]. PFOS was fed in the diet of Charles River CD rats at 0 (control), 30, 100, 300, 1,000 and 3,000 ppm for 90 days [Goldenthal et al., 1978a]. At the 300, 1,000 and 3,000 ppm dosage level, all rats died prior to scheduled termination. Toxicity signs included emaciation, convulsions, ocular and anogenital discharges, increased sensitivity to external stimuli and reduced motor activity. Histopathology showed compound-related lesions which included hepatic hypertrophy and necrosis, thymic and splenic follicular atrophy, bone marrow hypocellularity and atrophy of mesenteric lymph nodes, small intestinal villi and skeletal muscle. Among the 100 ppm dose group there was weight loss, elevated plasma creatinine phosphokinase, alkaline phosphatase, blood glucose and blood urea nitrogen, decreased hemoglobin, hematocrit, erythrocyte and leukocyte counts, hepatic enlargement and necrosis, and stomach discoloration and hemorrhage. Among the 30 ppm dose group there was weight loss, elevated plasma glutamate-pyruvate transaminase and plasma glutamate oxalacetate transaminase, and liver discoloration.

In a subchronic (90 day) study [Goldenthal et al., 1979], two male and two female rhesus monkeys per group received 0 (control), 10, 30, 100 and 300 mg/kg/day of PFOS by oral gavage. All animals (except controls) died within 20 days and timing was related to dosage. Monkeys treated with 300 mg/kg/day died between the second and fourth day. Monkeys treated with 100 mg/kg/day died between the 3$^{rd}$ and 5$^{th}$ day. Monkeys treated at 30 mg/kg/day died between the 7$^{th}$ and 10$^{th}$ day and those treated at 10 mg/kg/day died between the 11$^{th}$ and 20$^{th}$ day of the study. Signs of toxicity at each dosage level were comparable and included anorexia, diarrhea, decreased activity, emesis, weight loss, marked weakness, prostration, and general body tremors. There were no consistent histopathologic changes with exposure. Adrenal changes, including congestion, hemorrhage and lipid depletion of the adrenal cortex, were observed in all dose groups.

An additional subchronic rhesus monkey study was subsequently initiated at much lower dosages [Goldenthal, 1978b]. PFOS was administered by oral gavage to two male and two female monkeys at dosages of 0, 0.5,1.5 or 4.5 mg/kg/day for 90 days. Animals treated at the 4.5 mg/kg/day dosage level died or were sacrificed *in extremis* by the seventh week with signs of gastrointestinal toxicity comparable to those observed in the previous rhesus monkey study by Goldenthal et al. [1978a]. Also, in the 4.5 mg/kg/day dose group, mean serum cholesterol levels declined from 183 mg/100 ml to 99 within 30 days. SGOT increased from 36 to 95 u/l and alkaline phosphatase decreased from 1088 to 590 u/l. SGPT remained unchanged. Histopathology showed compound-related marked diffuse lipid depletion of the adrenals as well as diffuse atrophy of the pancreatic exocrine cells. Animals in the 0.5 mg/kg/day and 1.5 mg/kg/day dosage groups survived to the end of the study. Occasional diarrhea, anorexia and emesis were observed. There

was a decrease in serum alkaline phosphatase and inorganic phosphate in the 1.5 mg/kg/day group and a slight decrease in alkaline phosphatase in the 0.5 mg/kg/day group at the end of 90 days. Histopathology was unremarkable in both dosage groups.

A no observable adverse effect level (NOAEL) was not identified from any of the above three subchronic (90 day) studies. The results from these three subchronic studies suggest there may be a potential for cumulative toxicity over time with the primary toxic effect related to metabolic wasting. This may be due to an effect on peroxisome proliferation, fatty acid metabolism, membrane function, protein synthesis and/or mitochondrial bioenergetics.

To date, there are no data regarding the chronic toxicity and carcinogenicity of PFOS. PFOS was not observed to be mutagenic in several *Salmonella typhimurium* strains with or without metabolic activation [Jagannath and Brusic, 1978]. PFOS was negative in an *in vivo* mouse bone marrow micronucleus assay [Murli, 1996].

There have been two teratology studies conducted with PFOS. Oral administration, via corn oil, of PFOS at doses of 0, 1, 5 and 10 mg/kg/day to pregnant rats during days 6 - 15 of gestation resulted in fetuses with what was initially reported as teratogenic changes in the eye. [Gortner et al., 1980]. These fetal lens abnormalities were subsequently interpreted to be artifacts of the tissue sectioning process. Maternal body weights in the high dose group were significantly reduced but no significant treatment-related teratogenic or embryotoxic effects were reported. In the second teratology study, PFOS was administered in corn oil by oral gavage to groups of 25 pregnant rats on days 6 - 15 of gestation at doses of 0, 1, 5 and 10 mg/kg/day [Wetzel et al., 1983]. Maternal body weights and food consumption at 5 and 10 mg/kg/day were

significantly reduced compared to the control animals. Two female rats in the high dose group died before day 20. Clinical signs in surviving dams included hunching, thinness, alopecia, rough haircoat and anorexia. Treatment-related effects, primarily occurring in the high dose group, included increase resorptions and fetal death, decreased fetal body weight, delayed skeletal ossification, cleft palate, subcutaneous edema and cryptorchidism.

During the past 15 to 20 years there have been several endeavors designed to ascertain the health and exposure status of workers involved with fluorochemical production at the company's Decatur, Alabama and Antwerp, Belgium plants. Medical surveillance has been routinely conducted of fluorochemical production workers at both plants. Medical surveillance activities analyzed for total serum organic fluorine levels until the mid-1990's when serum PFOS determination, quantifiable by liquid chromatography mass spectrometry, became incorporated in the biennial medical surveillance examinations. However, we are aware of one occasion in 1979 where the serum of 5 Decatur employees was measured for PFOS by electron capture gas chromatograph and microwave plasma detection methods [Central Analytical Laboratory, 1979]. Total serum organic fluorine levels for these five employees were 10.1, 5.7, 9.4, 11.8 and 4.1 ppm. The percent of PFOS found was 60%, 70%, 80%, 55% and 65% of the total serum organic fluorine levels, respectively. In 1981, selected clinical chemistries and hematology values of Decatur employees in the chemical plant were compared to those results of employees in the adjacent 3M film plant [Roach, 1982; Schuman, 1982]. There were no significant correlation coefficients between total serum organic fluorine and gamma glutamyl transferase, serum glutamic oxaloacetic

transaminase, serum glutamic pyruvic transaminase, alkaline phosphatase, cholesterol, hemoglobin or red blood counts. However, this analysis was limited in scope (no dose response analysis), did not analyze specifically for PFOS, and did not account for several potential confounding factors. Another research initiative into the health status of Decatur employees was a retrospective cohort mortality study (1961 - 1991) conducted of former and current employees who had worked at least one year at the Decatur plant [Mandel and Johnson, 1995]. Vital status was determined for 99.7% of the 1,957 cohort members who had worked in the chemical and film plants. A total of 74 deaths were identified compared to 117.7 expected (U.S. rates). Among male employees who had worked only in the Decatur chemical plant, there were 32 deaths compared to 44.1 expected. There were no specific causes of death that had significantly elevated standardized mortality ratios. Because of its more recent construction in the 1970's, there has not been a retrospective cohort mortality study conducted of employees at the Antwerp plant.

The purpose of this report is to provide an aggregate analysis of the hematological, clinical chemistry and hormonal parameters, as measured in the medical surveillance examinations of Antwerp and Decatur employees in two separate time periods, in relation to the workers' serum PFOS levels. Although female employees also participated in these medical surveillance examinations, their actual numbers were too few to provide meaningful statistical analysis.

## METHODS

### PFOS Production

PFOS production began in Antwerp in 1976 and in Decatur in 1961. In general, perfluorinated chemicals are produced via an electrochemical process: a solution of organic substrate is electrolyzed in anhydrous hydrogen fluoride at a low voltage (Simons and Bryce, 1954). Basically, the products of this electrolysis cell reaction are highly fluorinated compounds with the end-product defined by the starting material. Products manufactured at these two plants include: Scotchgard™ brand fiber, leather and carpet protector; Light Water™ brand aqueous film forming foam (AFFF); Scotchban™ paper treatment; Kel-F™ brand plastic and Fluorel™ brand elastomers.

Subject Selection

General medical surveillance occurs biennially for employees at both of these plants. Participation is voluntary with approximately 100 Antwerp and 250 Decatur employees eligible for surveillance. A total of 88 Antwerp employees participated in the medical surveillance examinations in the Spring, 1995 and 90 Decatur employees participated in the Fall, 1994. In the Fall of 1997, a total of 149 employees (Antwerp = 65; Decatur = 84) participated in medical surveillance examinations. For purposes of brevity, these time periods will be referred to as 1995 and 1997. Altogether, 61 employees participated in both examination years (1995 and 1997). This lower number was due to a large turnover of employees at both plant locations during 1996-1997. For each time period the surveillance consisted of a medical questionnaire, measurement of height, weight and blood pressure, standard clinical chemistry and hematology tests, and determination of serum PFOS levels.

In 1995, several hormones were also analyzed for male employees who were judged *a priori* to have had likely PFOS exposure (i.e., those working in or in the immediate vicinity of the PFOS production area). Of the 88 Antwerp employees, 50 had hormone measurements. Of the 90 Decatur employees, 38 underwent hormone measurements.

PFOS Analysis

In 1995 the analysis for serum PFOS was conducted by 3M'S Environmental Technology Services in St. Paul, Minnesota. The method used tetrabutylammonium to ion-pair with PFOS in serum. The ion-pairs were then extracted with ethyl acetate. The abstraction product was then analyzed using high performance liquid chromatography-thermospray mass spectrometry [Johnson et al., 1996]. In 1997 the serum samples were analyzed by TurboIonSpray liquid chromatography/mass spectrometry using selected ion monitoring in the negative ion mode by Advanced Bioanalytical Services, Inc. [Anderson et al., 1997a; 1997b]. The lower limit of quantitation was 0.1 μg/mL for PFOS.

Laboratory Analyses

For both time periods, the United Laboratory Services (St. Paul, Minnesota) performed the standard hematological and clinical chemistry tests. These included the following hematological tests: hematocrit (percent), hemoglobin (gm/dl), red blood cells (RBC, 1000/$mm^3$), white blood cells (WBC, 1000/ $mm^3$) and platelet count (1000/ $mm^3$); and the following clinical chemistry tests: alkaline phosphatase (IU/L), gamma glutamyl transferase (GGT, IU/L), aspartate aminotransferase (AST, IU/L) formerly

known as serum glutamic oxaloacetic acid (SGOT), alanine aminotransferase (ALT, IU/L) formerly known as serum glutamic oxaloacetic transaminase (SGPT), total and direct bilirubin (mg/dl), blood urea nitrogen (BUN, mg/dl), serum creatinine (mg/dl), glucose (mg/dl), cholesterol (mg/dl), high density cholesterol (HDL, mg/dl) and triglycerides (mg/dl). Low density lipoprotein (mg/dl) was calculated as the following: LDL = [cholesterol - HDL - (tryglycerides/5)].

Eleven hormones were assayed in 1995: cortisol, dihydroepiandrosterone sulfate (DHEAS), estradiol, follicle stimulating hormone (FSH), 17 alpha hydroxyprogesterone (17-HP), free testosterone, total testosterone, luteinizing hormone (LH), prolactin, thyroid stimulating hormone (TSH) and sex hormone binding globulin (SHBG). All but SHBG (Endocrine Science Reference Laboratory, Tarzana, CA) were analyzed at the University of Minnesota's Endocrinology Laboratory.

Cortisol was assayed using a fluorescence polarization immunoassay (Abbott TDx). Radioimmunoassays (RIA) were used for DHEAS (Pantex), estradiol (modified Pantex), 17-HP (modified CIS) and total testosterone (Diagnostic Product Corp. Coat-A Count). Free testosterone was determined using equilibrium dialysis. LH, FSH and prolactin were assayed using a microparticle enzyme immunoassay (Abbott Imx). TSH was determined using a chemiluminescence immunometric assay (Nichols). SHBG was assessed via a radioimmunoassay after chromatographic sample purification (Endocrine Science Reference Laboratory). Bound testosterone was calculated as total testosterone less free testosterone.

Data Analysis

Descriptive simple and stratified analyses, Pearson correlation coefficients, ANOVA and ordinary multivariable regression were used to evaluate associations between PFOS and each hematological and clinical chemistry test and hormonal assay. Age, body mass index, current alcohol consumption (drinks per day) and cigarette use (cigarettes smoked per day) were potential confounding factors that were considered in the analyses. For stratified analyses, employees were divided into four PFOS categories: 0-1 ppm, 1 - < 3 ppm, 3 - < 6 ppm and $\geq$ 6 ppm in order to determine if an effect existed at the highest serum PFOS levels. Other categorical cutoff points were also used which provided similar results. For multivariable regression analyses, PFOS and the potential confounders of age, body mass index (BMI), alcohol use and cigarette use were examined as continuous explanatory variables in the models. Multivariable regression models were fitted with PFOS analyzed as a continuous variable using linear as well as non-linear transformations (quadratic, square, square root and inverse) in order to maximize the possibility of finding associations between PFOS and the dependent variable of interest. Linear and nonlinear relationships were examined by residual diagnostics using studentized and Cook's distance values. Natural log transformations of the dependent variables were performed, when necessary, to normalize variables and to enhance model fit. Traditional stepwise selection procedures were also employed (selection in and out of model was set at $p = 0.1$) as well as taking into account other covariants that may be on the biologic pathway of effect [Greenland, 1989]. We did not examine changes in measured PFOS between the two time periods because the estimated half-life of PFOS is at least two years. Study results were analyzed using the SAS System [1990].

Analyses are presented by plant, year and the three major groups of participants: all employees who participated in each year (1995: N = 178; 1997: N = 149); only those employees (N = 61) who participated in both years; and only those employees (N = 88) who participated in the hormone measurements in 1995.

## RESULTS

The distribution of employees, by serum PFOS exposure categorization, is presented in Table 1. Whereas 20 percent of the Decatur employees had exposures at $\geq 3$ ppm for both years, this proportion in Antwerp went from 25 percent in 1995 to 13 percent in 1997. For both years 95 percent of the measured serum PFOS levels were below 6 ppm. There were no PFOS measurements $\geq 6$ ppm in Antwerp in 1997.

The overall mean values of PFOS, demographic, serum chemistry and hematological parameters for both locations, as well as each location separately, are presented in Tables 2 and 3, respectively. In particular, the Antwerp male employee population was significantly younger than Decatur, had lower body mass indices and higher self-reported daily consumption of alcohol. In addition, their clinical profiles were also different for several tests. The Antwerp employees had lower mean alkaline phosphatase, creatinine, glucose and triglyceride values and higher total bilirubin, HDL and hematocrit values.

Presented in Table 4 are the Pearson correlation coefficients between PFOS and the selected parameters of interest by both locations combined, each location separately, and by year of examination. In 1995, variables that were significantly ($p < .05$) correlated with PFOS for both locations combined included total bilirubin, white blood

cells and platelets. Although creatinine was not significantly correlated when both locations were examined, it was negatively correlated with PFOS in Antwerp but positively correlated in Decatur. In 1997, variables that were significantly correlated with PFOS for both locations combined were BMI, ALT, direct bilirubin, cholesterol, LDL and hematocrit. In addition, GGT and triglycerides were significantly positively correlated with PFOS among only Antwerp employees.

Provided in Table 5 are the mean, median, standard deviation and range of the covariates and the clinical chemistries and hematological parameters by four levels of PFOS categorization (0 - < 1, 1 - < 3, 3 < 6 and $\geq$ 6 ppm) for both years. Several observations are noteworthy. First, the mean for the $\geq$ 6 ppm PFOS category was one order of magnitude higher than the lowest PFOS category (0 - < 1 ppm) for both years. Also, the means of the four PFOS categories were significantly different from each other. Second, the youngest employees had the lowest serum levels of PFOS. Third, there was only one variable, total bilirubin, which had significant ($p < .05$) F tests for differences in means in both years of analysis. Besides total bilirubin, the only other variable in which the mean of the higher levels of PFOS exposure (3 - < 6 ppm or $\geq$ 6 ppm) was significantly different from the lowest category level of PFOS exposure (0 - < 1 ppm) was for WBC's in 1995. This was not observed in 1997. The lowest mean platelet count was observed at the highest PFOS exposure category in both years although the mean platelet counts by PFOS categories were not significantly different from each other.

Provided in the next two tables are the mean, median, standard deviation and range of the covariates and the clinical chemistries and hematological parameters by the four levels of PFOS categorization for each plant for 1995 (Table 6) and 1997 (Table 7).

In 1995 (Table 6) in Antwerp only, alcohol consumption was associated with higher PFOS levels. Mean serum creatinine levels declined in Antwerp but increased in Decatur employees. Antwerp employees in the 3 - < 6 ppm PFOS category smoked more cigarettes and had higher WBC levels. In 1997, Antwerp employees in the lowest PFOS exposure category were significantly younger than their counterparts. Antwerp employees in the higher PFOS category levels had higher mean alcohol consumption levels. Mean cholesterol, LDL and triglyceride levels trended upwards by PFOS exposure categories for Antwerp employees.

Linear and nonlinear relationships between PFOS and the dependent variables of interest, taking into account the potential confounding affects of age, BMI, alcohol and cigarettes, resulted in numerous analyses. For purposes of brevity, linear regression models are presented in Table 8 which show the effect that the parameter of interest, PFOS, has on the various dependent variables, adjusted for age, body mass index, alcohol and cigarette use. These covariates were analyzed as continuous variables. In the case of serum creatinine and total bilirubin, a quadratic ($PFOS + PFOS^2$) analysis provided the best statistical model of the data adjusted for the four potential confounders. The natural log transformation of total bilirubin, GGT and glucose provided the best fit for these response variables. PFOS was significantly associated ( $p < .10$) in both years for only one clinical parameter: total bilirubin. PFOS was associated in one of the two years for the following variables: direct bilirubin, creatinine, cholesterol, LDL, HDL, hematocrit, hemoglobin and platelet count.

Those variables that were observed to be associated in at least one year in the regression models in Table 8 are separated by plant location and year in Table 9. After

separate analyses by employee population, only two variables, total bilirubin and HDL, remained significantly (negatively) associated with PFOS for at least one plant location for both time periods. Total bilirubin showed a significant negative association with PFOS (quadratic relation) for employees at the Decatur plant in both years. There were no significant associations among the Antwerp population between PFOS and total bilirubin. HDL was significantly negatively associated with PFOS in Antwerp in both 1995 and 1997 but was not significantly associated with PFOS in Decatur in either year. As for inconsistent associations observed in Table 8, direct bilirubin was not significantly associated with PFOS in either plant location (Table 9). The quadratic association for PFOS with creatinine was observed in Antwerp in 1995 and Decatur in 1997 but not in Antwerp in 1997 or Decatur in 1995. Cholesterol (and LDL) was observed to be positively associated with PFOS only in Decatur in 1997. Hematocrit and hemoglobin were associated with PFOS only in Decatur in 1997. Platelet counts were observed to be significantly negatively associated with PFOS only in Decatur in 1995.

Traditional stepwise regression modeling techniques were also used as well as testing models with variables that would be considered on the biological pathway of effect for any dependent variable. The associations (or lack thereof) from these analyses were similar to what has been presented in Tables 8 and 9. For purposes of brevity these analyses are not shown.

To further understand the association between total bilirubin and PFOS, scatter plots are presented for both time periods and by location in Appendix A. In addition, unconjugated bilirubin was also calculated (total bilirubin - direct) and these scatter plots are presented in Appendix B. Table 10 is a summary of these scatter plots from both

Appendices. The strongest associations appeared to be quadratic in nature primarily for the Decatur location and the percent of variability explained ranged between 3 (1995 data) and 7 percent (1997 data). The linear component of the quadratic was negative in direction. The upward trend appeared to occur around 6 ppm PFOS where the data are sparse. These simple linear and quadratic models were not influenced by any one employee according to residual diagnostics.

To further understand the possible association between HDL and PFOS, scatter plots are presented for both times and by location in Appendix C. Both locations combined resulted in significant negative linear and nonlinear (quadratic) associations in 1995 although the percent of variability explained in these models ranged between 3 and 5 percent. No significant associations were observed for each plant location in 1995. There were no significant negative associations between HDL and PFOS in 1997 for either the combined locations or each separate plant site.

Provided in Tables 11 through 14 are the analyses restricted to the 61 employees who participated in surveillance in both years. Table 11 provides the mean values for each parameter for the employees who participated in both exams compared to those who participated in only one of the two years. Overall, there were few differences. The mean age of the 61 employees was lower than that of the 1995 employees who didn't participate in 1997. Conversely, the mean age of the 61 employees was higher than that of the 1997 employees who didn't participate in 1995. Cholesterol and LDL were significantly higher in the 61 participants in 1997. Tables 12 and 13 present the mean values by plant location for 1995 and 1997, respectively. Of these 61 employees, 27 were from Antwerp and 34 from Decatur. Of noteworthy importance are the differences

between the 27 Antwerp employees and their fellow employees in 1997 (Table 13). The 27 Antwerp employees had significantly higher mean PFOS exposures, were significantly older, had greater BMI's and higher cholesterol values. Multivariable regression analyses for the 61 employees are presented in Table 14. The only significant association with PFOS appeared to be with serum creatinine (quadratic) in 1995.

Regardless of plant location, mean PFOS levels were higher for those employees who were selected for hormone measurements in 1995 (Table 15). This was expected as these employees were selected with the *a priori* belief that their serum measurements would be higher due to their workplace experience. For example, of the 42 employees in 1995 whose serum PFOS levels were $\geq 3$ ppm, 76% had hormone measurements.

Presented in Table 16 are the mean values for PFOS, demographic, serum chemistries and hematology for those employees who had hormone measurements compared to those employees who did not in 1995. Those employees who had hormone measurements were younger, higher users of alcohol (Antwerp only) and cigarettes (both locations), and had lower serum creatinine (Antwerp only) and higher WBC levels (both locations). The latter observation is confounded by cigarette smoking as among non-smokers, those selected for hormone measurements had a mean WBC of 6.24 compared to 6.03 for non-selected employees ($p = .36$). Among smokers, those selected had a mean WBC of 8.69 compared to 8.06 for non-selected employees ($p = .23$). All other clinical parameters were comparable, by PFOS exposure categories, between subjects who had hormone measurements and those who did not in 1995 (Tables 17 and 18).

The Pearson correlation coefficients between PFOS and the hormones tested among the 88 employees were the following: cortisol (.07), DHEAS (-.13), estradiol

(.09), FSH (.06), 17-hydroxyprogesterone (-.04), LH (.03), prolactin (.06), SHBG (.11), free testosterone (-.06), bound testosterone (.06), TSH (.01). None were statistically significant.

Presented in Table 19 are the mean, median, standard deviation and range of the various hormones by the four PFOS categories: 0- <1 ppm, 1 - < 3 ppm, 3 - < 6 ppm and $\geq$ 6 ppm. Several observations are noteworthy. First, the mean age of the lowest PFOS exposure category was 10 years less than that of the highest exposure category. Therefore it was not unexpected to observe that the mean DHEAS, 17-HP, free testosterone and bound testosterone levels of this lowest exposure category were greater than the means of the higher PFOS exposure categorizations. Adjusting for the differences in age (as well as the other three potential confounders) in the regression models (Table 20) resulted in no significant associations between PFOS and the hormones analyzed, except for estradiol. With estradiol, a quadratic model provided the best fit of the data and both PFOS terms were significant. Upon residual diagnostics it was determined that this estradiol model was influenced by one specific employee (employee A). The influence of employee A is best seen in Figures 1 and 2 which are simple scatter plots of both the linear and quadratic fits of estradiol and PFOS, with and without employee A, respectively. Employee A had a 12.83 ppm serum level of PFOS which was the highest value recorded in 1995. His estradiol value was 92 pg/dl (see upper right hand corner of Figure 1). Employee's A estradiol value was also influenced by the fact that his body mass index was 33 $kg/m^2$. Exclusion of this employee resulted in a nonsignificant quadratic equation. The variability ($R^2$) of the data explained went from 7.6 percent to 2.1 percent upon exclusion of this employee. The slope of the linear equation changed from

positive to negative although it was nonsignificant in both Figures 1 and 2. Finally, it should be noted that the estradiol models in Table 20, with and without employee A, did predict the known positive assocation between estradiol and body mass index.

## DISCUSSION

We conducted two cross-sectional analyses of surveillance data to examine the associations between serum PFOS levels and several hematological, clinical chemistry and hormonal parameters in male fluorochemical production employees. For both years, 95 percent of the measured serum PFOS levels were below 6 ppm. Because the Antwerp and Decatur employees were dissimilar by age, body mass indices and self-reported alcohol use, we conducted combined as well as separate analyses by plant location. These three demographic differences likely explain why the Antwerp employees had lower mean serum levels of alkaline phosphatase, HDL, triglycerides and blood glucose [Davern and Scharschmidt, 1993; Lewis, 1994; Friedman, 1998; Fu, 1998; Wolf, 1998].

In the present study, alkaline phosphatase, GGT, AST and ALT values were not significantly associated with the measured serum PFOS levels. This was an *a priori* question due to the fact that PFOS: 1) is a peroxisome proliferator in the rat [Ikeda et al., 1987; Sohlenius et al., 1993]; 2) resulted in slight to marked increases in plasma glutamic oxalacetic and pryuvic transaminase levels in a 90 day study of rats fed diets which contained PFOS at 100 ppm along with hypertrophy and liver necrosis observed at histopathology [Goldenthal, 1978a]; and 3) increased SGOT and decreased alkaline phosphatase levels in monkeys after administration, by oral gavage, for 30 days of doses of 4.5 mg/kg/day of PFOS [Goldenthal, 1978b]. On the other hand, SGPT values

remained constant and no histopathologic abnormalities were noted in the livers of these monkeys which died by the 7th week of the study. No significant liver enzymatic or histopathology changes occurred in monkeys in the 0.5 and 1.5 mg/kg/day dose groups.

We did observe a quadratic association with total bilirubin among only the Decatur employees. We do not suspect this is a biological association because the bilirubin levels were within the normal reference range. Also, the percent variability explained of total bilirubin by PFOS in the regression models was low. The Antwerp employees' total bilirubin levels were significantly higher than the Decatur employees' levels. We offer several possible explanations for this observation. First, we suspect there may be a greater prevalence of Gilbert's syndrome [Lidofsky and Scharschmidt, 1993; Friedman, 1998] among the Antwerp employees. In 1995, 15 (17%) Antwerp employees had total bilirubin values $\geq$ 1.2 mg/dl compared to 3 (3%) Decatur employees' levels. In 1997, there were 9 (15%) Antwerp and 2 (2%) Decatur employees with total bilirubin values $\geq$ 1.2 mg/dl. However, there was not a concomitant decline in bilirubin conjugation (i.e., direct bilirubin levels) as might be expected among individuals diagnosed with Gilbert's syndrome. Nevertheless, exclusion of these possible Gilbert's syndrome employees still resulted in higher mean total bilirubin values among the Antwerp employees in both years. Secondly, there were four Antwerp employees who self-reported hepatitis A histories and one employee self-reported a history of Hepatitis B. Fish and shellfish consumption is likely much greater in Antwerp than Decatur due to its vicinity near the North Atlantic. Third, bilirubin is a tetrapyrrole that is an end-product of heme degradation [Lidofsky and Scharschmidt, 1993]. Bilirubin levels may be increased due to disorders of bilirubin metabolism, liver

disease and obstruction of the bile ducts. Other hematological and clinical chemistry results did not suggest these conditions existed among the Decatur employees. Fourth, post-collection procedures may result in error. Total bilirubin determination may be falsely depressed if hemolysis is present because of increased absorbence in the blank [Kaplan and Pesce, 1984]. Bilirubin is also sensitive to and destroyed by light and heat. We are uncertain whether these factors could have contributed to the lower total bilirubin levels in the Decatur samples in both years. Finally, the linear component of the quadratic association observed among Decatur employees is negative in direction in relation with their measured PFOS levels. That is, total bilirubin levels declined with increasing PFOS levels. We would expect a positive association if PFOS impaired bilirubin conjugation. The trend upwards in the quadratic appears to occur at levels 6 ppm and higher where the data are sparse. We conclude that the association observed among only the Decatur employees is unlikely to be related to serum levels of PFOS.

We did observe a positive association between serum PFOS and serum cholesterol levels in the 1997 time period for Decatur employees. This result is unlikely to have a biological explanation as PFOS is a known peroxisome proliferator in the rat and was shown to have hypolipidemic properties in rhesus monkeys [Ikeda et al., 1987; Sohlenius et al., 1993; Goldenthal 1978b; 1979]. Rhesus monkeys fed PFOS at 4.5 mg/kg in their chow had serum cholesterol values reduced from 183 mg/L to 99 mg/L within 30 days. Rhesus monkeys fed 1.5 mg/kg in the chow had cholesterol levels reduced from 195 mg/kg to 111 mg/kg within 90 days [Goldenthal 1978b]. As for HDL, although the multivariable analyses were suggestive of a negative association between HDL and PFOS

in Antwerp (but not Decatur), the scatter plots presented in Appendix C do not support the notion of a biological association between PFOS and HDL.

It should be noted that total organic fluorine levels, primarily consisting of perfluorooctanoic acid (PFOA, $C_7F_{15}COO^-$), a seven carbon perfluorinated carboxylic acid, were reported to reduce the effect that alcohol has on HDL levels among higher exposed male PFOA production workers in Cottage Grove, Minnesota [Gilliland and Mandel, 1995]. However, this finding was not observed in subsequent analyses of these employees (Olsen et al., unpublished findings). This observation by Gilliland and Mandel was testable in the present study as both Antwerp and Decatur employees had measurable quantities of PFOA. We did not observe a significant negative modulation of the effect of alcohol consumption on HDL levels among Antwerp and Decatur employees with higher serum PFOA levels although their serum levels were approximately 3 to 5-fold less, on average, than that reported in Cottage Grove employees [Olsen et al., 1998]. The Antwerp and Decatur employees were exposed to PFOA, not in its actual production, but rather in its use as a surfactant in the production of fluoropolymers. In 1995 the mean serum PFOA level among the Antwerp and Decatur employees combined was 1.46 ppm (range 0 - 13.20 ppm) and in 1997 the mean serum level was 1.57 ppm (range 0.11 - 11.10). Stratified by plant location, the 1995 and 1997 mean serum PFOA levels were 1.19 and 1.78 ppm in the Antwerp employees and 1.72 and 1.40 ppm in the Decatur employees, respectively.

The multivariable regression models showed a negative association between PFOS and platelet counts at PFOS levels above 6 ppm in 1995 and this trend was also apparent, although to a lesser extent, in 1997. Nevertheless, platelet levels were well

within the normal reference range in both time periods. This association is not supported by a 90 day subchronic toxicity study which showed no decline in platelet counts for monkeys fed 0.5, 1.5 or 4.5 mg/kg for up to 90 days [Goldenthal, 1978b]. Mean platelet counts among the 1.5 mg/kg/day and 0.5 mg/kg/day dose groups were 226 and 231 ($10^3$/cmm) compared to 218 in the control group [Goldenthal, 1978b]. There were no platelet counts reported in the 90 day rat study although at the end of 3 months of study there were slight to moderate decreases in hemoglobin, hematocrit and erythrocyte counts observed for male and female rats in the 100 ppm dose group [Goldenthal, 1978a]. No consistent associations were observed between PFOS and hemoglobin, hematocrit or RBC values in the present epidemiologic investigation. In a prior subchronic rhesus monkey study that was aborted early due to all animals died by the 20$^{th}$ day, mean platelet counts were 203, 219, 136, 172 and 185 for the 300 mg/kg/day, 100 mg/kg/day, 30 mg/kg/day, 10 mg/kg/day and control groups, respectively [Goldenthal, 1979].

After controlling for age, a confounder for male testosterone hormone levels [Dali et al., 1981; Griffin and Wilson, 1994], we observed no significant associations with serum PFOS measurements. We did observe a quadratic association between estradiol and PFOS. Upon further examination, this finding was influenced by one particular employee who had the highest PFOS level but was confounded by the individual's large body mass index. Exclusion of this employee resulted in nonsignificant findings. Thus, any interpretation with estradiol is difficult because of the influence this one employee has on the statistical analyses.

It should be noted that perfluorooctanoic acid (PFOA), at approximately 50 - 100 ppm levels in serum, enhances the aromatase conversion of testosterone to estradiol in the

rat [Cook et al., 1992; Biegel et al., 1995]. However, PFOA production workers in Cottage Grove with serum levels up to 30 ppm appeared not to have altered serum estradiol levels [Olsen et al., 1998]. Again, like HDL, this was a testable hypothesis among the Antwerp and Decatur employees although their serum PFOA levels were lower than Cottage Grove employees. We did not observe any significant positive association between estradiol and serum PFOA levels in these Antwerp and Decatur employees.

Several methodological issues should be considered in evaluating the results from this study. First, the cross-sectional design does not allow for a direct analysis of the temporality of an association. Second, the voluntary participation rates in medical surveillance were not ideal as among eligible employees we had 88 and 65 percent participation in Antwerp for 1995 and 1997, respectively, but only 35 to 40 percent in Decatur for both years. Third, given the suspected long half-life of PFOS (at least two years), it may be conceivable that there may be some biological accommodation to the effects of PFOS which would minimize the possibility of finding an association. Fourth, it is known in laboratory animals that PFOS concentrates primarily in the liver. Serum measurements of PFOS may not adequately reflect body burden. Fifth, the two cross-sectional analyses cannot be viewed as independent populations as 61 employees were studied in both years. This was due, in part, to a large turnover of employees at both plants between examinations. Sixth, there could be measurement error in important confounding variables. Analysis of the data of the 61 subjects who participated in both years showed that there was excellent correlation for the confounding factors of BMI ($r = .92$, $p = .0001$), self-reported aspects of alcohol consumption ($r = .88$, $p = .0001$) and

cigarette smoking ($r = .79$, $p = .0001$). As expected, these 61 employees' serum PFOS levels for the two years were highly correlated ($r = .92$, $p = .0001$). Seventh, the quality of medical surveillance data, prior to its use for studying an *a priori* hypothesis, can often be evaluated by whether known positive associations are observed. In this regard, we observed various expected associations including cigarette smoking and elevated white blood cell counts and large body mass indices associated with elevated liver transaminase levels [Olsen et al., 1991; Burns et al., 1997]. Finally, the pulsatile nature of some of the hormones studied (e.g., FSH, LH, testosterone) has resulted in prior recommendations that mean hormone measurements should be the result of pooled blood from multiple samples taken at short intervals [Goldzieher et al., 1976]. In our study multiple samples were not feasible because of the low probability of employees voluntarily giving three serum samples over a 45 -60 minute period of time.

In summary, we conducted two cross-sectional analyses and did not observe consistent associations by plant location or time for several hematological parameters, serum chemistries and reproductive hormones with measured serum PFOS levels in male fluorochemical production employees. Ninety-five percent of the employees had serum PFOS levels below 6 ppm. Our findings suggest that, among these Antwerp and Decatur male fluorochemical production employees, significant hematological, clinical chemistry and hormonal abnormalities were not associated with serum PFOS concentrations less than 6 ppm. Any inferences derived from the few employees with serum PFOS levels $\geq 6$ ppm would be tenuous, at best. Limitations of this study include its cross-sectional design, the voluntary participation rates, the few subjects exposed at the highest levels,

and the lower levels of serum PFOS measured among these employees compared to those that caused effects in two species of laboratory animals.

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Table 1

Distribution of Employees by Year, Location and PFOS Exposure Level (ppm)

| | 1995 Data | | | | | | 1997 Data | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | All Employees | | Antwerp | | Decatur | | All Employees | | Antwerp | | Decatur | |
| PFOS | N | (%) | N | (%) | N | (%) | N | (%) | N | (%) | N | (%) |
| 0 - < 1 ppm | 45 | 25 | 34 | 39 | 11 | 12 | 60 | 40 | 31 | 48 | 29 | 35 |
| 1 - < 3 ppm | 91 | 51 | 32 | 36 | 59 | 66 | 63 | 43 | 25 | 38 | 38 | 45 |
| 3 - < 6 ppm | 35 | 20 | 19 | 22 | 16 | 18 | 21 | 14 | 9 | 14 | 12 | 14 |
| >= 6 ppm | 7 | 4 | 3 | 3 | 4 | 4 | 5 | 3 | 0 | 0 | 5 | 6 |
| | 178 | (100) | 88 | (100) | 90 | (100) | 149 | (100) | 65 | (100) | 84 | (100) |

Table 2

Mean, Median, Standard Deviation and Range of Study Parameters, Both Locations, 1995 and 1997

| | 1995 Data | | | | 1997 Data | | | |
|---|---|---|---|---|---|---|---|---|
| Variable | Mean | Median | Std Dev | Range | Mean | Median | Std. Dev. | Range |
| PFOS | 2.19 | 1.70 | 1.87 | 0 - 12.83 | 1.75 | 1.30 | 1.60 | 0.10 - 9.93 |
| Age | 40.6 | 40.0 | 8.76 | 21 - 60 | 39.3 | 40.0 | 9.7 | 21 - 63 |
| Alcohol | 0.7 | 0.1 | 1.1 | 0 - 6.0 | 0.5 | 0.1 | 1.0 | 0 - 7.1 |
| BMI | 26.6 | 25.8 | 5.1 | 17.9 - 60.7 | 27.1 | 26.0 | 5.2 | 18.1 - 48.5 |
| Cigarettes | 6.3 | 0.0 | 10.7 | 0 - 40 | 6.1 | 0.0 | 10.3 | 0 - 40 |
| Alk Phos | 86.2 | 85.0 | 24.6 | 31 - 191 | 79.8 | 77.0 | 20.8 | 29 - 163 |
| GGT | 44.4 | 36.0 | 32.1 | 2 - 293 | 31.6 | .24.0 | 25.9 | 10 - 179 |
| AST | 27.6 | 26.0 | 10.9 | 13 - 96 | 26.2 | 25.0 | 7.0 | 13 - 56 |
| ALT | 45.9 | 42.0 | 18.6 | 18 - 183 | 32.6 | 30.0 | 14.4 | 10 - 89 |
| T. Bilirubin | 0.72 | 0.70 | 0.37 | 0.20 - 2.90 | 0.67 | 0.60 | 0.32 | 0.30 - 2.30 |
| D. Bilirubin | 0.21 | 0.20 | 0.05 | 0.10 - 0.40 | 0.13 | 0.10 | 0.06 | 0.10 - 0.40 |

Table 2
(Continued)

| Variable | Mean | Median | Std Dev | Range | Mean | Median | Std. Dev. | Range |
|---|---|---|---|---|---|---|---|---|
| BUN | 15.9 | 15.0 | 3.8 | 8 - 26 | 14.4 | 14.0 | 3.0 | 6 - 26 |
| Creatinine | 1.0 | 1.0 | 0.2 | 0.6 - 1.6 | 0.9 | 0.9 | 0.1 | 0.6 - 1.4 |
| Glucose | 86.7 | 85.0 | 18.8 | 60 - 260 | 90.7 | 86.0 | 29.9 | 58 - 303 |
| Cholesterol | 215.9 | 214.0 | 42.5 | 100 - 340 | 211.2 | 213.0 | 40.7 | 110 - 365 |
| LDL | 136.6 | 134.0 | 39.1 | 28 - 261 | 135.3 | 135.0 | 35.0 | 50 - 290 |
| HDL | 48.5 | 48.0 | 12.7 | 23 - 94 | 45.5 | 45.0 | 10.6 | 19 - 74 |
| Triglycerides | 151.0 | 126.0 | 99.9 | 34 - 651 | 156.5 | 122.0 | 130.0 | 38 - 1209 |
| Hematocrit | 46.3 | 47.0 | 2.7 | 38.3 - 52.0 | 45.8 | 46.0 | 2.6 | 39 - 52.9 |
| Hemoglobin | 15.3 | 15.3 | 0.9 | 13 - 17.4 | 15.4 | 15.5 | 0.9 | 12.5 - 17.3 |
| RBC | 4.9 | 4.9 | 0.3 | 4.0 - 5.74 | 5.1 | 4.8 | 0.3 | 4.1 - 5.9 |
| MCH | 31.1 | 31.0 | 1.5 | 26.0 - 36.9 | 30.5 | 31.0 | 1.5 | 26.2 - 34.1 |
| MCHC | 33.1 | 33.0 | 0.7 | 31.3 - 34.7 | 33.6 | 34.0 | 0.5 | 31.8 - 34.9 |
| MCV | 93.7 | 94.0 | 4.9 | 79.7 - 114.6 | 90.7 | 91.0 | .42 | 80.0 - 101.0 |
| WBC | 6.9 | 6.6 | 1.9 | 3.6 - 15.5 | 6.5 | 6.2 | 1.7 | 3.8 - 13.2 |
| Platelets | 226.4 | 223.0 | 45.4 | 122 - 367 | 225.7 | 230.0 | 50.4 | 106 - 406 |

Table 3

Mean Values of PFOS, Demographic, Serum Chemistry and Hematologic Parameters for Antwerp and Decatur, 1995 and 1997 Examinations

| | 1995 Data | | 1997 Data | |
|---|---|---|---|---|
| Variable | Antwerp | Decatur | Antwerp | Decatur |
| PFOS (ppm) | 1.93 | 2.44 | 1.48 | 1.96 |
| Age | 37*** | 45 | 33*** | 44 |
| BMI | 23.9*** | 29.2 | 23.5*** | 30.0 |
| Cigarettes | 4.7* | 7.9 | 5.5 | 6.6 |
| Alcohol | 1.3*** | 0.2 | 1.1*** | 0.1 |
| Alk Phosphatase | 75*** | 97 | 70*** | 87 |
| GGT | 41 | 48 | 26* | 36 |
| AST | 26* | 29 | 27 | 26 |
| ALT | 44 | 47 | 31 | 34 |
| Total bilirubin | 0.86*** | 0.58 | 0.80*** | 0.58 |
| Direct bilirubin | 0.22 | 0.21 | 0.15*** | 0.12 |
| BUN | 17.0*** | 14.8 | 14.9 | 14.1 |
| Creatinine | 0.9*** | 1.1 | 0.9** | 1.0 |
| Glucose | 81*** | 92 | 81*** | 98 |
| Cholesterol | 214 | 218 | 206 | 215 |
| LDL | 138 | 136 | 134 | 137 |
| HDL | 54*** | 43 | 50*** | 42 |
| Triglycerides | 115*** | 187 | 111*** | 192 |

Table 3
(continued)

| | 1995 Data | | 1997 Data | |
|---|---|---|---|---|
| Variable | Antwerp | Decatur | Antwerp | Decatur |
| Hematocrit | 47*** | 46 | 46* | 45 |
| Hemoglobin | 15.4 | 15.2 | 15.4 | 15.3 |
| RBC | 4.9 | 5.0 | 5.1 | 5.1 |
| MCH | 31.4*** | 30.7 | 30.5 | 30.4 |
| MCHC | 32.9*** | 33.4 | 33.3*** | 33.7 |
| MVC | 95.7*** | 91.8 | 91.6* | 90.0 |
| WBC | 6.4*** | 7.5 | 6.5 | 6.4 |
| Platelets | 224 | 229 | 237* | 217 |

* $p < .05$; ** $p < .01$; ***$p < .001$

Table 4

Correlation Coefficients Between PFOS and Selected Variables by Location and Year of Examination

| | 1995 Data | | | 1997 Data | | |
|---|---|---|---|---|---|---|
| Variable | Both Locations | Antwerp | Decatur | Both Locations | Antwerp | Decatur |
| Age | .12 | .10 | .04 | .20* | .41*** | -.01 |
| Alcohol | .09 | .25* | .06 | .10 | .40*** | -.07 |
| BMI | .01 | -.14 | -.05 | .18* | .22 | .09 |
| Cigarettes | .14 | .19 | .08 | -.03 | .08 | -.08 |
| BUN | -.05 | -.04 | .01 | .01 | .13 | -.01 |
| Creatinine | .05 | -.37*** | .28** | .08 | -.12 | .12 |
| Glucose | -.02 | -.17 | -.02 | .10 | .04 | .06 |
| Alkaline Phosphatase | .06 | .07 | -.06 | .07 | .09 | -.02 |
| GGT | .01 | .02 | -.04 | .07 | .26* | -.06 |
| AST | .06 | .06 | .0002 | .003 | .03 | .001 |

Table 4
(continued)

| Variable | 1995 Data | | | 1997 Data | | |
|---|---|---|---|---|---|---|
| | Both Locations | Antwerp | Decatur | Both Locations | Antwerp | Decatur |
| ALT | -.01 | -.03 | -.03 | .16* | .11 | .16 |
| Total Bilirubin | -.15* | -.13 | -.07 | -.13 | -.12 | -.07 |
| Direct Bilirubin | -.03 | -.13 | .09 | -.18* | -.13 | -.17 |
| Cholesterol | -.02 | .02 | -.08 | .25** | .34** | .19 |
| LDL | .01 | .02 | .02 | .22** | .30* | .17 |
| HDL | -.17* | -.14 | -.12 | -.07 | -.05 | .0005 |
| Triglycerides | .04 | .11 | -.10 | .10 | .39*** | -.01 |
| Hematocrit | .002 | .10 | -.0003 | -.16* | -.05 | -.20 |
| Hemoglobin | -.01 | .05 | -.02 | -.15 | -.05 | -.20 |
| Red Blood Cells | -.03 | -.11 | .01 | -.11 | -.15 | -.10 |
| MCH | .04 | .21* | -.04 | -.04 | .17 | -.10 |

Table 4
(continued)

| | 1995 Data | | | 1997 Data | | |
|---|---|---|---|---|---|---|
| Variable | Both Locations | Antwerp | Decatur | Both Locations | Antwerp | Decatur |
| MCHC | -.03 | -.11 | -.09 | .01 | -.03 | -.06 |
| MCV | .05 | .25* | -.01 | -.03 | .20 | -.09 |
| White Blood Cells | .18* | .27** | .04 | .01 | .18 | -.09 |
| Platelets | -.15* | -.06 | -.25* | -.11 | -.06 | -.10 |

* $p < .05$; ** $p < .01$; *** $p < .001$

Table 5

Mean, Median, Standard Deviation (SD) of Mean and Range of PFOS, Demographic, Serum Chemistries and Hematological for Antwerp and Decatur Employees Combined, 1995 (N=178) and 1997 (N=147)

| PFOS* (ppm) | 1995 Data | | | | 1997 Data | | | |
|---|---|---|---|---|---|---|---|---|
| | Mean | Median | SD | Range | Mean | Median | SD | Range |
| | | | | PFOS (ppm) | | | | |
| 0 - < 1ppm | 0.49[1] | 0.5 | 0.27 | 000 - 0.90 | 0.52[1] | 0.52 | 0.27 | 0.10 - 0.97 |
| 1 - < 3ppm | 1.82[1] | 1.77 | 0.58 | 1.00 - 2.91 | 1.78[1] | 1.64 | 0.56 | 1.02 - 2.89 |
| 3 - < 6ppm | 4.12[1] | 3.97 | 0.81 | 3.00 - 5.80 | 3.87[1] | 3.59 | 0.70 | 3.09 - 5.30 |
| ≥ 6ppm | 8.17[1] | 7.73 | 2.52 | 6.06 - 12.83 | 7.20[1] | 6.68 | 1.59 | 6.05 - 9.3 |
| | F value = 321.9, p < .0001 | | | | F value = 367.6, p < .0001 | | | |
| | | | | Age (yrs) | | | | |
| 0 - < 1 ppm | 37 | 36 | 8 | 21 - 58 | 36 | 34 | 11 | 21 - 62 |
| 1 - < 3 ppm | 42[2] | 41 | 9 | 25 - 60 | 42[2] | 41 | 9 | 24 - 63 |
| 3 - < 6 ppm | 40 | 40 | 7 | 26 - 55 | 41 | 42 | 5 | 32 - 54 |
| ≥ 6 ppm | 45 | 43 | 7 | 37 - 56 | 42 | 45 | 9 | 29 - 52 |
| | F value = 3.7, p = .02 | | | | F value = 5.1, p = .002 | | | |

Table 5 (continued)

| PFOS (ppm) | 1995 Data Mean | Median | SD | Range | 1997 Data Mean | Median | SD | Range |
|---|---|---|---|---|---|---|---|---|
| **Alcohol (drinks/day)** | | | | | | | | |
| 0 - < 1ppm | 0.8 | 0.6 | 0.9 | 0.0 - 3.6 | 0.5 | 0.1 | 0.8 | 0 - 4.3 |
| 1 - < 3 ppm | 0.5 | 0.1 | 0.7 | 0.0 - 3.6 | 0.5 | 0.1 | 0.8 | 0 - 5.0 |
| 3 - < 6 ppm | 1.2 | 0.3 | 1.9 | 0.0 - 6.0 | 1.0 | 0.1 | 1.8 | 0 - 7.1 |
| ≥ 6ppm | 0.7 | 0.0 | 1.1 | 0.0 - 2.9 | 0.2 | 0.1 | 0.2 | 0.1 - 0.8 |
| | F value = 4.0, p = .009 | | | | F value = 1.8, p = .15 | | | |
| **BMI ($kg/m^2$)** | | | | | | | | |
| 0 - < 1 ppm | 25.5 | 24.8 | 4.2 | 17.9 - 38.7 | 26.0 | 24.9 | 4.9 | 20.1 - 41.7 |
| 1 - < 3 ppm | 27.7 | 26.3 | 5.8 | 19.6 - 60.7 | 27.7 | 26.4 | 5.7 | 18.1 - 48.5 |
| 3 - < 6 ppm | 24.9[3] | 25.0 | 3.8 | 17.9 - 32.5 | 27.3 | 27.9 | 4.4 | 19.1 - 36.0 |
| ≥ 6 ppm | 27.7 | 29.4 | 4.2 | 20.6 - 33.0 | 30.8 | 29.7 | 4.0 | 26.1 - 36.2 |
| | F value = 3.7, p = .02 | | | | F value = 2.1, p = .10 | | | |
| **Cigarettes (per day)** | | | | | | | | |
| 0 - < 1 ppm | 2.6 | 0.0 | 6.4 | 0.0 - 25.0 | 4.7 | 0.0 | 9.4 | 0 - 40 |
| 1 - < 3 ppm | 6.8 | 0.0 | 11.3 | 0.0 - 40.0 | 8.2 | 0.0 | 11.3 | 0 - 40 |
| 3 - < 6 ppm | 10.6 | 8.0 | 12.4 | 0.0 - 40.0 | 4.1 | 0.0 | 8.3 | 0 - 30 |
| ≥ 6 ppm | 0.4 | 0.0 | 1.1 | 0.0 - 3.0 | 6.0 | 0.0 | 13.4 | 0 - 30 |
| | F value = 4.8, p = .003 | | | | F value = 1.5, p = .23 | | | |

Table 5 (continued)

| PFOS (ppm) | 1995 Data Mean | Median | SD | Range | 1997 Data Mean | Median | SD | Range |
|---|---|---|---|---|---|---|---|---|
| | | | | BUN | | | | |
| 0 - < 1ppm | 16.5 | 15 | 3.5 | 11 - 26 | 14.5 | 14.0 | 2.8 | 9.0 - 21.0 |
| 1 - <3 ppm | 15.4 | 15.0 | 4.0 | 8.0 - 26.0 | 14.2 | 14.0 | 3.2 | 6.0 - 26.0 |
| 3 - < 6 ppm | 16.4 | 16.0 | 3.7 | 10.0 - 23.0 | 15.0 | 15.0 | 2.9 | 9.0 - 20.0 |
| ≥ 6 ppm | 15.1 | 14.0 | 4.2 | 10.0 - 21.0 | 13.8 | 12.0 | 4.1 | 9.0 - 19.0 |
| | F value = 1.1, p = .36 | | | | F value = 0.5, p = 0.67 | | | |
| | | | | Creatinine | | | | |
| 0 - < 1ppm | 1.0 | 1.0 | 0.2 | 0.7 - 1.6 | 0.9 | 0.9 | 0.1 | 0.6 - 1.2 |
| 1 - <3 ppm | 1.0 | 1.0 | 0.2 | 0.7 - 1.6 | 0.9 | 0.9 | 0.1 | 0.7 - 1.3 |
| 3 - < 6 ppm | 0.9 | 0.9 | 0.2 | 0.7 - 1.2 | 0.9 | 0.9 | 0.1 | 0.7 - 1.1 |
| ≥ 6 ppm | 1.1 | 1.2 | 0.3 | 0.6 - 1.6 | 1.0 | 0.9 | 0.2 | 0.8 - 1.4 |
| | F value = 2.3, p = .08 | | | | F value = 0.4, p = 0.78 | | | |
| | | | | Glucose | | | | |
| 0 - < 1 ppm | 85 | 85 | 15 | 66 - 170 | 87 | 85 | 17 | 58 - 174 |
| 1 - <3 ppm | 86 | 86 | 22 | 60 - 260 | 93 | 84 | 39 | 65 - 303 |
| 3 - < 6 ppm | 84 | 83 | 12 | 66 - 114 | 95 | 89 | 25 | 74 - 192 |
| ≥ 6 ppm | 84 | 83 | 14 | 71 - 105 | 89 | 88 | 7 | 80 - 97 |
| | F value = 0.9, p = .44 | | | | F value = 0.6, p = .59 | | | |

Table 5 (continued)

| PFOS (ppm) | 1995 Data | | | | 1997 Data | | | |
|---|---|---|---|---|---|---|---|---|
| | Mean | Median | SD | Range | Mean | Median | SD | Range |
| | | | | Alkaline Phosphatase | | | | |
| 0 - < 1 ppm | 80 | 78 | 22 | 31 - 158 | 77 | 73 | 17 | 49 - 132 |
| 1 - <3 ppm | 89 | 89 | 27 | 49 - 191 | 83 | 79 | 23 | 41 - 163 |
| 3 - < 6 ppm | 86 | 85 | 21 | 32 - 124 | 76 | 74 | 22 | 29 - 120 |
| ≥ 6 ppm | 88 | 85 | 24 | 63 - 136 | 88 | 84 | 18 | 65 - 114 |
| | F value = 1.3, p = .28 | | | | F value = 1.17, p = .32 | | | |
| | | | | GGT | | | | |
| 0 - < 1 ppm | 43 | 31 | 28 | 16 - 155 | 28 | 22 | 20 | 10 - 142 |
| 1 - <3 ppm | 47 | 36 | 39 | 2 - 293 | 36 | 25 | 33 | 10 - 179 |
| 3 - < 6 ppm | 40 | 39 | 15 | 21 - 80 | 28 | 27 | 14 | 13 - 71 |
| ≥ 6 ppm | 43 | 33 | 18 | 28 - 79 | 33 | 37 | 12 | 17 - 48 |
| | F value = 0.5, p = .71 | | | | F value = 1.1, p = .34 | | | |
| | | | | AST | | | | |
| 0 - < 1 ppm | 27 | 25 | 13 | 15 - 96 | 27 | 25 | 7 | 13 - 53 |
| 1 - <3 ppm | 29 | 26 | 12 | 14 - 90 | 26 | 25 | 7 | 15 - 56 |
| 3 - < 6 ppm | 25 | 24 | 5 | 13 - 37 | 25 | 23 | 7 | 14 - 43 |
| ≥ 6 ppm | 33 | 33 | 6 | 26 - 43 | 29 | 28 | 3 | 26 - 34 |
| | F value - 1.8, p = .14 | | | | F value = 0.5, p = .67 | | | |

Table 5 (continued)

| PFOS (ppm) | 1995 Data | | | | 1997 Data | | | |
|---|---|---|---|---|---|---|---|---|
| | Mean | Median | SD | Range | Mean | Median | SD | Range |
| | | | | ALT | | | | |
| 0 - < 1 ppm | 48 | 43 | 20 | 27 - 118 | 31 | 30 | 11 | 13 - 60 |
| 1 - <3 ppm | 46 | 42 | 21 | 18 - 183 | 33 | 29 | 16 | 10 - 89 |
| 3 - < 6 ppm | 42 | 41 | 7 | 30 - 59 | 34 | 31 | 18 | 14 - 82 |
| ≥ 6 ppm | 51 | 49 | 17 | 29 - 82 | 41 | 45 | 10 | 25 - 49 |
| | F value = 1.0, p = .38 | | | | F value = 0.9, p = .46 | | | |
| | | | | Total Bilirubin | | | | |
| 0 - < 1 ppm | 0.88 | 0.70 | 0.50 | 0.40 - 2.90 | 0.77 | 0.60 | 0.40 | 0.30 - 2.30 |
| 1 - <3 ppm | 0.66[2] | 0.60 | 0.30 | 0.20 - 1.50 | 0.61[2] | 0.60 | 0.21 | 0.30 - 1.30 |
| 3 - < 6 ppm | 0.64[2] | 0.60 | 0.28 | 0.20 - 1.40 | 0.63 | 0.50 | 0.31 | 0.40 - 1.30 |
| ≥ 6 ppm | 0.76 | 0.70 | 0.23 | 0.50 - 1.20 | 0.58 | 0.50 | 0.24 | 0.40 - 1.00 |
| | F value = 4.4, p = .005 | | | | F value = 2,9, p = .04 | | | |
| | | | | Direct Bilirubin | | | | |
| 0 - < 1 ppm | 0.22 | 0.20 | 0.05 | 0.02 - 0.40 | 0.15 | 0.10 | 0.07 | 0.10 - 0.40 |
| 1 - <3 ppm | 0.21 | 0.20 | 0.06 | 0.10 - 0.40 | 0.12[2] | 0.10 | 0.04 | 0.10 - 0.20 |
| 3 - < 6 ppm | 0.21 | 0.20 | 0.04 | 0.20 - 0.30 | 0.12 | 0.10 | 0.04 | 0.10 - 0.20 |
| ≥ 6 ppm | 0.20 | 0.20 | 0.02 | 0.10 0.30 | 0.10 | 0.10 | 0.00 | 0.10 - 0.10 |
| | F value = 0.6, p = .58 | | | | F value = 3.5, p = .02 | | | |

Table 5 (continued)

| PFOS (ppm) | 1995 Data Mean | Median | SD | Range | 1997 Data Mean | Median | SD | Range |
|---|---|---|---|---|---|---|---|---|
| | | | | Cholesterol | | | | |
| 0 - <1 ppm | 219 | 215 | 47 | 100 - 340 | 198 | 197 | 40 | 110 - 280 |
| 1 - <3 ppm | 216 | 213 | 43 | 118 - 315 | 216 | 219 | 42 | 116 - 365 |
| 3 - <6 ppm | 214 | 214 | 35 | 128 - 278 | 229[2] | 224 | 29 | 192 - 321 |
| ≥ 6 ppm | 213 | 221 | 36 | 160 - 251 | 229 | 238 | 26 | 186 - 250 |
| | F value = 0.1, p =.96 | | | | F value = 4.3, p =.006 | | | |
| | | | | LDL | | | | |
| 0 - <1 ppm | 140 | 137 | 43 | 29 - 261 | 124 | 128 | 34 | 50 - 205 |
| 1 - < 3 ppm | 134 | 134 | 40 | 44 - 234 | 141 | 134 | 38 | 61 - 290 |
| 3 - <6 ppm | 137 | 135 | 34 | 65 - 190 | 148[2] | 142 | 24 | 111 - 196 |
| ≥ 6 ppm | 142 | 136 | 32 | 95 - 178 | 145 | 156 | 26 | 103 - 164 |
| | F value = 0.2 , p =.87 | | | | F value = 3.7, p =.01 | | | |
| | | | | HDL | | | | |
| 0 - <1 ppm | 53 | 53 | 13 | 31 - 94 | 46 | 48 | 11 | 19 - 74 |
| 1- <3 ppm | 48 | 47 | 13 | 26 -94 | 44 | 45 | 10 | 28 - 69 |
| 3 - <6 ppm | 45 | 46 | 11 | 23 - 74 | 48 | 47 | 10 | 32 - 69 |
| ≥ 6 ppm | 45 | 46 | 9 | 34 - 61 | 40 | 38 | 4 | 37 - 45 |
| | F value = 2.9, p =.04 | | | | F value = 1.1, p =.34 | | | |
| | | | | Triglycerides | | | | |
| 0 - <1 ppm | 129 | 96 | 98 | 41 - 622 | 148 | 107 | 162 | 38 - 1209 |
| 1- <3 ppm | 161 | 133 | 107 | 41 - 651 | 156 | 122 | 108 | 44 - 534 |
| 3 - <6 ppm | 158 | 142 | 88 | 34 - 413 | 166 | 158 | 92 | 45 - 394 |
| ≥ 6 ppm | 132 | 151 | 45 | 64 - 187 | 220 | 191 | 83 | 149 - 352 |
| | F value = 1.1, p =.35 | | | | F value = 0.5, p =.67 | | | |

Table 5 (continued)

| PFOS (ppm) | 1995 Data Mean | Median | SD | Range | 1997 Data Mean | Median | SD | Range |
|---|---|---|---|---|---|---|---|---|
| | | | | Hematocrit | | | | |
| 0 - <1 ppm | 47 | 47 | 2 | 43 - 51 | 46 | 46 | 2 | 40 - 52 |
| 1 - <3 ppm | 46 | 46 | 3 | 38 - 52 | 45 | 46 | 3 | 39 - 53 |
| 3 - <6 ppm | 47 | 47 | 2 | 41 - 52 | 46 | 44 | 3 | 39 - 50 |
| ≥ 6 ppm | 47 | 48 | 2 | 44 - 49 | 45 | 44 | 2 | 42 - 47 |
| | F value = 2.4, p =.07 | | | | F value = 2.1, p = .11 | | | |
| | | | | Hemoglobin | | | | |
| 0 - <1 ppm | 15.5 | 15.5 | 0.7 | 14.0 - 16.7 | 15.5 | 15.5 | 0.8 | 13.5 - 17.0 |
| 1 - <3 ppm | 15.2 | 15.2 | 1.0 | 13.0 - 17.4 | 15.4 | 15.5 | 0.9 | 13.3 - 17.3 |
| 3 - <6 ppm | 15.5 | 15.5 | 0.8 | 13.6 - 17.4 | 15.0 | 14.7 | 1.0 | 12.5 - 16.7 |
| ≥ 6 ppm | 15.5 | 15.4 | 0.7 | 14.7 - 16.2 | 15.1 | 15.0 | 0.7 | 14.1 - 16.2 |
| | F value = 2.2, p =.10 | | | | F value = 1.8, p =.15 | | | |
| | | | | RBC | | | | |
| 0 - <1 ppm | 5.0 | 5.0 | 0.3 | 4.3 - 5.7 | 5.1 | 5.2 | 0.3 | 4.3 - 5.9 |
| 1 - <3 ppm | 4.9 | 4.9 | 0.3 | 4.3 - 5.7 | 5.0 | 5.1 | 0.3 | 4.1 - 5.5 |
| 3 - <6 ppm | 5.0 | 5.0 | 0.2 | 4.6 - 5.5 | 5.0 | 5.0 | 0.3 | 4.4 - 5.7 |
| ≥ 6 ppm | 5.0 | 4.9 | 0.5 | 4.0 - 5.7 | 5.0 | 4.9 | 0.3 | 4.7 - 5.5 |
| | F value = 0.4, p = .75 | | | | F value = 1.4, p = .25 | | | |

Table 5 (continued)

| PFOS (ppm) | 1995 Data Mean | Median | SD | Range | 1997 Data Mean | Median | SD | Range |
|---|---|---|---|---|---|---|---|---|
| | | | | MCH | | | | |
| 0 - <1 ppm | 31.3 | 31.2 | 1.6 | 27.7 - 34.3 | 30.4 | 30.3 | 1.5 | 27.6 - 34.1 |
| 1 - <3 ppm | 30.9 | 30.9 | 1.4 | 26.4 - 34.3 | 30.6 | 30.5 | 1.2 | 26.7 - 33.8 |
| 3 - <6 ppm | 31.2 | 31.3 | 1.5 | 26.0 - 33.6 | 30.2 | 31.2 | 1.9 | 26.2 - 32.9 |
| ≥ 6 ppm | 31.2 | 30.5 | 2.8 | 28.2 - 36.9 | 30.5 | 30.5 | 2.1 | 27.5 - 33.4 |
| | F value = 0.9 , p =.45 | | | | F value = 0.6, p = .65 | | | |
| | | | | MCHC | | | | |
| 0 - <1 ppm | 33.1 | 33.2 | 0.7 | 31.9 - 34.7 | 33.6 | 33.6 | 0.5 | 32.2 - 34.9 |
| 1 - <3 ppm | 33.2 | 33.1 | 0.6 | 31.7 - 34.5 | 33.6 | 33.6 | 0.5 | 31.8 - 34.6 |
| 3 - <6 ppm | 33.1 | 32.6 | 0.7 | 31.3 - 34.3 | 33.5 | 33.5 | 0.7 | 32.0 - 34.4 |
| ≥ 6 ppm | 33.1 | 33.3 | 0.6 | 32.2 - 34.0 | 33.9 | 33.9 | 0.5 | 33.4 - 34.6 |
| | F value = 0.2, p = .90 | | | | F value = 0.7, p = .56 | | | |
| | | | | MCV | | | | |
| 0 - <1 ppm | 94 | 95 | 5.2 | 85-106 | 90 | 90 | 4.4 | 83 - 101 |
| 1 - <3 ppm | 93 | 94 | 4.3 | 80-104 | 91 | 91 | 3.6 | 81 - 99 |
| 3 - <6 ppm | 94 | 94 | 4.8 | 81-104 | 90 | 91 | 5.2 | 80 - 97 |
| ≥ 6 ppm | 94 | 92 | 9.7 | 85-115 | 90 | 91 | 5.7 | 81 - 96 |
| | F value = 1.1, p = .35 | | | | F value = 0.6, p = .59 | | | |

Table 5 (continued)

| PFOS (ppm) | 1995 Data Mean | Median | SD | Range | 1997 Data Mean | Median | SD | Range |
|---|---|---|---|---|---|---|---|---|
| | | | | WBC | | | | |
| 0 - <1 ppm | 6.1 | 6.0 | 1.3 | 4.1 - 9.4 | 6.1 | 5.8 | 1.4 | 3.8 - 10.3 |
| 1 - <3 ppm | 7.0[2] | 6.8 | 2.0 | 3.6 - 15.5 | 6.9 | 6.6 | 1.9 | 3.8 - 13.2 |
| 3 - <6 ppm | 7.6[2] | 6.9 | 2.2 | 4.1 - 13.3 | 6.2 | 6.1 | 1.5 | 4.0 - 10.0 |
| ≥ 6 ppm | 7.0 | 6.9 | 0.6 | 6.4 - 7.8 | 6.2 | 7.1 | 1.5 | 4.2 - 7.4 |
| | F value = 4.3, p =.006 | | | | F value = 2.2, p =.09 | | | |
| | | | | Platelets | | | | |
| 0 - <1 ppm | 226 | 224 | 40 | 159 - 309 | 227 | 220 | 53 | 106 - 406 |
| 1 - <3 ppm | 229 | 224 | 47 | 122 - 367 | 229 | 223 | 49 | 124 - 359 |
| 3 - <6 ppm | 228 | 226 | 45 | 132 - 344 | 220 | 221 | 45 | 147 - 316 |
| ≥ 6 ppm | 185 | 182 | 50 | 132 - 277 | 199 | 191 | 58 | 146 - 295 |
| | F value = 2.1, p =.10 | | | | F value = 0.6, p = 0.60 | | | |

1. Mean is significantly different ($p < .05$, Bonferroni (Dunn) test) than the mean of the other PFOS categories.
2. Mean is significantly different ($p < .05$, Bonferroni (Dunn) test) than the mean of 0 - < 1 ppm PFOS category.
3. Mean is significantly different ($p < .05$, Bonferroni (Dunn) test) than the mean of 1 - < 3 ppm category.

| * Sample Size | 1995 Data | 1997 Data |
|---|---|---|
| 0 - <1 ppm | 45 | 60 |
| 1 - <3 ppm | 91 | 63 |
| 3 - <6 ppm | 35 | 21 |
| ≥ 6 ppm | 7 | 5 |

Table 6

Mean, Median (Med), Standard Deviation (SD) of Mean and Range of PFOS, Demographic, Serum Chemistries and Hematological Values by Plant Location, 1995

| PFOS* (ppm) | 1995 Data: Antwerp Mean | Med | SD | Range | Decatur Mean | Med | SD | Range |
|---|---|---|---|---|---|---|---|---|
| | | | | PFOS | | | | |
| 0 < 1 | 0.46[1] | 0.45 | 0.29 | 0.00 - 0.90 | 0.60[1] | 0.63 | 0.19 | 0.25 - 0.88 |
| 1 < 3 | 1.69[1] | 1.50 | 0.57 | 1.00 - 2.90 | 1.89[1] | 1.89 | 0.58 | 1.00 - 2.91 |
| 3 < 6 | 3.96[1] | 3.70 | 0.79 | 3.00 - 5.60 | 4.31[1] | 4.23 | 0.82 | 3.11 - 5.80 |
| ≥ 6 | 8.17[1] | 8.50 | 1.92 | 6.10 - 9.90 | 8.17[1] | 6.90 | 3.20 | 6.06 - 12.83 |
| | F value = 241.0, p = .0001 | | | | F value = 114.5, p = .0001 | | | |
| | | | | Age | | | | |
| 0 < 1 | 36 | 36 | 7 | 21 - 52 | 40 | 39 | 11 | 29 - 58 |
| 1 < 3 | 36 | 34 | 9 | 25 - 60 | 46 | 46 | 7 | 30 - 58 |
| 3 < 6 | 37 | 37 | 7 | 28 - 51 | 44 | 44 | 7 | 26 - 55 |
| ≥ 6 | 40 | 37 | 6 | 37 - 47 | 48 | 47 | 7 | 42 - 56 |
| | F value = 0.5, p = .71 | | | | F value = 2.0, p = .12 | | | |
| | | | | Alcohol | | | | |
| 0 < 1 | 1.0 | 0.7 | 1.0 | 0.0 - 3.6 | 0.1 | 0.0 | 0.3 | 0.0 - 0.9 |
| 1 < 3 | 1.0 | 0.8 | 0.9 | 0.0 - 3.6 | 0.2 | 0.0 | 0.4 | 0.0 - 2.0 |
| 3 < 6 | 2.0 | 1.3 | 2.2 | 0.0 - 6.0 | 0.4 | 0.0 | 0.9 | 0.0 - 3.4 |
| ≥ 6 | 1.7 | 1.4 | 1.1 | 0.7 - 2.9 | 0.0 | 0.0 | 0.0 | 0.0 - 0.1 |
| | F value = 2.9, p = .04 | | | | F value = 1.1, p = .37 | | | |
| | | | | BMI | | | | |
| 0 < 1 | 24.1 | 24.3 | 2.4 | 17.9 - 28.1 | 30.1 | 28.0 | 5.3 | 22.8 - 38.7 |
| 1 < 3 | 24.3 | 23.8 | 2.4 | 19.6 - 31.6 | 29.6 | 28.3 | 6.2 | 22.3 - 60.7 |
| 3 < 6 | 23.1 | 23.0 | 3.3 | 17.9 - 31.4 | 27.0 | 27.5 | 3.4 | 19.1 - 32.5 |
| ≥ 6 | 23.7 | 24.7 | 2.8 | 20.6 - 25.8 | 30.7 | 30.2 | 1.6 | 29.4 - 33.0 |
| | F value = 0.9, p = .47 | | | | F value = 1.1, p = .35 | | | |

Table 6
(continued)

| PFOS (ppm) | Antwerp Mean | Med | SD | Range | Decatur Mean | Med | SD | Range |
|---|---|---|---|---|---|---|---|---|
| | | | | Cigarettes | | | | |
| 0 < 1 | 3.0 | 0.0 | 7.0 | 0 - 25 | 1.4 | 0.0 | 3.8 | 0 - 13 |
| 1 < 3 | 4.1 | 0.0 | 7.0 | 0 - 23 | 8.3 | 0.0 | 12.9 | 0 - 40 |
| 3 < 6 | 9.1[3] | 7.5 | 9.0 | 0 - 25 | 12.5 | 0.0 | 15.7 | 0 - 40 |
| ≥ 6 | 1.0 | 0.0 | 1.7 | 0 - 3 | 0 | 0.0 | 0 | 0 - 0 |
| | F = 3.1, p = .03 | | | | F value = 2.3, p = .09 | | | |
| | | | | Alkaline Phosphatase | | | | |
| 0 < 1 | 75 | 75 | 16 | 31 - 104 | 96 | 99 | 29 | 47 - 158 |
| 1 < 3 | 73 | 66 | 19 | 49 - 108 | 98 | 95 | 27 | 49 - 191 |
| 3 < 6 | 79 | 78 | 20 | 32 -12195 | 95 | 96 | 18 | 58 - 124. |
| ≥ 6 | 74 | 74 | 11 | 63 - 85 | 98 | 91 | 27 | 73 - 136 |
| | F value = 0.5, p = .69 | | | | F value = 0.1, p = .98 | | | |
| | | | | GGT | | | | |
| 0 < 1 | 39 | 29 | 22 | 16 - 111 | 55 | 41 | 41 | 21 - 155 |
| 1 < 3 | 48 | 30 | 58 | 12 - 293 | 46 | 40 | 24 | 2 - 118 |
| 3 < 6 | 34 | 34 | 11 | 21 - 55 | 47 | 48 | 16 | 21 - 80 |
| ≥ 6 | 31 | 32 | 3 | 28 - 33 | 52 | 49 | 20 | 30 - 79 |
| | F value = 0.7, p = .55 | | | | F value = 0.5, p = .71 | | | |
| | | | | AST | | | | |
| 0 < 1 | 26 | 23 | 13 | 15 - 96 | 32 | 31 | 9 | 19 - 52 |
| 1 < 3 | 27 | 26 | 14 | 14 - 90 | 29 | 27 | 10 | 17 - 85 |
| 3 < 6 | 23 | 22 | 5 | 13 - 35 | 27 | 26 | 5 | 21 - 37 |
| ≥ 6 | 33 | 35 | 6 | 26 - 37 | 34 | 32 | 7 | 28 - 43 |
| | F value = 0.9, p = .45 | | | | F value = 0.9, p = .44 | | | |

Table 6
(continued)

| PFOS (ppm) | Antwerp Mean | Med | SD | Range | Decatur Mean | Med | SD | Range |
|---|---|---|---|---|---|---|---|---|
| | | | | ALT | | | | |
| 0 < 1 | 46 | 42 | 18 | 27 - 108 | 55 | 47 | 24 | 37 - 118 |
| 1 < 3 | 45 | 40 | 18 | 26 - 122 | 47 | 42 | 22 | 18 - 183 |
| 3 < 6 | 40 | 39 | 6 | 30 - 52 | 43 | 42 | 9 | 30 - 59 |
| ≥ 6 | 50 | 38 | 28 | 29 - 82 | 52 | 53 | 8 | 41 - 59 |
| | F value = 0.7, p = .59 | | | | F value = 0.8, p = .49 | | | |
| | | | | Total Bilirubin | | | | |
| 0 < 1 | 0.96 | 0.80 | 0.55 | 0.40 - 2.90 | 0.65 | 0.60 | 0.16 | 0.40 - 0.90 |
| 1 < 3 | 0.83 | 0.80 | 0.26 | 0.40 - 1.30 | 0.57 | 0.50 | 0.28 | 0.20 - 1.50 |
| 3 < 6 | 0.75 | 0.70 | 0.30 | 0.30 - 1.40 | 0.51 | 0.50 | 0.18 | 0.20 - 1.00 |
| ≥ 6 | 0.93 | 0.90 | 0.25 | 0.70 - 1.20 | 0.63 | 0.65 | 0.10 | 0.50 - 0.70 |
| | F value = 1.2, p = .31 | | | | F value = 0.7, p = .54 | | | |
| | | | | Direct Bilirubin | | | | |
| 0 < 1 | 0.23 | 0.20 | 0.06 | 0.20 - 0.40 | 0.20 | 0.20 | 0.00 | 0.20 - 0.20 |
| 1 < 3 | 0.22 | 0.20 | 0.04 | 0.20 - 0.30 | 0.20 | 0.20 | 0.06 | 0.10 - 0.40 |
| 3 < 6 | 0.21 | 0.20 | 0.03 | 0.20 - 0.30 | 0.20 | 0.20 | 0.04 | 0.20 - 0.30 |
| ≥ 6 | 0.20 | 0.20 | 0.00 | 0.20 - 0.20 | 0.20 | 0.20 | 0.08 | 0.10 - 0.30 |
| | F value = 0.7, p = .55 | | | | F value = 0.4, p = .74 | | | |
| | | | | BUN | | | | |
| 0 < 1 | 17.0 | 17.0 | 3.6 | 12.0 - 26.0 | 14.8 | 15.0 | 2.7 | 11.0 - 21.0 |
| 1 < 3 | 16.7 | 16.0 | 3.8 | 11.0 - 26.0 | 14.7 | 14.0 | 4.0 | 8.0 - 24.0 |
| 3 < 6 | 17.3 | 17.0 | 3.8 | 10.0 - 23.0 | 15.2 | 15.0 | 3.1 | 10.0 - 23.0 |
| ≥ 6 | 17.3 | 21.0 | 6.4 | 10.0 - 21.0 | 13.5 | 13.5 | 0.06 | 13.0 - 14.0 |
| | F value = 0.1, p = .95 | | | | F value = 0.2, p = .87 | | | |
| | | | | Creatinine | | | | |
| 0 < 1 | 1.0 | 0.9 | 0.2 | 0.8 - 1.6 | 1.1 | 1.1 | 0.2 | 0.7 - 1.3 |
| 1 < 3 | 0.9 | 0.9 | 0.1 | 0.7 - 1.1 | 1.1 | 1.1 | 0.2 | 0.9 - 1.6 |
| 3 < 6 | 0.9[3] | 0.9 | 0.1 | 0.7 - 1.0 | 1.1 | 1.1 | 0.1 | 0.8 - 1.2 |
| ≥ 6 | 0.8 | 0.8 | 0.2 | 0.6 - 0.9 | 1.3 | 1.3 | 0.2 | 1.2 - 1.6 |
| | | F value = 4.7, p = .004 | | | F value = 3.8, p = .01 | | | |

Table 6
(continued)

| PFOS (ppm) | Antwerp Mean | Med | SD | Range | Decatur Mean | Med | SD | Range |
|---|---|---|---|---|---|---|---|---|
| | | | | Glucose | | | | |
| 0 <1 | 83 | 83 | 8 | 66 - 103 | 90 | 86 | 28 | 66 -170 |
| 1 <3 | 82 | 81 | 13 | 60 - 126 | 93 | 89 | 25 | 67 - 260 |
| 3 <6 | 80 | 82 | 9 | 66 - 101 | 89 | 89 | 14 | 66 -114 |
| ≥6 | 72 | 72 | 2 | 71 - 74 | 93 | 92 | 12 | 83 - 105 |
| | F value = 1.3, p = .29 | | | | F value = 0.1, p = .94 | | | |
| | | | | Cholesterol | | | | |
| 0 <1 | 220 | 219 | 50 | 100 - 340 | 215 | 208 | 39 | 154 - 276 |
| 1 <3 | 206 | 211 | 49 | 118 - 315 | 221 | 218 | 39 | 132 - 300 |
| 3 <6 | 217 | 215 | 30 | 178 - 266 | 209 | 213 | 42 | 128 - 278 |
| ≥6 | 223 | 221 | 16 | 208 - 240 | 206 | 206 | 47 | 160 - 251 |
| | F value = 0.6, p = .61 | | | | F value = 0.5, p = .69 | | | |
| | | | | LDL | | | | |
| 0 <1 | 140 | 138 | 45 | 29 - 261 | 139 | 130 | 38 | 79 - 192 |
| 1 <3 | 131 | 124 | 46 | 44 - 220 | 136 | 136 | 36 | 62 - 234 |
| 3 <6 | 143 | 139 | 27 | 99 - 189 | 131 | 128 | 41 | 65 - 190 |
| ≥6 | 144 | 136 | 20 | 130 - 168 | 139 | 142 | 42 | 95 - 178 |
| | F value = 0.4, p = .76 | | | | F value = 0.1, p = .94 | | | |
| | | | | HDL | | | | |
| 0 <1 | 56 | 57 | 13 | 31 - 94 | 43 | 41 | 9 | 31 - 59 |
| 1 <3 | 53 | 51 | 13 | 33 - 79 | 45 | 44 | 12 | 26 - 94 |
| 3 <6 | 50 | 49 | 11 | 31 - 74 | 39 | 39 | 9 | 23 - 51 |
| ≥6 | 53 | 49 | 7 | 48 - 61 | 39 | 39 | 5 | 34 - 46 |
| | F value = 1.1, p = .35 | | | | F value = 1.4, p = .25 | | | |
| | | | | Triglycerides | | | | |
| 0 <1 | 117 | 93 | 98 | 41 - 622 | 167 | 151 | 94 | 62 - 307 |
| 1 <3 | 105 | 75 | 65 | 41 - 368 | 191 | 146 | 114 | 61 - 651 |
| 3 <6 | 126 | 112 | 64 | 34 - 278 | 199 | 198 | 99 | 78 - 413 |
| ≥6 | 129 | 116 | 52 | 85 - 187 | 135 | 153 | 48 | 64 - 168 |
| | F value = 0.3, p = .81 | | | | F value = 0.5, p = .67 | | | |

Table 6
(continued)

| PFOS (ppm) | Antwerp Mean | Med | SD | Range | Decatur Mean | Med | SD | Range |
|---|---|---|---|---|---|---|---|---|
| | | | | Hematocrit | | | | |
| 0 <1 | 47 | 47 | 2 | 43 -51 | 46 | 45 | 2 | 43 - 50 |
| 1 <3 | 46 | 47 | 2 | 42 - 51 | 45 | 45 | 3 | 38 - 52 |
| 3 <6 | 48 | 47 | 2 | 44 - 51 | 46 | 46 | 3 | 41 - 52 |
| ≥6 | 47 | 48 | 1 | 46 - 48 | 46 | 46 | 2 | 44 - 49 |
| | F value = 1.5, p = 23. | | | | F value = 0.3, p = .83 | | | |
| | | | | Hemoglobin | | | | |
| 0 <1 | 15.5 | 15.5 | 0.8 | 14.0 - 16.7 | 15.5 | 15.4 | 0.7 | 14.5 - 16.4 |
| 1 <3 | 15.2 | 15.3 | 0.7 | 13.8 - 16.6 | 15.1 | 15.1 | 1.1 | 13.0 - 17.4 |
| 3 <6 | 15.6 | 15.6 | 0.5 | 14.6 - 16.7 | 15.3 | 15.3 | 1.0 | 13.6 - 17.4 |
| ≥6 | 15.4 | 15.4 | 0.6 | 14.8 - 16.0 | 15.5 | 15.6 | 0.8 | 14.7 - 16.2 |
| | F value = 1.4, p = .26 | | | | F value = 0.7, p = .58 | | | |
| | | | | RBC | | | | |
| 0 <1 | 4.9 | 5.0 | 0.3 | 4.3 - 5.7 | 5.1 | 5.1 | 0.2 | 4.8 - 5.5 |
| 1 <3 | 4.9 | 4.9 | 0.2 | 4.3 - 5.4 | 4.9 | 4.9 | 0.3 | 4.3 -5.7 |
| 3 <6 | 5.0 | 5.0 | 0.2 | 4.7 - 5.3 | 5.0 | 4.9 | 0.3 | 4.6 - 5.5 |
| ≥6 | 4.7 | 4.9 | 0.6 | 4.0 - 5.2 | 5.2 | 5.1 | 0.4 | 4.8 - 5.7 |
| | F value = 0.9, p = .46 | | | | F value = 1.1, p = .35 | | | |
| | | | | MCH | | | | |
| 0 <1 | 31.5 | 31.3 | 1.5 | 27.7 - 34.3 | 30.7 | 30.7 | 1.6 | 28.7 - 33.5 |
| 1 <3 | 31.2 | 31.0 | 1.2 | 29.5 - 34.3 | 30.7 | 30.9 | 1.5 | 26.4 - 33.1 |
| 3 <6 | 31.5 | 31.9 | 1.2 | 29.1 - 33.3 | 30.9 | 31.2 | 1.7 | 26.0 - 33.6 |
| ≥6 | 33.0 | 32.5 | 3.7 | 29.6 - 36.9 | 29.9 | 30.4 | 1.2 | 28.2 - 30.7 |
| | F value = 1.4, p = .25 | | | | F value = 0.4, p = .74 | | | |
| | | | | MCHC | | | | |
| 0 <1 | 32.9 | 33.0 | 0.6 | 31.9 - 34.5 | 33.8 | 33.9 | 0.6 | 32.9 - 34.7 |
| 1 <3 | 32.9 | 32.8 | 0.6 | 31.7 - 33.8 | 33.3 | 33.3 | 0.5 | 31.9 - 34.5 |
| 3 <6 | 32.8 | 32.7 | 0.7 | 31.3 - 34.2 | 33.4 | 33.4 | 0.6 | 32.1 - 34.3 |
| ≥6 | 32.6 | 32.4 | 0.5 | 32.2 - 33.1 | 33.5 | 33.4 | 0.3 | 33.3 - 34.0 |
| | F value = 0.4, p = .78 | | | | F value = 2.2, p = .10 | | | |

Table 6
(continued)

| PFOS (ppm) | Antwerp Mean | Med | SD | Range | Decatur Mean | Med | SD | Range |
|---|---|---|---|---|---|---|---|---|
| | | | | MCV | | | | |
| 0 < 1 | 96 | 96 | 5 | 85 -106 | 91 | 90 | 4 | 85 - 99 |
| 1 < 3 | 95 | 95 | 3 | 90 - 104 | 92 | 93 | 4 | 80 - 100 |
| 3 < 6 | 96 | 97 | 4 | 88 - 104 | 92 | 92 | 5 | 81 - 101 |
| ≥ 6 | 101 | 98 | 12 | 91 - 115 | 89 | 90 | 3 | 85 - 92 |
| | F value = 1.8, p = .16 | | | | F value = 0.8, p = .50 | | | |
| | | | | WBC | | | | |
| 0 < 1 | 5.9 | 5.7 | 1.3 | 4.1 - 9.4 | 6.8 | 6.9 | 1.1 | 5.0 - 9.0 |
| 1 < 3 | 6.1 | 6.1 | 1.3 | 3.8 - 8.8 | 7.5 | 7.0 | 2.2 | 3.6 - 15.5 |
| 3 < 6 | 7.5[2] | 6.9 | 2.5 | 4.1 - 13.3 | 7.7 | 7.4 | 1.9 | 4.9 - 11.5 |
| ≥ 6 | 6.5 | 6.4 | 0.2 | 6.4 - 6.7 | 7.4 | 7.4 | 0.4 | 6.9 - 7.8 |
| | F value = 4.5, p = .006 | | | | F value = 0.5, p = .72 | | | |
| | | | | Platelets | | | | |
| 0 < 1 | 224 | 222 | 42 | 159 - 309 | 233 | 246 | 35 | 162 - 271 |
| 1 < 3 | 222 | 220 | 41 | 153 - 318 | 233 | 225 | 50 | 122 - 367 |
| 3 < 6 | 237[4] | 234 | 52 | 132 - 344 | 218 | 214 | 34 | 172 - 287 |
| ≥ 6 | 162 | 151 | 36 | 132 - 202 | 202 | 194 | 56 | 143 - 277 |
| | F value = 2.6, p = .06 | | | | F value = 1.0, p = .40 | | | |

*Sample sizes:

| FC95 Level | Antwerp | Decatur |
|---|---|---|
| 0 < 1 ppm | 34 | 11 |
| 1 < 3 ppm | 32 | 59 |
| 3 < 6 ppm | 19 | 16 |
| ≥ 6 ppm | 3 | 4 |
| | 88 | 90 |

1. Significantly different ($p < .05$, Bonferroni (Dunn) t-test) than the remaining three PFOS exposure categories.
2. Significantly different ($p < .05$, Bonferroni (Dunn) t-test) than the 0 - < 1 ppm and the 1 - < 3 ppm categories.
3. Significantly different ($p < .05$, Bonferroni (Dunn) t-test) than the 0 - < 1 ppm category.
4. Significantly different ($p < .05$, Bonferroni (Dunn) t-test) than the 3 - < 6 ppm category.

Table 7

Mean, Median (Med), Standard Deviation (SD) of Mean and Range of PFOS, Demographic, Serum Chemistries and Hematological Values by Plant Location, 1997

| PFOS* (ppm) | 1997 Data: Antwerp Mean | Med | SD | Range | Decatur Mean | Med | SD | Range |
|---|---|---|---|---|---|---|---|---|
| | | | | PFOS | | | | |
| 0 - < 1 | 0.46[1] | 0.37 | 0.27 | 0.10 - 0.94 | 0.60[1] | 0.59 | 0.26 | 0.10 - 0.97 |
| 1 - < 3 | 1.89[1] | 1.79 | 0.61 | 1.02 - 2.89 | 1.71[1] | 1.53 | 0.52 | 1.04 - 2.85 |
| 3 - < 6 | 3.87[1] | 3.66 | 0.59 | 3.22 - 4.83 | 3.87[1] | 3.51 | 0.81 | 3.09 - 5.30 |
| ≥ 6 | - | - | - | - | 7.20[1] | 6.68 | 1.59 | 6.05 - 9.93 |
| | F value = 195.3, p = .0001 | | | | F value = 218.1, p = .0001 | | | |
| | | | | Age | | | | |
| 0 - < 1 | 29 | 28 | 6 | 21 - 50 | 43 | 44 | 9 | 23 - 62 |
| 1 - < 3 | 37[3] | 37 | 9 | 24 - 63 | 45 | 45 | 8 | 31 - 62 |
| 3 - < 6 | 37[3] | 37 | 3 | 32 - 40 | 45 | 44 | 4 | 36 - 54 |
| ≥ 6 | - | - | - | - | 42 | 45 | 9 | 29 - 52 |
| | F value = 10.4, p = .0001 | | | | F value = 0.5, p = .69 | | | |
| | | | | Alcohol | | | | |
| 0 - < 1 | 0.8 | 0.5 | 1.0 | 0.0 - 4.3 | 0.2 | 0.1 | 0.4 | 0.1 - 2.0 |
| 1 - < 3 | 1.0 | 0.7 | 1.1 | 0.0 - 5.0 | 0.1 | 0.1 | 0.1 | 0.1 - 0.3 |
| 3 - < 6 | 2.2[3] | 1.4 | 2.3 | 0.0 - 7.1 | 0.1 | 0.1 | 0.1 | 0.1 - 0.3 |
| ≥ 6 | - | - | - | - | 0.2 | 0.1 | 0.3 | 0.1 - 0.8 |
| | F value = 4.3, p = .02 | | | | F value = 0.8, p = .49 | | | |
| | | | | BMI | | | | |
| 0 - < 1 | 22.9 | 21.9 | 2.1 | 20.2 - 28.3 | 29.3 | 28.9 | 4.9 | 22.4 - 41.7 |
| 1 - < 3 | 24.2 | 23.9 | 2.8 | 18.1 - 30.4 | 30.0 | 29.0 | 6.0 | 20.2 - 48.5 |
| 3 - < 6 | 23.6 | 24.9 | 3.1 | 19.2 - 28.3 | 30.0 | 29.3 | 3.0 | 25.4 - 36.0 |
| ≥ 6 | - | - | - | - | 30.8 | 29.7 | 4.0 | 26.1 - 36.2 |
| | F value = 2.0, p = .15 | | | | F value = 0.2, p = .91 | | | |

Table 7
(continued)

| PFOS (ppm) | Antwerp Mean | Med | SD | Range | Decatur Mean | Med | SD | Range |
|---|---|---|---|---|---|---|---|---|
| | | | | Cigarettes | | | | |
| 0 - < 1 | 4.2 | 0.0 | 6.7 | 0 - 20 | 5.3 | 0.0 | 11.6 | 0 - 40 |
| 1 - < 3 | 7.3 | 2.0 | 8.1 | 0 - 20 | 8.7 | 0.0 | 13.0 | 0 - 40 |
| 3 - < 6 | 5 | 0.0 | 7.8 | 0 - 20 | 3.3 | 0.0 | 9.0 | 0 - 30 |
| ≥ 6 | - | - | - | - | 6.0 | 0.0 | 13.4 | 0 - 30 |
| | F = 1.3, p = .28 | | | | F value = 0.8, p = .51 | | | |
| | | | | Alkaline Phosphatase | | | | |
| 0 - < 1 | 69 | 68 | 14 | 49 - 110 | 86 | 84 | 16 | 55 - 132 |
| 1 - < 3 | 74 | 74 | 16 | 41 - 113 | 88 | 83 | 26 | 41 - 163 |
| 3 - < 6 | 64 | 59 | 24 | 29 - 120 | 85 | 83 | 15 | 61 - 109 |
| ≥ 6 | - | - | - | - | 88 | 84 | 18 | 65 - 114 |
| | F value = 1.5, p = .22 | | | | F value = 0.1, p = .96 | | | |
| | | | | GGT | | | | |
| 0 - < 1 | 21 | 17 | 10 | 10 - 50 | 36 | 32 | 25 | 13 - 142 |
| 1 - < 3 | 34 | 24 | 34 | 10 - 144 | 37 | 27 | 33 | 13 - 179 |
| 3 - < 6 | 25 | 22 | 10 | 14 - 43 | 31 | 28 | 15 | 13 - 71 |
| ≥ 6 | - | - | - | - | 33 | 37 | 12 | 17 - 48 |
| | F value = 2.5, p = .09 | | | | F value = 0.2, p = .91 | | | |
| | | | | AST | | | | |
| 0 - < 1 | 27 | 26 | 7 | 17 - 53 | 26 | 25 | 7 | 13 - 48 |
| 1 - < 3 | 27 | 25 | 7 | 15 - 48 | 26 | 25 | 7 | 18 - 56 |
| 3 - < 6 | 25 | 24 | 4 | 19 - 30 | 25 | 23 | 9 | 14 -43 |
| ≥ 6 | - | - | - | - | 29 | 28 | 3 | 26 - 34 |
| | F value = 0.2, p = .80 | | | | F value = 0.4, p = .77 | | | |

Table 7
(continued)

| PFOS (ppm) | Antwerp Mean | Med | SD | Range | Decatur Mean | Med | SD | Range |
|---|---|---|---|---|---|---|---|---|
| | | | | ALT | | | | |
| 0 - < 1 | 30 | 25 | 12 | 13 - 60 | 33 | 31 | 11 | 17 - 57 |
| 1 - < 3 | 33 | 31 | 16 | 13 - 87 | 33 | 28 | 16 | 10 - 89 |
| 3 - < 6 | 28 | 23 | 10 | 14 - 46 | 38 | 33 | 21 | 17 - 82 |
| ≥ 6 | - | - | - | - | 41 | 45 | 10 | 25 - 49 |
| | F value = 0.6, p = .58 | | | | F value = 0.9, p = .45 | | | |
| | | | | Total Bilirubin | | | | |
| 0 - < 1 | 0.90 | 0.80 | 0.46 | 0.40 - 2.30 | 0.63 | 0.60 | 0.30 | 0.30 - 1.40 |
| 1 - < 3 | 0.68 | 0.70 | 0.23 | 0.30 - 1.30 | 0.56 | 0.50 | 0.18 | 0.30 - 1.00 |
| 3 - < 6 | 0.79 | 0.70 | 0.40 | 0.30 - 1.30 | 0.51 | 0.50 | 0.16 | 0.30 - 0.90 |
| ≥ 6 | - | - | - | - | 0.58 | 0.50 | 0.24 | 0.40 - 1.00 |
| | F value = 2.3, p = .11 | | | | F value = 1.0, p = .41 | | | |
| | | | | Direct Bilirubin | | | | |
| 0 - < 1 | 0.16 | 0.20 | 0.08 | 0.10 - 0.40 | 0.13 | 0.10 | 0.06 | 0.10 - 0.30 |
| 1 - < 3 | 0.13 | 0.10 | 0.05 | 0.10 - 0.20 | 0.11 | 0.10 | 0.03 | 0.10 - 0.20 |
| 3 - < 6 | 0.14 | 0.10 | 0.05 | 0.10 - 0.20 | 0.11 | 0.10 | 0.03 | 0.10 - 0.20 |
| ≥ 6 | - | - | - | - | 0.10 | 0.10 | 0.00 | 0.10 - 0.10 |
| | F value = 2.2, p = .12 | | | | F value= 1.3, p = .28 | | | |
| | | | | BUN | | | | |
| 0 - < 1 | 14.3 | 14.0 | 2.1 | 11.0 - 19.0 | 14.7 | 14.0 | 3.3 | 9.0 - 21.0 |
| 1 - < 3 | 15.2 | 15.0 | 2.6 | 10.0 - 20.0 | 13.5 | 13.5 | 3.5 | 6.0 - 26.0 |
| 3 - < 6 | 16.0 | 16.0 | 2.7 | 12.0 - 20.0 | 14.3 | 14.0 | 3.0 | 9.0 - 19.0 |
| ≥ 6 | - | - | - | - | 13.8 | 12.0 | 4.1 | 9.0 - 19.0 |
| | F value = 2.1, p = .13 | | | | F value = 0.7, p = .56 | | | |
| | | | | Creatinine | | | | |
| 0 - < 1 | 0.9 | 0.9 | 0.1 | 0.7 - 1.2 | 1.0 | 1.0 | 0.1 | 0.6 - 1.2 |
| 1 - < 3 | 0.9 | 0.9 | 0.1 | 0.7 - 1.3 | 1.0 | 1.0 | 0.1 | 0.7 - 1.3 |
| 3 - < 6 | 0.9 | 0.9 | 0.1 | 0.8 - 1.1 | 1.0 | 1.0 | 0.1 | 0.7 - 1.1 |
| ≥ 6 | - | - | - | - | 1.0 | 0.9 | 0.2 | 0.8 - 1.4 |
| | F value = 0.3, p = .76 | | | | F value = 0.2, p = .89 | | | |

Table 7
(continued)

| PFOS (ppm) | Antwerp Mean | Med | SD | Range | Decatur Mean | Med | SD | Range |
|---|---|---|---|---|---|---|---|---|
| | | | | Glucose | | | | |
| 0 - < 1 | 81 | 82 | 10 | 63 - 114 | 93 | 91 | 21 | 58 - 174 |
| 1 - < 3 | 79 | 78 | 9 | 65 - 102 | 102 | 89 | 47 | 75 - 303 |
| 3 - < 6 | 84 | 85 | 8 | 74 - 96 | 103 | 93 | 30 | 79 - 192 |
| ≥ 6 | - | - | - | - | 89 | 88 | 7 | 80 - 97 |
| | F value = 0.8, p = .47 | | | | F value = 0.5, p = .67 | | | |
| | | | | Cholesterol | | | | |
| 0 - < 1 | 193 | 190 | 41 | 110 - 277 | 204 | 208 | 38 | 145 - 277 |
| 1 - < 3 | 213 | 205 | 48 | 116 - 365 | 218 | 226 | 39 | 152 - 290 |
| 3 - < 6 | 228 | 223 | 38 | 192 - 321 | 230 | 230 | 23 | 197 - 280 |
| ≥ 6 | - | - | - | - | 229 | 238 | 26 | 186 - 250 |
| | F value = 2.9, p = .07 | | | | F value = 2.0, p = .13 | | | |
| | | | | LDL | | | | |
| 0 - < 1 | 122 | 114 | 35 | 57 - 205 | 127 | 133 | 33 | 50 - 178 |
| 1 - < 3 | 143 | 134 | 42 | 67 - 290 | 139 | 135 | 35 | 61 - 196 |
| 3 - < 6 | 147 | 141 | 24 | 111 - 195 | 149 | 144 | 25 | 113 - 196 |
| ≥ 6 | - | - | - | - | 145 | 156 | 26 | 103 - 164 |
| | F value = 3.0, p = .06 | | | | F value = 1.6, p = .19 | | | |
| | | | | HDL | | | | |
| 0 - < 1 | 51 | 50 | 12 | 19 - 74 | 42 | 41 | 9 | 26 - 59 |
| 1 - < 3 | 48 | 46 | 10 | 34 - 68 | 42 | 41 | 10 | 28 - 69 |
| 3 - < 6 | 51 | 50 | 10 | 39 - 69 | 45 | 45 | 10 | 32 - 62 |
| ≥ 6 | - | - | - | - | 40 | 38 | 4 | 37 - 45 |
| | F value = 0.8, p = .47 | | | | F value = 0.5, p = .67 | | | |
| | | | | Triglycerides | | | | |
| 0 - < 1 | 99 | 92 | 41 | 38 - 175 | 200 | 128 | 219 | 46 - 1209 |
| 1 - < 3 | 112 | 95 | 58 | 44 - 290 | 185 | 147 | 124 | 63 - 534 |
| 3 - < 6 | 150 | 122 | 88 | 65 - 362 | 179 | 183 | 98 | 45 - 394 |
| ≥ 6 | - | - | - | - | 220 | 191 | 83 | 149 - 352 |
| | F value = 2.9, p = .06 | | | | F value = 0.1, p = .95 | | | |

Table 7
(continued)

| PFOS (ppm) | Antwerp Mean | Med | SD | Range | Decatur Mean | Med | SD | Range |
|---|---|---|---|---|---|---|---|---|
| | | | | Hematocrit | | | | |
| 0 - < 1 | 47 | 47 | 3 | 42 - 52 | 46 | 45 | 2 | 40 - 50 |
| 1 - < 3 | 46 | 47 | 3 | 40 - 53 | 46 | 46 | 3 | 39 - 51 |
| 3 - < 6 | 46 | 45 | 3 | 42 - 50 | 44 | 44 | 2 | 39 - 48 |
| ≥ 6 | - | - | - | - | 45 | 44 | 2 | 42 - 47 |
| | F value = 0.7, p = .51 | | | | F value = 1.6, p = .18 | | | |
| | | | | Hemoglobin | | | | |
| 0 - < 1 | 15.6 | 15.5 | 0.8 | 14.2 - 17.0 | 15.4 | 15.4 | 0.7 | 13.5 - 16.9 |
| 1 - < 3 | 15.4 | 15.6 | 1.0 | 13.3 - 17.3 | 15.4 | 15.5 | 0.9 | 13.5 - 17.3 |
| 3 - < 6 | 15.2 | 14.7 | 1.0 | 14.0 - 16.7 | 14.8 | 14.7 | 1.0 | 12.5 - 16.5 |
| ≥ 6 | - | - | - | - | 15.1 | 15.0 | 0.8 | 14.1 - 16.2 |
| | F value = 0.7, p = .48 | | | | F value = 1.7, p = .18 | | | |
| | | | | RBC | | | | |
| 0 - < 1 | 5.1 | 5.2 | 0.4 | 4.6 - 5.9 | 5.1 | 5.1 | 0.3 | 4.3 - 5.7 |
| 1 - < 3 | 5.0 | 5.1 | 0.3 | 4.1 - 5.5 | 5.1 | 5.1 | 0.3 | 4.2 - 5.5 |
| 3 - < 6 | 4.9 | 4.8 | 0.4 | 4.4 - 5.7 | 5.0 | 5.0 | 0.3 | 4.5 - 5.4 |
| ≥ 6 | - | - | - | - | 5.0 | 4.9 | 0.3 | 4.7 - 5.5 |
| | F value = 1.7, p = .19 | | | | F value = 0.4, p = .78 | | | |
| | | | | MCH | | | | |
| 0 - < 1 | 30.4 | 30.4 | 1.3 | 27.9 - 33.5 | 30.3 | 30.2 | 1.8 | 27.6 - 34.1 |
| 1 - < 3 | 30.6 | 30.5 | 0.9 | 29.2 - 32.8 | 30.6 | 30.6 | 1.4 | 26.7 - 33.8 |
| 3 - < 6 | 30.9 | 31.4 | 1.4 | 28.8 - 32.7 | 29.7 | 30.5 | 2.2 | 26.2 - 32.9 |
| ≥ 6 | - | - | - | - | 30.5 | 30.5 | 2.1 | 27.5 - 33.4 |
| | F value = 0.9, p = .40 | | | | F value = 1.0, p = .41 | | | |
| | | | | MCHC | | | | |
| 0 - < 1 | 33.4 | 33.4 | 0.5 | 32.2 - 34.0 | 33.8 | 33.7 | 0.5 | 32.8 - 34.9 |
| 1 - < 3 | 33.3 | 33.2 | 0.5 | 31.8 - 34.1 | 33.8 | 33.8 | 0.5 | 32.7 - 34.6 |
| 3 - < 6 | 33.4 | 33.5 | 0.5 | 32.4 - 34.3 | 33.6 | 33.9 | 0.8 | 32.0 - 34.4 |
| ≥ 6 | - | - | - | - | 33.9 | 33.9 | 0.5 | 33.4 - 34.6 |
| | F value = 0.6, p = .54 | | | | F value = 0.6, p = .62 | | | |

Table 7
(continued)

| PFOS (ppm) | Antwerp Mean | Med | SD | Range | Decatur Mean | Med | SD | Range |
|---|---|---|---|---|---|---|---|---|
| | | | | MCV | | | | |
| 0 - < 1 | 91 | 91 | 4 | 84 - 101 | 90 | 89 | 5 | 83 - 101 |
| 1 - < 3 | 92 | 92 | 3 | 87 - 99 | 91 | 90 | 4 | 81 - 99 |
| 3 - < 6 | 93 | 95 | 5 | 86 - 97 | 88 | 89 | 5 | 80 - 96 |
| ≥ 6 | - | - | - | - | 90 | 91 | 6 | 81 - 96 |
| | F value = 1.3, p = .29 | | | | F value = 0.9, p = .45 | | | |
| | | | | WBC | | | | |
| 0 - < 1 | 6.0 | 5.7 | 1.3 | 3.8 - 8.8 | 6.3 | 5.9 | 1.6 | 4.0 - 10.3 |
| 1 - < 3 | 7.1 | 6.8 | 2.2 | 4.4 - 13.2 | 6.7 | 6.6 | 1.6 | 3.8 - 10.1 |
| 3 - < 6 | 6.4 | 6.0 | 1.8 | 4.2 - 10.0 | 6.1 | 6.1 | 1.3 | 4.0 - 8.9 |
| ≥ 6 | - | - | - | - | 6.2 | 7.1 | 1.5 | 4.2 - 7.4 |
| | F value = 2.6, p = .08 | | | | F value = 0.8, p = .51 | | | |
| | | | | Platelets | | | | |
| 0 - < 1 | 237 | 232 | 55 | 126 - 406 | 215 | 207 | 50 | 106 - 363 |
| 1 - < 3 | 243 | 232 | 48 | 151 - 359 | 219 | 210 | 48 | 124 - 323 |
| 3 - < 6 | 215 | 225 | 41 | 147 - 263 | 224 | 219 | 50 | 159 - 316 |
| ≥ 6 | - | - | - | - | 199 | 191 | 58 | 146 - 295 |
| | F value = 1.1, p = .35 | | | | F value = 0.3, p = .80 | | | |

*Sample sizes:

| FC95 Level | Antwerp | Decatur |
|---|---|---|
| 0 - < 1 ppm | 31 | 29 |
| 1 - < 3 ppm | 25 | 38 |
| 3 - < 6 ppm | 9 | 12 |
| ≥ 6 ppm | 0 | 5 |
| | 65 | 84 |

1. Significantly different ($p < .05$, Bonferroni (Dunn) t-test) than the remaining three PFOS exposure categories.
2. Significantly different ($p < .05$, Bonferroni (Dunn) t-test) than the 0 - < 1 ppm and the 1 - < 3 ppm categories.
3. Significantly different ($p < .05$, Bonferroni (Dunn) t-test) than the 0 - < 1 ppm category.

Table 8

Multivariable Regression of Serum Chemistries and Hematological Parameters - Examination of the Effect of PFOS Adjusting for Age, Alcohol, BMI and Cigarettes, Antwerp and Decatur Data Combined, 1995 and 1997 Examinations

Alkaline Phosphatase

| | 1995 Data | | | 1997 Data | | |
|---|---|---|---|---|---|---|
| | Parameter | SE | p value | Parameter | SE | p value |
| Intercept | 52.99 | 11.14 | .0001 | 40.87 | 9.60 | .0001 |
| PFOS | 0.32 | 0.89 | .72 | 0.19 | 1.03 | .86 |
| Age | 0.08 | 0.20 | .68 | 0.45 | 0.18 | .01 |
| Alcohol | -5.43 | 1.53 | .0005 | -2.09 | 1.61 | .20 |
| BMI | 1.04 | 0.34 | .002 | 0.69 | 0.34 | .04 |
| Cigarettes | 0.85 | 0.15 | .0001 | 0.49 | 0.15 | .002 |
| | $R^2 = .26$ | Adj $R^2 = .24$ | | $R^2 = .19$ | Adj $R^2 = .16$ | |

ln GGT

| | 1995 Data | | | 1997 Data | | |
|---|---|---|---|---|---|---|
| | Parameter | SE | p value | Parameter | SE | p value |
| Intercept | 2.3816 | 0.2711 | .0001 | 2.0471 | 0.2592 | .0001 |
| PFOS | 0.0032 | 0.0217 | .88 | 0.0178 | 0.0280 | .53 |
| Age | 0.0040 | 0.0048 | .41 | 0.0036 | 0.0049 | .47 |
| Alcohol | 0.0605 | 0.0373 | .11 | 0.0747 | 0.0438 | .09 |
| BMI | 0.0372 | 0.0082 | .0001 | 0.0365 | 0.0091 | .0001 |
| Cigarettes | 0.0076 | 0.0038 | .05 | 0.0030 | 0.0042 | .48 |
| | $R^2 = .14$ | Adj $R^2 = .12$ | | $R^2 = .15$ | Adj $R^2 = .12$ | |

AST

| | 1995 Data | | | 1997 Data | | |
|---|---|---|---|---|---|---|
| | Parameter | SE | p value | Parameter | SE | p value |
| Intercept | 12.62 | 5.52 | .02 | 23.25 | 3.50 | .0001 |
| PFOS | 0.42 | 0.44 | .35 | -0.11 | 0.38 | .77 |
| Age | 0.0005 | 0.10 | .99 | -0.07 | 0.07 | .29 |
| Alcohol | 0.70 | 0.76 | .36 | 0.40 | 0.59 | .50 |
| BMI | 0.54 | 0.17 | .002 | 0.23 | 0.12 | .07 |
| Cigarettes | -0.11 | 0.08 | .14 | -0.07 | 0.06 | .20 |
| | $R^2 = .08$ | Adj $R^2 = .05$ | | $R^2 = .04$ | Adj $R^2 = .00$ | |

Table 8 (continued)

ALT

| | 1995 Data | | | 1997 Data | | |
|---|---|---|---|---|---|---|
| | Parameter | SE | p value | Parameter | SE | p value |
| Intercept | 28.54 | 9.46 | .003 | 11.60 | 6.78 | .09 |
| PFOS | 0.09 | 0.76 | .91 | 0.97 | 0.73 | .19 |
| Age | -0.18 | 0.17 | .28 | -0.19 | 0.13 | .14 |
| Alcohol | -0.16 | 1.30 | .90 | 0.31 | 1.14 | .79 |
| BMI | 0.96 | 0.29 | .001 | 1.00 | 0.24 | .0001 |
| Cigarettes | -0.14 | 0.13 | .28 | -0.09 | 0.11 | .40 |
| | $R^2 = .08$ | Adj $R^2 = .05$ | | $R^2 = .13$ | Adj $R^2 = .10$ | |

ln Total Bilirubin

| | 1995 Data | | | 1997 Data | | |
|---|---|---|---|---|---|---|
| | Parameter | SE | p value | Parameter | SE | p value |
| Intercept | 0.2742 | 0.1958 | .16 | -0.1395 | 0.1945 | .47 |
| PFOS | -0.0984 | 0.0368 | .008 | -0.1620 | 0.0515 | .002 |
| $PFOS^2$ | 0.0086 | 0.0039 | .03 | 0.0188 | 0.0070 | .009 |
| Age | 0.0052 | 0.0035 | .14 | 0.0015 | 0.0037 | .70 |
| Alcohol | 0.0738 | 0.0268 | .007 | 0.1220 | 0.0327 | .0003 |
| BMI | -0.0273 | 0.0059 | .0001 | -0.0097 | 0.0068 | .16 |
| Cigarettes | -0.0158 | 0.0028 | .0001 | -0.0054 | 0.0031 | .09 |
| | $R^2 = .32$ | Adj $R^2 = .30$ | | $R^2 = .18$ | Adj $R^2 = .14$ | |

Direct Bilirubin

| | 1995 Data | | | 1997 Data | | |
|---|---|---|---|---|---|---|
| | Parameter | SE | p value | Parameter | SE | p value |
| Intercept | 0.2196 | 0.0259 | .0001 | 0.1929 | 0.0264 | .0001 |
| PFOS | -0.0009 | 0.0021 | .68 | -0.0061 | 0.0029 | .03 |
| Age | 0.0006 | 0.0005 | .17 | -0.0002 | 0.0005 | .69 |
| Alcohol | 0.0074 | 0.0036 | .04 | 0.0106 | 0.0045 | .02 |
| BMI | -0.0012 | 0.0008 | .13 | -0.0017 | 0.0009 | .07 |
| Cigarettes | -0.0007 | 0.0004 | .06 | -0.0009 | 0.0004 | .05 |
| | $R^2 = .06$ | Adj $R^2 = .03$ | | $R^2 = .14$ | Adj $R^2 = .11$ | |

Table 8 (continued)

BUN

| | 1995 Data | | | 1997 Data | | |
|---|---|---|---|---|---|---|
| | Parameter | SE | p value | Parameter | SE | p value |
| Intercept | 18.64 | 1.94 | .0001 | 13.22 | 1.47 | .0001 |
| PFOS | -0.02 | 0.15 | .91 | -0.08 | 0.16 | .60 |
| Age | -0.03 | 0.03 | .39 | 0.08 | 0.03 | .005 |
| Alcohol | 0.37 | 0.27 | .17 | 0.50 | 0.25 | .05 |
| BMI | -0.05 | 0.06 | .42 | -0.07 | 0.05 | .20 |
| Cigarettes | -0.08 | .03 | .004 | -0.05 | 0.02 | .05 |
| | $R^2 = .08$ | Adj $R^2 = .05$ | | $R^2 = .09$ | Adj $R^2 = .06$ | |

Creatinine

| | 1995 Data | | | 1997 Data | | |
|---|---|---|---|---|---|---|
| | Parameter | SE | p value | Parameter | SE | p value |
| Intercept | 0.5744 | 0.0779 | .0001 | 0.9478 | 0.0602 | .0001 |
| PFOS | -0.0223 | 0.0146 | .13 | -0.0302 | 0.0159 | .06 |
| $PFOS^2$ | 0.0033 | 0.0016 | .04 | 0.0055 | 0.0022 | .01 |
| Age | 0.0059 | 0.0013 | .0001 | 0.0027 | 0.0012 | 0.02 |
| Alcohol | -0.0260 | 0.0106 | .02 | -0.0242 | 0.0101 | .02 |
| BMI | 0.0086 | 0.0023 | .0003 | -0.0022 | 0.0021 | .30 |
| Cigarettes | -0.0005 | 0.0011 | .65 | -0.0019 | 0.0010 | .05 |
| | $R^2 = .29$ | Adj $R^2 = .27$ | | $R^2 = .16$ | Adj $R^2 = .13$ | |

ln Glucose

| | 1995 Data | | | 1997 Data | | |
|---|---|---|---|---|---|---|
| | Parameter | SE | p value | Parameter | SE | p value |
| Intercept | 3.8943 | 0.0732 | .0001 | 3.8597 | 0.0919 | .0001 |
| PFOS | -0.0039 | 0.0058 | .51 | 0.0014 | 0.0098 | .89 |
| Age | 0.0045 | 0.0013 | .0006 | 0.0025 | 0.0017 | .15 |
| Alcohol | -0.0026 | 0.0101 | .79 | -0.0068 | 0.0154 | .66 |
| BMI | 0.0143 | 0.0022 | .0001 | 0.0195 | 0.0032 | .0001 |
| Cigarettes | -0.0003 | 0.0010 | .78 | -0.0013 | 0.0015 | .39 |
| | $R^2 = .31$ | Adj $R^2 = .29$ | | $R^2 = .30$ | Adj $R^2 = .27$ | |

Table 8 (continued)

Cholesterol

| | 1995 Data | | | 1997 Data | | |
|---|---|---|---|---|---|---|
| | Parameter | SE | p value | Parameter | SE | p value |
| Intercept | 190.1 | 22.1 | .0001 | 155.5 | 19.0 | .0001 |
| PFOS | -0.99 | 1.77 | .58 | 4.66 | 2.04 | .02 |
| Age | 0.74 | 0.39 | .06 | 1.39 | 0.36 | .0002 |
| Alcohol | -0.40 | 3.04 | .90 | 7.50 | 3.18 | .02 |
| BMI | -0.04 | 0.67 | .95 | -0.40 | 0.67 | .55 |
| Cigarettes | -0.18 | 0.31 | .56 | -0.08 | 0.30 | .80 |
| | $R^2 = .02$ | Adj $R^2 = .00$ | | $R^2 = .17$ | Adj $R^2 = .14$ | |

LDL

| | 1995 Data | | | 1997 Data | | |
|---|---|---|---|---|---|---|
| | Parameter | SE | p value | Parameter | SE | p value |
| Intercept | 135.26 | 20.27 | .0001 | 114.69 | 17.06 | .0001 |
| PFOS | 0.50 | 1.61 | .76 | 4.01 | 1.82 | .03 |
| Age | 0.58 | 0.36 | .11 | 1.04 | 0.32 | .002 |
| Alcohol | -3.33 | 2.78 | .23 | 4.29 | 2.84 | .13 |
| BMI | -6.67 | 0.61 | .28 | -1.09 | 0.60 | .07 |
| Cigarettes | -0.52 | 0.28 | .07 | -0.02 | 0.28 | .95 |
| | $R^2 = .05$ | Adj $R^2 = .02$ | | $R^2 = .13$ | Adj $R^2 = .10$ | |

HDL

| | 1995 Data | | | 1997 Data | | |
|---|---|---|---|---|---|---|
| | Parameter | SE | p value | Parameter | SE | p value |
| Intercept | 70.82 | 5.73 | .0001 | 66.71 | 4.52 | .0001 |
| PFOS | -1.17 | 0.46 | .01 | -0.22 | 0.49 | .65 |
| Age | -0.11 | 0.10 | .27 | 0.12 | 0.09 | .17 |
| Alcohol | 3.53 | 0.79 | .0001 | 2.01 | 0.76 | .009 |
| BMI | -0.63 | 0.17 | .0004 | -0.95 | 0.16 | .0001 |
| Cigarettes | -0.17 | 0.08 | 0.03 | -0.16 | 0.07 | .03 |
| | $R^2 = .28$ | Adj $R^2 = .26$ | | $R^2 = .29$ | Adj $R^2 = .26$ | |

Table 8 (continued)

Triglycerides

| | 1995 Data | | | 1997 Data | | |
|---|---|---|---|---|---|---|
| | Parameter | SE | p value | Parameter | SE | p value |
| Intercept | -103.29 | 45.97 | .03 | -187.99 | 58.18 | .002 |
| PFOS | -1.78 | 3.68 | .63 | -0.33 | 6.28 | .96 |
| Age | 1.54 | 0.82 | .06 | 1.37 | 1.11 | .22 |
| Alcohol | -0.43 | 6.32 | .95 | 14.68 | 9.82 | .14 |
| BMI | 6.71 | 1.39 | .0001 | 10.06 | 2.05 | .0001 |
| Cigarettes | 2.70 | 0.64 | .0001 | 1.87 | 0.94 | .05 |
| | $R^2 = .24$ | Adj $R^2 = .22$ | | $R^2 = .23$ | Adj $R^2 = .20$ | |

Hematocrit

| | 1995 Data | | | 1997 Data | | |
|---|---|---|---|---|---|---|
| | Parameter | SE | p value | Parameter | SE | p value |
| Intercept | 48.01 | 1.36 | .0001 | 46.73 | 1.28 | .0001 |
| PFOS | -0.06 | 0.11 | .57 | -0.25 | 0.14 | .07 |
| Age | 0.0005 | 0.02 | .98 | -0.03 | 0.02 | .20 |
| Alcohol | 0.10 | 0.19 | .58 | 0.15 | 0.22 | 0.50 |
| BMI | -0.08 | 0.04 | .06 | 0.01 | 0.05 | 0.75 |
| Cigarettes | 0.05 | 0.02 | .007 | 0.04 | 0.02 | .04 |
| | $R^2 = .08$ | Adj $R^2 = .05$ | | $R^2 = .08$ | Adj $R^2 = .04$ | |

Hemoglobin

| | 1995 Data | | | 1997 Data | | |
|---|---|---|---|---|---|---|
| | Parameter | SE | p value | Parameter | SE | p value |
| Intercept | 15.78 | 0.45 | .0001 | 15.43 | 0.43 | .0001 |
| PFOS | -0.02 | 0.04 | .53 | -0.08 | 0.05 | .07 |
| Age | 0.004 | 0.008 | .57 | -0.006 | 0.01 | .46 |
| Alcohol | -0.02 | 0.06 | .77 | 0.01 | 0.07 | .85 |
| BMI | -0.03 | 0.01 | .06 | 0.008 | 0.02 | .59 |
| Cigarettes | 0.02 | 0.006 | .02 | 0.02 | 0.007 | .03 |
| | $R^2 = .06$ | Adj $R^2 = .03$ | | $R^2 = .06$ | Adj $R^2 = .03$ | |

Table 8 (continued)

RBC

| | 1995 Data | | | 1997 Data | | |
|---|---|---|---|---|---|---|
| | Parameter | SE | p value | Parameter | SE | p value |
| Intercept | 4.8766 | 0.1559 | .0001 | 5.1416 | 0.1626 | .0001 |
| PFOS | -0.0026 | 0.0123 | .83 | -0.0208 | 0.1756 | .24 |
| Age | -0.0022 | 0.0028 | .42 | -0.0068 | 0.0031 | .03 |
| Alcohol | -0.0323 | 0.0213 | .13 | -0.0111 | 0.0274 | .69 |
| BMI | 0.0069 | 0.0047 | .14 | 0.0089 | 0.0057 | .12 |
| Cigarettes | -0.0006 | 0.0022 | .77 | -0.0025 | 0.0026 | .35 |
| | $R^2 = .04$ | Adj $R^2 = .01$ | | $R^2 = .06$ | Adj $R^2 = .02$ | |

MCH

| | 1995 Data | | | 1997 Data | | |
|---|---|---|---|---|---|---|
| | Parameter | SE | p value | Parameter | SE | p value |
| Intercept | 32.292 | 0.725 | .0001 | 30.062 | 0.706 | .0001 |
| PFOS | -0.015 | 0.058 | .79 | -0.047 | 0.076 | .54 |
| Age | 0.23 | 0.013 | .08 | 0.028 | 0.013 | .04 |
| Alcohol | 0.189 | 0.099 | .06 | 0.095 | 0.119 | .43 |
| BMI | -0.093 | 0.022 | .0001 | -0.035 | 0.025 | .16 |
| Cigarettes | 0.0347 | 0.010 | .001 | 0.046 | 0.011 | .0001 |
| | $R^2 = .20$ | Adj $R^2 = .18$ | | $R^2 = .13$ | Adj $R^2 = .10$ | |

MCHC

| | 1995 Data | | | 1997 Data | | |
|---|---|---|---|---|---|---|
| | Parameter | SE | p value | Parameter | SE | p value |
| Intercept | 32.8525 | 0.3341 | .0001 | 33.0109 | 0.2675 | .0001 |
| PFOS | -0.0015 | 0.0266 | .96 | -0.0092 | 0.0289 | .75 |
| Age | 0.0097 | 0.0059 | .11 | 0.0101 | 0.0051 | .05 |
| Alcohol | -0.1121 | 0.0458 | .02 | -0.0589 | 0.0451 | .19 |
| BMI | -0.0006 | 0.0100 | .95 | 0.0072 | 0.0094 | .45 |
| Cigarettes | -0.0041 | 0.0047 | .39 | 0.0016 | 0.0043 | .72 |
| | $R^2 = .07$ | Adj $R^2 = .05$ | | $R^2 = .07$ | Adj $R^2 = .04$ | |

Table 8 (continued)

MCV

| | 1995 Data | | | 1997 Data | | |
|---|---|---|---|---|---|---|
| | Parameter | SE | p value | Parameter | SE | p value |
| Intercept | 98.29 | 2.29 | .0001 | 90.91 | 1.98 | .0001 |
| PFOS | -0.03 | 0.18 | .88 | -0.09 | 0.21 | .67 |
| Age | 0.04 | 0.04 | .33 | 0.06 | 0.04 | .15 |
| Alcohol | 0.88 | 0.31 | .01 | 0.49 | 0.33 | .14 |
| BMI | -0.28 | 0.07 | .0001 | -0.12 | 0.07 | .08 |
| Cigarettes | 0.12 | 0.03 | .0005 | 0.13 | 0.03 | .0001 |
| | $R^2 = .23$ | Adj $R^2 = .21$ | | $R^2 = .15$ | Adj $R^2 = .12$ | |

Platelets

| | 1995 Data | | | 1997 Data | | |
|---|---|---|---|---|---|---|
| | Parameter | SE | p value | Parameter | SE | p value |
| Intercept | 272.49 | 23.37 | .0001 | 260.92 | 25.27 | .0001 |
| PFOS | -3.37 | 1.86 | .07 | -2.91 | 2.73 | .29 |
| Age | -0.88 | 0.41 | .04 | -0.25 | 0.48 | .61 |
| Alcohol | -4.80 | 3.20 | .14 | 2.37 | 4.26 | .58 |
| BMI | -0.04 | 0.70 | .95 | -0.73 | 0.89 | .41 |
| Cigarettes | 0.21 | 0.33 | 0.52 | -0.30 | 0.41 | .46 |
| | $R^2 = .06$ | Adj $R^2 = .03$ | | $R^2 = .03$ | Adj $R^2 = .00$ | |

WBC

| | 1995 Data | | | 1997 Data | | |
|---|---|---|---|---|---|---|
| | Parameter | SE | p value | Parameter | SE | p value |
| Intercept | 3.9538 | 0.8120 | .0001 | 5.1296 | 0.6927 | .0001 |
| PFOS | 0.0893 | 0.0646 | .17 | -0.0048 | 0.0748 | .95 |
| Age | 0.0214 | 0.0144 | .14 | 0.0139 | 0.0132 | .30 |
| Alcohol | -0.0860 | 0.1111 | .44 | 0.2471 | 0.1169 | .04 |
| BMI | 0.0492 | 0.0244 | .05 | 0.0045 | 0.0244 | .86 |
| Cigarettes | 0.1009 | 0.0115 | .0001 | 0.0878 | 0.0111 | .0001 |
| | $R^2 = .36$ | Adj $R^2 = .34$ | | $R^2 = .33$ | Adj $R^2 = .31$ | |

Table 9

Multivariable Regression of Total Bilirubin, Direct Bilirubin, Creatinine Cholesterol, LDL, HDL, Heamtocrit, Hemoglobin and Platelets - Examination of the Effect of PFOS Adjusting for Age, Alcohol, BMI and Cigarettes, by Location, 1995 and 1997

ln Total Bilirubin - Both Locations

| | 1995 Data | | | 1997 Data | | |
|---|---|---|---|---|---|---|
| | Parameter | SE | p value | Parameter | SE | p value |
| Intercept | 0.2742 | 0.1958 | .16 | -0.1395 | 0.1945 | .47 |
| PFOS | -0.0984 | 0.0368 | .008 | -0.1620 | 0.0515 | .002 |
| $PFOS^2$ | 0.0086 | 0.0039 | .03 | 0.0188 | 0.0070 | .009 |
| Age | 0.0052 | 0.0035 | .14 | 0.0015 | 0.0037 | .70 |
| Alcohol | 0.0738 | 0.0268 | .007 | 0.1220 | 0.0327 | .0003 |
| BMI | -0.0273 | 0.0059 | .0001 | -0.0097 | 0.0068 | .16 |
| Cigarettes | -0.0158 | 0.0028 | .0001 | -0.0054 | 0.0031 | .09 |
| | $R^2 = .32$ | Adj $R^2 = .30$ | | $R^2 = .18$ | Adj $R^2 = .14$ | |

ln Total Bilirubin - Antwerp Only

| | 1995 Data | | | 1997 Data | | |
|---|---|---|---|---|---|---|
| | Parameter | SE | p value | Parameter | SE | p value |
| Intercept | -0.0776 | 0.0475 | .85 | -0.3130 | 0.5586 | 0.58 |
| PFOS | -0.0473 | 0.0575 | .41 | -0.2157 | 0.1779 | .23 |
| $PFOS^2$ | 0.0035 | 0.0072 | .63 | 0.0336 | 0.0385 | .39 |
| Age | 0.0062 | 0.0055 | .27 | -0.0036 | 0.0081 | .66 |
| Alcohol | 0.0398 | 0.0316 | .21 | 0.0826 | 0.0441 | .07 |
| BMI | -0.0115 | 0.0161 | .48 | 0.0114 | 0.0222 | .61 |
| Cigarettes | -0.0176 | 0.0056 | .002 | -0.0102 | 0.0074 | .17 |
| | $R^2 = .15$ | Adj $R^2 = .08$ | | $R^2 = .14$ | Adj $R^2 = .05$ | |

ln Total Bilirubin - Decatur Only

| | 1995 Data | | | 1997 Data | | |
|---|---|---|---|---|---|---|
| | Parameter | SE | p value | Parameter | SE | p value |
| Intercept | -0.4462 | 0.3154 | .16 | -0.9486 | 0.2932 | .002 |
| PFOS | -0.0862 | 0.0509 | .09 | -0.1160 | 0.0578 | .05 |
| $PFOS^2$ | 0.0081 | 0.0048 | .10 | 0.0144 | 0.0072 | .05 |
| Age | 0.0128 | 0.0048 | .01 | 0.0134 | 0.0046 | .005 |
| Alcohol | -0.0045 | 0.0828 | .59 | 0.1708 | 0.1607 | .29 |
| BMI | -0.0179 | 0.0068 | .01 | -0.0045 | 0.0073 | .54 |
| Cigarettes | -0.0117 | 0.0031 | .0004 | -0.0031 | 0.0032 | .33 |
| | $R^2 = .29$ | Adj $R^2 = .24$ | | $R^2 = .17$ | Adj $R^2 = .10$ | |

Table 9
(continued)

HDL - Both Locations

| | 1995 Data (N = 178) | | | 1997 Data (N = 149) | | |
|---|---|---|---|---|---|---|
| | Parameter | SE | p value | Parameter | SE | p value |
| Intercept | 70.82 | 5.73 | .0001 | 66.71 | 4.52 | .0001 |
| PFOS | -1.17 | 0.46 | .01 | -0.22 | 0.49 | .65 |
| Age | -0.11 | 0.10 | .27 | 0.12 | 0.09 | .17 |
| Alcohol | 3.53 | 0.79 | .0001 | 2.01 | 0.76 | .009 |
| BMI | -0.63 | 0.17 | .0004 | -0.95 | 0.16 | .0001 |
| Cigarettes | -0.17 | 0.08 | 0.03 | -0.16 | 0.07 | .03 |
| | $R^2$ = .28 | Adj $R^2$ = .26 | | $R^2$ = .28 | Adj $R^2$ = .26 | |

HDL - Antwerp Only

| | 1995 Data (N = 86) | | | 1997 Data (N = 63) | | |
|---|---|---|---|---|---|---|
| | Parameter | SE | p value | Parameter | SE | p value |
| Intercept | 73.44 | 12.69 | .0001 | 57.30 | 12.12 | .0001 |
| PFOS | -1.55 | 0.73 | .04 | -2.26 | 1.17 | .06 |
| Age | 0.01 | 0.17 | .93 | 0.43 | 0.17 | .01 |
| Alcohol | 3.31 | 0.98 | .001 | 2.78 | 0.99 | .007 |
| BMI | -0.87 | 0.50 | .09 | -0.82 | 0.48 | .10 |
| Cigarettes | -0.19 | 0.17 | .28 | -0.45 | 0.16 | .007 |
| | $R^2$ = .16 | Adj $R^2$ = .11 | | $R^2$ = .28 | Adj $R^2$ = .21 | |

HDL - Decatur Only

| | 1995 Data (N = 85) | | | 1997 Data (N = 83) | | |
|---|---|---|---|---|---|---|
| | Parameter | SE | p value | Parameter | SE | p value |
| Intercept | 66.35 | 9.42 | .0001 | 69.17 | 7.01 | .0001 |
| PFOS | -0.75 | 0.60 | .22 | 0.17 | 0.50 | .73 |
| Age | -0.14 | 0.14 | .32 | 0.01 | 0.11 | .96 |
| Alcohol | 4.71 | 2.48 | .06 | -3.07 | 3.87 | .43 |
| BMI | -0.49 | 0.21 | .02 | -0.90 | 0.18 | .0001 |
| Cigarettes | -0.16 | 0.09 | .09 | -0.04 | 0.08 | .61 |
| | $R^2$ = .14 | Adj $R^2$ = .09 | | $R^2$ = .27 | Adj $R^2$ = .22 | |

Table 9
(continued)

Platelets - Both Locations

| | 1995 Data | | | 1997 Data | | |
|---|---|---|---|---|---|---|
| | Parameter | SE | p value | Parameter | SE | p value |
| Intercept | 272.49 | 23.37 | .0001 | 260.92 | 25.27 | .0001 |
| PFOS | -3.37 | 1.86 | .07 | -2.91 | 2.73 | .29 |
| Age | -0.88 | 0.41 | .04 | -0.25 | 0.48 | .61 |
| Alcohol | -4.80 | 3.20 | .14 | 2.37 | 4.26 | .58 |
| BMI | -0.04 | 0.70 | .95 | -0.73 | 0.89 | .41 |
| Cigarettes | 0.21 | 0.33 | .52 | -0.30 | 0.41 | .46 |
| | $R^2 = .06$ | Adj $R^2 = .03$ | | $R^2 = .03$ | Adj $R^2 = .00$ | |

Platelets, Antwerp Only

| | 1995 Data | | | 1997 Data | | |
|---|---|---|---|---|---|---|
| | Parameter | SE | p value | Parameter | SE | p value |
| Intercept | 294.81 | 48.19 | .0001 | 258.21 | 66.58 | .0003 |
| PFOS | -2.57 | 2.77 | .36 | -1.99 | 6.44 | .76 |
| Age | -0.35 | 0.65 | .60 | 0.41 | 0.91 | .65 |
| Alcohol | -3.65 | 3.74 | .33 | -0.87 | 5.42 | .87 |
| BMI | -2.23 | 1.91 | .25 | -1.16 | 2.65 | .66 |
| Cigarettes | 0.82 | 0.65 | .21 | -0.70 | 0.90 | .44 |
| | $R^2 = .06$ | Adj $R^2 = .00$ | | $R^2 = .02$ | Adj $R^2 = .00$ | |

Platelets, Decatur Only

| | 1995 Data | | | 1997 Data | | |
|---|---|---|---|---|---|---|
| | Parameter | SE | p value | Parameter | SE | p value |
| Intercept | 353.90 | 39.04 | .0001 | 225.66 | 42.96 | .0001 |
| PFOS | -6.08 | 2.50 | .02 | -2.75 | 3.09 | .38 |
| Age | -1.99 | 0.59 | .001 | -0.16 | 0.69 | .82 |
| Alcohol | 5.36 | 10.14 | .60 | 8.45 | 23.70 | .72 |
| BMI | -0.64 | 0.84 | .45 | 0.14 | 1.10 | .90 |
| Cigarettes | -0.35 | 0.40 | .38 | -0.19 | 0.47 | .69 |
| | $R^2 = .19$ | Adj $R^2 = .14$ | | $R^2 = .01$ | Adj $R^2 = .00$ | |

Table 9
(continued)

Creatinine - Both Locations

| | 1995 Data | | | 1997 Data | | |
|---|---|---|---|---|---|---|
| | Parameter | SE | p value | Parameter | SE | p value |
| Intercept | 0.5744 | 0.0779 | .0001 | 0.9478 | 0.0602 | .0001 |
| PFOS | -0.0223 | 0.0146 | .13 | -0.0302 | 0.0159 | .06 |
| $PFOS^2$ | 0.0033 | 0.0016 | .04 | 0.0055 | 0.0022 | .01 |
| Age | 0.0059 | 0.0013 | .0001 | 0.0027 | 0.0012 | 0.02 |
| Alcohol | -0.0260 | 0.0106 | .02 | -0.0242 | 0.0101 | .02 |
| BMI | 0.0086 | 0.0023 | .0003 | -0.0022 | 0.0021 | .30 |
| Cigarettes | -0.0005 | 0.0011 | .65 | -0.0019 | 0.0010 | .05 |
| | $R^2 = .29$ | Adj $R^2 = .27$ | | $R^2 = .16$ | Adj $R^2 = .13$ | |

Creatinine - Antwerp Only

| | 1995 Data | | | 1997 Data | | |
|---|---|---|---|---|---|---|
| | Parameter | SE | p value | Parameter | SE | p value |
| Intercept | 0.7319 | 0.1382 | .0001 | 0.8600 | 0.1430 | .0001 |
| PFOS | -0.0324 | 0.0195 | .10 | -0.0453 | 0.0455 | .32 |
| $PFOS^2$ | 0.0008 | 0.0024 | .74 | 0.0074 | 0.0099 | .46 |
| Age | 0.0044 | 0.0019 | .02 | 0.0033 | 0.0021 | .11 |
| Alcohol | -0.0055 | 0.0107 | .61 | -0.0142 | 0.0113 | .21 |
| BMI | 0.0037 | 0.0055 | .50 | -0.0012 | 0.0057 | .83 |
| Cigarettes | 0.0017 | 0.0019 | .36 | 0.0041 | 0.0019 | .04 |
| | $R^2 = .20$ | Adj $R^2 = .14$ | | $R^2 = .14$ | Adj $R^2 = .05$ | |

Creatinine - Decatur Only

| | 1995 Data | | | 1997 Data | | |
|---|---|---|---|---|---|---|
| | Parameter | SE | p value | Parameter | SE | p value |
| Intercept | 0.8641 | 0.1300 | .0001 | 1.1363 | 0.1021 | .0001 |
| PFOS | -0.0093 | 0.0206 | .65 | -0.0430 | 0.0201 | .04 |
| $PFOS^2$ | 0.0036 | 0.0019 | .07 | 0.0067 | 0.0025 | .009 |
| Age | 0.0032 | 0.0020 | .11 | 0.0006 | 0.0016 | .72 |
| Alcohol | 0.0082 | 0.0336 | .81 | -0.1133 | 0.0559 | .05 |
| BMI | 0.0032 | 0.0028 | .26 | -0.0038 | 0.0026 | .14 |
| Cigarettes | -0.0030 | 0.0013 | .02 | -0.0034 | 0.0011 | .003 |
| | $R^2 = .23$ | Adj $R^2 = .18$ | | $R^2 = .27$ | Adj $R^2 = .22$ | |

Table 9
(continued)

Cholesterol - Both Locations

| | 1995 Data | | | 1997 Data | | |
|---|---|---|---|---|---|---|
| | Parameter | SE | p value | Parameter | SE | p value |
| Intercept | 190.1 | 22.1 | .0001 | 155.5 | 19.0 | .0001 |
| PFOS | -0.99 | 1.77 | .58 | 4.66 | 2.04 | .02 |
| Age | 0.74 | 0.39 | .06 | 1.39 | 0.36 | .0002 |
| Alcohol | -0.40 | 3.04 | .90 | 7.50 | 3.18 | .02 |
| BMI | -0.04 | 0.67 | .95 | -0.40 | 0.67 | .55 |
| Cigarettes | -0.18 | 0.31 | .56 | -0.08 | 0.30 | .80 |
| | $R^2 = .02$ | Adj $R^2 = .00$ | | $R^2 = .17$ | Adj $R^2 = .14$ | |

Cholesterol - Antwerp Only

| | 1995 Data | | | 1997 Data | | |
|---|---|---|---|---|---|---|
| | Parameter | SE | p value | Parameter | SE | p value |
| Intercept | 62.17 | 43.72 | .16 | 93.11 | 49.20 | .06 |
| PFOS | -1.22 | 2.51 | .63 | 2.37 | 4.74 | .62 |
| Age | 2.60 | 0.59 | .0001 | 2.54 | 0.67 | .0004 |
| Alcohol | 1.13 | 3.39 | .74 | 7.49 | 3.98 | .06 |
| BMI | 2.28 | 1.73 | .19 | 0.78 | 1.95 | .69 |
| Cigarettes | 0.81 | 0.59 | .17 | -0.23 | 0.66 | .72 |
| | $R^2 = .25$ | Adj $R^2 = .20$ | | $R^2 = .33$ | Adj $R^2 = .27$ | |

Cholesterol - Decatur Only

| | 1995 Data | | | 1997 Data | | |
|---|---|---|---|---|---|---|
| | Parameter | SE | p value | Parameter | SE | p value |
| Intercept | 304.27 | 33.14 | .0001 | 207.01 | 31.55 | .0001 |
| PFOS | -1.03 | 2.19 | .64 | 4.26 | 2.27 | .06 |
| Age | -1.05 | 0.51 | .04 | 0.48 | 0.51 | .35 |
| Alcohol | -21.16 | 8.88 | .02 | 19.54 | 17.41 | .27 |
| BMI | -1.03 | .73 | .17 | -.78 | 0.81 | .34 |
| Cigarettes | -0.40 | 0.33 | .23 | -0.11 | .35 | .75 |
| | $R^2 = .14$ | Adj $R^2 = .09$ | | $R^2 = .07$ | Adj $R^2 = .01$ | |

Table 9
(continued)

LDL

| | 1995 Data | | | 1997 Data | | |
|---|---|---|---|---|---|---|
| | Parameter | SE | p value | Parameter | SE | p value |
| Intercept | 135.26 | 20.27 | .0001 | 114.69 | 17.06 | .0001 |
| PFOS | 0.50 | 1.61 | .76 | 4.01 | 1.82 | .03 |
| Age | 0.58 | 0.36 | .11 | 1.04 | 0.32 | .002 |
| Alcohol | -3.33 | 2.78 | .23 | 4.29 | 2.84 | .13 |
| BMI | -6.67 | 0.61 | .28 | -1.09 | 0.60 | .07 |
| Cigarettes | -0.52 | 0.28 | .07 | -0.02 | 0.28 | .95 |
| | $R^2 = .05$ | Adj $R^2 = .02$ | | $R^2 = .13$ | Adj $R^2 = .10$ | |

LDL - Antwerp Only

| | 1995 Data | | | 1997 Data | | |
|---|---|---|---|---|---|---|
| | Parameter | SE | p value | Parameter | SE | p value |
| Intercept | 12.14 | 41.44 | .77 | 40.88 | 42.42 | .34 |
| PFOS | 0.24 | 2.38 | .92 | 1.50 | 4.08 | .71 |
| Age | 2.15 | 0.56 | .0003 | 2.22 | 0.58 | .0003 |
| Alcohol | -3.04 | 3.21 | .35 | 4.12 | 3.43 | .23 |
| BMI | 2.04 | 1.64 | .22 | 0.48 | 1.68 | .78 |
| Cigarettes | 0.35 | 0.56 | .53 | 0.26 | 0.57 | .65 |
| | $R^2 = .20$ | Adj $R^2 = .15$ | | $R^2 = .29$ | Adj $R^2 = .23$ | |

LDL - Decatur Only

| | 1995 Data | | | 1997 Data | | |
|---|---|---|---|---|---|---|
| | Parameter | SE | p value | Parameter | SE | p value |
| Intercept | 218.24 | 30.58 | .0001 | 160.50 | 28.17 | .0001 |
| PFOS | 1.06 | 1.96 | .59 | 3.55 | 2.03 | .08 |
| Age | -0.79 | 0.46 | .09 | 0.20 | 0.45 | .65 |
| Alcohol | -22.95 | 8.04 | .006 | -12.68 | 28.72 | .66 |
| BMI | -1.38 | 0.67 | .04 | -1.27 | 0.72 | .08 |
| Cigarettes | -0.65 | 0.30 | .03 | -0.13 | 0.31 | .67 |
| | $R^2 = .20$ | Adj $R^2 = .15$ | | $R^2 = .07$ | Adj $R^2 = .01$ | |

Table 9
(continued)

Hematocrit - Both Locations

| | 1995 Data | | | 1997 Data | | |
|---|---|---|---|---|---|---|
| | Parameter | SE | p value | Parameter | SE | p value |
| Intercept | 48.01 | 1.36 | .0001 | 46.73 | 1.28 | .0001 |
| PFOS | -0.06 | 0.11 | ,57 | -0.25 | 0.14 | .07 |
| Age | 0.0005 | 0.02 | .98 | -0.03 | 0.02 | .20 |
| Alcohol | 0.10 | 0.19 | .58 | 0.15 | 0.22 | 0.50 |
| BMI | -0.08 | 0.04 | .06 | 0.01 | 0.05 | 0.75 |
| Cigarettes | 0.05 | 0.02 | .007 | 0.04 | 0.02 | .04 |
| | $R^2 = .08$ | Adj $R^2 = .05$ | | $R^2 = .08$ | Adj $R^2 = .04$ | |

Hematocrit - Antwerp Only

| | 1995 Data | | | 1997 Data | | |
|---|---|---|---|---|---|---|
| | Parameter | SE | p value | Parameter | SE | p value |
| Intercept | 44.00 | 2.30 | .0001 | 45.63 | 3.63 | .0001 |
| PFOS | 0.06 | 0.13 | .63 | -0.29 | 0.35 | .42 |
| Age | 0.06 | 0.03 | .06 | 0.04 | 0.50 | .37 |
| Alcohol | -0.12 | 0.18 | .51 | 0.06 | 0.30 | .84 |
| BMI | 0.02 | 0.09 | .80 | -0.02 | 0.14 | .89 |
| Cigarettes | 0.05 | 0.03 | .14 | 0.01 | 0.05 | .79 |
| | $R^2 = .08$ | Adj $R^2 = .03$ | | $R^2 = .01$ | Adj $R^2 = .00$ | |

Hematocrit - Decatur Only

| | 1995 Data | | | 1997 Data | | |
|---|---|---|---|---|---|---|
| | Parameter | SE | p value | Parameter | SE | p value |
| Intercept | 45.56 | 2.62 | .0001 | 45.69 | 1.95 | .0001 |
| PFOS | -0.05 | 0.17 | .79 | -0.28 | 0.14 | .05 |
| Age | 0.01 | 0.04 | .89 | -0.05 | 0.03 | .09 |
| Alcohol | -0.56 | 0.68 | .41 | -1.52 | 1.08 | .16 |
| BMI | -0.02 | 0.06 | .71 | 0.08 | 0.05 | .11 |
| Cigarettes | 0.08 | 0.03 | .004 | 0.06 | 0.02 | .006 |
| | $R^2 = .10$ | Adj $R^2 = .04$ | | $R^2 = .19$ | Adj $R^2 = .13$ | |

Table 9
(continued)

Hemoglobin - Both Locations

| | 1995 Data | | | 1997 Data | | |
|---|---|---|---|---|---|---|
| | Parameter | SE | p value | Parameter | SE | p value |
| Intercept | 15.78 | 0.45 | .0001 | 15.43 | 0.43 | .0001 |
| PFOS | -0.02 | 0.04 | .53 | -0.08 | 0.05 | .07 |
| Age | 0.004 | 0.008 | .57 | -0.006 | 0.01 | .46 |
| Alcohol | -0.02 | 0.06 | .77 | 0.01 | 0.07 | .85 |
| BMI | -0.03 | 0.01 | .06 | 0.008 | 0.02 | .59 |
| Cigarettes | 0.02 | 0.006 | .02 | 0.02 | 0.007 | .03 |
| | $R^2 = .06$ | Adj $R^2 = .03$ | | $R^2 = .06$ | Adj $R^2 = .03$ | |

Hemoglobin - Antwerp Only

| | 1995 Data | | | 1997 Data | | |
|---|---|---|---|---|---|---|
| | Parameter | SE | p value | Parameter | SE | p value |
| Intercept | 14.72 | 0.74 | .0001 | 15.32 | 1.15 | .0001 |
| PFOS | 0.008 | 0.04 | .86 | -0.10 | 0.11 | .40 |
| Age | 0.02 | 0.01 | .02 | 0.02 | 0.02 | .33 |
| Alcohol | -0.04 | 0.06 | .51 | 0.02 | 0.09 | .81 |
| BMI | -0.007 | 0.03 | .81 | -0.01 | 0.05 | .81 |
| Cigarettes | 0.005 | 0.01 | .61 | -0.006 | 0.02 | .70 |
| | $R^2 = .08$ | Adj $R^2 = .02$ | | $R^2 = .03$ | Adj $R^2 = .00$ | |

Hemoglobin - Decatur Only

| | 1995 Data | | | 1997 Data | | |
|---|---|---|---|---|---|---|
| | Parameter | SE | p value | Parameter | SE | p value |
| Intercept | 15.87 | 0.90 | .0001 | 15.58 | 0.71 | .0001 |
| PFOS | -0.03 | 0.06 | .63 | -0.10 | 0.05 | .07 |
| Age | -0.004 | 0.01 | .79 | -0.02 | 0.01 | .12 |
| Alcohol | -0.22 | 0.23 | .35 | -0.47 | 0.39 | .23 |
| BMI | -0.02 | 0.02 | .32 | 0.02 | 0.02 | .25 |
| Cigarettes | 0.02 | 0.009 | .01 | 0.02 | 0.008 | .004 |
| | $R^2 = .10$ | Adj $R^2 = .04$ | | $R^2 = .17$ | Adj $R^2 = .12$ | |

Table 9
(continued)

Direct Bilirubin - Both Locations

| | 1995 Data | | | 1997 Data | | |
|---|---|---|---|---|---|---|
| | Parameter | SE | p value | Parameter | SE | p value |
| Intercept | 0.2196 | 0.0259 | .0001 | 0.1929 | 0.0264 | .0001 |
| PFOS | -0.0009 | 0.0021 | .68 | -0.0061 | 0.0029 | .03 |
| Age | 0.0006 | 0.0005 | .17 | -0.0002 | 0.0005 | .69 |
| Alcohol | 0.0074 | 0.0036 | .04 | 0.0106 | 0.0045 | .02 |
| BMI | -0.0012 | 0.0008 | .13 | -0.0017 | 0.0009 | .07 |
| Cigarettes | -0.0007 | 0.0004 | .06 | -0.0009 | 0.0004 | .05 |
| | $R^2 = .06$ | Adj $R^2 = .03$ | | $R^2 = .14$ | Adj $R^2 = .11$ | |

Direct Bilirubin - Antwerp Only

| | 1995 Data | | | 1997 Data | | |
|---|---|---|---|---|---|---|
| | Parameter | SE | p value | Parameter | SE | p value |
| Intercept | 0.1794 | 0.0461 | .0002 | 0.1963 | 0.0813 | .02 |
| PFOS | -0.0034 | 0.0026 | .21 | -0.0077 | 0.0079 | .33 |
| Age | 0.00004 | 0.0006 | .95 | -0.0017 | 0.0011 | .13 |
| Alcohol | 0.0102 | 0.0036 | .006 | 0.0112 | 0.0066 | .10 |
| BMI | 0.0017 | 0.0018 | .36 | 0.0006 | 0.0032 | .84 |
| Cigarettes | -0.0016 | 0.0006 | 0.009 | -0.0017 | 0.0011 | .12 |
| | $R^2 = .17$ | Adj $R^2 = .12$ | | $R^2 = .14$ | Adj $R^2 = .06$ | |

Direct Bilirubin - Decatur Only

| | 1995 Data | | | 1997 Data | | |
|---|---|---|---|---|---|---|
| | Parameter | SE | p value | Parameter | SE | p value |
| Intercept | 0.1972 | 0.0478 | .0001 | 0.1205 | 0.0347 | .0008 |
| PFOS | 0.0025 | 0.0032 | .44 | -0.0038 | 0.0025 | .13 |
| Age | 0.0012 | 0.0007 | 0.11 | 0.0014 | 0.0006 | .02 |
| Alcohol | -0.0114 | 0.0128 | .37 | -0.0042 | 0.0191 | .83 |
| BMI | -0.0016 | 0.0011 | .13 | -0.0018 | 0.0009 | .04 |
| Cigarettes | -0.0001 | 0.0005 | .79 | -0.0004 | 0.0004 | .27 |
| | $R^2 = .07$ | Adj $R^2 = .02$ | | $R^2 = .15$ | Adj $R^2 = .10$ | |

Table 10

Summaries of Simple Linear and Quadratic Regression Models for Total and Unconjugated Bilirubin, 1995 and 1997

| | 1995 Data | | | | 1997 Data | | | |
|---|---|---|---|---|---|---|---|---|
| | Total Bilirubin | | Unconjugated | | Total Bilirubin | | Unconjugated | |
| | Linear | Quadratic | Linear | Quadratic | Linear | Quadratic | Linear | Quadratic |
| **Both Locations** | | | | | | | | |
| $R^2$ | .002 | .052 | .024 | .059 | .016 | .046 | .012 | .046 |
| Intercept | 0.78247 | 0.86532 | 0.56837 | 0.65239 | 0.8175 | 0.78963 | 0.57745 | 0.64247 |
| PFOS(p value) | -0.02927 (.047) | -0.00918 (.03) | -0.0285 (.04) | -0.09941 (.002) | -0.02583 (.12) | -0.10456 (.01) | -0.01940 (.18) | -0.09138 (.01) |
| $PFOS^2$ (p value) | | 0.00846 (.02) | | 0.00858 (.01) | | 0.01200 (.03) | | 0.01097 (.03) |
| **Antwerp** | | | | | | | | |
| $R^2$ | .018 | .028 | .017 | .028 | .014 | .052 | .012 | .050 |
| Intercept | 0.92001 | 0.96548 | 0.69447 | 0.73919 | 0.85170 | 0.96350 | 0.69161 | 0.78708 |
| PFOS (p value) | -0.02927 (.21) | -0.07872 (.18) | -0.02604 (.23) | -0.07468 (.17) | -0.03647 (.35) | -0.22847 (.08) | -0.02872 (.39) | -0.19268 (.09) |
| $PFOS^2$ (p value) | | 0.00697 (.31) | | 0.00686 (.32) | | 0.04620 (.20) | | 0.03945 (.13) |
| **Decatur** | | | | | | | | |
| $R^2$ | .004 | .010 | .008 | .029 | 0.009 | .071 | .002 | .077 |
| Intercept | 0.59712 | 0.66974 | 0.39803 | 0.48279 | 0.59609 | 0.68287 | 0.47268 | 0.55440 |
| PFOS (p value) | -0.014363 (.53) | -0.05867 (.09) | -0.01166 (.39) | -0.06966 (.03) | -0.00894 (.53) | -0.09408 (.02) | -0.00489 (.69) | -0.08508 (.01) |
| $PFOS^2$ (p value) | | 0.00518 (.12) | | 0.00605 (.05) | | 0.001143 (.02) | | 0.01076 (.01) |

Table 11

Mean Values of PFOS, Demographic, Serum Chemistry and Hematologic Parameters for Antwerp and Decatur Combined Locations, 1995 and 1997 Examinations for Employees Who Participated and Did Not Participate in Both Years

| | 1995 Data | | 1997 Data | |
|---|---|---|---|---|
| Variable | Both Years (N = 61) | Only 1995 (N = 117) | Both Years (N = 61) | Only 1997 (N = 88) |
| PFOS (ppm) | 2.40 | 2.08 | 2.34*** | 1.34 |
| Age | 39* | 42 | 41* | 38 |
| BMI | 27.1 | 26.3 | 27.3 | 26.9 |
| Cigarettes | 5.4 | 6.7 | 5.2 | 6.8 |
| Alcohol | 0.8 | 0.6 | 0.4* | 0.4 |
| Alk Phosphatase | 87 | 86 | 79 | 80 |
| GGT | 44 | 44 | 37* | 27 |
| AST | 29 | 27 | 26 | 26 |
| ALT | 46 | 46 | 33 | 32 |
| Total bilirubin | 0.71 | 0.72 | 0.65 | 0.69 |
| Direct bilirubin | 0.21 | 0.22 | 0.13 | 0.13 |
| BUN | 16.2 | 15.7 | 14.6 | 14.3 |
| Creatinine | 1.0 | 1.0 | 1.0 | 1.0 |
| Glucose | 86 | 87 | 93 | 89 |
| Cholesterol | 212 | 213 | 225*** | 201 |
| LDL | 142 | 134 | 145*** | 128 |
| HDL | 50 | 47 | 46 | 45 |

Table 11
(continued)

| Variable | 1995 Data | | 1997 Data | |
|---|---|---|---|---|
| | Antwerp | Decatur | Antwerp | Decatur |
| Triglycerides | 139 | 157 | 167 | 149 |
| Hematocrit | 45 | 47 | 46 | 46 |
| Hemoglobin | 15.0 | 15.5 | 15.3 | 15.4 |
| RBC | 4.9 | 5.0 | 5.0* | 5.1 |
| MCH | 30.8 | 31.2 | 30.8* | 30.2 |
| MCHC | 33.2 | 33.1 | 33.6 | 33.6 |
| MVC | 93 | 94 | 92** | 90 |
| WBC | 6.6 | 7.0 | 6.5 | 6.4 |
| Platelets | 226 | 227 | 228 | 224 |

* $p < .05$; ** $p < .01$; ***$p < .001$

Table 12

Mean Values of PFOS, Demographic, Serum Chemistry and Hematologic Parameters
for Antwerp and Decatur, 1995 Examinations
for Employees Who Participated and Did not Participate in Both 1995 and 1997

| | Antwerp | | Decatur | |
|---|---|---|---|---|
| Variable | Both Years (N = 27) | Only 1995 (N = 61) | Both Years (N = 34) | Only 1995 (N = 56) |
| PFOS (ppm) | 2.30 | 1.76 | 2.48 | 2.42 |
| Age | 34 | 37 | 42* | 46 |
| BMI | 24.0 | 23.9 | 29.6 | 29.0 |
| Cigarettes | 5.4 | 4.3 | 5.4 | 9.4 |
| Alcohol | 1.7* | 1.0 | 0.1 | 0.2 |
| Alk Phosphatase | 75 | 75 | 96 | 98 |
| GGT | 46 | 39 | 43 | 50 |
| AST | 28 | 25 | 30 | 29 |
| ALT | 43 | 45 | 48 | 47 |
| Total bilirubin | 0.91 | 0.84 | 0.54 | 0.59 |
| Direct bilirubin | 0.23 | 0.22 | 0.19 | 0.21 |
| BUN | 17.7 | 16.7 | 15.0 | 15.0 |
| Creatinine | 0.9 | 0.9 | 1.1 | 1.1 |
| Glucose | 78* | 83 | 92 | 92 |
| Cholesterol | 209 | 216 | 232** | 209 |
| LDL | 133 | 140 | 150** | 128 |
| HDL | 56 | 53 | 46 | 42 |

Table 12
(continued)

| Variable | 1995 Data | | 1997 Data | |
|---|---|---|---|---|
| | Antwerp | Decatur | Antwerp | Decatur |
| Triglycerides | 100 | 122 | 170 | 197 |
| Hematocrit | 46 | 47 | 44** | 46 |
| Hemoglobin | 15.3 | 15.5 | 14.8** | 15.4 |
| RBC | 4.9 | 4.9 | 4.9* | 5.0 |
| MCH | 31.2 | 31.5 | 30.5 | 30.8 |
| MCHC | 33.0 | 32.8 | 33.4 | 33.4 |
| MVC | 95 | 96 | 91 | 92 |
| WBC | 6.4 | 6.3 | 6.8* | 7.8 |
| Platelets | 222 | 225 | 23.0 | 228 |

* $p < .05$; ** $p < .01$; ***$p < .001$

Table 13

Mean Values of PFOS, Demographic, Serum Chemistry and Hematologic Parameters
for Antwerp and Decatur, 1997 Examinations
for Employees Who Participated and Did not Participate in Both Years

| | Antwerp | | Decatur | |
|---|---|---|---|---|
| Variable | Both Years (N = 27) | Only 1997 (N = 38) | Both Years (N = 34) | Only 1997 (N = 50) |
| PFOS (ppm) | 2.33*** | 0.88 | 2.35 | 1.69 |
| Age | 37*** | 30 | 45 | 44 |
| BMI | 24.4* | 22.8 | 29.5 | 29.9 |
| Cigarettes | 5.9 | 5.2 | 4.7 | 7.9 |
| Alcohol | 1.0 | 0.7 | 0.1 | 0.2 |
| Alk Phosphatase | 72 | 69 | 85 | 88 |
| GGT | 33* | 21 | 41 | 32 |
| AST | 27 | 26 | 26 | 26 |
| ALT | 32 | 30 | 34 | 34 |
| Total bilirubin | 0.77 | 0.81 | 0.56 | 0.59 |
| Direct bilirubin | 0.14 | 0.16 | 0.12 | 0.11 |
| BUN | 15.2 | 14.6 | 14.1 | 14.0 |
| Creatinine | 0.9 | 0.9 | 1.0 | 1.0 |
| Glucose | 80 | 81 | 103 | 95 |
| Cholesterol | 224*** | 192 | 226* | 208 |
| LDL | 148 | 123 | 143 | 132 |
| HDL | 51 | 49 | 43 | 42 |

Table 13
(continued)

| Variable | 1995 Data | | 1997 Data | |
|---|---|---|---|---|
| | Antwerp | Decatur | Antwerp | Decatur |
| Triglycerides | 125 | 101 | 201 | 185 |
| Hematocrit | 46 | 46 | 45 | 46 |
| Hemoglobin | 15.5 | 15.4 | 15.2 | 15.4 |
| RBC | 5.0 | 5.1 | 4.9** | 5.1 |
| MCH | 30.8 | 30.4 | 30.9 | 30.0 |
| MCHC | 33.4 | 33.3 | 33.7 | 33.8 |
| MVC | 92 | 91 | 91* | 89 |
| WBC | 6.8 | 6.3 | 6.4 | 6.5 |
| Platelets | 241 | 234 | 218 | 217 |

* $p < .05$; ** $p < .01$; ***$p < .001$

Table 14

Multivariable Regression of Serum Chemistries and Hematological Parameters - Examination of the Effect of PFOS Adjusting for Age, Alcohol, BMI and Cigarettes, Antwerp and Decatur Employees (N = 61) Who Participated in Both the 1995 and 1997 Examinations

Alkaline Phospatase

| | 1995 Data | | | 1997 Data | | |
|---|---|---|---|---|---|---|
| | Parameter | SE | p value | Parameter | SE | p value |
| Intercept | 55.23 | 22.22 | .02 | 45.74 | 22.07 | .04 |
| PFOS | -1.71 | 1.77 | .34 | 0.46 | 1.71 | .79 |
| Age | 0.42 | 0.43 | .33 | 0.33 | 0.37 | .37 |
| Alcohol | -5.34 | 2.47 | .04 | -2.93 | 2.36 | .22 |
| BMI | 0.70 | 0.67 | .30 | 0.62 | 0.61 | .31 |
| Cigarettes | 0.82 | 0.34 | .02 | 0.76 | 0.32 | .02 |
| | $R^2 = .24$ | Adj $R^2 = .17$ | | $R^2 = .15$ | Adj $R^2 = .07$ | |

ln GGT

| | 1995 Data | | | 1997 Data | | |
|---|---|---|---|---|---|---|
| | Parameter | SE | p value | Parameter | SE | p value |
| Intercept | 2.5359 | 0.5561 | .0001 | 2.5660 | 0.5965 | .0001 |
| PFOS | -0.0028 | 0.0443 | .95 | -0.0357 | 0.0461 | .44 |
| Age | -0.0078 | 0.0107 | .47 | -0.0095 | 0.0010 | .35 |
| Alcohol | 0.0795 | 0.0619 | .20 | 0.0673 | 0.0638 | .30 |
| BMI | 0.0469 | 0.0167 | .007 | 0.0463 | 0.0165 | .007 |
| Cigarettes | 0.0023 | 0.0084 | .79 | -0.0025 | 0.0087 | .77 |
| | $R^2 = .14$ | Adj $R^2 = .06$ | | $R^2 = .14$ | Adj $R^2 = .07$ | |

SGOT

| | 1995 Data | | | 1997 Data | | |
|---|---|---|---|---|---|---|
| | Parameter | SE | p value | Parameter | SE | p value |
| Intercept | 15.27 | 11.19 | .18 | 21.68 | 6.80 | .002 |
| PFOS | 0.40 | 0.89 | .65 | -0.22 | 0.53 | .67 |
| Age | 0.17 | 0.22 | .42 | 0.001 | 0.11 | .99 |
| Alcohol | 1.01 | 1.25 | .42 | 0.47 | .73 | 52 |
| BMI | 0.24 | 0.34 | .47 | 0.17 | 0.19 | .38 |
| Cigarettes | -0.26 | 0.17 | .13 | 0.07 | 0.10 | .49 |
| | $R^2 = .08$ | Adj $R^2 = .00$ | | $R^2 = .03$ | Adj $R^2 = .00$ | |

Table 14
(continued)

SGPT

| | 1995 Data | | | 1997 Data | | |
|---|---|---|---|---|---|---|
| | Parameter | SE | p value | Parameter | SE | p value |
| Intercept | 26.32 | 17.83 | .15 | 15.34 | 13.86 | .27 |
| PFOS | -0.03 | 1.42 | .98 | 0.27 | 1.07 | .80 |
| Age | -0.20 | 0.34 | .57 | -0.34 | 0.23 | .14 |
| Alcohol | 0.13 | 1.98 | .95 | 0.22 | 1.48 | .88 |
| BMI | 1.05 | 0.54 | .06 | 1.15 | 0.38 | .004 |
| Cigarettes | -0.25 | 0.27 | .35 | -0.04 | 0.20 | .83 |
| | $R^2 = .10$ | Adj $R^2 = .02$ | | $R^2 = .18$ | Adj $R^2 = .11$ | |

ln Total Bilirubin

| | 1995 Data | | | 1997 Data | | |
|---|---|---|---|---|---|---|
| | Parameter | SE | p value | Parameter | SE | p value |
| Intercept | 0.7086 | 0.3971 | .08 | -0.3739 | 0.3996 | .35 |
| PFOS | -0.0874 | 0.0806 | .28 | 0.0202 | 0.0308 | .51 |
| $PFOS^2$ | 0.0081 | 0.0068 | .24 | -0.0014 | 0.0026 | .58 |
| Age | -0.0030 | 0.0073 | .69 | 0.0072 | 0.0068 | .29 |
| Alcohol | 0.0344 | 0.0436 | .43 | 0.1045 | 0.0426 | .02 |
| BMI | -0.0319 | 0.0115 | .01 | -0.0182 | 0.0112 | .11 |
| Cigarettes | -0.0130 | 0.0060 | .03 | -0.0105 | 0.0058 | .08 |
| | $R^2 = .23$ | Adj $R^2 = .14$ | | $R^2 = .19$ | Adj $R^2 = .10$ | |

Direct Bilirubin

| | 1995 Data | | | 1997 Data | | |
|---|---|---|---|---|---|---|
| | Parameter | SE | p value | Parameter | SE | p value |
| Intercept | 0.2579 | 0.0469 | .0001 | 0.1711 | 0.0462 | .0005 |
| PFOS | -0.0027 | 0.0037 | .47 | -0.0026 | 0.0036 | .47 |
| Age | -0.0019 | 0.0009 | .04 | 0.0004 | 0.0008 | .60 |
| Alcohol | 0.0049 | 0.0052 | .35 | 0.0089 | 0.0049 | .08 |
| BMI | 0.0010 | 0.0014 | .49 | -0.0021 | 0.0013 | .10 |
| Cigarettes | -0.0005 | 0.0007 | .50 | -0.0008 | 0.0007 | .22 |
| | $R^2 = .13$ | Adj $R^2 = .05$ | | $R^2 = .14$ | Adj $R^2 = .07$ | |

Table 14
(continued)

BUN

| | 1995 Data | | | 1997 Data | | |
|---|---|---|---|---|---|---|
| | Parameter | SE | p value | Parameter | SE | p value |
| Intercept | 18.33 | 3.62 | .0001 | 14.06 | 3.09 | .0001 |
| PFOS | -0.09 | 0.29 | .75 | 0.29 | 0.24 | .22 |
| Age | -0.01 | 0.07 | .87 | 0.07 | 0.05 | .16 |
| Alcohol | 0.59 | 0.40 | .15 | 0.18 | 0.33 | .59 |
| BMI | -0.04 | 0.11 | .71 | -0.12 | 0.09 | .18 |
| Cigarettes | -0.15 | 0.05 | .007 | -0.03 | 0.04 | .55 |
| | $R^2 = .16$ | Adj $R^2 = .09$ | | $R^2 = .08$ | Adj $R^2 = .00$ | |

Creatinine

| | 1995 Data | | | 1997 Data | | |
|---|---|---|---|---|---|---|
| | Parameter | SE | p value | Parameter | SE | p value |
| Intercept | 0.5185 | 0.1308 | .0002 | 0.8785 | 0.1333 | .0001 |
| PFOS | -0.0515 | 0.0264 | .06 | 0.0168 | 0.0103 | .11 |
| $PFOS^2$ | 0.0068 | 0.0022 | .004 | -0.0005 | 0.0009 | .57 |
| Age | 0.0073 | 0.0024 | .004 | 0.0036 | 0.0023 | .12 |
| Alcohol | -0.0100 | 0.0143 | .49 | -0.0266 | 0.0142 | .07 |
| BMI | 0.0099 | 0.0038 | .01 | -0.0030 | 0.0037 | .43 |
| Cigarettes | -0.0003 | 0.0019 | .89 | -0.0028 | 0.0020 | .15 |
| | $R^2 = .49$ | Adj $R^2 = .43$ | | $R^2 = .18$ | Adj $R^2 = .09$ | |

ln Glucose

| | 1995 Data | | | 1997 Data | | |
|---|---|---|---|---|---|---|
| | Parameter | SE | p value | Parameter | SE | p value |
| Intercept | 3.7479 | 0.1311 | .0001 | 3.4111 | 0.2013 | .0001 |
| PFOS | -0.0017 | 0.0103 | .87 | 0.0036 | 0.0156 | .82 |
| Age | 0.0008 | 0.0025 | .74 | 0.0063 | 0.0034 | .07 |
| Alcohol | -0.0050 | 0.0145 | .73 | 0.0005 | 0.0215 | .98 |
| BMI | 0.0236 | 0.0039 | .0001 | 0.0306 | 0.0056 | .0001 |
| Cigarettes | 0.0023 | 0.0020 | .26 | -0.0051 | 0.0029 | .09 |
| | $R^2 = .46$ | Adj $R^2 = .41$ | | $R^2 = .48$ | Adj $R^2 = .43$ | |

Table 14
(continued)

Cholesterol

| | 1995 Data | | | 1997 Data | | |
|---|---|---|---|---|---|---|
| | Parameter | SE | p value | Parameter | SE | p value |
| Intercept | 184.37 | 34.59 | .0001 | 179.50 | 38.87 | .0001 |
| PFOS | -1.15 | 2.76 | .68 | 3.75 | 3.01 | .22 |
| Age | 1.37 | 0.67 | .04 | 0.73 | 0.65 | .27 |
| Alcohol | -2.72 | 3.85 | .48 | 6.57 | 4.16 | .12 |
| BMI | -0.24 | 1.04 | .81 | 0.09 | 1.07 | .94 |
| Cigarettes | -0.82 | 0.52 | .12 | -0.07 | 0.57 | .90 |
| | $R^2 = .13$ | Adj $R^2 = .05$ | | $R^2 = .09$ | Adj $R^2 = .01$ | |

LDL

| | 1995 Data | | | 1997 Data | | |
|---|---|---|---|---|---|---|
| | Parameter | SE | p value | Parameter | SE | p value |
| Intercept | 115.89 | 30.35 | .0004 | 150.88 | 34.90 | .0001 |
| PFOS | 0.36 | 2.38 | .88 | 2.68 | 2.70 | .33 |
| Age | 1.26 | 0.58 | .88 | 0.44 | 0.58 | .45 |
| Alcohol | -3.74 | 3.35 | .27 | 3.81 | 3.73 | .31 |
| BMI | -0.61 | 0.91 | .51 | -1.20 | 0.96 | .22 |
| Cigarettes | -0.72 | 0.45 | .12 | -0.10 | 0.51 | .85 |
| | $R^2 = .15$ | Adj $R^2 = .07$ | | $R^2 = .07$ | Adj $R^2 = .00$ | |

HDL

| | 1995 Data | | | 1997 Data | | |
|---|---|---|---|---|---|---|
| | Parameter | SE | p value | Parameter | SE | p value |
| Intercept | 75.25 | 11.01 | .0001 | 68.22 | 8.91 | .0001 |
| PFOS | -0.68 | 0.86 | .44 | -0.33 | 0.69 | .63 |
| Age | -0.0005 | 0.21 | .99 | 0.11 | 0.15 | .47 |
| Alcohol | 2.31 | 1.21 | .06 | 2.10 | 0.95 | .03 |
| BMI | -0.86 | 0.33 | .01 | -0.97 | 0.25 | .0002 |
| Cigarettes | -0.30 | 0.17 | .08 | -0.12 | 0.13 | .37 |
| | $R^2 = .25$ | Adj $R^2 = .18$ | | $R^2 = .34$ | Adj $R^2 = .28$ | |

Table 14
(continued)

Triglycerides

| | 1995 Data | | | 1997 Data | | |
|---|---|---|---|---|---|---|
| | Parameter | SE | p value | Parameter | SE | p value |
| Intercept | -89.52 | 66.79 | .19 | -198.05 | 82.02 | .02 |
| PFOS | -3.78 | 5.32 | .48 | 7.03 | 6.35 | .27 |
| Age | 0.72 | 1.29 | .58 | 0.87 | 1.37 | .53 |
| Alcohol | -1.93 | 7.43 | .80 | 3.28 | 8.77 | .71 |
| BMI | 7.50 | 2.00 | .0004 | 11.26 | 2.26 | .0001 |
| Cigarettes | 1.40 | 1.01 | .17 | 0.73 | 1.19 | .54 |
| | $R^2 = .26$ | Adj $R^2 = .19$ | | $R^2 = .38$ | Adj $R^2 = .32$ | |

Hematocrit

| | 1995 Data | | | 1997 Data | | |
|---|---|---|---|---|---|---|
| | Parameter | SE | p value | Parameter | SE | p value |
| Intercept | 50.87 | 2.15 | .0001 | 46.61 | 2.56 | .0001 |
| PFOS | -0.03 | 0.17 | .87 | -0.20 | 0.20 | .33 |
| Age | -0.05 | 0.04 | .19 | -0.04 | 0.04 | .38 |
| Alcohol | 0.09 | 0.24 | .70 | 0.31 | 0.27 | .26 |
| BMI | -0.13 | 0.06 | .04 | 0.02 | 0.07 | .77 |
| Cigarettes | 0.05 | 0.04 | .21 | 0.06 | 0.04 | .14 |
| | $R^2 = .20$ | Adj $R^2 = .13$ | | $R^2 = .10$ | Adj $R^2 = .02$ | |

Hemoglobin

| | 1995 Data | | | 1997 Data | | |
|---|---|---|---|---|---|---|
| | Parameter | SE | p value | Parameter | SE | p value |
| Intercept | 17.09 | 0.72 | .0001 | 15.55 | 0.88 | .0001 |
| PFOS | -0.02 | 0.06 | .70 | -0.07 | 0.07 | .33 |
| Age | -0.01 | 0.01 | .36 | -0.01 | 0.01 | .44 |
| Alcohol | -0.002 | 0.08 | .98 | 0.05 | 0.09 | .61 |
| BMI | -0.06 | 0.02 | .01 | 0.01 | 0.02 | .70 |
| Cigarettes | 0.003 | 0.01 | .79 | 0.02 | 0.01 | .12 |
| | $R^2 = .18$ | Adj $R^2 = .10$ | | $R^2 = .07$ | Adj $R^2 = .00$ | |

Table 14
(continued)

RBC

| | 1995 Data | | | 1997 Data | | |
|---|---|---|---|---|---|---|
| | Parameter | SE | p value | Parameter | SE | p value |
| Intercept | 5.21 | 0.22 | .0001 | 5.02 | 0.30 | .0001 |
| PFOS | 0.002 | 0.018 | .89 | -0.003 | 0.024 | .88 |
| Age | -0.003 | 0.004 | .55 | -0.003 | 0.005 | .53 |
| Alcohol | -0.006 | 0.025 | .81 | 0.025 | 0.033 | .44 |
| BMI | -0.007 | 0.007 | .28 | 0.004 | 0.008 | .64 |
| Cigarettes | -0.005 | 0.004 | .18 | -0.005 | 0.004 | .28 |
| | $R^2 = .06$ | Adj $R^2 = .03$ | | $R^2 = .04$ | Adj $R^2 = .04$ | |

MCH

| | 1995 Data | | | 1997 Data | | |
|---|---|---|---|---|---|---|
| | Parameter | SE | p value | Parameter | SE | p value |
| Intercept | 32.97 | 1.25 | .0001 | 31.13 | 1.43 | .0001 |
| PFOS | -0.05 | 0.10 | .60 | -0.11 | 0.11 | .31 |
| Age | -0.01 | 0.02 | .67 | -0.004 | 0.024 | .85 |
| Alcohol | 0.04 | 0.14 | .79 | -0.06 | 0.15 | .71 |
| BMI | -0.07 | 0.04 | .07 | -0.007 | 0.039 | .86 |
| Cigarettes | 0.04 | 0.02 | .06 | 0.07 | 0.02 | .001 |
| | $R^2 = .18$ | Adj $R^2 = .10$ | | $R^2 = .19$ | Adj $R^2 = .12$ | |

MCHC

| | 1995 Data | | | 1997 Data | | |
|---|---|---|---|---|---|---|
| | Parameter | SE | p value | Parameter | SE | p value |
| Intercept | 33.55 | 0.53 | .0001 | 33.40 | 0.50 | .0001 |
| PFOS | -0.03 | 0.04 | .55 | -0.005 | 0.039 | .89 |
| Age | 0.01 | 0.01 | .20 | 0.005 | 0.008 | .55 |
| Alcohol | -0.08 | 0.06 | .18 | -0.10 | 0.05 | .07 |
| BMI | -0.02 | 0.02 | .17 | 0.001 | 0.014 | .92 |
| Cigarettes | -0.02 | 0.01 | .01 | 0.003 | 0.007 | .69 |
| | $R^2 = .18$ | Adj $R^2 = .10$ | | $R^2 = .09$ | Adj $R^2 = .01$ | |

Table 14
(continued)

MCV

| | 1995 Data | | | 1997 Data | | |
|---|---|---|---|---|---|---|
| | Parameter | SE | p value | Parameter | SE | p value |
| Intercept | 98.33 | 3.59 | .0001 | 92.85 | 3.82 | .0001 |
| PFOS | -0.09 | 0.29 | .76 | -0.28 | 0.30 | .34 |
| Age | -0.07 | 0.07 | .34 | -0.02 | 0.06 | .76 |
| Alcohol | 0.30 | 0.40 | .45 | 0.19 | 0.41 | .65 |
| BMI | -0.15 | 0.11 | .18 | -0.03 | 0.11 | .78 |
| Cigarettes | 0.19 | 0.06 | .003 | 0.20 | 0.06 | .0008 |
| | $R^2 = .27$ | Adj $R^2 = .20$ | | $R^2 = .22$ | Adj $R^2 = .15$ | |

Platelets

| | 1995 Data | | | 1997 Data | | |
|---|---|---|---|---|---|---|
| | Parameter | SE | p value | Parameter | SE | p value |
| Intercept | 295.55 | 37.09 | .0001 | 392.12 | 48.22 | .0001 |
| PFOS | -3.96 | 2.96 | .19 | -3.84 | 3.73 | .31 |
| Age | -0.84 | 0.71 | .24 | -2.31 | 0.81 | .006 |
| Alcohol | -10.54 | 4.13 | .01 | -6.59 | 5.16 | .21 |
| BMI | -0.54 | 1.12 | .63 | -1.85 | 1.33 | .17 |
| Cigarettes | -0.78 | 0.63 | .22 | -0.82 | 0.70 | .25 |
| | $R^2 = .19$ | Adj $R^2 = .11$ | | $R^2 = .21$ | Adj $R^2 = .14$ | |

WBC

| | 1995 Data | | | 1997 Data | | |
|---|---|---|---|---|---|---|
| | Parameter | SE | p value | Parameter | SE | p value |
| Intercept | 3.10 | 1.19 | .01 | 4.46 | 1.36 | .002 |
| PFOS | 0.03 | 0.09 | .77 | -0.04 | 0.11 | .70 |
| Age | 0.002 | 0.023 | .93 | -0.007 | 0.02 | .75 |
| Alcohol | 0.07 | 0.13 | .62 | 0.21 | 0.15 | .15 |
| BMI | 0.10 | 0.04 | .007 | 0.06 | 0.04 | .09 |
| Cigarettes | 0.12 | 0.02 | .0001 | 0.11 | 0.02 | .0001 |
| | $R^2 = .43$ | Adj $R^2 = .38$ | | $R^2 = .40$ | Adj $R^2 = .34$ | |

Table 15

Employee Distribution as to Plant Location and Whether Hormones Were Measured, 1995

| PFOS (ppm) | Total | Both Locations | | By Location | | | |
|---|---|---|---|---|---|---|---|
| | | | | Antwerp | | Decatur | |
| | | Hormones Measured | | Hormones Measured | | Hormones Measured | |
| | | Yes | No | Yes | No | Yes | No |
| 0 - < 1 | 45 | 10 (22%) | 35 (78%) | 9 (27%) | 25 (73%) | 1 (9%) | 10 (91%) |
| 1 - < 3 | 91 | 46 (51%) | 45 (49%) | 21 (66%) | 11 (34%) | 25 (43%) | 34 (57%) |
| 3 - < 6 | 35 | 27 (77%) | 8 (23%) | 18 (95%) | 1 (5%) | 9 (56%) | 7 (44%) |
| >= 6 | 7 | 5 (71%) | 2 (29%) | 2 (67%) | 1 (33%) | 3 (75%) | 1 (25%) |
| | 178 | 88 | 90 | 50 | 38 | 38 | 52 |

Table 16

Mean Values for PFOS, Demographic, Serum Chemistries and Hematology,
by Plant Location and Whether Hormones Were Measured, 1995

| | Both Locations Hormones Measured | | Antwerp Hormones Measured | | Decatur Hormones Measured | |
|---|---|---|---|---|---|---|
| Variable | Yes N = 88 | No N = 90 | Yes N = 50 | No N = 38 | Yes N = 38 | No N = 52 |
| PFOS | 2.87*** | 1.52 | 2.69*** | 0.92 | 3.10** | 1.96 |
| Age | 38.4*** | 42.7 | 35.0* | 38.4 | 42.9 | 45.9 |
| Alcohol | 1.0** | 0.4 | 1.6** | 0.8 | 0.2 | 0.2 |
| BMI | 26.5 | 26.7 | 23.6 | 24.4 | 30.3 | 28.5 |
| Cigarettes | 8.3* | 4.3 | 6.7** | 1.9 | 10.3 | 6.0 |
| BUN | 16.3 | 15.5 | 17.1 | 16.8 | 15.1 | 14.5 |
| Creatinine | 0.97* | 1.02 | 0.87*** | 0.94 | 1.10 | 1.08 |
| Glucose | 86 | 88 | 80 | 84 | 94 | 90 |
| AlkalinePhosphatase | 86 | 86 | 77 | 73 | 99 | 96 |

Table 16
(continued)

| Variable | Both Locations Hormones Measured Yes N = 88 | Both Locations Hormones Measured No N = 90 | Antwerp Hormones Measured Yes N = 50 | Antwerp Hormones Measured No N = 38 | Decatur Hormones Measured Yes N = 38 | Decatur Hormones Measured No N = 52 |
|---|---|---|---|---|---|---|
| GGT | 47 | 42 | 45 | 37 | 50 | 46 |
| AST | 29 | 27 | 27 | 24 | 31 | 29 |
| ALT | 47 | 45 | 44 | 45 | 51 | 45 |
| Total Bilirubin | 0.7 | 0.8 | 0.8 | 0.9 | 0.5 | 0.6 |
| Direct Bilirubin | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 | 0.2 |
| Cholesterol | 217 | 215 | 210 | 220 | 227 | 211 |
| LDL | 136 | 137 | 133 | 144 | 141 | 132 |
| HDL | 49 | 48 | 52 | 55 | 43 | 43 |
| Triglycerides | 158 | 144 | 124 | 104 | 205 | 174 |
| Hematocrit | 47 | 46 | 47 | 47 | 46 | 45 |
| Hemoglobin | 15.4 | 15.3 | 15.4 | 15.4 | 15.3 | 15.1 |

Table 16
(continued)

| Variable | Both Locations Hormones Measured | | Antwerp Hormones Measured | | Decatur Hormones Measured | |
|---|---|---|---|---|---|---|
| | Yes N = 88 | No N = 90 | Yes N = 50 | No N = 38 | Yes N = 38 | No N = 52 |
| RBC | 5.0 | 4.9 | 4.9 | 4.9 | 5.0 | 4.9 |
| MCH | 31.1 | 31.0 | 31.5 | 31.3 | 30.5 | 30.8 |
| MCHC | 33.0* | 33.3 | 32.9 | 32.8 | 33.2* | 33.5 |
| MCV | 94 | 93 | 96 | 95 | 92 | 92 |
| WBC | 7.3** | 6.5 | 6.8*** | 5.7 | 8.0* | 7.0 |
| Platelets | 230 | 223 | 233** | 212 | 226 | 231 |

* $p < .05$; ** $p < .01$; *** $p < .001$

Table 17

Mean, Median (Med), Standard Deviation (SD) of Mean and Range of PFOS, Demographic, Serum Chemistries and Hematological Values for N = 88 Employees, Antwerp and Decatur Combined, who Had Hormone Measurements, 1995

| PFOS (ppm) | Mean | Med | SD | Range |
|---|---|---|---|---|
| | | PFOS | | |
| 0 - < 1 | 0.68[1] | 0.75 | 0.21 | 0.37-0.90 |
| 1 - < 3 | 1.96[1] | 1.96 | 0.62 | 1.00-2.90 |
| 3 - < 6 | 4.15[1] | 3.97 | 0.85 | 3.00-5.80 |
| ≥ 6 | 8.67[1] | 8.50 | 2.85 | 6.06-12.83 |
| | F value = 121.3, p = .0001 | | | |
| | | Age | | |
| 0 - < 1 | 32.7 | 32.5 | 6.3 | 21.0-43.0 |
| 1 - < 3 | 38.7 | 39.0 | 8.4 | 25.0-58.0 |
| 3 - < 6 | 39.0 | 39.0 | 7.6 | 26.0-54.0 |
| ≥ 6 | 43.0 | 42.0 | 7.8 | 37.0-56.0 |
| | F value = 2.4, p = .08 | | | |
| | | Alcohol | | |
| 0 - < 1 | 1.4 | 1.1 | 1.2 | 0.0-3.6 |
| 1 - < 3 | 0.6 | 0.2 | 0.8 | 0.0-3.6 |
| 3 - < 6 | 1.4 | 0.5 | 2.0 | 0.0-6.0 |
| ≥ 6 | 0.9 | 0.0 | 1.3 | 0.0-2.9 |
| | F value = 2.1, p = .11 | | | |
| | | BMI | | |
| 0 - < 1 | 24.5 | 24.5 | 2.4 | 20.4-28.0 |
| 1 - < 3 | 27.9 | 26.2 | 7.2 | 19.6-60.7 |
| 3 - < 6 | 24.7 | 24.2 | 4.2 | 17.9-32.5 |
| ≥ 6 | 27.5 | 29.4 | 4.9 | 20.6-33.0 |
| | F value = 2.1, p = .10 | | | |

Table 17
(continued)

| PFOS (ppm) | Mean | Med | SD | Range |
|---|---|---|---|---|
| | | Cigarettes | | |
| 0 - < 1 | 6.0 | 0.0 | 10.5 | 0.0-25.0 |
| 1 - < 3 | 7.7 | 0.0 | 11.2 | 0.0-35.0 |
| 3 - < 6 | 11.6 | 12.0 | 11.8 | 0.0-40.0 |
| ≥ 6 | 0.6 | 0.0 | 1.3 | 0.0-3.0 |
| | F = 1.8, p = .16 | | | |
| | | BUN | | |
| 0 - < 1 | 17.0 | 16.0 | 3.1 | 14.0-22.0 |
| 1 - < 3 | 15.8 | 15.0 | 3.8 | 8.0-26.0 |
| 3 - < 6 | 17.0 | 17.0 | 3.8 | 10.0-23.0 |
| ≥ 6 | 14.4 | 14.0 | 4.0 | 10.0-21.0 |
| | F value = 1.1, p = .35 | | | |
| | | Creatinine | | |
| 0 - < 1 | 1.0 | 1.0 | 0.1 | 0.8-1.1 |
| 1 - < 3 | 1.0 | 0.9 | 0.2 | 0.7-1.6 |
| 3 - < 6 | 0.9 | 0.9 | 0.1 | 0.7-1.2 |
| ≥ 6 | 1.1 | 1.2 | 0.4 | 0.6-1.6 |
| | F value = 2.7, p = .05 | | | |
| | | Glucose | | |
| 0 - < 1 | 82 | 82 | 7 | 70-93 |
| 1 - < 3 | 89 | 84 | 29 | 62-260 |
| 3 - < 6 | 81 | 82 | 12 | 66-112 |
| ≥ 6 | 87 | 83 | 16 | 71-105 |
| | F value = 0.8, p = .52 | | | |
| | | Alkaline Phosphatase | | |
| 0 - < 1 | 82 | 82 | 14 | 66-103 |
| 1 - < 3 | 88 | 89 | 25 | 49-146 |
| 3 - < 6 | 85 | 82 | 21 | 32-124 |
| ≥ 6 | 88 | 74 | 29 | 63-136 |
| | F value = 0.3, p = .84 | | | |

Table 17
(continued)

| PFOS (ppm) | Mean | Med | SD | Range |
|---|---|---|---|---|
| | | GGT | | |
| 0 - < 1 | 38 | 28 | 27 | 23-111 |
| 1 - < 3 | 53 | 41 | 49 | 2-293 |
| 3 - < 6 | 39 | 39 | 15 | 21-80 |
| ≥ 6 | 48 | 49 | 19 | 32-79 |
| | F value = 0.9, p = .44 | | | |
| | | AST | | |
| 0 - < 1 | 31 | 25 | 23 | 17-96 |
| 1 - < 3 | 30 | 27 | 14 | 14-90 |
| 3 - < 6 | 25 | 24 | 6 | 13-37 |
| ≥ 6 | 31 | 30 | 4 | 26-37 |
| | F value = 1.2, p = .31 | | | |
| | | ALT | | |
| 0 - < 1 | 52 | 48 | 21 | 36-108 |
| 1 - < 3 | 48 | 43 | 24 | 25-183 |
| 3 - < 6 | 42 | 41 | 7 | 30-59 |
| ≥ 6 | 54 | 57 | 20 | 29-82 |
| | F value =1.1, p = .36 | | | |
| | | Total Bilirubin | | |
| 0 - < 1 | 0.86 | 0.70 | 0.45 | 0.40-2.00 |
| 1 - < 3 | 0.67 | 0.65 | 0.28 | 0.20-1.30 |
| 3 - < 6 | 0.65 | 0.60 | 0.31 | 0.20-1.40 |
| ≥ 6 | 0.68 | 0.70 | 0.15 | 0.50-0.90 |
| | F value = 1.2, p = .30 | | | |
| | | Direct Bilirubin | | |
| 0 - < 1 | 0.22 | 0.20 | 0.04 | 0.20-0.30 |
| 1 - < 3 | 0.20 | 0.20 | 0.05 | 0.10-0.30 |
| 3 - < 6 | 0.22 | 0.20 | 0.04 | 0.20-0.30 |
| ≥ 6 | 0.22 | 0.20 | 0.04 | 0.20-0.30 |
| | F value = 0.6, p = .63 | | | |

Table 17
(continued)

| PFOS (ppm) | Mean | Med | SD | Range |
|---|---|---|---|---|
| | | Cholesterol | | |
| 0 - < 1 | 213 | 207 | 33 | 180-290 |
| 1 - < 3 | 220 | 227 | 42 | 144-315 |
| 3 - < 6 | 217 | 214 | 29 | 171-270 |
| ≥ 6 | 200 | 208 | 34 | 160-240 |
| | F value = 0.5, p = .69 | | | |
| | | LDL | | |
| 0 - < 1 | 129 | 128 | 22 | 106-177 |
| 1 - < 3 | 136 | 146 | 39 | 65-228 |
| 3 - < 6 | 139 | 135 | 29 | 84-190 |
| ≥ 6 | 129 | 130 | 29 | 95-172 |
| | F value = 0.3, p = .85 | | | |
| | | HDL | | |
| 0 - < 1 | 52 | 57 | 12 | 31-63 |
| 1 - < 3 | 50 | 46 | 15 | 28-94 |
| 3 - < 6 | 46 | 48 | 12 | 23-74 |
| ≥ 6 | 45 | 46 | 10 | 34-61 |
| | F value = 0.6, p = .64 | | | |
| | | Triglycerides | | |
| 0 - < 1 | 157 | 121 | 167 | 41-622 |
| 1 - < 3 | 163 | 129 | 118 | 41-651 |
| 3 - < 6 | 156 | 138 | 97 | 34-413 |
| ≥ 6 | 128 | 151 | 52 | 64-187 |
| | F value = 0.1, p = .94 | | | |
| | | Hematocrit | | |
| 0 - < 1 | 47 | 48 | 2 | 44-49 |
| 1 - < 3 | 46 | 46 | 3 | 39-52 |
| 3 - < 6 | 47 | 47 | 2 | 43-52 |
| ≥ 6 | 47 | 48 | 1 | 45-49 |
| | F value = 2.3, p = .08 | | | |

Table 17
(continued)

| PFOS (ppm) | Mean | Med | SD | Range |
|---|---|---|---|---|
| | | Hemoglobin | | |
| 0 - < 1 | 15.6 | 15.8 | 0.5 | 14.6-16.1 |
| 1 - < 3 | 15.2 | 15.3 | 0.9 | 13.0-17.1 |
| 3 - < 6 | 15.6 | 15.6 | 0.7 | 13.8-17.4 |
| ≥ 6 | 15.5 | 15.4 | 0.7 | 14.8-16.2 |
| | F value = 1.8, p = .16 | | | |
| | | RBC | | |
| 0 - < 1 | 4.9 | 5.0 | 0.3 | 4.3-5.2 |
| 1 - < 3 | 4.9 | 4.9 | 0.3 | 4.3-5.7 |
| 3 - < 6 | 5.0 | 5.0 | 0.2 | 4.6-5.4 |
| ≥ 6 | 5.0 | 5.2 | 0.7 | 4.0-5.7 |
| | F value = 0.4, p = .74 | | | |
| | | MCH | | |
| 0 - < 1 | 32.0 | 31.7 | 1.1 | 30.8-33.9 |
| 1 - < 3 | 30.8 | 30.8 | 1.4 | 27.3-33.2 |
| 3 - < 6 | 31.2 | 31.8 | 1.5 | 26.0-33.3 |
| ≥ 6 | 31.1 | 30.2 | 3.4 | 28.2-36.9 |
| | F value = 1.9, p = .14 | | | |
| | | MCHC | | |
| 0 - < 1 | 32.9 | 33.1 | 0.8 | 31.9-34.5 |
| 1 - < 3 | 33.0 | 33.1 | 0.7 | 31.7-34.5 |
| 3 - < 6 | 32.9 | 32.8 | 0.7 | 31.3-34.2 |
| ≥ 6 | 33.1 | 33.3 | 0.8 | 32.2-34.0 |
| | F value = 0.2, p = .93 | | | |
| | | MCV | | |
| 0 - < 1 | 97 | 95 | 5 | 92-106 |
| 1 - < 3 | 93 | 93 | 4 | 83-101 |
| 3 - < 6 | 95 | 95 | 5 | 81-104 |
| ≥ 6 | 94 | 91 | 12 | 85-115 |
| | F value = 1.9, p = .13 | | | |

Table 17
(continued)

| PFOS (ppm) | Mean | Med | SD | Range |
|---|---|---|---|---|
| | | WBC | | |
| 0 - < 1 | 6.7 | 6.5 | 1.8 | 4.4-9.4 |
| 1 - < 3 | 7.3 | 6.9 | 2.2 | 3.6-15.5 |
| 3 - < 6 | 7.7 | 7.5 | 2.3 | 4.1-13.3 |
| ≥ 6 | 7.1 | 6.9 | 0.6 | 6.4-7.8 |
| | F value = 0.7, p = .59 | | | |
| | | Platelets | | |
| 0 - < 1 | 243 | 230 | 43 | 189-309 |
| 1 - < 3 | 234 | 227 | 44 | 153-365 |
| 3 - < 6 | 229 | 230 | 50 | 132-344 |
| ≥ 6 | 177 | 182 | 29 | 143-205 |
| | F value = 2.7, p = .05 | | | |

1. Significantly different ($p < .05$) than the remaining three PFOS exposure categories.
2. Significantly different ($p < .05$) than the 0 - < 1 ppm PFOS category.
3. Significantly different ($p < .05$) than the 1 - < 3 ppm PFOS category.
4. Significantly different ($p < .05$) than the 3 - < 6 ppm PFOS category.
5. Significantly different ($p < .05$) than the ≥ 6ppm PFOS category.

Sample sizes:

| PFOS Level | Both Locations | Antwerp | Decatur |
|---|---|---|---|
| 0 - < 1 ppm | 10 | 9 | 1 |
| 1 - < 3 ppm | 46 | 21 | 25 |
| 3 - < 6 ppm | 27 | 18 | 9 |
| ≥ 6 ppm | 5 | 2 | 3 |
| | 88 | 50 | 38 |

Table 18

Multivariable Regression of Serum Chemistries and Hematological Parameters in Relation to PFOS Adjusting for Age, Alcohol, BMI and Cigarettes, Antwerp and Decatur Data Combined, For Those Employees Who Had Hormone Measurements in 1995

Alkaline Phosphatase

| Variable | Parameter | SE | p value |
|---|---|---|---|
| Intercept | 64.57 | 15.23 | .001 |
| PFOS | 0.002 | 1.11 | .99 |
| Age | 0.13 | 0.30 | .66 |
| Alcohol | -4.17 | 1.75 | .02 |
| BMI | 0.60 | 0.39 | .13 |
| Cigarettes | 0.60 | 0.20 | .004 |
| | $R^2 = .22$ | Adj $R^2 = .17$ | |

ln GGT

| Variable | Parameter | SE | p value |
|---|---|---|---|
| Intercept | 1.9570 | 0.4203 | .0001 |
| PFOS | 0.0077 | 0.0301 | .80 |
| Age | 0.0157 | 0.0084 | .07 |
| Alcohol | 0.1043 | 0.0484 | .03 |
| BMI | 0.0341 | 0.0107 | .002 |
| Cigarettes | 0.0096 | 0.0056 | .09 |
| | $R^2 = .20$ | Adj $R^2 = .15$ | |

AST

| Variable | Parameter | SE | p value |
|---|---|---|---|
| Intercept | 16.13 | 9.90 | .11 |
| PFOS | -0.13 | .72 | .86 |
| Age | 0.006 | 0.20 | .98 |
| Alcohol | 1.02 | 1.14 | .37 |
| BMI | 0.51 | 0.25 | .04 |
| Cigarettes | -0.20 | 0.13 | .13 |
| | $R^2 = .08$ | Adj $R^2 = .02$ | |

Table 18
(continued)

ALT

| Variable | Parameter | SE | p value |
|---|---|---|---|
| Intercept | 25.19 | 14.22 | .08 |
| PFOS | -0.12 | 1.04 | .90 |
| Age | -0.04 | 0.28 | .89 |
| Alcohol | 0.20 | 1.64 | .90 |
| BMI | 0.95 | 0.36 | .01 |
| Cigarettes | -0.20 | 0.19 | .29 |
| | $R^2 = .10$ | Adj $R^2 = .04$ | |

ln Total Bilirubin

| Variable | Parameter | SE | p value |
|---|---|---|---|
| Intercept | 0.6133 | 0.2726 | .03 |
| PFOS | -0.0885 | 0.0518 | .09 |
| $PFOS^2$ | 0.0073 | 0.0048 | .13 |
| Age | -0.0025 | 0.0054 | .64 |
| Alcohol | 0.0235 | 0.0309 | .45 |
| BMI | -0.0270 | 0.0068 | .0002 |
| Cigarettes | -0.0162 | 0.0036 | .0001 |
| | $R^2 = .39$ | Adj $R^2 = .34$ | |

Direct Bilirubin

| Variable | Parameter | SE | p value |
|---|---|---|---|
| Intercept | 0.225 | 0.0335 | .0001 |
| PFOS | 0.001 | 0.002 | .64 |
| Age | 0.0007 | 0.0007 | .31 |
| Alcohol | 0.004 | 0.004 | .26 |
| BMI | -0.002 | 0.0009 | 0.05 |
| Cigarettes | -0.0003 | 0.0004 | .44 |
| | $R^2 = .09$ | Adj $R^2 = .03$ | |

Table 18
(continued)

BUN

| Variable | Parameter | SE | p value |
|---|---|---|---|
| Intercept | 18.73 | 2.72 | .0001 |
| PFOS | -0.10 | 0.20 | .60 |
| Age | -0.05 | 0.05 | .35 |
| Alcohol | 0.37 | 0.31 | .24 |
| BMI | -0.003 | 0.07 | .97 |
| Cigarettes | -0.05 | 0.04 | .14 |
| | $R^2 = .08$ | Adj $R^2 = .02$ | |

Creatinine

| Variable | Parameter | SE | p value |
|---|---|---|---|
| Intercept | 0.5031 | 0.1178 | .0001 |
| PFOS | -0.0488 | 0.0223 | .03 |
| $PFOS^2$ | 0.0051 | 0.0020 | .01 |
| Age | 0.0086 | 0.0023 | .0004 |
| Alcohol | -0.0119 | 0.0133 | .38 |
| BMI | 0.0090 | 0.0029 | .003 |
| Cigarettes | -0.0017 | 0.0016 | .28 |
| | $R^2 = .37$ | Adj $R^2 = .32$ | |

ln Glucose

| Variable | Parameter | SE | p value |
|---|---|---|---|
| Intercept | 3.8241 | 0.1090 | .0001 |
| PFOS | -0.0029 | 0.0079 | .71 |
| Age | 0.0051 | 0.0022 | .02 |
| Alcohol | -0.0052 | 0.0125 | .68 |
| BMI | 0.0166 | 0.0028 | .0001 |
| Cigarettes | -0.0018 | 0.0014 | .22 |
| | $R^2 = .42$ | Adj $R^2 = .38$ | |

Table 18
(continued)

Cholesterol

| Variable | Parameter | SE | p value |
|---|---|---|---|
| Intercept | 198.04 | 26.88 | .0001 |
| PFOS | -2.83 | 1.97 | .15 |
| Age | 1.26 | 0.54 | .02 |
| Alcohol | -1.32 | 3.09 | .67 |
| BMI | -0.73 | 0.68 | .29 |
| Cigarettes | -0.07 | 0.35 | .85 |
| | $R^2 = .09$ | Adj $R^2 = .03$ | |

LDL

| Variable | Parameter | SE | p value |
|---|---|---|---|
| Intercept | 152.37 | 23.90 | .0001 |
| PFOS | -0.45 | 1.74 | .80 |
| Age | 0.70 | 0.48 | .14 |
| Alcohol | -5.58 | 2.75 | .05 |
| BMI | -1.19 | 0.61 | .05 |
| Cigarettes | -0.59 | 0.32 | .07 |
| | $R^2 = .14$ | Adj $R^2 = .08$ | |

HDL

| Variable | Parameter | SE | p value |
|---|---|---|---|
| Intercept | 77.68 | 8.51 | .0001 |
| PFOS | -0.66 | 0.62 | .29 |
| Age | -0.31 | 0.17 | .07 |
| Alcohol | 2.68 | 0.98 | .008 |
| BMI | -0.66 | 0.22 | .003 |
| Cigarettes | -0.07 | 0.11 | .56 |
| | $R^2 = .32$ | Adj $R^2 = .28$ | |

Table 18
(continued)

Triglycerides

| Variable | Parameter | SE | p value |
|---|---|---|---|
| Intercept | -178.52 | 71.97 | .02 |
| PFOS | -7.89 | 5.26 | .14 |
| Age | 4.22 | 1.44 | .005 |
| Alcohol | 9.90 | 8.28 | .24 |
| BMI | 6.07 | 1.83 | .001 |
| Cigarettes | 3.17 | 0.95 | .001 |
| | $R^2 = .32$ | Adj $R^2 = .28$ | |

Hematocrit

| Variable | Parameter | SE | p value |
|---|---|---|---|
| Intercept | 48.03 | 1.66 | .0001 |
| PFOS | -0.05 | 0.12 | .70 |
| Age | 0.02 | 0.03 | .48 |
| Alcohol | -0.003 | 0.19 | .99 |
| BMI | -0.10 | 0.04 | .02 |
| Cigarettes | 0.04 | 0.02 | .05 |
| | $R^2 = .12$ | Adj $R^2 = .06$ | |

Hemoglobin

| Variable | Parameter | SE | p value |
|---|---|---|---|
| Intercept | 15.76 | 0.58 | .0001 |
| PFOS | -0.02 | 0.04 | .67 |
| Age | -0.04 | 0.07 | .28 |
| Alcohol | 0.01 | 0.01 | .58 |
| BMI | -0.03 | 0.01 | .03 |
| Cigarettes | 0.009 | 0.008 | .25 |
| | $R^2 = .09$ | Adj $R^2 = .03$ | |

Table 18
(continued)

MCH

| Variable | Parameter | SE | p value |
|---|---|---|---|
| Intercept | 33.52 | 1.05 | .0001 |
| PFOS | 0.04 | 0.08 | .59 |
| Age | -0.006 | 0.02 | .79 |
| Alcohol | 0.11 | 0.12 | .35 |
| BMI | -0.10 | 0.03 | .0003 |
| Cigarettes | 0.03 | 0.01 | .03 |
| | $R^2 = .24$ | | Adj $R^2 = .20$ |

MCHC

| Variable | Parameter | SE | p value |
|---|---|---|---|
| Intercept | 32.87 | 0.50 | .0001 |
| PFOS | -0.001 | .037 | .98 |
| Age | 0.008 | 0.01 | .42 |
| Alcohol | -0.08 | 0.06 | .19 |
| BMI | -0.0006 | 0.01 | .96 |
| Cigarettes | -0.01 | 0.007 | 0.08 |
| | $R^2 = .07$ | Adj $R^2 = .02$ | |

MCV

| Variable | Parameter | SE | p value |
|---|---|---|---|
| Intercept | 101.97 | 3.36 | .0001 |
| PFOS | 0.14 | 0.25 | .56 |
| Age | -0.04 | 0.07 | .53 |
| Alcohol | 0.56 | 0.39 | .15 |
| BMI | -0.31 | 0.09 | .0005 |
| Cigarettes | 0.12 | 0.04 | 0.007 |
| | $R^2 = .28$ | Adj $R^2 = .23$ | |

Table 18
(continued)

RBC

| Variable | Parameter | SE | p value |
|---|---|---|---|
| Intercept | 4.673 | 0.214 | .0001 |
| PFOS | -0.009 | 0.016 | .58 |
| Age | 0.005 | 0.004 | .28 |
| Alcohol | -0.026 | 0.025 | .29 |
| BMI | 0.006 | 0.005 | .24 |
| Cigarettes | -0.002 | 0.003 | .48 |
| | $R^2 = .08$ | Adj $R^2 = .02$ | |

Platelets

| Variable | Parameter | SE | p value |
|---|---|---|---|
| Intercept | 320.83 | 32.21 | .0001 |
| PFOS | -6.73 | 2.36 | .006 |
| Age | -0.94 | 0.64 | .15 |
| Alcohol | -6.95 | 3.70 | .06 |
| BMI | -1.26 | 0.82 | .13 |
| Cigarettes | 0.43 | 0.43 | .32 |
| | $R^2 = .18$ | Adj $R^2 = .13$ | |

WBC

| Variable | Parameter | SE | p value |
|---|---|---|---|
| Intercept | 3.24 | 1.32 | .02 |
| PFOS | -0.03 | 0.10 | .74 |
| Age | 0.07 | 0.03 | .01 |
| Alcohol | 0.03 | 0.15 | .82 |
| BMI | 0.03 | 0.03 | .42 |
| Cigarettes | 0.09 | 0.02 | .0001 |
| | $R^2 = .35$ | Adj $R^2 = .31$ | |

Table 19

Mean, Median (Med), Standard Deviation (SD) of Mean and Range of PFOS, Hormonal Measurements for N = 88 Employees, Antwerp and Decatur Combined, 1995

| PFOS (ppm) | Mean | Med | SD | Range |
|---|---|---|---|---|
| | | Cortisol | | |
| 0 - < 1 | 19.3 | 17.5 | 7.0-29.0 | |
| 1 - < 3 | 17.7 | 18.0 | 7.2 | 1.0-42.0 |
| 3 - < 6 | 21.4 | 23.0 | 7.2 | 7.0-31.0 |
| ≥ 6 | 17.0 | 19.0 | 6.2 | 9.0-23.0 |
| | F = 1.7, p = .18 | | | |
| | | DHEA-S | | |
| 0 - < 1 | 388[3,5] | 358 | 168 | 88-605 |
| 1 - < 3 | 234[2,4] | 210 | 95 | 69-460 |
| 3 - < 6 | 316[3] | 318 | 106 | 90-530 |
| ≥ 6 | 194[2] | 190 | 19 | 176-215 |
| | F = 8.3, p = .0001 | | | |
| | | Estradiol | | |
| 0 - < 1 | 67.1 | 67.0 | 12.8 | 50.0-87.0 |
| 1 - < 3 | 60.3 | 59.0 | 15.2 | 35.0-101.0 |
| 3 - < 6 | 60.5 | 61.0 | 10.1 | 42.0-81.0 |
| ≥ 6 | 64.8 | 65.0 | 18.7 | 47.0-92.0 |
| | F = 0.8, p = .49 | | | |
| | | FSH | | |
| 0 - < 1 | 3.8 | 3.5 | 1.5 | 2.0-6.0 |
| 1 - < 3 | 5.6 | 4.0 | 4.2 | 1.0-26.0 |
| 3 - < 6 | 5.6 | 4.0 | 3.9 | 2.0-18.0 |
| ≥ 6 | 6.6 | 6.0 | 3.4 | 3.0-12.0 |
| | F value = 0.8, p = 0.48 | | | |
| | | 17-Hydroxyprogesterone | | |
| 0 - < 1 | 170 | 164 | 41 | 121-245 |
| 1 - < 3 | 131 | 123 | 52 | 53-294 |
| 3 - < 6 | 150 | 153 | 52 | 65-245 |
| ≥ 6 | 119 | 98 | 4590-197 | |
| | F value = 2.4, p = .08 | | | |

Table 19
(continued)

| PFOS (ppm) | Mean | Med | SD | Range |
|---|---|---|---|---|
| | | LH | | |
| 0 - < 1 | 3.8 | 4.0 | 0.9 | 2.0-5.0 |
| 1 - < 3 | 4.6 | 4.0 | 3.0 | 1.0-21.0 |
| 3 - < 6 | 4.6 | 5.0 | 1.9 | 2.0-9.0 |
| ≥ 6 | 4.8 | 5.0 | 1.3 | 3.0-6.0 |
| | F value = 0.3, p = .81 | | | |
| | | Prolactin | | |
| 0 - < 1 | 13.5 | 13.0 | 7.0 | 6.0-29.0 |
| 1 - < 3 | 11.8 | 11.0 | 5.0 | 3.0-30.0 |
| 3 - < 6 | 13.4 | 10.0 | 7.9 | 5.0-39.0 |
| ≥ 6 | 13.6 | 10.0 | 6.3 | 9.0-24.0 |
| | F value = 0.5, p = .67 | | | |
| | | SHBG | | |
| 0 - < 1 | 0.9 | 0.9 | 0.3 | 0.5-1.3 |
| 1 - < 3 | 1.0 | 0.9 | 0.4 | 0.4-1.9 |
| 3 - < 6 | 1.0 | 0.9 | 0.3 | 0.4-1.7 |
| ≥ 6 | 1.2 | 1.3 | 0.6 | 0.6-2.1 |
| | F = 1.1, p = .35 | | | |
| | | Free testosterone | | |
| 0 - < 1 | 20.5[3] | 20.2 | 5.2 | 10.2-28.2 |
| 1 - < 3 | 16.2[2] | 16.1 | 3.3 | 8.9-27.1 |
| 3 - < 6 | 17.7 | 18.2 | 3.2 | 12.2-25.2 |
| ≥ 6 | 17.5 | 17.7 | 2.0 | 15.3-20.5 |
| | F value = 4.5, p = .006 | | | |
| | | Bound testosterone | | |
| 0 - < 1 | 739[3] | 757 | 175 | 5281094 |
| 1 - < 3 | 580[2,4] | 589 | 110 | 278-762 |
| 3 - < 6 | 676[3] | 659 | 171 | 410-1039 |
| ≥ 6 | 711 | 752 | 160 | 462-883 |
| | F value = 5.2, p = .003 | | | |

Table 19
(continued)

| PFOS (ppm) | Mean | Med | SD | Range |
|---|---|---|---|---|
| | | TSH | | |
| 0 - < 1 | 1.9 | 1.4 | 1.3 | 0.6-4.5 |
| 1 - < 3 | 1.0 | 1.5 | 1.4 | 0.5-8.1 |
| 3 - < 6 | 1.5 | 1.4 | 0.8 | 0.5-3.4 |
| ≥ 6 | 2.0 | 1.6 | 1.2 | 0.7-3.8 |

F value = 0.6, p = .62

Sample sizes:

| PFOS Level | Both Locations | Antwerp | Decatur |
|---|---|---|---|
| 0 - < 1 ppm | 10 | 9 | 1 |
| 1 - < 3 ppm | 46 | 21 | 25 |
| 3 - < 6 ppm | 27 | 18 | 9 |
| ≥ 6 ppm | 5 | 2 | 3 |
| | 88 | 50 | 38 |

Table 20

Multivariable Regression Analysis of Hormones in Relation to PFOS
Adjusting for Age, Alcohol, BMI and Cigarettes,
Antwerp and Decatur Data Combined, 1995

Cortisol

| Variable | Parameter | SE | p value |
|---|---|---|---|
| Intercept | 27.13 | 4.84 | .0001 |
| PFOS | 0.27 | 0.35 | .45 |
| Age | -0.10 | 0.10 | .31 |
| Alcohol | 1.56 | 0.56 | .006 |
| BMI | -0.25 | 0.12 | .04 |
| Cigarettes | 0.01 | 0.06 | .87 |
| | $R^2 = .22$ | Adj $R^2 = .17$ | |

DHEAS

| Variable | Parameter | SE | p value |
|---|---|---|---|
| Intercept | 499.17 | 76.98 | .0001 |
| PFOS | -2.95 | 5.63 | .60 |
| Age | -5.30 | 1.54 | .0009 |
| Alcohol | 17.88 | 8.84 | .05 |
| BMI | -1.82 | 1.95 | .35 |
| Cigarettes | 2.25 | 1.01 | .03 |
| | $R^2 = .28$ | Adj $R^2 = .24$ | |

Estradiol

| Variable | Parameter | SE | p value |
|---|---|---|---|
| Intercept | 53.56 | 9.76 | .0001 |
| PFOS | -3.82 | 1.85 | .04 |
| $PFOS^2$ | 0.44 | 0.17 | .01 |
| Age | -0.13 | 0.19 | .51 |
| Alcohol | 2.42 | 1.10 | .03 |
| BMI | 0.57 | 0.24 | .02 |
| Cigarettes | 0.07 | 0.13 | .58 |
| | $R^2 = .18$ | Adj $R^2 = .12$ | |

Table 20
(continued)

Estradiol (without employee C)

| Variable | Parameter | SE | p value |
|---|---|---|---|
| Intercept | 53.43 | 9.84 | .0001 |
| PFOS | -3.56 | 2.39 | .14 |
| $PFOS^2$ | 0.40 | 0.28 | .15 |
| Age | -0.13 | 0.19 | .51 |
| Alcohol | 2.43 | 1.11 | .03 |
| BMI | 0.56 | 0.25 | .03 |
| Cigarettes | 0.69 | 0.13 | .60 |
| | $R^2 = .13$ | Adj $R^2 = .06$ | |

FSH

| Variable | Parameter | SE | p value |
|---|---|---|---|
| Intercept | 3.64 | 2.79 | .20 |
| PFOS | 0.02 | 0.20 | .91 |
| Age | 0.14 | 0.06 | .02 |
| Alcohol | 0.04 | 0.32 | .89 |
| BMI | -0.13 | 0.07 | .07 |
| Cigarettes | 0.005 | 0.04 | .90 |
| | $R^2 = .10$ | Adj $R^2 = .05$ | |

17-Hydroxyprogesterone

| Variable | Parameter | SE | p value |
|---|---|---|---|
| Intercept | 306.10 | 32.69 | .0001 |
| PFOS | -0.04 | 2.36 | .99 |
| Age | -2.13 | 0.67 | .002 |
| Alcohol | -0.76 | 3.68 | .84 |
| BMI | -3.47 | 0.82 | .0001 |
| Cigarettes | 0.79 | 0.42 | .07 |
| | $R^2 = .33$ | Adj $R^2 = .28$ | |

Table 20
(continued)

LH

| Variable | Parameter | SE | p value |
|---|---|---|---|
| Intercept | 5.65 | 1.86 | .003 |
| PFOS | 0.05 | 0.13 | .69 |
| Age | -0.02 | 0.04 | .69 |
| Alcohol | -0.24 | 0.21 | .26 |
| BMI | -0.03 | 0.05 | .56 |
| Cigarettes | 0.03 | 0.02 | .21 |
| | $R^2 = .04$ | Adj $R^2 = .02$ | |

Prolactin

| Variable | Parameter | SE | p value |
|---|---|---|---|
| Intercept | 16.67 | 3.99 | .0001 |
| PFOS | 0.34 | 0.29 | .25 |
| Age | -0.15 | 0.08 | .07 |
| Alcohol | 1.75 | 0.46 | .0003 |
| BMI | 0.004 | 0.10 | .97 |
| Cigarettes | -0.14 | 0.05 | .01 |
| | $R^2 = .31$ | Adj $R^2 = .27$ | |

SHBG

| Variable | Parameter | SE | p value |
|---|---|---|---|
| Intercept | 0.03 | 0.24 | .89 |
| PFOS | 0.005 | 0.02 | .77 |
| Age | 0.02 | 0.005 | .0001 |
| Alcohol | -0.005 | 0.03 | .86 |
| BMI | 0.005 | 0.006 | .40 |
| Cigarettes | 0.004 | 0.003 | .19 |
| | $R^2 = .28$ | Adj $R^2 = .23$ | |

Table 20
(continued)

Free Testosterone

| Variable | Parameter | SE | p value |
|---|---|---|---|
| Intercept | 27.37 | 2.57 | .0001 |
| PFOS | 0.02 | 0.19 | .90 |
| Age | -0.14 | 0.05 | .01 |
| Alcohol | -0.11 | 0.30 | .69 |
| BMI | -0.19 | 0.06 | .005 |
| Cigarettes | 0.01 | 0.03 | .68 |
| | $R^2 = .19$ | Adj $R^2 = .14$ | |

Bound Testosterone

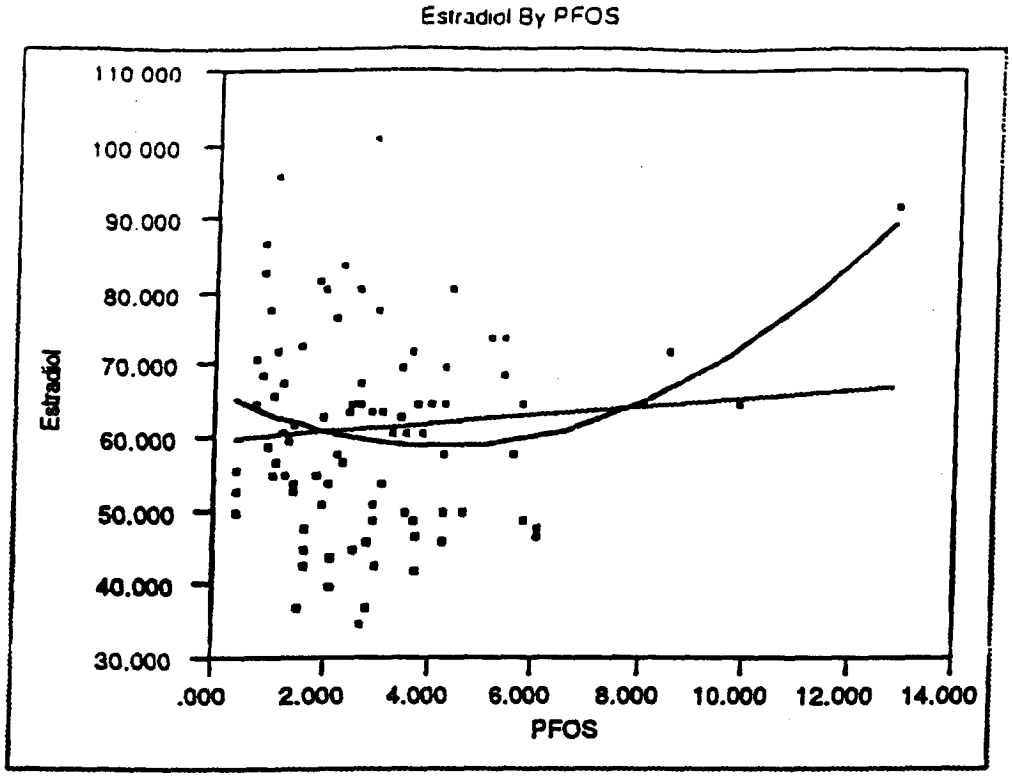
| Variable | Parameter | SE | p value |
|---|---|---|---|
| Intercept | 993.88 | 100.93 | .0001 |
| PFOS | 6.91 | 7.28 | .35 |
| Age | -2.43 | 2.06 | .24 |
| Alcohol | 7.41 | 11.37 | .52 |
| BMI | -11.43 | 2.52 | .0001 |
| Cigarettes | 1.22 | 1.31 | .35 |
| | $R^2 = .28$ | Adj $R^2 = .23$ | |

TSH

| Variable | Parameter | SE | p value |
|---|---|---|---|
| Intercept | -0.873 | 0.826 | .29 |
| PFOS | 0.004 | 0.060 | .95 |
| Age | 0.003 | 0.016 | .85 |
| Alcohol | 0.078 | 0.095 | .41 |
| BMI | 0.096 | 0.021 | .0001 |
| Cigarettes | -0.011 | 0.011 | .32 |
| | $R^2 = .23$ | Adj $R^2 = .18$ | |

FIGURE 1

Scatter Plot of Estradiol and PFOS, Both Locations Combined, 1995




**Polynomial Fit degree=2**

**Estradiol = 66.4703 – 3.60448 PFOS + 0.42197 PFOS^2**

**Summary of Fit**

| | |
|---|---|
| **RSquare** | **0.07616** |
| **RSquare Adj** | **0.054423** |
| **Root Mean Square Error** | **13.33314** |
| **Mean of Response** | **61.36364** |
| **Observations (or Sum Wgts)** | **88** |

**Analysis of Variance**

| Source | DF | Sum of Squares | Mean Square | F Ratio |
|---|---|---|---|---|
| Model | 2 | 1245.701 | 622.850 | 3.5036 |
| Error | 85 | 15110.663 | 177.773 | Prob>F |
| C Total | 87 | 16356.364 | | 0.0345 |

**Parameter Estimates**

| Term | Estimate | Std Error | t Ratio | Prob>\|t\| |
|---|---|---|---|---|
| Intercept | 66.470276 | 3.632698 | 18.30 | <.0001 |
| PFOS | -3.604477 | 1.7997 | -2.00 | 0.0484 |
| PFOS^2 | 0.4219692 | 0.167705 | 2.52 | 0.0137 |

Estradiol = 59.7222 + 0.57198 PFOS

Summary of Fit

| | |
|---|---|
| RSquare | 0.00735 |
| RSquare Adj | -0.00419 |
| Root Mean Square Error | 13.74017 |
| Mean of Response | 61.36364 |
| Observations (or Sum Wgts) | 88 |

Analysis of Variance

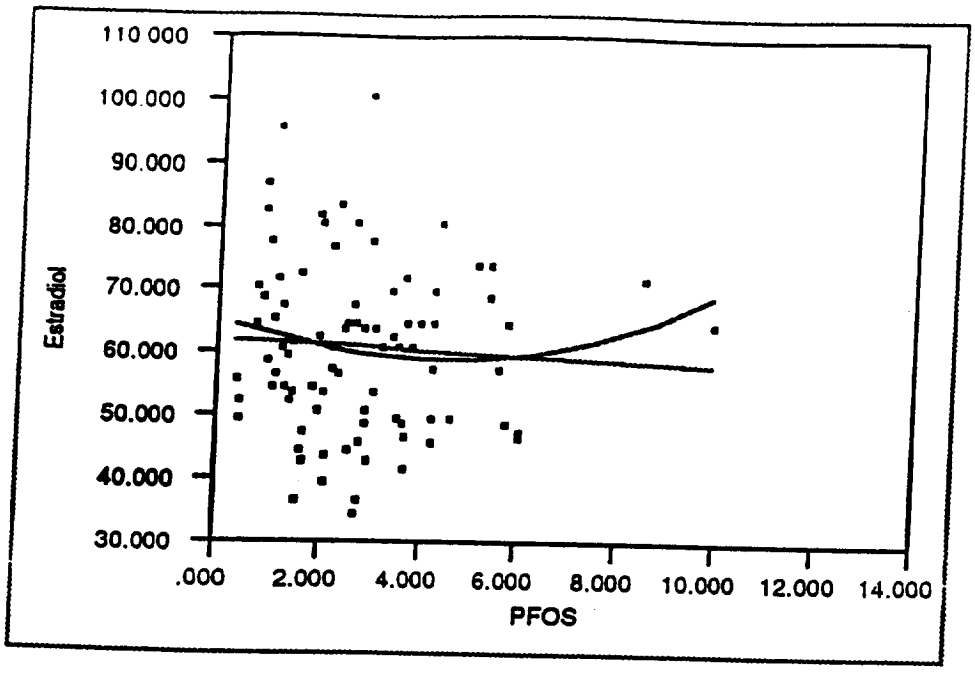
| Source | DF | Sum of Squares | Mean Square | F Ratio |
|---|---|---|---|---|
| Model | 1 | 120.226 | 120.226 | 0.6368 |
| Error | 86 | 16236.138 | 188.792 | Prob>F |
| C Total | 87 | 16356.364 | | 0.4271 |

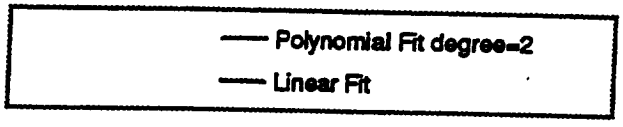
Parameter Estimates

| Term | Estimate | Std Error | t Ratio | Prob>\|t\| |
|---|---|---|---|---|
| Intercept | 59.722236 | 2.525093 | 23.65 | <.0001 |
| PFOS | 0.5719843 | 0.716766 | 0.80 | 0.4271 |

FIGURE 2

Scatter Plot of Estradiol and PFOS, Both Locations Cominbed, 1995 Without Employee A




**Polynomial Fit degree=2**

**Estradiol = 65.8629 – 3.10569 PFOS + 0.34755 PFOS^2**

**Summary of Fit**

| | |
|---|---|
| RSquare | 0.020552 |
| RSquare Adj | -0.00277 |
| Root Mean Square Error | 13.40325 |
| Mean of Response | 61.01149 |
| Observations (or Sum Wgts) | 87 |

**Analysis of Variance**

| Source | DF | Sum of Squares | Mean Square | F Ratio |
|---|---|---|---|---|
| Model | 2 | 316.639 | 158.320 | 0.8813 |
| Error | 84 | 15090.349 | 179.647 | Prob>F |
| C Total | 86 | 15406.989 | | 0.4180 |

**Parameter Estimates**

| Term | Estimate | Std Error | t Ratio | Prob>\|t\| |
|---|---|---|---|---|
| Intercept | 65.862871 | 4.074112 | 16.17 | <.0001 |
| PFOS | -3.105693 | 2.339491 | -1.33 | 0.1879 |
| PFOS^2 | 0.3475472 | 0.278213 | 1.25 | 0.2151 |

Linear Fit

Estradiol = 62.0271 - 0.36861 PFOS

Summary of Fit

| | |
|---|---|
| RSquare | 0.002356 |
| RSquare Adj | -0.00938 |
| Root Mean Square Error | 13.44737 |
| Mean of Response | 61.01149 |
| Observations (or Sum Wgts) | 87 |

Analysis of Variance

| Source | DF | Sum of Squares | Mean Square | F Ratio |
|---|---|---|---|---|
| Model | 1 | 36.295 | 36.295 | 0.2007 |
| Error | 85 | 15370.694 | 180.832 | Prob>F |
| C Total | 86 | 15406.989 | | 0.6553 |

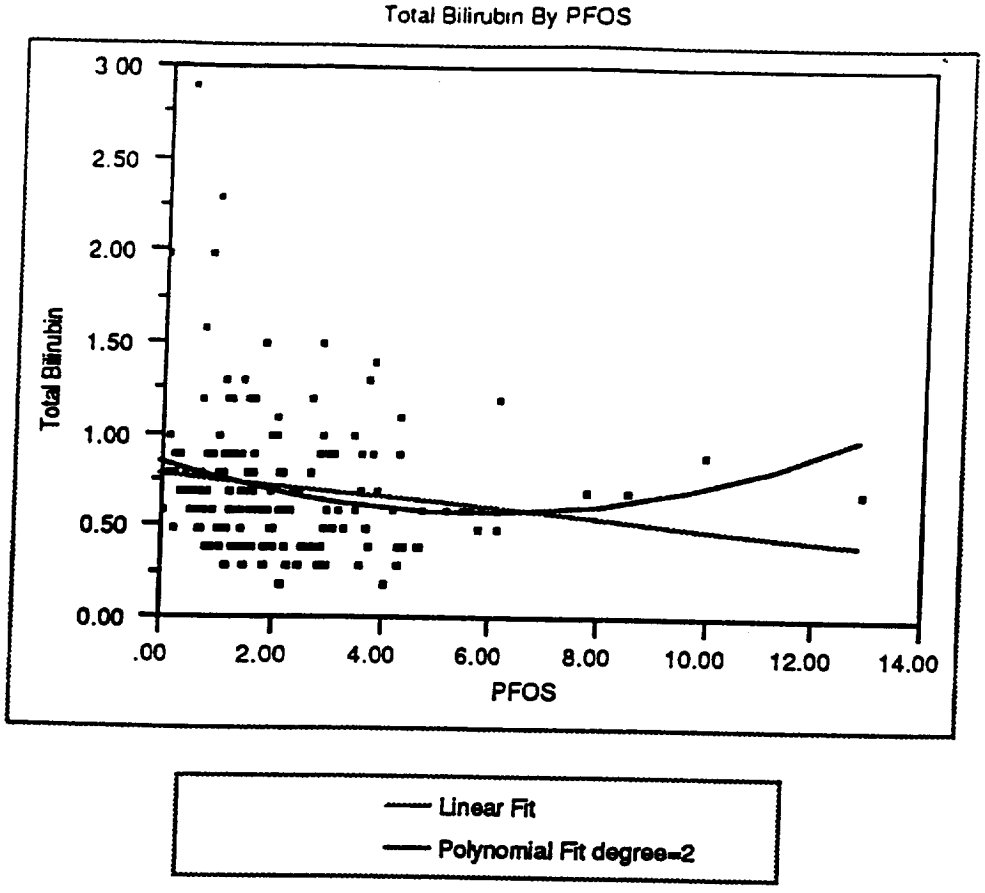
Parameter Estimates

| Term | Estimate | Std Error | t Ratio | Prob>\|t\| |
|---|---|---|---|---|
| Intercept | 62.027069 | 2.686488 | 23.09 | <.0001 |
| PFOS | -0.368607 | 0.822768 | -0.45 | 0.6553 |

# APPENDIX A

## Total Bilirubin and PFOS Scatter Plots

Scatter Plot of Total Bilirubin and PFOS, Both Locations Combined, 1995




**Linear Fit**

**Total Bilirubin = 0.78247 – 0.02927 PFOS**

**Summary of Fit**

| | |
|---|---|
| RSquare | 0.022279 |
| RSquare Adj | 0.016692 |
| Root Mean Square Error | 0.363488 |
| Mean of Response | 0.718644 |
| Observations (or Sum Wgts) | 177 |

**Analysis of Variance**

| Source | DF | Sum of Squares | Mean Square | F Ratio |
|---|---|---|---|---|
| Model | 1 | 0.526856 | 0.526856 | 3.9876 |
| Error | 175 | 23.121618 | 0.132124 | Prob>F |
| C Total | 176 | 23.648475 | | 0.0474 |

**Parameter Estimates**

| Term | Estimate | Std Error | t Ratio | Prob>\|t\| |
|---|---|---|---|---|
| Intercept | 0.7824732 | 0.04205 | 18.61 | <.0001 |
| PFOS | -0.029269 | 0.014657 | -2.00 | 0.0474 |

**Polynomial Fit degree=2**

**Total Bilirubin = 0.86532 – 0.09918 PFOS + 0.00846 PFOS^2**

**Summary of Fit**

| | |
|---|---|
| RSquare | 0.051674 |
| RSquare Adj | 0.040773 |
| Root Mean Square Error | 0.359009 |
| Mean of Response | 0.718644 |
| Observations (or Sum Wgts) | 177 |

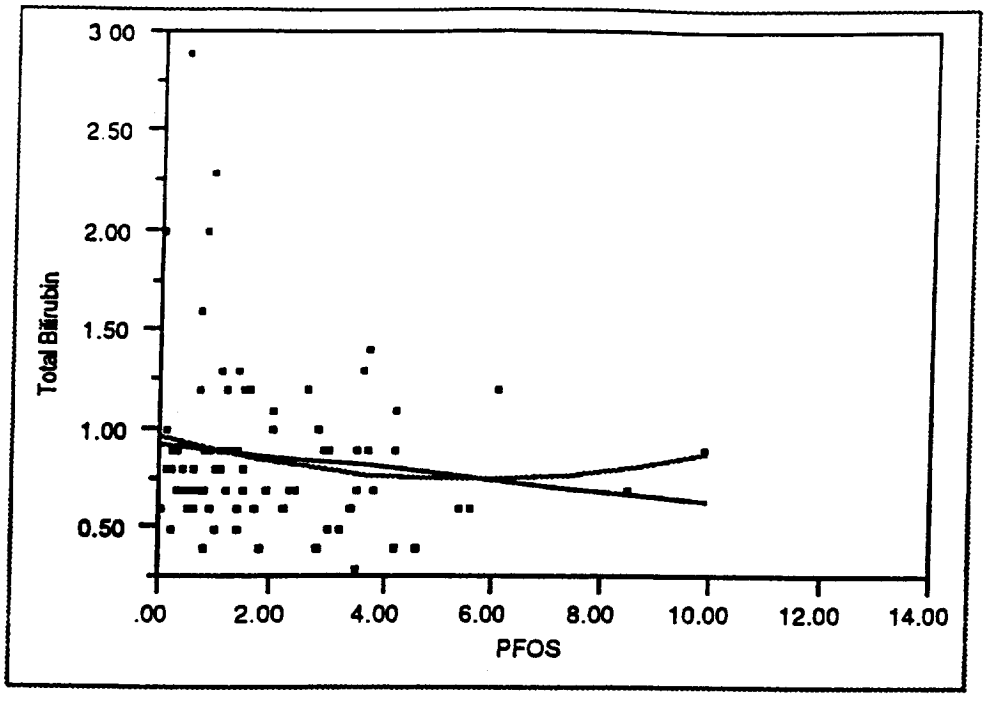
Analysis of Variance

| Source | DF | Sum of Squares | Mean Square | F Ratio |
|---|---|---|---|---|
| Model | 2 | 1.222006 | 0.611003 | 4.7406 |
| Error | 174 | 22.426468 | 0.128888 | Prob>F |
| C Total | 176 | 23.648475 | | 0.0099 |

Parameter Estimates

| Term | Estimate | Std Error | t Ratio | Prob>\|t\| |
|---|---|---|---|---|
| Intercept | 0.865318 | 0.054748 | 15.81 | <.0001 |
| PFOS | -0.099182 | 0.033404 | -2.97 | 0.0034 |
| PFOS^2 | 0.008459 | 0.003642 | 2.32 | 0.0214 |

Scatter Plot of Total Bilirubin and PFOS, Antwecp, 1995




**Linear Fit**

**Total Bilirubin = 0.92001 – 0.02927 PFOS**

**Summary of Fit**

| | |
|---|---|
| RSquare | 0.017786 |
| RSquare Adj | 0.006365 |
| Root Mean Square Error | 0.407279 |
| Mean of Response | 0.863636 |
| Observations (or Sum Wgts) | 88 |

**Analysis of Variance**

| Source | DF | Sum of Squares | Mean Square | F Ratio |
|---|---|---|---|---|
| Model | 1 | 0.258313 | 0.258313 | 1.5573 |
| Error | 86 | 14.265323 | 0.165876 | Prob>F |
| C Total | 87 | 14.523636 | | 0.2155 |

**Parameter Estimates**

| Term | Estimate | Std Error | t Ratio | Prob>\|t\| |
|---|---|---|---|---|
| Intercept | 0.9200069 | 0.062654 | 14.68 | <.0001 |
| PFOS | -0.029266 | 0.023452 | -1.25 | 0.2155 |

**Polynomial Fit degree=2**

**Total Bilirubin = 0.96548 – 0.07872 PFOS + 0.00697 PFOS^2**

**Summary of Fit**

| | |
|---|---|
| RSquare | 0.027505 |
| RSquare Adj | 0.004623 |
| Root Mean Square Error | 0.407635 |
| Mean of Response | 0.863636 |
| Observations (or Sum Wgts) | 88 |

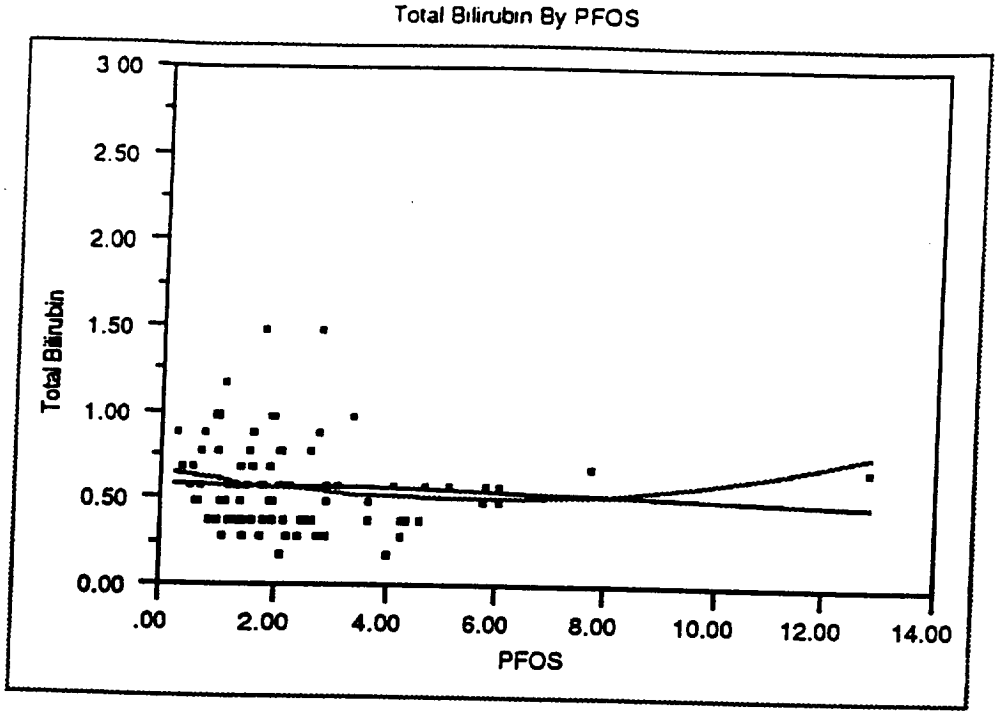
Analysis of Variance

| Source | DF | Sum of Squares | Mean Square | F Ratio |
|---|---|---|---|---|
| Model | 2 | 0.399470 | 0.199735 | 1.2020 |
| Error | 85 | 14.124166 | 0.166167 | Prob>F |
| C Total | 87 | 14.523636 | | 0.3056 |

Parameter Estimates

| Term | Estimate | Std Error | t Ratio | Prob>\|t\| |
|---|---|---|---|---|
| Intercept | 0.9654789 | 0.07979 | 12.10 | <.0001 |
| PFOS | -0.078719 | 0.058565 | -1.34 | 0.1825 |
| PFOS^2 | 0.0069749 | 0.007568 | 0.92 | 0.3593 |

Scatter Plot of Total Bilirubin and PFOS, Decatur, 1995




**Linear Fit**

**Total Bilirubin = 0.59712 – 0.00898 PFOS**

**Summary of Fit**

| | |
|---|---|
| RSquare | 0.004472 |
| RSquare Adj | -0.00697 |
| Root Mean Square Error | 0.249626 |
| Mean of Response | 0.575281 |
| Observations (or Sum Wgts) | 89 |

**Analysis of Variance**

| Source | DF | Sum of Squares | Mean Square | F Ratio |
|---|---|---|---|---|
| Model | 1 | 0.0243540 | 0.024354 | 0.3908 |
| Error | 87 | 5.4212639 | 0.062313 | Prob>F |
| C Total | 88 | 5.4456180 | | 0.5335 |

**Parameter Estimates**

| Term | Estimate | Std Error | t Ratio | Prob>\|t\| |
|---|---|---|---|---|
| Intercept | 0.5971232 | 0.043827 | 13.62 | <.0001 |
| PFOS | -0.008979 | 0.014363 | -0.63 | 0.5335 |

**Polynomial Fit degree=2**

**Total Bilirubin = 0.66974 – 0.05867 PFOS + 0.00518 PFOS^2**

**Summary of Fit**

| | |
|---|---|
| RSquare | 0.032545 |

| | |
|---|---|
| RSquare Adj | 0.010046 |
| Root Mean Square Error | 0.247508 |
| Mean of Response | 0.575281 |
| Observations (or Sum Wgts) | 89 |

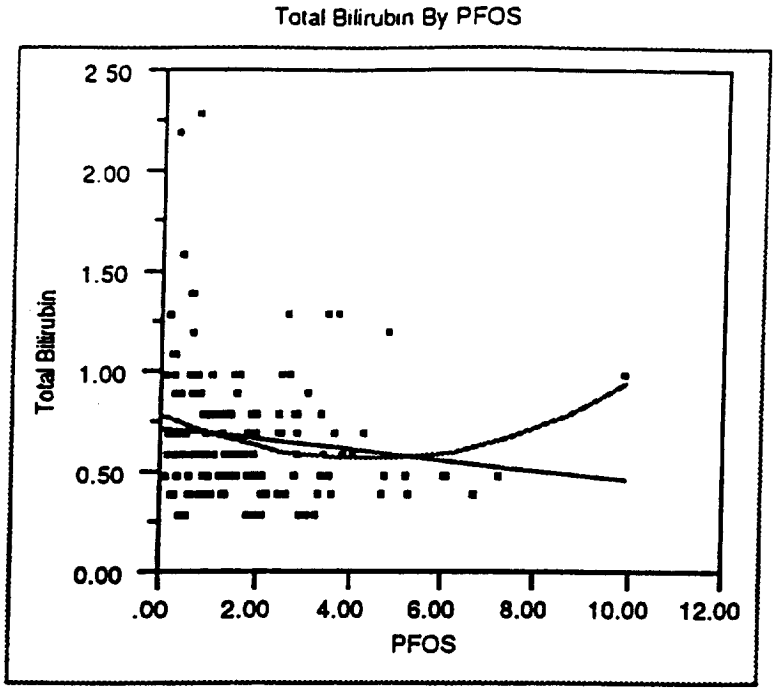
Analysis of Variance

| Source | DF | Sum of Squares | Mean Square | F Ratio |
|---|---|---|---|---|
| Model | 2 | 0.1772262 | 0.088613 | 1.4465 |
| Error | 86 | 5.2683918 | 0.061260 | Prob>F |
| C Total | 88 | 5.4456180 | | 0.2411 |

Parameter Estimates

| Term | Estimate | Std Error | t Ratio | Prob>\|t\| |
|---|---|---|---|---|
| Intercept | 0.6697418 | 0.063258 | 10.59 | <.0001 |
| PFOS | -0.058672 | 0.034531 | -1.70 | 0.0929 |
| PFOS^2 | 0.0051833 | 0.003281 | 1.58 | 0.1178 |

Scatter Plot of Total Bilirubin and PFOS, Both Locations Combined, 1997




Linear Fit

Total Bilirubin = 0.7185 – 0.02583 PFOS

Summary of Fit

| | |
|---|---|
| RSquare | 0.016221 |
| RSquare Adj | 0.009483 |
| Root Mean Square Error | 0.322046 |
| Mean of Response | 0.672973 |
| Observations (or Sum Wgts) | 148 |

Analysis of Variance

| Source | DF | Sum of Squares | Mean Square | F Ratio |
|---|---|---|---|---|
| Model | 1 | 0.249674 | 0.249674 | 2.4073 |
| Error | 146 | 15.142218 | 0.103714 | Prob>F |
| C Total | 147 | 15.391892 | | 0.1229 |

Parameter Estimates

| Term | Estimate | Std Error | t Ratio | Prob>\|t\| |
|---|---|---|---|---|
| Intercept | 0.7184974 | 0.039518 | 18.18 | <.0001 |
| PFOS | -0.025825 | 0.016645 | -1.55 | 0.1229 |

Polynomial Fit degree=2

Total Bilirubin = 0.78963 – 0.10456 PFOS + 0.012 PFOS^2

Summary of Fit

| | |
|---|---|
| RSquare | 0.045789 |
| RSquare Adj | 0.032628 |

| | |
|---|---|
| Root Mean Square Error | 0.318261 |
| Mean of Response | 0.672973 |
| Observations (or Sum Wgts) | 148 |

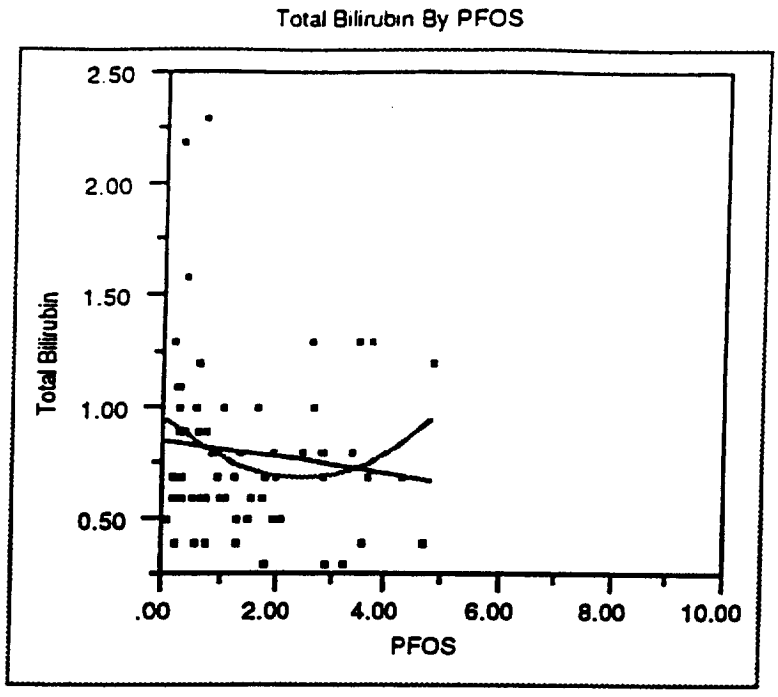
Analysis of Variance

| Source | DF | Sum of Squares | Mean Square | F Ratio |
|---|---|---|---|---|
| Model | 2 | 0.704787 | 0.352393 | 3.4790 |
| Error | 145 | 14.687105 | 0.101290 | Prob>F |
| C Total | 147 | 15.391892 | | 0.0334 |

**Parameter Estimates**

| Term | Estimate | Std Error | t Ratio | Prob>\|t\| |
|---|---|---|---|---|
| **Intercept** | **0.7896264** | **0.05149** | **15.34** | **<.0001** |
| **PFOS** | **-0.104564** | **0.040625** | **-2.57** | **0.0111** |
| **PFOS^2** | **0.0120049** | **0.005663** | **2.12** | **0.0357** |

# Scatter Plot of Total Bilirubin and PFOS, Antwerp, 1997




**Linear Fit**

**Total Bilirubin = 0.8517 – 0.03647 PFOS**

**Summary of Fit**

| | |
|---|---|
| RSquare | 0.014291 |
| RSquare Adj | -0.00161 |
| Root Mean Square Error | 0.385334 |
| Mean of Response | 0.796875 |
| Observations (or Sum Wgts) | 64 |

**Analysis of Variance**

| Source | DF | Sum of Squares | Mean Square | F Ratio |
|---|---|---|---|---|
| Model | 1 | 0.1334670 | 0.133467 | 0.8989 |
| Error | 62 | 9.2059080 | 0.148482 | Prob>F |
| C Total | 63 | 9.3393750 | | 0.3468 |

**Parameter Estimates**

| Term | Estimate | Std Error | t Ratio | Prob>\|t\| |
|---|---|---|---|---|
| Intercept | 0.8516999 | 0.075259 | 11.32 | <.0001 |
| PFOS | -0.036474 | 0.038471 | -0.95 | 0.3468 |

**Polynomial Fit degree=2**

**Total Bilirubin = 0.9635 – 0.22847 PFOS + 0.0462 PFOS^2**

**Summary of Fit**

| | |
|---|---|
| RSquare | 0.051848 |
| RSquare Adj | 0.020761 |

| | |
|---|---|
| Root Mean Square Error | 0.318261 |
| Mean of Response | 0.672973 |
| Observations (or Sum Wgts) | 148 |

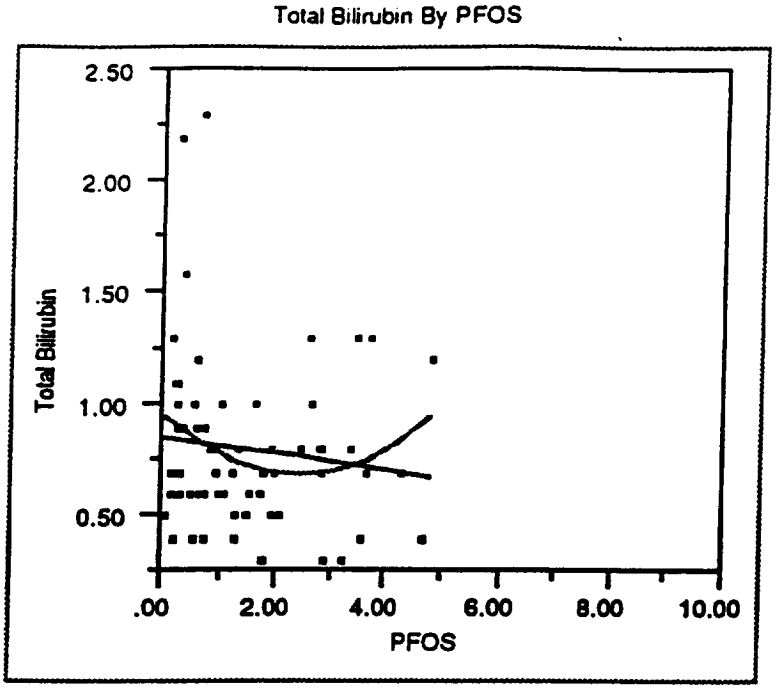
Analysis of Variance

| Source | DF | Sum of Squares | Mean Square | F Ratio |
|---|---|---|---|---|
| Model | 2 | 0.704787 | 0.352393 | 3.4790 |
| Error | 145 | 14.687105 | 0.101290 | Prob>F |
| C Total | 147 | 15.391892 | | 0.0334 |

Parameter Estimates

| Term | Estimate | Std Error | t Ratio | Prob>\|t\| |
|---|---|---|---|---|
| Intercept | 0.7896264 | 0.05149 | 15.34 | <.0001 |
| PFOS | -0.104564 | 0.040625 | -2.57 | 0.0111 |
| PFOS^2 | 0.0120049 | 0.005663 | 2.12 | 0.0357 |

Scatter Plot of Total Bilirubin and PFOS, Antwerp, 1997




**Linear Fit**

**Total Bilirubin = 0.8517 – 0.03647 PFOS**

**Summary of Fit**

| | |
|---|---|
| RSquare | 0.014291 |
| RSquare Adj | -0.00161 |
| Root Mean Square Error | 0.385334 |
| Mean of Response | 0.796875 |
| Observations (or Sum Wgts) | 64 |

**Analysis of Variance**

| Source | DF | Sum of Squares | Mean Square | F Ratio |
|---|---|---|---|---|
| Model | 1 | 0.1334670 | 0.133467 | 0.8989 |
| Error | 62 | 9.2059080 | 0.148482 | Prob>F |
| C Total | 63 | 9.3393750 | | 0.3468 |

**Parameter Estimates**

| Term | Estimate | Std Error | t Ratio | Prob>\|t\| |
|---|---|---|---|---|
| Intercept | 0.8516999 | 0.075259 | 11.32 | <.0001 |
| PFOS | -0.036474 | 0.038471 | -0.95 | 0.3468 |

**Polynomial Fit degree=2**

**Total Bilirubin = 0.9635 – 0.22847 PFOS + 0.0462 PFOS^2**

**Summary of Fit**

| | |
|---|---|
| RSquare | 0.051848 |
| RSquare Adj | 0.020761 |

| | |
|---|---|
| Root Mean Square Error | 0.381007 |
| Mean of Response | 0.796875 |
| Observations (or Sum Wgts) | 64 |

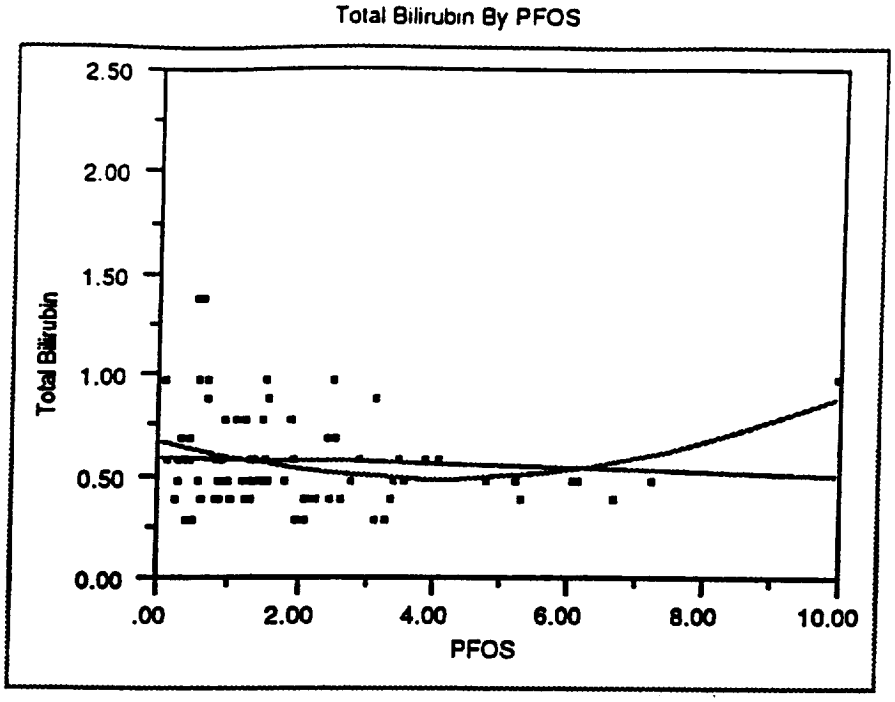
Analysis of Variance

| Source | DF | Sum of Squares | Mean Square | F Ratio |
|---|---|---|---|---|
| Model | 2 | 0.4842255 | 0.242113 | 1.6678 |
| Error | 61 | 8.8551495 | 0.145166 | Prob>F |
| C Total | 63 | 9.3393750 | | 0.1971 |

Parameter Estimates

| Term | Estimate | Std Error | t Ratio | Prob>\|t\| |
|---|---|---|---|---|
| Intercept | 0.963501 | 0.103492 | 9.31 | <.0001 |
| PFOS | -0.228466 | 0.129238 | -1.77 | 0.0821 |
| PFOS^2 | 0.0461951 | 0.029718 | 1.55 | 0.1253 |

Scatter Plot of Total Bilirubin and PFOS, Decatur, 1997




**Linear Fit**

**Total Bilirubin = 0.59609 – 0.00894 PFOS**

**Summary of Fit**

| | |
|---|---|
| RSquare | 0.004924 |
| RSquare Adj | -0.00721 |
| Root Mean Square Error | 0.229 |
| Mean of Response | 0.578571 |
| Observations (or Sum Wgts) | 84 |

**Analysis of Variance**

| Source | DF | Sum of Squares | Mean Square | F Ratio |
|---|---|---|---|---|
| Model | 1 | 0.0212775 | 0.021278 | 0.4057 |
| Error | 82 | 4.3001510 | 0.052441 | Prob>F |
| C Total | 83 | 4.3214286 | | 0.5259 |

**Parameter Estimates**

| Term | Estimate | Std Error | t Ratio | Prob>\|t\| |
|---|---|---|---|---|
| Intercept | 0.5960926 | 0.037161 | 16.04 | <.0001 |
| PFOS | -0.008937 | 0.01403 | -0.64 | 0.5259 |

**Polynomial Fit degree=2**

**Total Bilirubin = 0.68287 – 0.09408 PFOS + 0.01143 PFOS^2**

**Summary of Fit**

| | |
|---|---|
| RSquare | 0.071405 |
| RSquare Adj | 0.048477 |

| | |
|---|---|
| Root Mean Square Error | 0.222579 |
| Mean of Response | 0.578571 |
| Observations (or Sum Wgts) | 84 |

Analysis of Variance

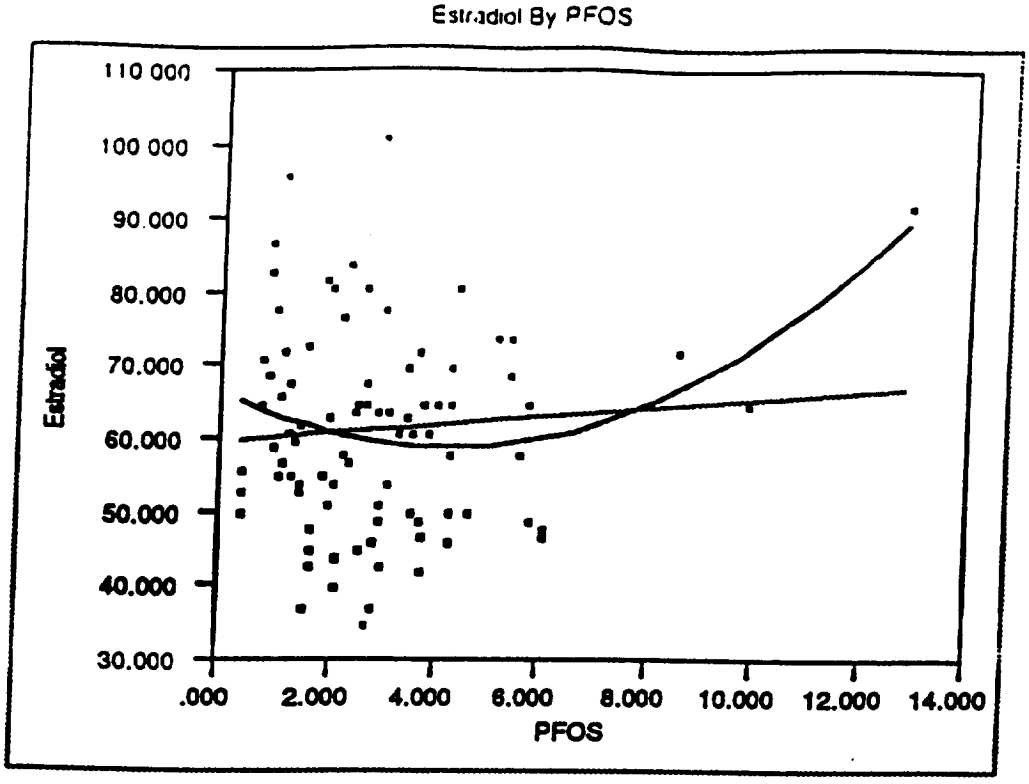
| Source | DF | Sum of Squares | Mean Square | F Ratio |
|---|---|---|---|---|
| Model | 2 | 0.3085734 | 0.154287 | 3.1143 |
| Error | 81 | 4.0128552 | 0.049541 | Prob>F |
| C Total | 83 | 4.3214286 | | 0.0498 |

Parameter Estimates

| Term | Estimate | Std Error | t Ratio | Prob>\|t\| |
|---|---|---|---|---|
| Intercept | 0.6828676 | 0.05102 | 13.38 | <.0001 |
| PFOS | -0.094082 | 0.037896 | -2.48 | 0.0151 |
| PFOS^2 | 0.011426 | 0.004745 | 2.41 | 0.0183 |

FIGURE 1

Scatter Plot of Estradiol and PFOS, Both Locations Combined, 1995




**Polynomial Fit degree=2**

**Estradiol = 66.4703 – 3.60448 PFOS + 0.42197 PFOS^2**

**Summary of Fit**

| | |
|---|---|
| RSquare | 0.07616 |
| RSquare Adj | 0.054423 |
| Root Mean Square Error | 13.33314 |
| Mean of Response | 61.36364 |
| Observations (or Sum Wgts) | 88 |

**Analysis of Variance**

| Source | DF | Sum of Squares | Mean Square | F Ratio |
|---|---|---|---|---|
| Model | 2 | 1245.701 | 622.850 | 3.5036 |
| Error | 85 | 15110.663 | 177.773 | Prob>F |
| C Total | 87 | 16356.364 | | 0.0345 |

**Parameter Estimates**

| Term | Estimate | Std Error | t Ratio | Prob>\|t\| |
|---|---|---|---|---|
| Intercept | 66.470276 | 3.632698 | 18.30 | <.0001 |
| PFOS | -3.604477 | 1.7997 | -2.00 | 0.0484 |
| PFOS^2 | 0.4219692 | 0.167705 | 2.52 | 0.0137 |

Estradiol = 59.7222 + 0.57198 PFOS

Summary of Fit

| | |
|---|---|
| RSquare | 0.00735 |
| RSquare Adj | -0.00419 |
| Root Mean Square Error | 13.74017 |
| Mean of Response | 61.36364 |
| Observations (or Sum Wgts) | 88 |

Analysis of Variance

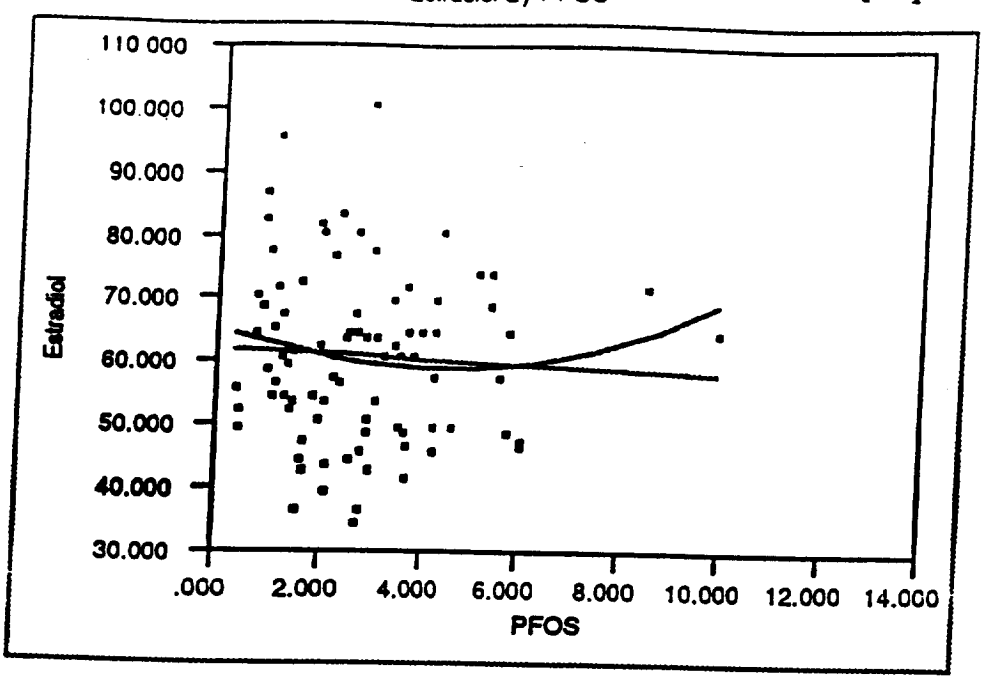
| Source | DF | Sum of Squares | Mean Square | F Ratio |
|---|---|---|---|---|
| Model | 1 | 120.226 | 120.226 | 0.6368 |
| Error | 86 | 16236.138 | 188.792 | Prob>F |
| C Total | 87 | 16356.364 | | 0.4271 |

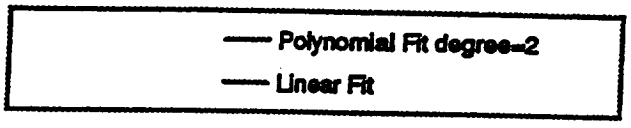
Parameter Estimates

| Term | Estimate | Std Error | t Ratio | Prob>\|t\| |
|---|---|---|---|---|
| Intercept | 59.722236 | 2.525093 | 23.65 | <.0001 |
| PFOS | 0.5719843 | 0.716766 | 0.80 | 0.4271 |

FIGURE 2

Scatter Plot of Estradiol and PFOS, Both Locations Cominbed, 1995 Without Employee A




**Polynomial Fit degree=2**

**Estradiol = 65.8629 – 3.10569 PFOS + 0.34755 PFOS^2**

Summary of Fit

| | |
|---|---|
| RSquare | 0.020552 |
| RSquare Adj | -0.00277 |
| Root Mean Square Error | 13.40325 |
| Mean of Response | 61.01149 |
| Observations (or Sum Wgts) | 87 |

Analysis of Variance

| Source | DF | Sum of Squares | Mean Square | F Ratio |
|---|---|---|---|---|
| Model | 2 | 316.639 | 158.320 | 0.8813 |
| Error | 84 | 15090.349 | 179.647 | Prob>F |
| C Total | 86 | 15406.989 | | 0.4180 |

Parameter Estimates

| Term | Estimate | Std Error | t Ratio | Prob>\|t\| |
|---|---|---|---|---|
| Intercept | 65.862871 | 4.074112 | 16.17 | <.0001 |
| PFOS | -3.105693 | 2.339491 | -1.33 | 0.1879 |
| PFOS^2 | 0.3475472 | 0.278213 | 1.25 | 0.2151 |

Linear Fit

Estradiol = 62.0271 - 0.36861 PFOS

Summary of Fit

| | |
|---|---|
| RSquare | 0.002356 |
| RSquare Adj | -0.00938 |
| Root Mean Square Error | 13.44737 |
| Mean of Response | 61.01149 |
| Observations (or Sum Wgts) | 87 |

Analysis of Variance

| Source | DF | Sum of Squares | Mean Square | F Ratio |
|---|---|---|---|---|
| Model | 1 | 36.295 | 36.295 | 0.2007 |
| Error | 85 | 15370.694 | 180.832 | Prob>F |
| C Total | 86 | 15406.989 | | 0.6553 |

Parameter Estimates

| Term | Estimate | Std Error | t Ratio | Prob>\|t\| |
|---|---|---|---|---|
| Intercept | 62.027069 | 2.686488 | 23.09 | <.0001 |
| PFOS | -0.368607 | 0.822768 | -0.45 | 0.6553 |

# APPENDIX B

## Unconjugated Bilirubin and PFOS Scatter Plots

| | |
|---|---|
| RSquare Adj | -0.02446 |
| Root Mean Square Error | 9.349875 |
| Mean of Response | 42.33333 |
| Observations (or Sum Wgts) | 84 |

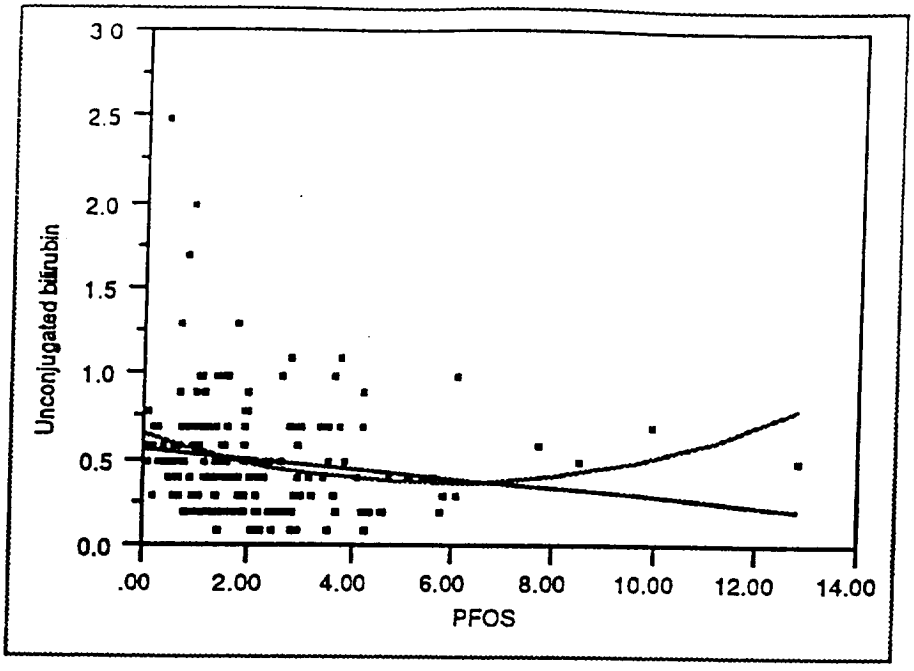
Analysis of Variance

| Source | DF | Sum of Squares | Mean Square | F Ratio |
|---|---|---|---|---|
| Model | 2 | 1.6333 | 0.8166 | 0.0093 |
| Error | 81 | 7081.0334 | 87.4202 | Prob>F |
| C Total | 83 | 7082.6667 | | 0.9907 |

Parameter Estimates

| Term | Estimate | Std Error | t Ratio | Prob>\|t\| |
|---|---|---|---|---|
| Intercept | 42.534847 | 2.143189 | 19.85 | <.0001 |
| PFOS | -0.20021 | 1.591892 | -0.13 | 0.9002 |
| PFOS^2 | 0.0272273 | 0.199313 | 0.14 | 0.8917 |

Scatter Plot of Unconjugated Bilirubin and PFOS, Both Locations Combined, 1995




**Linear Fit**

**Unconjugated bilirubin = 0.56837 – 0.0285 PFOS**

**Summary of Fit**

| | |
|---|---|
| RSquare | 0.024418 |
| RSquare Adj | 0.018843 |
| Root Mean Square Error | 0.337753 |
| Mean of Response | 0.506215 |
| Observations (or Sum Wgts) | 177 |

**Analysis of Variance**

| Source | DF | Sum of Squares | Mean Square | F Ratio |
|---|---|---|---|---|
| Model | 1 | 0.499660 | 0.499660 | 4.3800 |
| Error | 175 | 19.963503 | 0.114077 | Prob>F |
| C Total | 176 | 20.463164 | | 0.0378 |

**Parameter Estimates**

| Term | Estimate | Std Error | t Ratio | Prob>\|t\| |
|---|---|---|---|---|
| Intercept | 0.5683746 | 0.039072 | 14.55 | <.0001 |
| PFOS | -0.028503 | 0.013619 | -2.09 | 0.0378 |

**Polynomial Fit degree=2**

**Unconjugated bilirubin = 0.65239 – 0.09941 PFOS + 0.00858 PFOS^2**

**Summary of Fit**

| | |
|---|---|
| RSquare | 0.059356 |
| RSquare Adj | 0.048544 |

| | |
|---|---|
| Root Mean Square Error | 0.332602 |
| Mean of Response | 0.506215 |
| Observations (or Sum Wgts) | 177 |

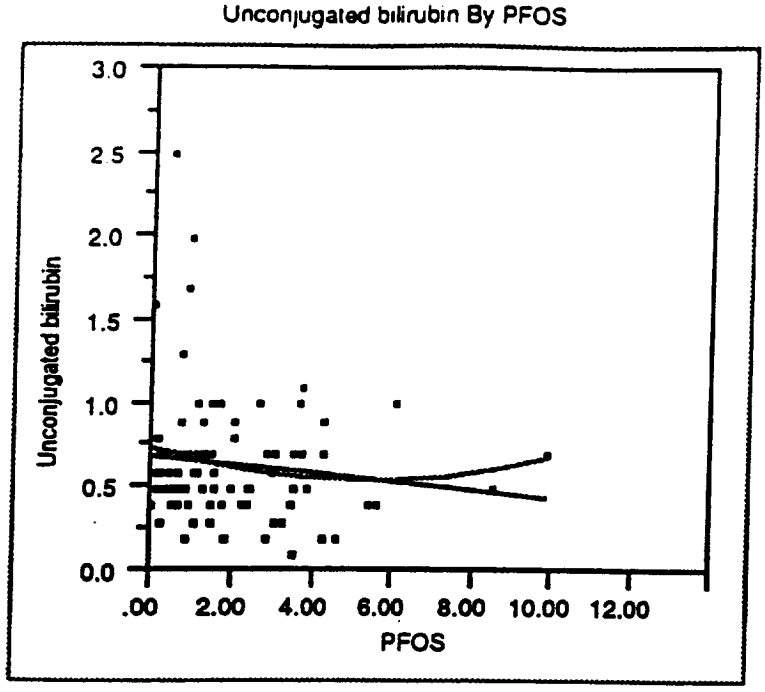
Analysis of Variance

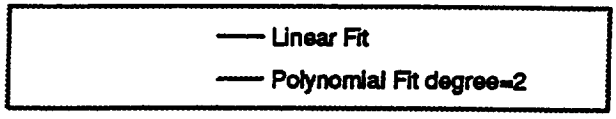
| Source | DF | Sum of Squares | Mean Square | F Ratio |
|---|---|---|---|---|
| Model | 2 | 1.214616 | 0.607308 | 5.4898 |
| Error | 174 | 19.248548 | 0.110624 | Prob>F |
| C Total | 176 | 20.463164 | | 0.0049 |

Parameter Estimates

| Term | Estimate | Std Error | t Ratio | Prob>\|t\| |
|---|---|---|---|---|
| Intercept | 0.6523913 | 0.050721 | 12.86 | <.0001 |
| PFOS | -0.099406 | 0.030947 | -3.21 | 0.0016 |
| PFOS^2 | 0.0085787 | 0.003374 | 2.54 | 0.0119 |

Scatter Plot of Unconjugated Bilirubin and PFOS, Antwerp, 1995




**Linear Fit**

**Unconjugated bilirubin = 0.69447 – 0.02604 PFOS**

**Summary of Fit**

| | |
|---|---|
| RSquare | 0.016651 |
| RSquare Adj | 0.005217 |
| Root Mean Square Error | 0.374674 |
| Mean of Response | 0.644318 |
| Observations (or Sum Wgts) | 88 |

**Analysis of Variance**

| Source | DF | Sum of Squares | Mean Square | F Ratio |
|---|---|---|---|---|
| Model | 1 | 0.204426 | 0.204426 | 1.4562 |
| Error | 86 | 12.072733 | 0.140381 | Prob>F |
| C Total | 87 | 12.277159 | | 0.2308 |

**Parameter Estimates**

| Term | Estimate | Std Error | t Ratio | Prob>\|t\| |
|---|---|---|---|---|
| Intercept | 0.6944654 | 0.057638 | 12.05 | <.0001 |
| PFOS | -0.026035 | 0.021575 | -1.21 | 0.2308 |

**Polynomial Fit degree=2**

**Unconjugated bilirubin = 0.73919 – 0.07468 PFOS + 0.00686 PFOS^2**

**Summary of Fit**

| | |
|---|---|
| RSquare | 0.027775 |
| RSquare Adj | 0.004899 |

| | |
|---|---|
| Root Mean Square Error | 0.374734 |
| Mean of Response | 0.644318 |
| Observations (or Sum Wgts) | 88 |

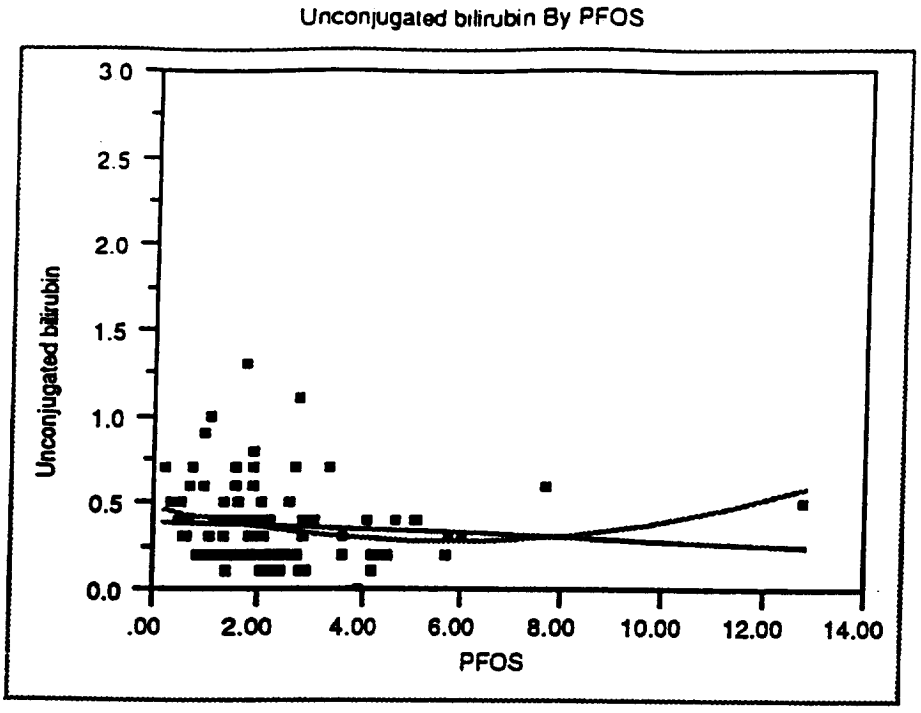
Analysis of Variance

| Source | DF | Sum of Squares | Mean Square | F Ratio |
|---|---|---|---|---|
| Model | 2 | 0.340994 | 0.170497 | 1.2141 |
| Error | 85 | 11.936165 | 0.140425 | Prob>F |
| C Total | 87 | 12.277159 | | 0.3021 |

Parameter Estimates

| Term | Estimate | Std Error | t Ratio | Prob>\|t\| |
|---|---|---|---|---|
| Intercept | 0.7391923 | 0.07335 | 10.08 | <.0001 |
| PFOS | -0.074678 | 0.053838 | -1.39 | 0.1690 |
| PFOS^2 | 0.0068606 | 0.006957 | 0.99 | 0.3268 |

Scatter Plot of Unconjugated Bilirubin and PFOS, Decatur, 1995




**Linear Fit**

**Unconjugated bilirubin = 0.39803 – 0.01166 PFOS**

**Summary of Fit**

| | |
|---|---|
| RSquare | 0.008475 |
| RSquare Adj | -0.00292 |
| Root Mean Square Error | 0.235059 |
| Mean of Response | 0.369663 |
| Observations (or Sum Wgts) | 89 |

**Analysis of Variance**

| Source | DF | Sum of Squares | Mean Square | F Ratio |
|---|---|---|---|---|
| Model | 1 | 0.0410886 | 0.041089 | 0.7436 |
| Error | 87 | 4.8070013 | 0.055253 | Prob>F |
| C Total | 88 | 4.8480899 | | 0.3909 |

**Parameter Estimates**

| Term | Estimate | Std Error | t Ratio | Prob>\|t\| |
|---|---|---|---|---|
| Intercept | 0.3980339 | 0.04127 | 9.64 | <.0001 |
| PFOS | -0.011663 | 0.013525 | -0.86 | 0.3909 |

**Polynomial Fit degree=2**

**Unconjugated bilirubin = 0.48279 – 0.06966 PFOS + 0.00605 PFOS^2**

**Summary of Fit**

| | |
|---|---|
| RSquare | 0.051431 |

| | |
|---|---|
| RSquare Adj | 0.029371 |
| Root Mean Square Error | 0.231244 |
| Mean of Response | 0.369663 |
| Observations (or Sum Wgts) | 89 |

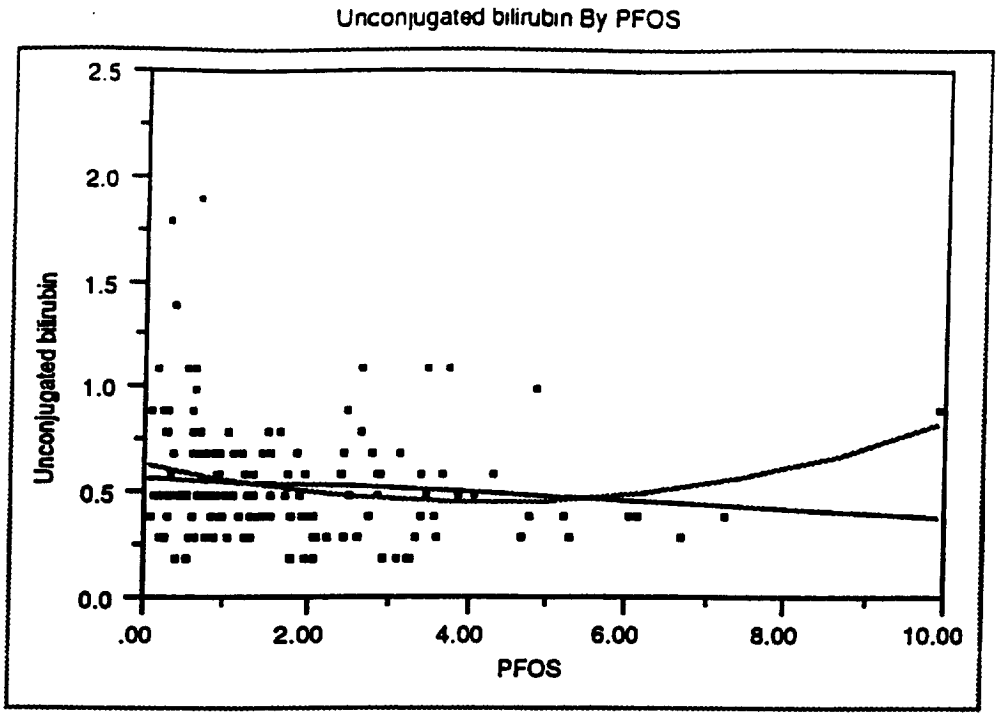
Analysis of Variance

| Source | DF | Sum of Squares | Mean Square | F Ratio |
|---|---|---|---|---|
| Model | 2 | 0.2493418 | 0.124671 | 2.3314 |
| Error | 86 | 4.5987481 | 0.053474 | Prob>F |
| C Total | 88 | 4.8480899 | | 0.1033 |

Parameter Estimates

| Term | Estimate | Std Error | t Ratio | Prob>\|t\| |
|---|---|---|---|---|
| Intercept | 0.4827917 | 0.059102 | 8.17 | <.0001 |
| PFOS | -0.069663 | 0.032262 | -2.16 | 0.0336 |
| PFOS^2 | 0.0060498 | 0.003066 | 1.97 | 0.0517 |

Scatter Plot of Unconjugated Bilirubin and PFOS, Both Locations Combined, 1997




Linear Fit

Unconjugated bilirubin = 0.57745 – 0.0194 PFOS

Summary of Fit

| | |
|---|---|
| RSquare | 0.012338 |
| RSquare Adj | 0.005573 |
| Root Mean Square Error | 0.277986 |
| Mean of Response | 0.543243 |
| Observations (or Sum Wgts) | 148 |

Analysis of Variance

| Source | DF | Sum of Squares | Mean Square | F Ratio |
|---|---|---|---|---|
| Model | 1 | 0.140939 | 0.140939 | 1.8238 |
| Error | 146 | 11.282304 | 0.077276 | Prob>F |
| C Total | 147 | 11.423243 | | 0.1789 |

Parameter Estimates

| Term | Estimate | Std Error | t Ratio | Prob>\|t\| |
|---|---|---|---|---|
| Intercept | 0.577447 | 0.034111 | 16.93 | <.0001 |
| PFOS | -0.019403 | 0.014368 | -1.35 | 0.1789 |

Polynomial Fit degree=2

Unconjugated bilirubin = 0.64247 – 0.09138 PFOS + 0.01097 PFOS^2

Summary of Fit

| | |
|---|---|
| RSquare | 0.045634 |

| | |
|---|---|
| RSquare Adj | 0.03247 |
| Root Mean Square Error | 0.274201 |
| Mean of Response | 0.543243 |
| Observations (or Sum Wgts) | 148 |

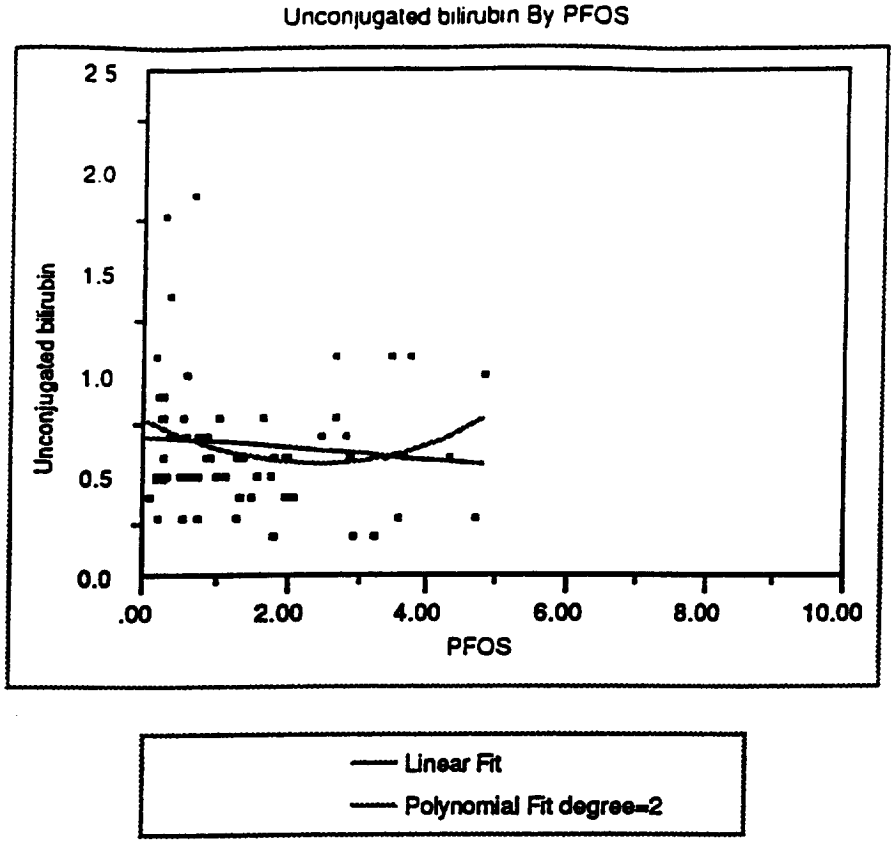
Analysis of Variance

| Source | DF | Sum of Squares | Mean Square | F Ratio |
|---|---|---|---|---|
| Model | 2 | 0.521284 | 0.260642 | 3.4666 |
| Error | 145 | 10.901959 | 0.075186 | Prob>F |
| C Total | 147 | 11.423243 | | 0.0338 |

Parameter Estimates

| Term | Estimate | Std Error | t Ratio | Prob>\|t\| |
|---|---|---|---|---|
| Intercept | 0.6424713 | 0.044361 | 14.48 | <.0001 |
| PFOS | -0.091384 | 0.035001 | -2.61 | 0.0100 |
| PFOS^2 | 0.0109748 | 0.004879 | 2.25 | 0.0260 |

Scatter Plot of Unconjugated Bilirubin and PFOS, Antwerp, 1997




**Linear Fit**

**Unconjugated bilirubin = 0.69161 – 0.02872 PFOS**

**Summary of Fit**

| | |
|---|---|
| RSquare | 0.01217 |
| RSquare Adj | -0.00376 |
| Root Mean Square Error | 0.329151 |
| Mean of Response | 0.648438 |
| Observations (or Sum Wgts) | 64 |

**Analysis of Variance**

| Source | DF | Sum of Squares | Mean Square | F Ratio |
|---|---|---|---|---|
| Model | 1 | 0.0827520 | 0.082752 | 0.7638 |
| Error | 62 | 6.7170917 | 0.108340 | Prob>F |
| C Total | 63 | 6.7998437 | | 0.3855 |

**Parameter Estimates**

| Term | Estimate | Std Error | t Ratio | Prob>\|t\| |
|---|---|---|---|---|
| Intercept | 0.6916073 | 0.064286 | 10.76 | <.0001 |
| PFOS | -0.02872 | 0.032862 | -0.87 | 0.3855 |

**Polynomial Fit degree=2**

**Unconjugated bilirubin = 0.78708 – 0.19268 PFOS + 0.03945 PFOS^2**

**Summary of Fit**

| | |
|---|---|
| RSquare | 0.049788 |
| RSquare Adj | 0.018634 |

| | |
|---|---|
| Root Mean Square Error | 0.325458 |
| Mean of Response | 0.648438 |
| Observations (or Sum Wgts) | 64 |

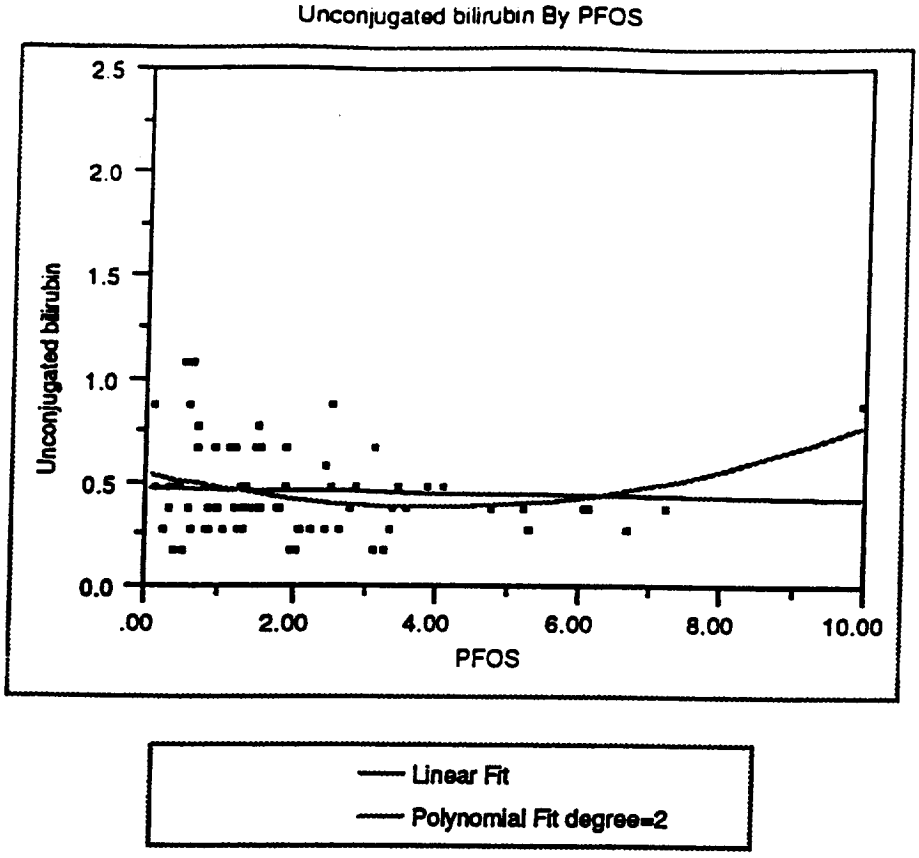
Analysis of Variance

| Source | DF | Sum of Squares | Mean Square | F Ratio |
|---|---|---|---|---|
| Model | 2 | 0.3385540 | 0.169277 | 1.5981 |
| Error | 61 | 6.4612897 | 0.105923 | Prob>F |
| C Total | 63 | 6.7998437 | | 0.2106 |

Parameter Estimates

| Term | Estimate | Std Error | t Ratio | Prob>\|t\| |
|---|---|---|---|---|
| Intercept | 0.7870832 | 0.088403 | 8.90 | <.0001 |
| PFOS | -0.192677 | 0.110395 | -1.75 | 0.0860 |
| PFOS^2 | 0.0394497 | 0.025386 | 1.55 | 0.1254 |

Scatter Plot of Unconjugated Bilirubin and PFOS, Decatur, 1997




**Linear Fit**

**Unconjugated bilirubin = 0.47268 – 0.00489 PFOS**

**Summary of Fit**

| | |
|---|---|
| RSquare | 0.001886 |
| RSquare Adj | -0.01029 |
| Root Mean Square Error | 0.202702 |
| Mean of Response | 0.463095 |
| Observations (or Sum Wgts) | 84 |

**Analysis of Variance**

| Source | DF | Sum of Squares | Mean Square | F Ratio |
|---|---|---|---|---|
| Model | 1 | 0.0063673 | 0.006367 | 0.1550 |
| Error | 82 | 3.3692280 | 0.041088 | Prob>F |
| C Total | 83 | 3.3755952 | | 0.6949 |

**Parameter Estimates**

| Term | Estimate | Std Error | t Ratio | Prob>\|t\| |
|---|---|---|---|---|
| Intercept | 0.47268 | 0.032893 | 14.37 | <.0001 |
| PFOS | -0.004889 | 0.012419 | -0.39 | 0.6949 |

**Polynomial Fit degree=2**

**Unconjugated bilirubin = 0.5544 – 0.08508 PFOS + 0.01076 PFOS^2**

**Summary of Fit**

| | |
|---|---|
| RSquare | 0.077372 |

| | |
|---|---|
| RSquare Adj | 0.054591 |
| Root Mean Square Error | 0.196086 |
| Mean of Response | 0.463095 |
| Observations (or Sum Wgts) | 84 |

Analysis of Variance

| Source | DF | Sum of Squares | Mean Square | F Ratio |
|---|---|---|---|---|
| Model | 2 | 0.2611750 | 0.130588 | 3.3963 |
| Error | 81 | 3.1144202 | 0.038450 | Prob>F |
| C Total | 83 | 3.3755952 | | 0.0383 |

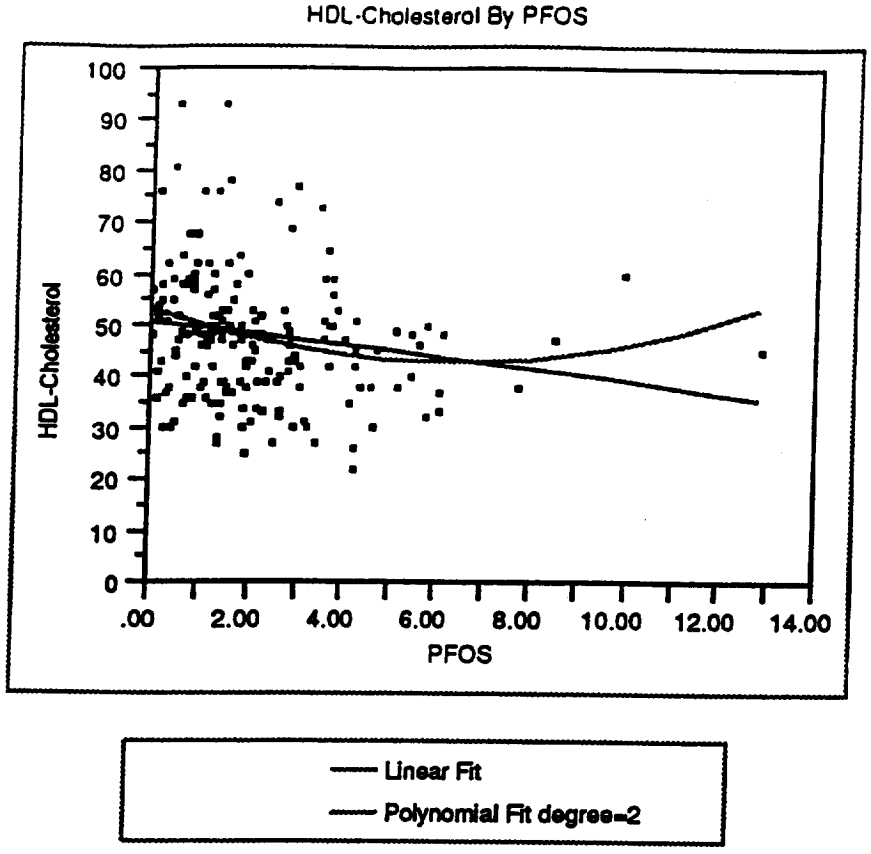
Parameter Estimates

| Term | Estimate | Std Error | t Ratio | Prob>\|t\| |
|---|---|---|---|---|
| Intercept | 0.5544015 | 0.044947 | 12.33 | <.0001 |
| PFOS | -0.085075 | 0.033385 | -2.55 | 0.0127 |
| PFOS^2 | 0.0107606 | 0.00418 | 2.57 | 0.0119 |

# APPENDIX C

## HDL and PFOS Scatter Plots

Scatter Plot of HDL Cholesterol and PFOS, Both Locations Combined, 1995




**Linear Fit**

**HDL-Cholesterol = 51.0197 – 1.17509 PFOS**

**Summary of Fit**

| | |
|---|---|
| RSquare | 0.030337 |
| RSquare Adj | 0.0247 |
| Root Mean Square Error | 12.55611 |
| Mean of Response | 48.45977 |
| Observations (or Sum Wgts) | 174 |

**Analysis of Variance**

| Source | DF | Sum of Squares | Mean Square | F Ratio |
|---|---|---|---|---|
| Model | 1 | 848.392 | 848.392 | 5.3813 |
| Error | 172 | 27116.827 | 157.656 | Prob>F |
| C Total | 173 | 27965.218 | | 0.0215 |

**Parameter Estimates**

| Term | Estimate | Std Error | t Ratio | Prob>\|t\| |
|---|---|---|---|---|
| Intercept | 51.01971 | 1.457347 | 35.01 | <.0001 |
| PFOS | -1.17509 | 0.506557 | -2.32 | 0.0215 |

**Polynomial Fit degree=2**

**HDL-Cholesterol = 53.5286 – 3.30537 PFOS + 0.25758 PFOS^2**

**Summary of Fit**

| | |
|---|---|
| RSquare | 0.053266 |
| RSquare Adj | 0.042193 |

| | |
|---|---|
| Root Mean Square Error | 12.443 |
| Mean of Response | 48.45977 |
| Observations (or Sum Wgts) | 174 |

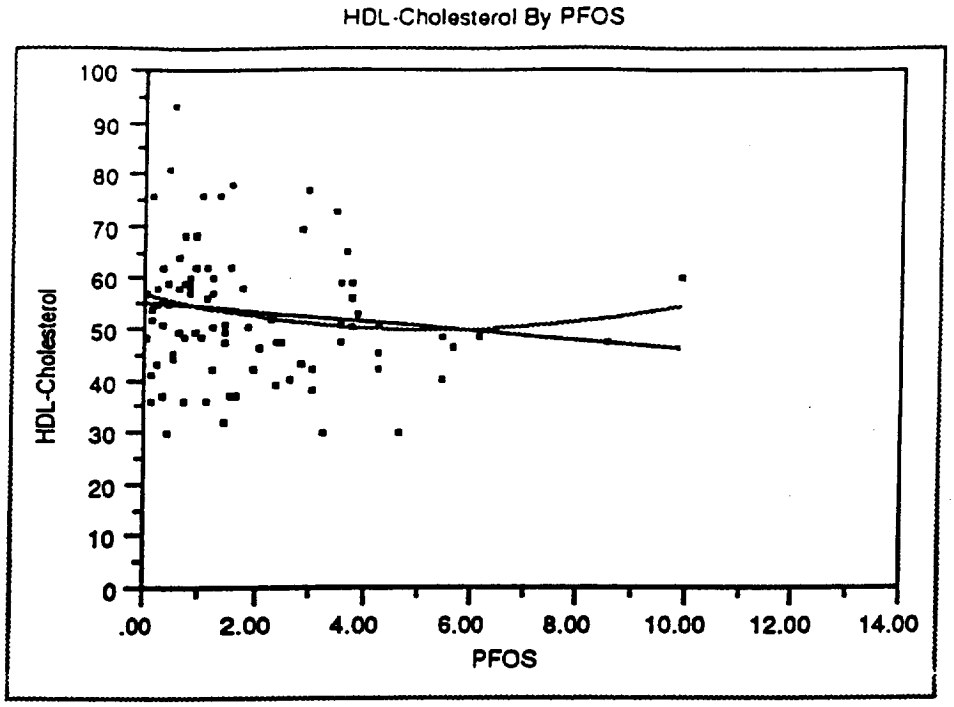
Analysis of Variance

| Source | DF | Sum of Squares | Mean Square | F Ratio |
|---|---|---|---|---|
| Model | 2 | 1489.605 | 744.802 | 4.8105 |
| Error | 171 | 26475.614 | 154.828 | Prob>F |
| C Total | 173 | 27965.218 | | 0.0093 |

Parameter Estimates

| Term | Estimate | Std Error | t Ratio | Prob>\|t\| |
|---|---|---|---|---|
| Intercept | 53.5286 | 1.898856 | 28.19 | <.0001 |
| PFOS | -3.305373 | 1.160937 | -2.85 | 0.0050 |
| PFOS^2 | 0.257576 | 0.12657 | 2.04 | 0.0434 |

Scatter Plot of HDL and PFOS, Antwerp, 1995




**Linear Fit**

**HDL-Cholesterol = 55.2981 – 0.93355 PFOS**

**Summary of Fit**

| | |
|---|---|
| RSquare | 0.019736 |
| RSquare Adj | 0.008337 |
| Root Mean Square Error | 12.32088 |
| Mean of Response | 53.5 |
| Observations (or Sum Wgts) | 88 |

**Analysis of Variance**

| Source | DF | Sum of Squares | Mean Square | F Ratio |
|---|---|---|---|---|
| Model | 1 | 262.842 | 262.842 | 1.7315 |
| Error | 86 | 13055.158 | 151.804 | Prob>F |
| C Total | 87 | 13318.000 | | 0.1917 |

**Parameter Estimates**

| Term | Estimate | Std Error | t Ratio | Prob>\|t\| |
|---|---|---|---|---|
| Intercept | 55.298149 | 1.895379 | 29.18 | <.0001 |
| PFOS | -0.933553 | 0.709469 | -1.32 | 0.1917 |

**Polynomial Fit degree=2**

**HDL-Cholesterol = 56.91 – 2.68656 PFOS + 0.24725 PFOS^2**

**Summary of Fit**

| | |
|---|---|
| RSquare | 0.033054 |

| | |
|---|---|
| RSquare Adj | 0.010302 |
| Root Mean Square Error | 12.30867 |
| Mean of Response | 53.5 |
| Observations (or Sum Wgts) | 88 |

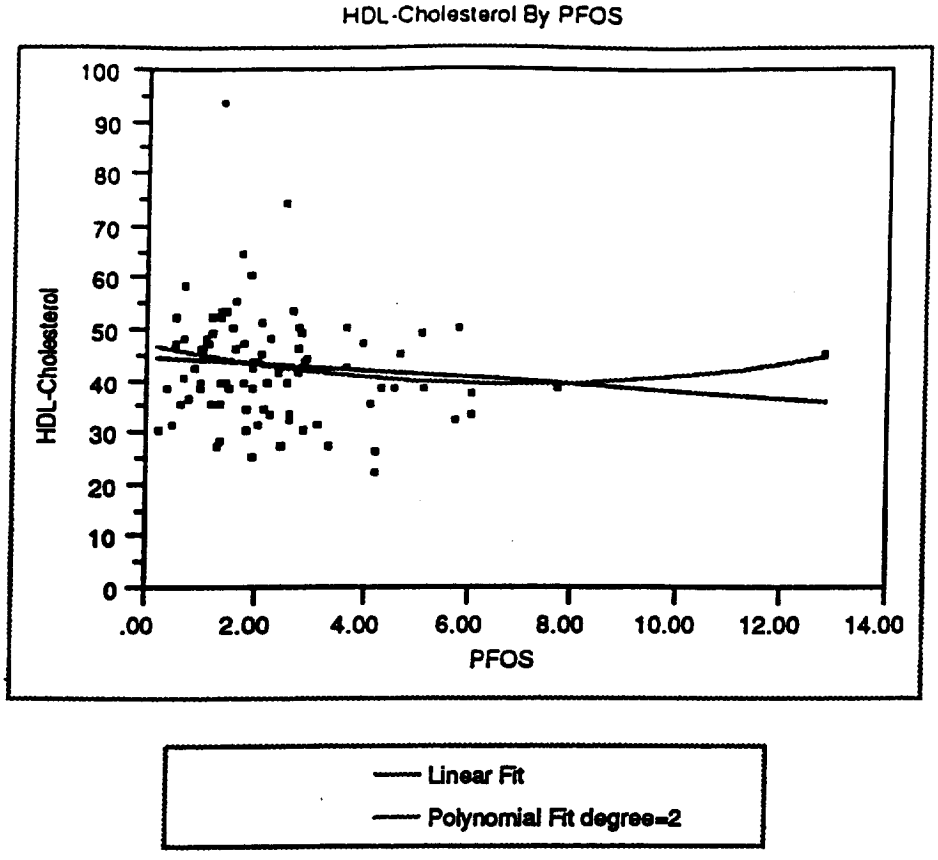
Analysis of Variance

| Source | DF | Sum of Squares | Mean Square | F Ratio |
|---|---|---|---|---|
| Model | 2 | 440.212 | 220.106 | 1.4528 |
| Error | 85 | 12877.788 | 151.503 | Prob>F |
| C Total | 87 | 13318.000 | | 0.2397 |

Parameter Estimates

| Term | Estimate | Std Error | t Ratio | Prob>\|t\| |
|---|---|---|---|---|
| Intercept | 56.910034 | 2.409276 | 23.62 | <.0001 |
| PFOS | -2.686556 | 1.768392 | -1.52 | 0.1324 |
| PFOS^2 | 0.2472466 | 0.228508 | 1.08 | 0.2823 |

Scatter Plot of HDL and PFOS, Decatur, 1995




**Linear Fit**

**HDL-Cholesterol = 45.0317 – 0.7097 PFOS**

**Summary of Fit**

| | |
|---|---|
| RSquare | 0.014998 |
| RSquare Adj | 0.003272 |
| Root Mean Square Error | 10.89577 |
| Mean of Response | 43.30233 |
| Observations (or Sum Wgts) | 86 |

**Analysis of Variance**

| Source | DF | Sum of Squares | Mean Square | F Ratio |
|---|---|---|---|---|
| Model | 1 | 151.843 | 151.843 | 1.2790 |
| Error | 84 | 9972.296 | 118.718 | Prob>F |
| C Total | 85 | 10124.140 | | 0.2613 |

**Parameter Estimates**

| Term | Estimate | Std Error | t Ratio | Prob>\|t\| |
|---|---|---|---|---|
| Intercept | 45.031672 | 1.928382 | 23.35 | <.0001 |
| PFOS | -0.709695 | 0.627527 | -1.13 | 0.2613 |

**Polynomial Fit degree=2**

**HDL-Cholesterol = 47.1802 – 2.18908 PFOS + 0.15422 PFOS^2**

**Summary of Fit**

| | |
|---|---|
| RSquare | 0.028286 |

| | |
|---|---|
| RSquare Adj | 0.004872 |
| Root Mean Square Error | 10.88702 |
| Mean of Response | 43.30233 |
| Observations (or Sum Wgts) | 86 |

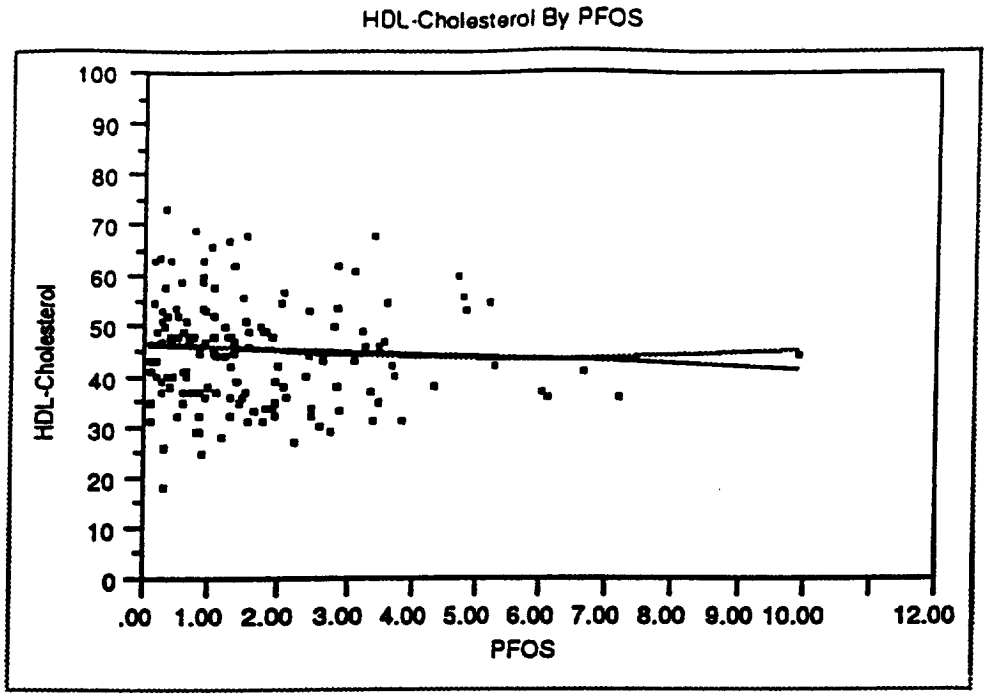
Analysis of Variance

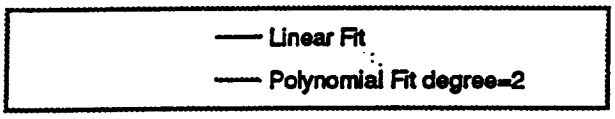
| Source | DF | Sum of Squares | Mean Square | F Ratio |
|---|---|---|---|---|
| Model | 2 | 286.376 | 143.188 | 1.2081 |
| Error | 83 | 9837.764 | 118.527 | Prob>F |
| C Total | 85 | 10124.140 | | 0.3040 |

Parameter Estimates

| Term | Estimate | Std Error | t Ratio | Prob>\|t\| |
|---|---|---|---|---|
| Intercept | 47.180201 | 2.789208 | 16.92 | <.0001 |
| PFOS | -2.189082 | 1.523604 | -1.44 | 0.1545 |
| PFOS^2 | 0.1542222 | 0.144758 | 1.07 | 0.2898 |

Scatter Plot of HDL and PFOS, Both Locations Combined, 1997




**Linear Fit**

**HDL-Cholesterol = 46.3275 – 0.45133 PFOS**

**Summary of Fit**

| | |
|---|---|
| RSquare | 0.004651 |
| RSquare Adj | -0.00212 |
| Root Mean Square Error | 10.57408 |
| Mean of Response | 45.53691 |
| Observations (or Sum Wgts) | 149 |

**Analysis of Variance**

| Source | DF | Sum of Squares | Mean Square | F Ratio |
|---|---|---|---|---|
| Model | 1 | 76.804 | 76.804 | 0.6869 |
| Error | 147 | 16436.243 | 111.811 | Prob>F |
| C Total | 148 | 16513.047 | | 0.4086 |

**Parameter Estimates**

| Term | Estimate | Std Error | t Ratio | Prob>\|t\| |
|---|---|---|---|---|
| Intercept | 46.327525 | 1.288559 | 35.95 | <.0001 |
| PFOS | -0.451333 | 0.544563 | -0.83 | 0.4086 |

**Polynomial Fit degree=2**

**HDL-Cholesterol = 46.8473 – 1.03203 PFOS + 0.08884 PFOS^2**

**Summary of Fit**

| | |
|---|---|
| RSquare | 0.006173 |
| RSquare Adj | -0.00744 |

| | |
|---|---|
| Root Mean Square Error | 10.60212 |
| Mean of Response | 45.53691 |
| Observations (or Sum Wgts) | 149 |

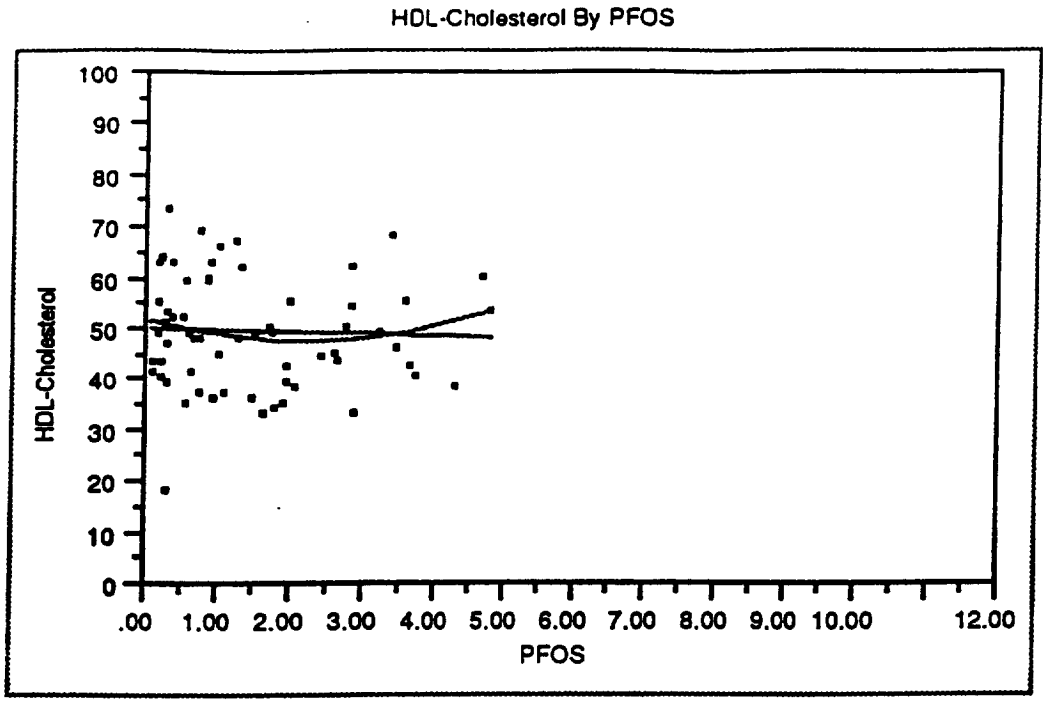
Analysis of Variance

| Source | DF | Sum of Squares | Mean Square | F Ratio |
|---|---|---|---|---|
| Model | 2 | 101.936 | 50.968 | 0.4534 |
| Error | 146 | 16411.111 | 112.405 | Prob>F |
| C Total | 148 | 16513.047 | | 0.6363 |

Parameter Estimates

| Term | Estimate | Std Error | t Ratio | Prob>\|t\| |
|---|---|---|---|---|
| Intercept | 46.847332 | 1.696367 | 27.62 | <.0001 |
| PFOS | -1.032032 | 1.343985 | -0.77 | 0.4438 |
| PFOS^2 | 0.0888404 | 0.187882 | 0.47 | 0.6370 |

Scatter Plot of HDL and PFOS, Antwerp, 1997




**Linear Fit**

**HDL-Cholesterol = 50.2864 – 0.41131 PFOS**

**Summary of Fit**

| | |
|---|---|
| RSquare | 0.00232 |
| RSquare Adj | -0.01352 |
| Root Mean Square Error | 10.86492 |
| Mean of Response | 49.67692 |
| Observations (or Sum Wgts) | 65 |

**Analysis of Variance**

| Source | DF | Sum of Squares | Mean Square | F Ratio |
|---|---|---|---|---|
| Model | 1 | 17.2928 | 17.293 | 0.1465 |
| Error | 63 | 7436.9226 | 118.046 | Prob>F |
| C Total | 64 | 7454.2154 | | 0.7032 |

**Parameter Estimates**

| Term | Estimate | Std Error | t Ratio | Prob>\|t\| |
|---|---|---|---|---|
| Intercept | 50.286404 | 2.086111 | 24.11 | <.0001 |
| PFOS | -0.41131 | 1.074642 | -0.38 | 0.7032 |

**Polynomial Fit degree=2**

**HDL-Cholesterol = 52.4254 – 4.16781 PFOS + 0.90954 PFOS^2**

**Summary of Fit**

| | |
|---|---|
| RSquare | 0.020968 |
| RSquare Adj | -0.01061 |

| | |
|---|---|
| Root Mean Square Error | 10.84934 |
| Mean of Response | 49.67692 |
| Observations (or Sum Wgts) | 65 |

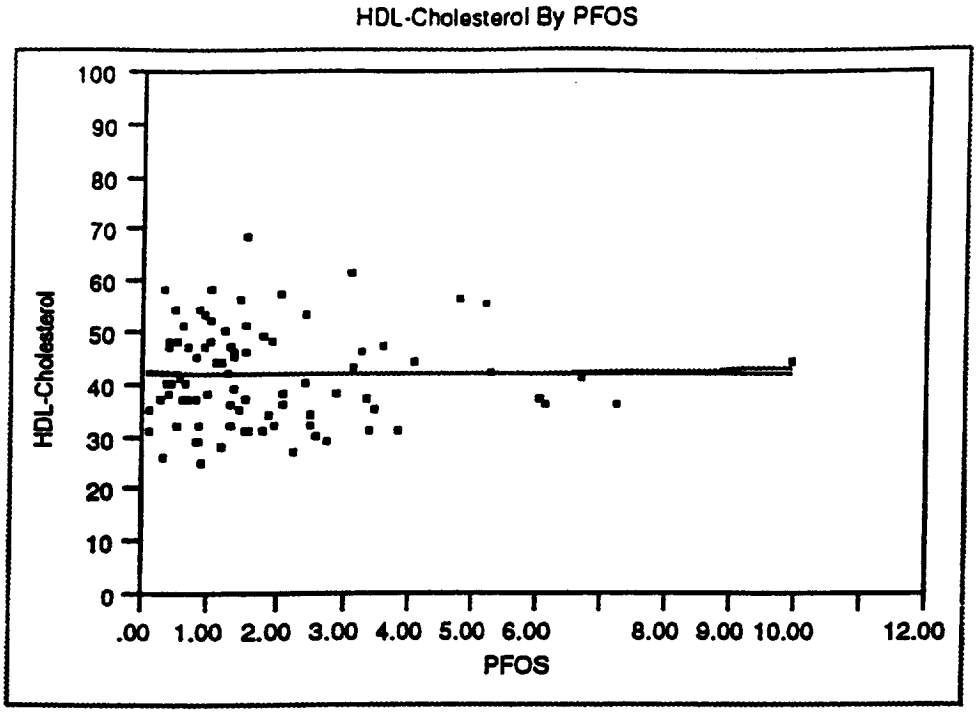
Analysis of Variance

| Source | DF | Sum of Squares | Mean Square | F Ratio |
|---|---|---|---|---|
| Model | 2 | 156.3026 | 78.151 | 0.6639 |
| Error | 62 | 7297.9128 | 117.708 | Prob>F |
| C Total | 64 | 7454.2154 | | 0.5184 |

Parameter Estimates

| Term | Estimate | Std Error | t Ratio | Prob>\|t\| |
|---|---|---|---|---|
| Intercept | 52.425357 | 2.865909 | 18.29 | <.0001 |
| PFOS | -4.167812 | 3.619456 | -1.15 | 0.2539 |
| PFOS^2 | 0.9095417 | 0.836957 | 1.09 | 0.2814 |

Scatter Plot of HDL and PFOS, Decatur, 1995




Linear Fit

HDL-Cholesterol = 42.3281 + 0.00268 PFOS

Summary of Fit

| | |
|---|---|
| RSquare | 2.712e-7 |
| RSquare Adj | -0.01219 |
| Root Mean Square Error | 9.293759 |
| Mean of Response | 42.33333 |
| Observations (or Sum Wgts) | 84 |

Analysis of Variance

| Source | DF | Sum of Squares | Mean Square | F Ratio |
|---|---|---|---|---|
| Model | 1 | 0.0019 | 0.0019 | 0.0000 |
| Error | 82 | 7082.6647 | 86.3740 | Prob>F |
| C Total | 83 | 7082.6667 | | 0.9962 |

Parameter Estimates

| Term | Estimate | Std Error | t Ratio | Prob>\|t\| |
|---|---|---|---|---|
| Intercept | 42.328069 | 1.508131 | 28.07 | <.0001 |
| PFOS | 0.002685 | 0.569385 | 0.00 | 0.9962 |

Polynomial Fit degree=2

HDL-Cholesterol = 42.5348 – 0.20021 PFOS + 0.02723 PFOS^2

Summary of Fit

| | |
|---|---|
| RSquare | 0.000231 |