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Title: A Longitudinal Analysis of Serum Perfluorooctanesulfonate (PFOS) and Perfluorooctanoate (PFOA) Levels in Relation to Lipid and Hepatic Clinical Chemistry Test Results from Male Employee Participants of the 1994/95, 1997 and 2000 Fluorochemical Medical Surveillance Program

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ABSTRACT

The 3M fluorochemical medical surveillance program was conducted in 1994/95, 1997 and 2000 at the company's Antwerp (Belgium) and Decatur (Alabama) manufacturing plants. Although cross-sectional assessments of the data have been reported, the opportunity to conduct a longitudinal assessment became possible as a result of a large number of employee participants in the 2000 fluorochemical medical surveillance program. A total of 175 male employees voluntarily participated in the 2000 program and at least one of the two previous program years. A total of 106 (61 percent) of the 175 employees participated in the 1994/95 program and 110 (63 percent) of the 175 participated in the 1997 program. Of these 175 employees, a total of 41 (24 percent) participated in all three years (Antwerp = 21, Decatur = 20), 65 (37 percent) participated in 1994/95 and 2000 (Antwerp = 45, Decatur = 20) and 69 (39 percent) participated in 1997 and 2000 (Antwerp = 34, Decatur = 35). There were insufficient number of female employees to conduct any meaningful longitudinal assessment. Only 14 female employees participated in the 2000 fluorochemical medical surveillance program and at least one of the previous program years.

Serum perfluorooctanesulfonate (PFOS) and perfluorooctanoate (PFOA) were assayed in each surveillance program year although the method of analysis (high performance liquid chromatography mass spectrometry) differed slightly between years. A different research laboratory was used to assay PFOS and PFOA in each year.

The same hospital laboratory analyzed the clinical chemistries for all three surveillance years. These included: cholesterol (mg/dl), high density lipoproteins (HDL,

mg/dl) and triglycerides (mg/dl); alkaline phosphatase (IU/L), gamma glutamyl transferase (GGT, IU/L), aspartate aminotransferase (AST, IU/L), alanine aminotransferase (ALT, IU/L), total and direct bilirubin (mg/dl). Most reference ranges remained relatively constant over time except for ALT. In each surveillance year, potential confounding factors were also determined. These covariates included age, body mass index, number of alcoholic drinks per day and cigarettes smoked per day.

The continuous outcomes of lipid and hepatic clinical chemistry tests were evaluated as repeated measures incorporating the random subject effect fitted to a mixed model by the MIXED procedure in the SAS statistical package. Restricted maximum likelihood estimates of variance parameters were computed. Adjusted regression models were built by introducing all covariates and testing the covariance structure. Significant coefficients were defined when the p value was $< .05$.

There was a positive association between PFOA and serum cholesterol and triglycerides over time but not with PFOS. This was association was limited to the Antwerp employees and, in particular, the 21 Antwerp employees who participated in all three surveillance years. This positive association between PFOA and serum lipids is opposite the inconsistent toxicological evidence that suggested a possible hypolipidemic effect of PFOA in rodents and no effect in primates. Adjusting for potential confounders, there were no temporal changes associated with the fluorochemical tests, PFOS, PFOA and TOF, and the hepatic clinical chemistry tests.

Limitations of this study included the number of employees with three years of surveillance data (only 24% of the 175 subjects), the inability to analyze temporal changes due to small numbers in female employees, the use of different laboratories and

the associated systematic (experimental error) with each fluorochemical assay for the three surveillance program years and the lower levels of serum PFOS and PFOA measured in each program year among these employees compared with those that cause effects in laboratory animals.

INTRODUCTION

The 3M fluorochemical medical surveillance program is conducted on a routine basis at the company's Antwerp (Belgium) and Decatur (Alabama) manufacturing plants. Employee participation is voluntary. Prior to 1994, only total organic fluorine was measured and no specific fluorochemical analytes were measured. Serum perfluorooctanesulfonate (PFOS) and perfluorooctanoate (PFOA) have been routinely assayed since 1994/95 rather than total organic fluorine as the analytical capabilities have improved. Cross-sectional analyses of the 1994/95 and 1997 medical surveillance program data and the 2000 data in relation to Antwerp and Decatur employees' serum PFOS levels have been reported elsewhere (Olsen et al, 1999a, 1999b, 2001). In the 1994/1995 medical surveillance program, a total of 178 male employees participated (Antwerp = 88; Decatur = 90) and 149 male employees participated in the 1997 program (Antwerp = 65; Decatur = 84). For these two program years, there were too few female participants to include in the data analysis (Olsen et al 1998). In the 2000 fluorochemical medical surveillance program, there were considerably more participants: 421 males (Antwerp = 206; Decatur = 215) and 97 females (Antwerp = 49; Decatur = 48). It was suspected that the increased voluntary participation in 2000 was due to increased employee awareness of the persistence and prevalence of PFOS in human tissue and the environment and the company's May 16, 2000 phase out announcement that it would cease the production of perfluorooctanyl chemistry in certain repellents and surfactants by the end of 2000.

Regardless of the surveillance year, there have been several consistent differences between the Antwerp and Decatur male employee populations. The Antwerp male

employee population has been significantly younger than Decatur, has had lower Body Mass Indices (BMI) and higher self-reported daily consumption of alcohol. In addition, the Antwerp male employee population clinical chemistry profiles were different for several tests including lower mean alkaline phosphatase and triglyceride values and higher total bilirubin and HDL values than the Decatur male employee population. Analyses of workers' lipid and hepatic clinical chemistry results have not been associated with hypolipidemic effects and PFOS as reported in rodents (3M Company 2000; Haughom and Spydevold 1992; Ikeda et al 1987; Pastoor et al 1987; Seacat et al 2001a; Sohlenius et al 1993) and primates (Seacat et al 2001b). In the 2000 medical surveillance program, statistical analyses also examined the relation between PFOA and a calculated total organic fluorine index (TOF) to clinical chemistries, hematology, thyroid hormones and urinalyses (Olsen et al 2001). A positive association was observed between triglycerides and PFOA; however, this association was opposite the data that have inconsistently reported a hypolipidemia effect of PFOA in rodents (Haughom and Spydevold 1992; Pastoor et al 1987) and no effect in primates (Butenhoff et al 2001). Furthermore, this positive association between PFOA and triglycerides has not been observed at the 3M Cottage Grove manufacturing plant (Olsen et al 2000) where employees' serum levels have, historically, been much higher than those measured among Antwerp and Decatur employees (Olsen et al 1999; 2001a; Olsen et al 2001b).

The inability to assess temporal changes in cross-sectional studies is a well-known limitation of this design. The large participation of employees in the 2000 fluorochemical medical surveillance who may have participated in the 1994/95 and/or 1997 surveillance programs at these two manufacturing sites allowed for an opportunity

to conduct a longitudinal analysis among the male employee population. Altogether, a total of 175 employees (Antwerp = 100; Decatur = 75) who participated in 2000 had also participated in at least one previous fluorochemical medical surveillance exam since 1994/95. Therefore, the purpose of this analysis was to conduct a longitudinal assessment of this 6 year time period regarding the relationship of PFOS, PFOA and TOF to the medical surveillance data collected on these 175 Antwerp and Decatur male employees.

METHODS

Data Collection

Data were compiled from the 1994/95, 1997 and 2000 fluorochemical medical surveillance program databases. A total of 175 male employees participated in the 2000 program and at least one of the two previous program years. A total of 106 (61 percent) of the 175 employees participated in the 1994/95 program and 110 (63 percent) of the 175 participated in the 1997 program. Of these 175 employees, a total of 41 (24 percent) participated in all three years (Antwerp = 21, Decatur = 20), 65 (37 percent) participated in 1994/95 and 2000 (Antwerp = 45, Decatur = 20) and 69 (39 percent) participated in 1997 and 2000 (Antwerp = 34, Decatur = 35). For purposes of brevity, these three subpopulations will hereafter be referred to as subcohorts A, B and C.

Demographic data (age, BMI, alcoholic drinks per day and cigarettes per day) were recorded for each employee in each surveillance year. A standard set of clinical chemistries and hematology data was also obtained for each employee. Given results from previous toxicological studies, the longitudinal analyses focused on lipid

[cholesterol (mg/dl), high density lipoproteins (HDL, mg/dl) and triglycerides (mg/dl)] and hepatic [alkaline phosphatase (IU/L), gamma glutamyl transferase (GGT, IU/L), aspartate aminotransferase (AST, IU/L), alanine aminotransferase (ALT, IU/L), total and direct bilirubin (mg/dl)] clinical chemistries that were measured in each program year by the same laboratory (Allina Laboratories, St. Paul , MN). Reference ranges were relatively constant over time, although for ALT the range declined from 20-65 IU/L in 1994/95 to 1-40 IU/L in 1997 and 2000.

Fluorochemical Analyses

PFOS and PFOA were assayed in 1994/95, 1997 and 2000. However, the method of analysis differed slightly for each year. In 1994/95, the method used tetrabutylammonium to ion-pair with PFOS and PFOA in the serum (Johnson et al 1996). The ion-pairs were then extracted with ethyl acetate. The abstraction product was then analyzed using high-performance liquid chromatograph-thermospray mass spectrometry. In 1997, the serum samples were analyzed by liquid chromatography/mass spectrometry, using selected ion monitoring in the negative-ion mode (Anderson and Mulvanna 1997a; 1997b). In 2000, sera samples were extracted using an ion-pairing extraction procedure (Hansen et al, 2001). Only in 2000 were the extracts quantitatively analyzed for PFOS and PFOA as well as the other analytes: PFHS (perfluorohexanesulfonate), PFOSAA (N-ethyl perfluorooctanesulfonamidoacetate), M570 (N-methyl perfluorooctanesulfonamidoacetate), PFOSA (perfluorooctanesulfonateamide) and M556 (perfluorooctanesulfonamidoacetate). High-performance liquid chromatography/electrospray tandem mass spectrometry (HPLC/ESMSMS) was the

technique used in 2000. The samples were evaluated versus an extracted curve from a human serum matrix. Analyses were conducted at different laboratories in the three surveillance years. For purposes of this longitudinal analysis, a total organic fluorine index (TOF) was determined by calculating the percent of PFOS and PFOA that was attributed to organic fluorine (64.7 and 69.0 percent, respectively) multiplied by the ppm measured for each of these two fluorochemicals and then summed to produce the TOF.

Data Analysis

Briefly, mixed models can be used in the analysis of repeated measures data which are simply data sets with multiple measurements of a response variable on the same subject over time. Detailed explanation of these models is provided elsewhere (Littell 1996; 2000). Mixed models contain factor effects which are considered both fixed and random. An effect is fixed if the levels in the study represent all possible levels of the factor, or at least all levels about which inference is to be made. Factor effects are random if the levels of the factor that are used in the study represent only a random sample of a larger set of potential levels.

The focus of the standard linear model is to model the mean of **y** by using the fixed-effects parameters $\boldsymbol{\beta}$. That is,

$$\mathbf{y} = \mathbf{X}\boldsymbol{\beta} + \boldsymbol{\epsilon}$$

where y represents a vector of observed data, $\boldsymbol{\beta}$ is an unknown vector of fixed effects parameters with known design matrix **X**, and $\boldsymbol{\epsilon}$ is an unknown random error vector modeling the statistical 'noise' around $\mathbf{X}\boldsymbol{\beta}$. The residual errors $\boldsymbol{\epsilon}$ are assumed to be

independent and identically distributed Gaussian random variables with mean 0 and variance σ^2.

A generalized standard linear model is a mixed model which is:

$$\mathbf{y} = \mathbf{X}\beta + \mathbf{Z}\gamma + \epsilon$$

where γ is an unknown vector of random-effects parameters with known design matrix **Z**, and ϵ is an unknown random error vector whose elements are no longer required to be independent and homogeneous. If $\gamma + \epsilon$ are assumed to be Gaussian random variables that are uncorrelated and have expectations **0** and variances **G** and **R**, respectively, then the variance of **y** is:

$$\mathbf{V} = \mathbf{ZGZ}' + \mathbf{R}$$

The variance of the data, y, can be modeled by specifying the structure of **Z**, **G** and **R**. The model matrix **Z** is designed in the same fashion as **X**, the model matrix for the fixed-effects parameters.

For the matrices **G** and **R**, a covariance structure must be selected in using mixed models. Since observations on different subjects are assumed to be independent, the structure refers to the covariance pattern of repeated measurements on the same subject. For most of these structures, the covariance between two observations on the same subject depends only on the length of the time interval between measurements and the variance is constant over time. Numerous covariance structures exist. Common examples include the following. Simple covariance structure (SIM) specifies that the observations are independent, even on the same subject, and have homogeneous variance. It is usually not realistic for most repeated measures data because it specifies that observations on the same subject are independent. Compound symmetric (CS, otherwise

known as variance components) structure specifies that observations on the same subject have homogeneous covariance and homogeneous variance. Correlations between two observations are equal for all pairs of observations on the same subject. Autoregressive order 1 (AR(1))covariance structure specifies homogeneous variance but that covariances between observations on the same subject are not equal, but decrease toward zero with increasing time interval between measurements (lag). Its limitation is that observations on the same subject far apart in time would be essentially independent. Autoregressive with random effect for subject (AR + RE) covariance structure specifies homogeneous variance plus the covariance between observations on the same subject arises from two sources: 1) any two observations share a common contribution because they are on the same subject; and 2) the covariance between observations decreases exponentially with lag but only to the common contribution (not to independence). Toeplitz (TOEP) structure specifies that covariance depends only on lag but not as a mathematical function with a small number of parameters. The 'unstructured' structure (UN) specifies no patterns in the covariance matrix and is therefore completely general. The above structures are appropriate if equal spacing (of data) is assumed in a time series analyses. In situations where unequally spaced longitudinal measurements exist, spatial covariance structures can be used. In the present analyses, equal spacing was assumed given there were approximately 3 years between each medical surveillance program examinations.

Akaike's information criterion (AIC) and Schwarz's Bayesian criterion (SBC) are indices of relative goodness-of-fit that were used to compare models with the same fixed effects, but different covariance structures. SBC penalizes models more severely for the

number of estimated parameters than AIC and thus the two criteria did not always agree on the choice of 'best' model. SBC was preferred.

In the present study, the continuous outcomes of lipid and hepatic clinical chemistry tests were evaluated as repeated measures incorporating the random subject effect fitted to a mixed model by the MIXED procedure in the SAS statistical package (Littell et al 1996). Restricted maximum likelihood estimates (REML) of variance parameters were computed. Adjusted regression models were built by introducing all covariates (see below) and testing the covariance structure. Based on goodness-of-fit tests described above, AR+RE, was routinely considered the best covariance structure chosen for the mixed models. Covariates included PFOS (or PFOA or TOF), years of observation, the interaction term of PFOS and years of observation, age, body mass index (BMI), cigarettes smoked per day, alcohol drinks per day, year at first entry and baseline (at first observation) years worked. For hepatic clinical chemistry tests, serum triglycerides was also considered a covariate (Olsen et al 2001a).

RESULTS

Provided in Table 1 are cross-sectional analyses of the study subjects who participated in each of the three years (1994/95, 1997 and 2000) stratified by location. As reported previously in the complete cross-sectional analyses of these programs (Olsen et al 1998; 1999; 2001), Antwerp employees in this longitudinal investigation were younger, had lower BMIs and drank more alcoholic beverages than Decatur employees. They also had consistently lower triglyceride and alkaline phosphatase levels and higher HDL and total bilirubin levels. Decatur employees, on average, had serum PFOS levels

that were higher by approximately 0.5 ppm in each cross-sectional analysis. Similar findings were observed for PFOA except with the 1997 data where the two populations had comparable mean PFOA levels.

Provided in the following two tables are the cross-sectional analyses for the three subcohorts by location. Among Antwerp employees (Table 2), each of the three subcohorts had lower mean serum PFOS levels in 2000 than at their year of entry whereas there were no consistent changes across subcohorts with PFOA. Among the three Decatur subcohorts (Table 3) mean PFOS values declined over time but mean PFOA levels tended to increase.

Provided in tables 4 through 30 are the mixed model coefficient estimates, standard errors, p-values and 95% confidence intervals from testing potential determinants of lipid and hepatic clinical chemistry change. The natural log was used for all dependent variables.

Tables 4 through 6 contain the analyses for cholesterol. There was no change in cholesterol associated with PFOS (Table 4). Overall, PFOA was positively associated with cholesterol as the main effect coefficient was significantly positive but its interaction with time (years variable) was negative (Table 5). Provided in Tables 5A through 5D are separate analyses for Antwerp for all subjects (Table 5A) and by each subcohort. The PFOA and cholesterol association appeared to primarily reside with the 21 Antwerp employees in subcohort A (Table 5B). This finding can also be observed in Table 2 as the subcohort's mean PFOA levels went from 1.32 ppm. to 2.37 ppm and then declined to 2.06 ppm at the same time their cholesterol values rose from 208 mg/dL to 226 mg/dL to 229 mg/dL. There were no associations between cholesterol and PFOA observed among

the Decatur employee population (Table 5E) nor were there significant associations between TOF and Antwerp or Decatur but when the two sites were combined there was a significant positive association between TOF and cholesterol (Tables 6, 6A and 6B).

There were no significant associations between PFOS, PFOA or TOF with HDL (Tables 7 through 9). BMI, alcoholic drinks per day and cigarettes smoked per day were the most significant associations with HDL.

Triglycerides were not significantly associated with PFOS over time when both Antwerp and Decatur populations were examined together (Table 10). However, among the combined Antwerp and Decatur populations, PFOA was positively associated with triglycerides (Table 11) as seen with the significant positive coefficient for the main effect of PFOA and the nonsignificant positive main coefficient of years and the negative coefficient for their interaction (PFOA x years). The significant main effect of PFOA was the consequence of the Antwerp population (Table 11A) and primarily subcohort A (table 11B) and, to a lesser extent subcohort B (Table 11C), but not subcohort C (Table 11D). Therefore, the association appeared to be related to the Antwerp workers who were enrolled in this longitudinal cohort beginning in 1995, but not 1997. There was not a significant association between PFOA and triglycerides among Decatur workers (Table 11E). Among the Antwerp subcohort A, their mean triglyceride levels rose from 85 mg/dL to 115 mg/dL to 123 mg/dL at the same time their PFOA levels increased from 1.32 ppm to 2.37 ppm and then declined to 2.06 ppm. Although the main effect for TOF was significantly positive, the interaction term with time (years) was not significant (Table 12). Again, this association was more consistent for Antwerp employees (Table 12A) than Decatur employees (Table 12B).

Among the hepatic clinical chemistry tests that were adjusted for the various changing demographic factors and triglyceride levels, there were no significant associations between PFOS, PFOA and TOF with changes in alkaline phosphatase (Tables 13 – 15), GGT (Tables 16-18), AST (Tables 19-21), ALT (Tables 22-24), total bilirubin (Tables 25 – 27) or direct bilirubin (Tables 28-30). Observations apparent in Tables 2 and 3 can also be seen in these mixed model analyses. For example, the two most significant predictors of alkaline phosphatase were time (years) and location (as seen with the lower values among Antwerp employees). For ALT, entry period was also significant as it reflected the higher reference range values for ALT that were used in 1994/95 than in subsequent years.

DISCUSSION

These analyses were the first longitudinal assessment of the fluorochemical medical surveillance program at 3M's Antwerp and Decatur manufacturing sites. Overall, we observed no associations that were consistent with the toxicological evidence that PFOS produces a hypolipidemic effect at threshold dosages in rats and primates (3M Company 2000; Haughom and Spydevold 1992; Ikeda et al 1987; Pastoor et al 1987; Seacat et al 2001a; 2001b; Sohlenius et al 1993). Our results did suggest a positive association between temporal changes in cholesterol and triglycerides and PFOA; however this is also inconsistent with the toxicological evidence that PFOA may result in a hypolipidemic effect in rats (Haughom and Spydevold 1992; Pastoor et al 1987) but produced no effect on blood lipids in primates (Butenhoff et al 2001).

Even though we were able to perform a longitudinal assessment, there were several limitations to our analyses. We were limited to 175 employees of which only 41 (24 percent) participated in all three surveillance years. Although a greater absolute number of Decatur employees (but not percent-wise) have participated during each year, for this longitudinal assessment there were more Antwerp (57 percent) than Decatur (43 percent) employees. Antwerp employees have had lower serum PFOS level by approximately 0.5 ppm (Olsen et al 1998; Olsen et al 1999a; 1999b; 2001a; 2001b; 2001c). There were insufficient numbers of female employees for any meaningful longitudinal analysis. Given the variability inherent in the analytical method (Hansen et al 2001) and the different laboratories used, serum PFOS and PFOA levels may have systematic error incorporated in each measurement that we were unable to assess as blood samples were analyzed only at the time of the surveillance program. This systematic error may have masked associations with lipid or hepatic clinical chemistries, although the range of PFOS and PFOA measured was relatively consistent throughout the study time period. Because 3M has announced a phase-out of the production of perfluorooctanyl chemistry-related materials, we doubt that there will be many more subjects in the future that can be included in this longitudinal assessment. Also, the findings from this assessment would suggest that serum PFOS levels have either remained constant or declined slightly over time among these 175 employees. On the other hand, serum PFOA levels appeared to trend upwards, on average, by approximately 0.5 to 1.0 ppm for these employees. Another limitation is the fact that the serum PFOS and PFOA levels measured in these employees were lower than those that cause effects in laboratory animals.

In summary, a longitudinal analysis over a six year time period of 175 Antwerp and Decatur male employees did not show significant changes, consistent with toxicological data, of lipid or hepatic clinical chemistry values associated with either PFOS or PFOA. The PFOS and PFOA serum levels measured in these employees were lower than those that cause effects in laboratory animals.

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Table 1. Cross-Sectional Analysis of Mean and Standard Deviation of Serum PFOS, PFOA, TOF, Demographic Characteristics and Clinical Chemistries of Antwerp and Decatur Male Employees Who Participated in Two or More Medical Surveillance Examinations Between 1994/95 and 2000

	1994/1995				1997				2000			
	Antwerp (N = 66)		Decatur (N = 40)		Antwerp (N = 55)		Decatur (N = 55)		Antwerp (N=100)		Decatur (N = 75)	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
PFOS	1.87	1.96	2.62[a]	1.78	1.42	1.26	1.85	1.64	1.16	1.07	1.67[b]	1.39
PFOA	1.08	1.53	1.90[b]	1.08	1.54	1.61	1.41	1.17	1.43	1.21	1.83[a]	1.53
TOF	1.96	1.77	3.00[b]	1.77	1.98	1.48	2.17	1.76	1.74	1.24	2.34[b]	1.72
Age	36	6.6	43[d]	6.0	32	6.8	43[d]	7.3	38	7.8	47[d]	7.0
BMI	23.9	2.4	28.0[d]	3.7	23.2	2.4	29.1[d]	4.3	24.7	2.8	29.0[d]	4.1
Alcohol	1.1[d]	1.1	0.3	0.6	0.9[d]	1.0	0.1	0.1	1.1[d]	1.0	0.1	0.2
Baseline Years Worked	11.0	5.7	20.4[d]	7.1	7.0	5.2	20.0[d]	6.1	9.1	6.1	20.3[c]	8.5
Cigarettes	4	7	10[b]	15	5	7	5	10	5	8	5	11
Cholesterol	217	43	219	38	202	45	214	35	220	41	213	40
HDL	54[d]	13	43	13	49[c]	11	43	10	53[d]	12	44	10
Triglycerides	111	79	204[d]	122	108	53	181[d]	112	131	80	178[c]	115
Alk Phos	72	18	103[d]	27	68	15	87[d]	20	58	14	74[d]	21
GGT	37	25	47	24	23	11	33[a]	27	25	19	29	18
AST	25	11	31[a]	11	26	6	26	8	24	7	25	7
ALT	44	17	49	25	30	12	32	15	23	11	32[d]	14
Total Bilirubin	0.9[d]	0.4	0.5	0.2	0.8[b]	0.4	0.6	0.2	1.0[d]	0.3	0.8	0.2
Direct Bilirubin	0.2	0.4	0.2	0.04	0.1[b]	0.07	0.1	0.04	0.1[b]	0.05	0.1	0.06

a. $p < .05$ b. $p < .01$ c. $p < .001$ d. $p < .0001$ compared to year-specific analyses of other manufacturing site.

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Table 2. Cross-Sectional Analysis of Mean and Standard Deviation of Serum PFOS, PFOA, TOF, Demographic Characteristics and Clinical Chemistries of Three Subgroups of Antwerp Male Employees (A, B and C) Who Participated in Two or More Medical Surveillance Examinations Between 1995 and 2000

	1995				1997				2000					
	A (N = 21)		B (N = 45)		A (N = 21)		C (N = 34)		A (N = 21)		B (N = 45)		C (N = 34)	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
PFOS	2.19	1.27	1.72	2.20	2.24[a]	1.32	0.91	0.93	1.53	0.87	1.20	1.31	0.87[b]	0.71
PFOA	1.32	1.28	0.96	1.64	2.37[a]	2.28	1.04	0.61	2.06[a]	1.04	1.17	1.37	1.38	0.94
TOF	2.33	1.20	1.78	1.98	3.08[a]	1.59	1.31	0.91	2.41[a]	0.81	1.58	1.51	1.52	0.89
Age	33	6	37[a]	7	35[a]	5	30	7	38[a]	6	42[a]	7	32[a]	7
BMI	23.4	2.7	24.1	2.3	23.8	2.8	22.7	2.0	24.3	3.4	25.5[c]	2.7	23.9	2.4
Drinks/day	1.3	1.4	1.0	0.9	1.2	1.2	0.7	0.8	1.7[c]	1.3	1.2	1.1	0.8	0.6
Cigarettes/day	4	7	4	8	5	7	5	7	6	8	4	8	5	8
Baseline Years Worked	9.9	4.3	11.6	63	9.9	4.3	5.3	4.9	9.9	4.3	11.6	6.3	5.3	4.9
Cholesterol	208	46	220	41	226[a]	50	187	34	229	46	233[a]	38	196	31
HDL	56	11	53	13	51	9	48	11	56	12	52	11	52	13
Triglycerides	85	49	123	88	115	69	104	41	123	65	154	95	105	55
Alk Phos	69	20	73	16	67	19	69	12	55	17	60	14	58	12
GGT	30	9	41	29	25	10	22	11	23	13	30[c]	25	19	11
AST	25	5	25	13	26	5	26	7	22	5	25	9	23	6
ALT	42	8	46	20	31	12	30	13	22	11	25	13	21	7
Total Bilirubin	1.0	0.3	0.8	0.4	0.8	0.3	0.8	0.4	1.0	0.3	1.0	0.3	0.9	0.3
Direct Bilirubin	0.2	0.04	0.2	0.04	0.1	0.05	0.2	0.08	0.1	0.03	0.1	0.06	0.1	0.06

a. $p < .05$ than other comparison(s) in year b. $p < .05$ than group A c. $p < .05$ than group C

Table 3. Cross-Sectional Analysis of Mean and Standard Deviation of Serum PFOS, PFOA, TOF, Demographic Characteristics and Clinical Chemistries of Three Subgroups of Decatur Male Employees (A, B and C) Who Participated in Two or More Medical Surveillance Examinations Between 1994 and 2000

	1994				1997				2000					
	A (N = 20)		B (N = 20)		A (N = 20)		C (N = 35)		A (N = 20)		B (N = 20)		C (N = 35)	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
PFOS	2.07	1.67	3.17[a]	1.76	1.93	1.76	1.80	1.59	1.78	2.14	1.84	1.03	1.51	0.98
PFOA	1.50	0.87	2.30[a]	1.14	1.41	1.16	1.41	1.20	1.46	1.34	2.60[a]	2.02	1.60	1.14
TOF	2.37	1.54	3.64[a]	1.79	2.22	1.78	2.14	1.78	2.16	2.16	2.98	1.76	2.08	1.32
Age	42	7	44	5	45	7	42	8	48	7	50	5	45	8
BMI	28.2	4.0	27.7	3.3	28.3	4.1	29.6	4.5	28.9	4.1	28.7	3.3	29.3	4.5
Drinks/day	0.1	0.3	0.4	0.8	0.1	0.1	0.1	0.2	0.0	0.1	0.2	0.3	0.1	0.2
Cigarettes/day	6	13	14	15	4	10	5	11	3	8	10	15	4	9
Baseline Years Worked	19.6	8.6	21.3	5.2	19.6	8.6	20.2	10.0	19.6	8.6	21.3	5.2	20.2	10.0
Cholesterol	235[a]	34	204	36	223	31	208	37	228	39	199[b]	33	212	41
HDL	47[a]	16	39	9	45	11	41	9	47	12	38[a]	6	45	9
Triglycerides	180	88	229	148	188	115	178	112	193	124	187	76	165	128
Alk Phos	98	29	107	24	85	22	87	18	70	27	82	17	72	20
GGT	41	25	52	22	35	36	31	20	29	16	34	23	27	17
AST	32	15	29	6	25	6	27	8	26	8	25	4	25	7
ALT	52	33	47	11	30	15	34	16	30	18	32	11	33	14
Total Bilirubin	0.6	0.2	0.5	0.2	0.6	0.2	0.6	0.2	0.8	0.2	0.7	0.2[c]	0.8	0.2
Direct Bilirubin	0.2[a]	0.05	0.2	0.04	0.1	0.04	0.1	0.05	0.1	0.08	0.1	0.04	0.1	0.06

a. $p < .05$ than other comparison(s) in year b. $p < .05$ than group A c. $p < .05$ than group C

3M_MN02482184

Table 4. Mixed Model Coefficient Estimates, Standard Errors (SE), P-Values and 95% Confidence Limits from Testing Potential Determinants of Cholesterol# Change Including PFOS and the Interaction with Number of Years of Observation of Antwerp and Decatur Male Employees

				95% Confidence Limits	
	Coefficient	SE	p-value	Lower	Upper
Intercept	4.868	0.127	< .0001	4.618	5.118
PFOS	0.010	0.008	.18	- 0.005	0.025
Years Observation	0.0009	0.005	.84	- 0.008	0.010
PFOS x Years Obs	- 0.0004	0.002	.83	- 0.004	0.003
Age	0.007	0.003	.01	0.002	0.013
BMI	0.006	0.003	.07	- 0.0005	0.013
Drinks/day	0.014	0.012	.27	- 0.011	0.038
Cigarettes/day	- 0.0009	0.001	.41	- 0.003	0.001
Location*	0.034	0.037	.36	- 0.039	0.108
Entry Period**	0.064	0.028	.02	0.009	0.119
Baseline Years Worked	- 0.004	0.003	.20	- 0.009	0.002

#natural log
*Antwerp vs Decatur
**1994/95 vs 1997

3M_MN02482185

Table 5. Mixed Model Coefficient Estimates, Standard Errors (SE), P-Values and 95% Confidence Limits from Testing Potential Determinants of Cholesterol# Change Including PFOA and the Interaction with Number of Years of Observation of Antwerp and Decatur Male Employees

				95% Confidence Limits	
	Coefficient	SE	p-value	Lower	Upper
Intercept	4.812	0.127	< .0001	4.561	5.063
PFOA	0.032	0.009	.0008	0.013	0.051
Years Observation	0.005	0.005	.24	- 0.004	0.014
PFOA x Years Obs	- 0.005	0.002	.005	- 0.009	- 0.002
Age	0.008	0.003	.007	0.002	0.013
BMI	0.007	0.003	.049	0.00004	0.013
Drinks/day	0.014	0.012	.263	- 0.010	0.037
Cigarettes/day	- 0.001	0.001	.32	- 0.003	0.001
Location*	0.041	0.037	.27	- 0.032	0.114
Entry Period**	0.068	0.027	.01	0.015	0.122
Baseline Years Worked	- 0.004	0.003	.15	- 0.009	0.001

#natural log
*Antwerp vs Decatur
**1994/95 vs 1997

3M_MN02482186

Table 5A. Mixed Model Coefficient Estimates, Standard Errors (SE), P-Values and 95% Confidence Limits from Testing Potential Determinants of Cholesterol# Change Including PFOA and the Interaction with Number of Years of Observation of Antwerp Male Employees

				95% Confidence Limits	
	Coefficient	SE	p-value	Lower	Upper
Intercept	4.710	0.149	<.0001	4.414	5.005
PFOA	0.029	0.012	.01	0.006	0.053
Years Observation	0.005	0.006	.36	- 0.006	0.017
PFOA x Years Obs	- 0.003	0.003	.20	- 0.009	0.002
Age	0.009	0.003	.008	0.003	0.016
BMI	0.008	0.005	.14	- 0.003	0.019
Drinks/day	0.022	0.013	.09	- 0.004	0.047
Cigarettes/day	0.0007	0.002	.70	- 0.003	0.004
Entry Period**	0.079	0.038	.04	0.004	0.153
Baseline Years Worked	- 0.002	0.004	.67	- 0.010	0.007

#natural log
**1994/95 vs 1997

3M_MN02482187

Table 5B. Mixed Model Coefficient Estimates, Standard Errors (SE), P-Values and 95% Confidence Limits from Testing Potential Determinants of Cholesterol[#] Change Including PFOA and the Interaction with Number of Years of Observation of Antwerp Subgroup A (1995, 1997 and 2000) Male Employees

				95% Confidence Limits	
	Coefficient	SE	p-value	Lower	Upper
Intercept	5.059	0.414	< .0001	4.194	5.925
PFOA	0.044	0.020	.03	0.004	0.084
Years Observation	0.037	0.015	.02	0.007	0.067
PFOA x Years Obs	- 0.013	0.005	.02	- 0.023	- 0.002
Age	- 0.0007	0.012	.95	- 0.025	0.024
BMI	0.004	0.012	.77	- 0.020	0.028
Drinks/day	- 0.016	0.019	.41	- 0.054	0.023
Cigarettes/day	0.003	0.005	.51	- 0.007	0.013
Baseline Years Worked	0.015	0.016	.36	- 0.018	0.047

[#]natural log

3M_MN02482188

Table 5C. Mixed Model Coefficient Estimates, Standard Errors (SE), P-Values and 95% Confidence Limits from Testing Potential Determinants of Cholesterol[#] Change Including PFOA and the Interaction with Number of Years of Observation of Antwerp Subgroup B (1995 and 2000) Male Employees

				95% Confidence Limits	
	Coefficient	SE	p-value	Lower	Upper
Intercept	4.838	0.244	< 0.001	4.346	5.330
PFOA	0.018	0.017	.30	- 0.016	0.052
Years Observation	0.005	0.008	.55	- 0.011	0.021
PFOA x Years Obs	- 0.002	0.004	.58	- 0.009	0.005
Age	0.004	0.005	.40	- 0.006	0.015
BMI	0.014	0.009	.13	- 0.004	0.031
Drinks/day	0.017	0.022	.45	- 0.028	0.061
Cigarettes/day	0.002	0.003	.44	- 0.004	0.009
Baseline Years Worked	- 0.0001	0.006	.99	- 0.011	0.011

[#]natural log

3M_MN02482189

Table 5D. Mixed Model Coefficient Estimates, Standard Errors (SE), P-Values and 95% Confidence Limits from Testing Potential Determinants of Cholesterol# Change Including PFOA and the Interaction with Number of Years of Observation of Antwerp Subgroup C (1997 and 2000) Male Employees

				95% Confidence Limits	
	Coefficient	SE	p-value	Lower	Upper
Intercept	4.528	0.281	< .0001	3.955	5.100
PFOA	0.004	0.062	.95	- 0.125	0.132
Years Observation	- 0.010	0.026	.70	- 0.065	0.044
PFOA x Years Obs	0.010	0.022	.65	- 0.035	0.055
Age	0.016	0.006	.01	0.004	0.028
BMI	0.009	0.012	.43	- 0.015	0.033
Drinks/day	0.033	0.032	.31	- 0.033	0.100
Cigarettes/day	- 0.0001	0.003	.97	- 0.007	0.006
Baseline Years Work	- 0.005	0.008	.49	- 0.021	0.011

#natural log

Table 5E. Mixed Model Coefficient Estimates, Standard Errors (SE), P-Values and 95% Confidence Limits from Testing Potential Determinants of Cholesterol[#] Change Including PFOA and the Interaction with Number of Years of Observation of Decatur Male Employees

				95% Confidence Limits	
	Coefficient	SE	p-value	Lower	Upper
Intercept	5.220	0.206	< .0001	4.810	5.630
PFOA	0.016	0.016	.34	- 0.017	0.048
Years Observation	- 0.002	0.008	.77	- 0.017	0.013
PFOA x Years Obs	- 0.003	0.003	.22	- 0.009	0.002
Age	0.002	0.005	.70	- 0.008	0.012
BMI	0.003	0.004	.55	- 0.006	0.011
Drinks/day	- 0.088	0.035	.01	- 0.158	- 0.018
Cigarettes/day	- 0.002	0.001	.15	- 0.004	0.0007
Entry Period**	0.047	0.040	.24	- 0.032	0.125
Baseline Years Worked	- 0.002	0.004	.62	- 0.010	0.006

[#]natural log
**1994/95 vs 1997

3M_MN02482191

Table 6. Mixed Model Coefficient Estimates, Standard Errors (SE), P-Values and 95% Confidence Limits from Testing Potential Determinants of Cholesterol# Change Including TOF and the Interaction with Number of Years of Observation of Antwerp and Decatur Male Employees

				95% Confidence Limits	
	Coefficient	SE	p-value	Lower	Upper
Intercept	4.828	0.127	< .0001	4.577	5.079
TOF	0.021	0.008	.007	0.006	0.035
Years Observation	0.004	0.005	.37	- 0.005	0.014
TOF x Years Obs	- 0.003	0.001	.07	- 0.005	0.0003
Age	0.007	0.003	.01	0.002	0.013
BMI	0.006	0.003	.05	- 0.0001	0.013
Drinks/day	0.012	0.012	.32	- 0.012	0.036
Cigarettes/day	- 0.001	0.001	.37	- 0.003	0.001
Location*	0.042	0.037	.26	- 0.032	0.115
Entry Period**	0.063	0.027	.02	0.010	0.117
Baseline Years Worked	- 0.004	0.003	.17	- 0.009	0.002

#natural log
*Antwerp vs Decatur
**1994/95 vs 1997

3M_MN02482192

Table 6A. Mixed Model Coefficient Estimates, Standard Errors (SE), P-Values and 95% Confidence Limits from Testing Potential Determinants of Cholesterol# Change Including TOF and the Interaction with Number of Years of Observation of Antwerp Male Employees

				95% Confidence Limits	
	Coefficient	SE	p-value	Lower	Upper
Intercept	4.721	0.150	< .0001	4.424	5.018
TOF	0.017	0.011	.12	- 0.004	0.038
Years Observation	0.004	0.007	.55	- 0.009	0.017
TOF x Years Obs	- 0.0008	0.002	.70	- 0.005	0.003
Age	0.009	0.003	.01	0.002	0.016
BMI	0.009	0.006	.12	- 0.002	0.020
Drinks/day	0.019	0.013	.14	- 0.006	0.045
Cigarettes/day	0.0008	0.002	.69	- 0.003	0.005
Entry Period**	0.070	0.038	.07	- 0.006	0.145
Baseline Years Worked	- 0.0008	0.004	.85	- 0.009	0.008

#natural log
**1994/95 vs 1997

3M_MN02482193

Table 6B. Mixed Model Coefficient Estimates, Standard Errors (SE), P-Values and 95% Confidence Limits from Testing Potential Determinants of Cholesterol# Change Including TOF and the Interaction with Number of Years of Observation of Decatur Male Employees

				95% Confidence Limits	
	Coefficient	SE	p-value	Lower	Upper
Intercept	5.214	0.202	< .0001	4.811	5.616
TOF	0.014	0.011	.19	- 0.007	0.035
Years Observation	- 0.002	0.008	.79	- 0.018	0.013
TOF x Years Obs	- 0.002	0.002	.22	- 0.006	0.001
Age	0.002	0.005	.69	- 0.008	0.012
BMI	0.002	0.004	.55	- 0.006	0.011
Drinks/day	- 0.090	0.035	.012	- 0.160	- 0.020
Cigarettes/day	- 0.002	0.001	.161	- 0.004	0.0007
Baseline Years Worked	- 0.002	0.004	.60	- 0.010	0.006

#natural log
**1994/95 vs 1997

3M_MN02482194

Table 7. Mixed Model Coefficient Estimates, Standard Errors (SE), P-Values and 95% Confidence Limits from Testing Potential Determinants of HDL# Change Including PFOS and the Interaction with Number of Years of Observation of Antwerp and Decatur Male Employees

				95% Confidence Limits	
	Coefficient	SE	p-value	Lower	Upper
Intercept	4.212	0.144	< .0001	3.930	4.495
PFOS	- 0.010	0.008	.24	- 0.026	0.007
Years Observation	0.002	0.005	.71	- 0.008	0.012
PFOS x Years Obs	- 0.001	0.002	.52	- 0.005	0.002
Age	0.004	0.003	.22	- 0.002	0.011
BMI	- 0.017	0.004	< .0001	- 0.025	0.010
Drinks/day	0.064	0.013	< .0001	0.037	0.090
Cigarettes/day	- 0.004	0.001	.0005	- 0.007	- 0.002
Location*	0.006	0.043	.89	- 0.079	0.091
Entry Period**	0.025	0.032	.44	- 0.038	0.088
Baseline Years Worked	- 0.007	0.003	.03	- 0.013	- 0.0005

#natural log
*Antwerp vs Decatur
**1994/95 vs 1997

3M_MN02482195

Table 8. Mixed Model Coefficient Estimates, Standard Errors (SE), P-Values and 95% Confidence Limits from Testing Potential Determinants of HDL# Change Including PFOA and the Interaction with Number of Years of Observation of Antwerp and Decatur Male Employees

				95% Confidence Limits	
	Coefficient	SE	p-value	Lower	Upper
Intercept	4.216	0.145	< .0001	3.929	4.503
PFOA	- 0.006	0.011	.56	- 0.027	0.015
Years Observation	0.005	0.005	.35	- 0.005	0.014
PFOA x Years Obs	- 0.002	0.002	.40	- 0.006	0.002
Age	0.004	0.003	.28	- 0.003	0.010
BMI	- 0.017	0.004	< .0001	- 0.024	- 0.010
Drinks/day	0.062	0.013	< .0001	0.036	0.088
Cigarettes/day	- 0.004	0.001	.0004	- 0.007	- 0.002
Location*	0.008	0.043	.85	- 0.076	0.093
Entry Period**	0.020	0.032	.53	- 0.042	0.082
Baseline Years Worked	- 0.007	0.003	.04	- 0.013	- 0.0004

#natural log
*Antwerp vs Decatur
**1994/95 vs 1997

3M_MN02482196

Table 9. Mixed Model Coefficient Estimates, Standard Errors (SE), P-Values and 95% Confidence Limits from Testing Potential Determinants of HDL# Change Including TOF and the Interaction with Number of Years of Observation of Antwerp and Decatur Male Employees

				95% Confidence Limits	
	Coefficient	SE	p-value	Lower	Upper
Intercept	4.217	0.145	< .0001	3.931	4.502
TOF	- 0.006	0.008	.44	- 0.023	0.010
Years Observation	0.004	0.005	.47	- 0.007	0.014
TOF x Years Obs	- 0.0009	0.001	.57	- 0.004	0.002
Age	0.004	0.003	.25	- 0.003	0.010
BMI	- 0.017	0.004	< .0001	- 0.025	- 0.010
Drinks/day	0.063	0.013	< .0001	0.037	0.089
Cigarettes/day	- 0.004	0.001	.0005	- 0.007	- 0.002
Location*	0.007	0.043	.88	- 0.078	0.092
Entry Period**	0.021	0.032	.50	- 0.041	0.084
Baseline Years Worked	- 0.007	0.003	.04	- 0.013	- 0.0004

#natural log
*Antwerp vs Decatur
**1994/95 vs 1997

3M_MN02482197

Table 10. Mixed Model Coefficient Estimates, Standard Errors (SE), P-Values and 95% Confidence Limits from Testing Potential Determinants of Triglyceride# Change Including PFOS and the Interaction with Number of Years of Observation of Antwerp and Decatur Male Employees

				95% Confidence Limits	
	Coefficient	SE	p-value	Lower	Upper
Intercept	2.730	0.335	< .0001	2.068	3.392
PFOS	0.025	0.020	.22	- 0.015	0.065
Years Observation	- 0.004	0.013	.73	- 0.029	0.021
PFOS x Years Obs	0.006	0.005	.22	- 0.004	0.015
Age	0.003	0.008	.67	- 0.011	0.018
BMI	0.006	0.009	< .0001	0.048	0.083
Drinks/day	- 0.029	0.033	.37	- 0.094	0.035
Cigarettes/day	0.011	0.003	.0002	0.005	0.017
Location*	0.052	0.099	.60	- 0.143	0.247
Entry Period**	0.089	0.073	.22	- 0.055	0.234
Baseline Years Worked	0.005	0.007	.50	- 0.010	0.019

#natural log
*Antwerp vs Decatur
**1994/95 vs 1997

3M_MN02482198

Table 11. Mixed Model Coefficient Estimates, Standard Errors (SE), P-Values and 95% Confidence Limits from Testing Potential Determinants of Triglyceride[#] Change Including PFOA and the Interaction with Number of Years of Observation of Antwerp and Decatur Male Employees

				95% Confidence Limits	
	Coefficient	SE	p-value	Lower	Upper
Intercept	2.539	0.332	<.0001	1.883	3.196
PFOA	0.094	0.025	.0002	0.045	0.144
Years Observation	0.007	0.012	.57	-0.017	0.031
PFOA x Years Obs	-0.008	0.005	.12	-0.018	0.002
Age	0.006	0.007	.42	-0.009	0.021
BMI	0.066	0.009	<.0001	0.049	0.083
Drinks/day	-0.027	0.032	.40	-0.090	0.037
Cigarettes/day	0.011	0.003	.0002	0.005	0.017
Location*	0.072	0.096	.46	-0.118	0.262
Entry Period**	0.098	0.070	.17	-0.041	0.236
Baseline Years Worked	0.003	0.007	.67	-0.011	0.017

[#]natural log
*Antwerp vs Decatur
**1994/95 vs 1997

3M_MN02482199

Table 11A. Mixed Model Coefficient Estimates, Standard Errors (SE), P-Values and 95% Confidence Limits from Testing Potential Determinants of Triglyceride# Change Including PFOA and the Interaction with Number of Years of Observation of Antwerp Male Employees

				95% Confidence Limits	
	Coefficient	SE	p-value	Lower	Upper
Intercept	3.067	0.394	<.0001	2.286	3.848
PFOA	0.089	0.030	.005	0.028	0.149
Years Observation	0.024	0.015	.12	- 0.006	0.053
PFOA x Years Obs	- 0.010	0.007	.15	- 0.023	0.004
Age	0.012	0.009	.22	- 0.007	0.030
BMI	0.039	0.014	.007	0.011	0.068
Drinks/day	- 0.026	0.033	.44	- 0.092	0.040
Cigarettes/day	0.018	0.005	.0004	0.008	0.028
Entry Period**	0.013	0.100	.90	- 0.212	0.186
Baseline Years Worked	0.003	0.011	.76	- 0.019	0.026

#natural log
**1994/95 vs 1997

3M_MN02482200

Table 11B. Mixed Model Coefficient Estimates, Standard Errors (SE), P-Values and 95% Confidence Limits from Testing Potential Determinants of Triglyceride# Change Including PFOA and the Interaction with Number of Years of Observation of Antwerp Subgroup A (1995, 1997 and 2000) Male Employees

				95% Confidence Limits	
	Coefficient	SE	p-value	Lower	Upper
Intercept	3.104	1.063	.009	0.880	5.328
PFOA	0.182	0.051	.001	0.079	0.286
Years Observation	0.167	0.037	< .0001	0.091	0.241
PFOA x Years Obs	- 0.061	0.011	< .0001	- 0.084	- 0.039
Age	- 0.007	0.031	.83	- 0.069	0.056
BMI	0.039	0.030	.20	- 0.021	0.100
Drinks/day	- 0.082	0.051	.12	- 0.186	0.023
Cigarettes/day	0.008	0.012	.52	- 0.017	0.033
Baseline Years Worked	0.036	0.041	.40	- 0.049	0.120

#natural log

3M_MN02482201

Table 11C. Mixed Model Coefficient Estimates, Standard Errors (SE), P-Values and 95% Confidence Limits from Testing Potential Determinants of Triglyceride[#] Change Including PFOA and the Interaction with Number of Years of Observation of Antwerp Subgroup B (1995 and 2000) Male Employees

				95% Confidence Limits	
	Coefficient	SE	p-value	Lower	Upper
Intercept	2.775	0.523	< .0001	1.720	3.830
PFOA	0.097	0.038	.02	0.019	0.174
Years Observation	0.005	0.018	.80	- 0.033	0.042
PFOA x Years Obs	0.0008	0.009	.93	- 0.017	0.018
Age	0.019	0.011	.10	- 0.004	0.041
BMI	0.042	0.019	.04	0.003	0.081
Drinks/day	0.038	0.050	.45	- 0.062	0.138
Cigarettes/day	0.022	0.007	.003	0.008	0.036
Baseline Years Worked	- 0.002	0.012	.83	- 0.026	0.021

[#]natural log

3M_MN02482202

Table 11D. Mixed Model Coefficient Estimates, Standard Errors (SE), P-Values and 95% Confidence Limits from Testing Potential Determinants of Triglyceride[#] Change Including PFOA and the Interaction with Number of Years of Observation of Antwerp Subgroup C (1997 and 2000) Male Employees

				95% Confidence Limits	
	Coefficient	SE	p-value	Lower	Upper
Intercept	3.285	0.744	.0001	1.769	4.801
PFOA	0.032	0.149	.83	- 0.280	0.344
Years Observation	- 0.072	0.063	.26	- 0.203	0.058
PFOA x Years Obs	0.020	0.051	.70	- 0.087	0.128
Age	- 0.005	0.016	.77	- 0.038	0.028
BMI	0.057	0.030	.08	- 0.006	0.120
Drinks/day	- 0.025	0.081	.76	0.195	0.145
Cigarettes/day	0.019	0.008	.032	0.002	0.036
Baseline Years Worked	0.010	0.021	.65	- 0.034	0.053

[#]natural log

3M_MN02482203

Table 11E. Mixed Model Coefficient Estimates, Standard Errors (SE), P-Values and 95% Confidence Limits from Testing Potential Determinants of Triglyceride# Change Including PFOA and the Interaction with Number of Years of Observation of Decatur Male Employees

				95% Confidence Limits	
	Coefficient	SE	p-value	Lower	Upper
Intercept	2.581	0.567	< .0001	1.450	3.712
PFOA	0.054	0.046	.24	- 0.037	0.145
Years Observation	- 0.028	0.022	.20	- 0.071	0.015
PFOA x Years Obs	0.002	0.008	.85	- 0.014	0.017
Age	- 0.0008	0.013	.95	- 0.028	0.026
BMI	0.073	0.012	< .0001	0.050	0.096
Drinks/day	- 0.038	0.099	.70	- 0.235	0.158
Cigarettes/day	0.005	0.004	.16	- 0.002	0.012
Entry Period**	0.274	0.109	.01	0.058	0.491
Baseline Years Worked	0.009	0.011	.44	- 0.013	0.030

#natural log
**1994/95 vs 1997

3M_MN02482204

Table 12. Mixed Model Coefficient Estimates, Standard Errors (SE), P-Values and 95% Confidence Limits from Testing Potential Determinants of Triglyceride# Change Including TOF and the Interaction with Number of Years of Observation of Antwerp and Decatur Male Employees

				95% Confidence Limits	
	Coefficient	SE	p-value	Lower	Upper
Intercept	2.612	0.334	< .0001	1.953	3.272
TOF	0.053	0.020	.008	0.014	0.093
Years Observation	- 0.0005	0.013	.97	- 0.027	0.026
TOF x Years Obs	- 0.0005	0.004	.91	- 0.008	0.007
Age	0.004	0.007	.57	- 0.010	0.019
BMI	0.066	0.009	< .0001	0.049	0.084
Drinks/day	- 0.031	0.032	.34	- 0.095	0.033
Cigarettes/day	0.011	0.003	.0002	0.005	0.017
Location*	0.074	0.098	.45	- 0.119	0.266
Entry Period**	0.085	0.071	.23	- 0.055	0.226
Baseline Years Worked	0.004	0.007	.58	- 0.010	0.018

#natural log
*Antwerp vs Decatur
**1994/95 vs 1997

3M_MN02482205

Table 12A. Mixed Model Coefficient Estimates, Standard Errors (SE), P-Values and 95% Confidence Limits from Testing Potential Determinants of Triglyceride# Change Including TOF and the Interaction with Number of Years of Observation for Antwerp Male Employees

				95% Confidence Limits	
	Coefficient	SE	p-value	Lower	Upper
Intercept	3.078	0.395	< .0001	2.294	3.862
TOF	0.053	0.028	.06	- 0.002	0.107
Years Observation	0.016	0.017	.35	- 0.018	0.049
TOF x Years Obs	- 0.0007	0.006	.90	- 0.012	0.010
Age	0.009	0.009	.32	- 0.009	0.028
BMI	0.042	0.014	0.004	0.014	0.071
Drinks/day	- 0.032	0.034	.34	- 0.099	0.035
Cigarettes/day	0.018	0.005	.0005	0.008	0.029
Entry Period**	- 0.045	0.101	.66	- 0.245	0.155
Baseline Years Worked	0.007	0.011	.56	- 0.016	0.029

#natural log
**1994/95 vs 1997

3M_MN02482206

Table 12B. Mixed Model Coefficient Estimates, Standard Errors (SE), P-Values and 95% Confidence Limits from Testing Potential Determinants of Triglyceride# Change Including TOF and the Interaction with Number of Years of Observation for Decatur Male Employees

				95% Confidence Limits	
	Coefficient	SE	p-value	Lower	Upper
Intercept	2.644	0.563	< .0001	1.521	3.766
TOF	0.031	0.030	.29	- 0.028	0.090
Years Observation	- 0.035	0.022	.12	- 0.079	0.009
TOF x Years Obs	0.004	0.005	.45	- 0.007	0.015
Age	- 0.002	0.014	.90	- 0.029	0.025
BMI	0.073	0.012	< .0001	0.050	0.010
Drinks/day	- 0.030	0.099	.76	- 0.227	0.166
Cigarettes/day	0.005	0.004	.20	- 0.003	0.012
Entry Period**	0.275	0.111	.01	0.055	0.494
Baseline Years Worked	0.009	0.011	.44	- 0.013	0.030

#natural log
**1994/95 vs 1997

3M_MN02482207

Table 13. Mixed Model Coefficient Estimates, Standard Errors (SE), P-Values and 95% Confidence Limits from Testing Potential Determinants of Alkaline Phosphatase# Change Including PFOS and the Interaction with Number of Years of Observation of Antwerp and Decatur Male Employees

				95% Confidence Limits	
	Coefficient	SE	p-value	Lower	Upper
Intercept	3.789	0.176	< .0001	3.442	4.137
PFOS	0.002	0.009	.87	- 0.017	0.020
Years Observation	- 0.051	0.006	< .0001	- 0.062	- 0.040
PFOS x Years Obs	0.002	0.002	.47	- 0.003	0.006
Age	0.005	0.004	.20	- 0.003	0.012
BMI	- 0.0007	0.004	.88	- 0.009	0.008
Drinks/day	- 0.001	0.014	.94	- 0.030	0.028
Cigarettes/day	0.003	0.001	.03	0.0004	0.006
Location*	- 0.242	0.049	< .0001	- 0.338	- 0.145
Entry Period**	0.098	0.037	.008	0.025	0.171
Baseline Years Worked	- 0.006	0.004	.10	- 0.013	0.001
Triglycerides#	0.113	0.024	< .0001	0.067	0.160

#natural log
*Antwerp vs Decatur
**1994/95 vs 1997

3M_MN02482208

Table 14. Mixed Model Coefficient Estimates, Standard Errors (SE), P-Values and 95% Confidence Limits from Testing Potential Determinants of Alkaline Phosphatase# Change Including PFOA and the Interaction with Number of Years of Observation of Antwerp and Decatur Male Employees

				95% Confidence Limits	
	Coefficient	SE	p-value	Lower	Upper
Intercept	3.785	0.176	< .0001	3.437	4.133
PFOA	0.005	0.012	.69	- 0.019	0.028
Years Observation	- 0.047	0.006	< .0001	- 0.058	- 0.036
PFOA x Years Obs	- 0.001	0.002	.62	- 0.005	0.003
Age	0.005	0.004	.19	- 0.002	0.013
BMI	- 0.0009	0.004	.85	- 0.010	0.008
Drinks/day	- 0.002	0.015	.89	- 0.031	0.027
Cigarettes/day	0.003	0.001	.03	0.0004	0.006
Location*	- 0.243	0.049	< .0001	- 0.340	- 0.147
Entry Period**	0.100	0.036	.007	0.028	0.172
Baseline Years Worked	- 0.006	0.004	.09	- 0.014	0.001
Triglycerides#	0.114	0.024	< .0001	0.066	0.161

#natural log
*Antwerp vs Decatur
**1994/95 vs 1997

3M_MN02482209

Table 15. Mixed Model Coefficient Estimates, Standard Errors (SE), P-Values and 95% Confidence Limits from Testing Potential Determinants of Alkaline Phosphatase# Change Including TOF and the Interaction with Number of Years of Observation of Antwerp and Decatur Male Employees

				95% Confidence Limits	
	Coefficient	SE	p-value	Lower	Upper
Intercept	3.789	0.177	< .0001	3.441	4.138
TOF	- 0.00004	0.009	.99	- 0.019	0.018
Years Observation	- 0.049	0.006	< .0001	- 0.060	- 0.037
TOF x Years Obs	- 0.00006	0.0017	.97	- 0.003	0.003
Age	0.005	0.004	.19	- 0.003	0.012
BMI	- 0.001	0.004	.82	- 0.010	0.008
Drinks/day	- 0.002	0.015	.91	- 0.031	0.028
Cigarettes/day	0.003	0.001	.03	0.0004	0.006
Location*	- 0.245	0.049	< .0001	- 0.342	- 0.148
Entry Period**	0.100	0.036	.007	0.028	0.172
Baseline Years Worked	- 0.006	0.004	.10	- 0.013	0.001
Triglycerides#	0.115	0.024	< .0001	0.068	0.162

#natural log
*Antwerp vs Decatur
**1994/95 vs 1997

3M_MN02482210

Table 16. Mixed Model Coefficient Estimates, Standard Errors (SE), P-Values and 95% Confidence Limits from Testing Potential Determinants of GGT# Change Including PFOS and the Interaction with Number of Years of Observation of Antwerp and Decatur Male Employees

				95% Confidence Limits	
	Coefficient	SE	p-value	Lower	Upper
Intercept	1.883	0.373	< .0001	1.146	2.620
PFOS	- 0.004	0.020	.84	- 0.043	0.035
Years Observation	- 0.075	0.012	< .0001	- 0.098	- 0.051
PFOS x Years Obs	0.004	0.004	.42	- 0.005	0.012
Age	- 0.003	0.008	.74	- 0.019	0.013
BMI	0.005	0.009	.59	- 0.013	0.024
Drinks/day	0.042	0.031	.18	- 0.020	0.104
Cigarettes/day	- 0.0009	0.003	.77	- 0.007	0.005
Location*	- 0.096	0.104	.36	- 0.030	0.110
Entry Period**	0.358	0.078	< .0001	0.204	0.512
Baseline Years Worked	0.008	0.007	.30	- 0.007	0.024
Triglycerides#	0.251	0.050	< .0001	0.152	0.350

#natural log
*Antwerp vs Decatur
**1994/95 vs 1997

3M_MN02482211

Table 17. Mixed Model Coefficient Estimates, Standard Errors (SE), P-Values and 95% Confidence Limits from Testing Potential Determinants of GGT# Change Including PFOA and the Interaction with Number of Years of Observation of Antwerp and Decatur Male Employees

				95% Confidence Limits	
	Coefficient	SE	p-value	Lower	Upper
Intercept	1.876	0.374	< .0001	1.138	2.613
PFOA	- 0.009	0.025	.72	- 0.058	0.040
Years Observation	- 0.077	0.012	< .0001	- 0.100	- 0.054
PFOA x Years Obs	0.005	0.005	.29	- 0.004	0.014
Age	- 0.002	0.008	.76	- 0.018	0.013
BMI	0.004	0.009	.64	- 0.014	0.023
Drinks/day	0.043	0.031	.17	- 0.019	0.105
Cigarettes/day	- 0.0007	0.003	.82	- 0.007	0.005
Location*	- 0.097	0.104	.35	- 0.301	0.108
Entry Period**	0.355	0.077	< .0001	0.203	0.507
Baseline Years Worked	0.008	0.008	.30	- 0.007	0.024
Triglycerides#	0.256	0.051	< .0001	0.156	0.356

#natural log
*Antwerp vs Decatur
**1994/95 vs 1997

3M_MN02482212

Table 18. Mixed Model Coefficient Estimates, Standard Errors (SE), P-Values and 95% Confidence Limits from Testing Potential Determinants of GGT# Change Including TOF and the Interaction with Number of Years of Observation of Antwerp and Decatur Male Employees

				95% Confidence Limits	
	Coefficient	SE	p-value	Lower	Upper
Intercept	1.870	0.374	< .0001	1.132	2.608
TOF	0.002	0.020	.93	- 0.037	0.041
Years Observation	- 0.079	0.013	< .0001	- 0.104	- 0.054
TOF x Years Obs	0.004	0.003	.25	- 0.003	0.011
Age	- 0.003	0.008	.75	- 0.018	0.013
BMI	0.005	0.009	.57	- 0.013	0.024
Drinks/day	0.043	0.031	.17	- 0.019	0.104
Cigarettes/day	- 0.0009	0.003	.77	- 0.007	0.005
Location*	- 0.088	0.104	.40	- 0.294	0.117
Entry Period**	0.352	0.078	< .0001	0.200	0.505
Baseline Years Worked	0.008	0.008	.31	- 0.007	0.024
Triglycerides#	0.249	0.050	< .0001	0.149	0.348

#natural log
*Antwerp vs Decatur
**1994/95 vs 1997

3M_MN02482213

Table 19. Mixed Model Coefficient Estimates, Standard Errors (SE), P-Values and 95% Confidence Limits from Testing Potential Determinants of AST# Change Including PFOS and the Interaction with Number of Years of Observation of Antwerp and Decatur Male Employees

				95% Confidence Limits	
	Coefficient	SE	p-value	Lower	Upper
Intercept	3.080	0.198	< .0001	2.689	3.471
PFOS	0.010	0.011	.39	- 0.013	0.032
Years Observation	- 0.009	0.007	.19	- 0.024	0.005
PFOS x Years Obs	0.0007	0.003	.79	- 0.005	0.006
Age	- 0.008	0.004	.05	- 0.016	- 0.00005
BMI	0.004	0.005	.47	- 0.007	0.014
Drinks/day	0.030	0.018	.11	- 0.007	0.066
Cigarettes/day	- 0.003	0.002	.07	- 0.006	0.0002
Location*	0.102	0.053	.06	- 0.206	0.003
Entry Period**	0.039	0.039	.32	- 0.038	0.116
Baseline Years Worked	0.005	0.004	.22	- 0.003	0.012
Triglycerides#	0.063	0.029	.03	0.005	0.121

#natural log
*Antwerp vs Decatur
**1994/95 vs 1997

3M_MN02482214

Table 20. Mixed Model Coefficient Estimates, Standard Errors (SE), P-Values and 95% Confidence Limits from Testing Potential Determinants of AST# Change Including PFOA and the Interaction with Number of Years of Observation of Antwerp and Decatur Male Employees

				95% Confidence Limits	
	Coefficient	SE	p-value	Lower	Upper
Intercept	3.053	0.199	< .0001	2.661	3.445
PFOA	0.027	0.015	.06	- 0.002	0.056
Years Observation	- 0.008	0.007	.28	- 0.022	0.006
PFOA x Years Obs	- 0.002	0.003	.41	- 0.008	0.003
Age	- 0.007	0.004	.08	- 0.015	0.0008
BMI	0.004	0.005	.39	- 0.006	0.015
Drinks/day	0.030	0.018	.10	- 0.006	0.066
Cigarettes/day	- 0.003	0.002	.07	- 0.006	0.0002
Location*	- 0.097	0.053	.07	- 0.201	0.008
Entry Period**	0.044	0.039	.26	- 0.032	0.120
Baseline Years Worked	0.004	0.004	.27	- 0.003	0.012
Triglycerides#	0.054	0.030	.07	- 0.004	0.113

#natural log
*Antwerp vs Decatur
**1994/95 vs 1997

3M_MN02482215

Table 21. Mixed Model Coefficient Estimates, Standard Errors (SE), P-Values and 95% Confidence Limits from Testing Potential Determinants of AST# Change Including TOF and the Interaction with Number of Years of Observation of Antwerp and Decatur Male Employees

				95% Confidence Limits	
	Coefficient	SE	p-value	Lower	Upper
Intercept	3.058	0.198	< .0001	2.666	3.449
TOF	0.018	0.011	.12	- 0.005	0.04
Years Observation	- 0.009	0.008	.24	- 0.024	0.006
TOF x Years Obs	- 0.006	0.002	.79	- 0.005	0.004
Age	- 0.008	0.004	.06	- 0.016	0.0002
BMI	0.004	0.005	.40	- 0.006	0.015
Drinks/day	0.029	0.018	.12	- 0.007	0.065
Cigarettes/day	- 0.003	0.002	.07	- 0.006	0.0002
Location*	- 0.095	0.053	.08	- 0.199	0.010
Entry Period**	0.039	0.039	.31	- 0.037	0.115
Baseline Years Worked	0.005	0.004	.24	- 0.003	0.012
Triglycerides#	0.058	0.029	.05	0.00003	0.116

#natural log
*Antwerp vs Decatur
**1994/95 vs 1997

3M_MN02482216

Table 22. Mixed Model Coefficient Estimates, Standard Errors (SE), P-Values and 95% Confidence Limits from Testing Potential Determinants of ALT# Change Including PFOS and the Interaction with Number of Years of Observation of Antwerp and Decatur Male Employees

				95% Confidence Limits	
	Coefficient	SE	p-value	Lower	Upper
Intercept	2.501	0.273	< .0001	1.961	3.041
PFOS	0.010	0.016	.54	- 0.021	0.041
Years Observation	- 0.095	0.010	< .0001	- 0.115	- 0.075
PFOS x Years Obs	- 0.00003	0.004	.99	- 0.008	0.008
Age	0.0009	0.006	.88	- 0.012	0.010
BMI	0.010	0.007	.17	- 0.004	0.024
Drinks/day	- 0.012	0.025	.63	- 0.062	0.038
Cigarettes/day	- 0.008	0.002	.001	- 0.012	- 0.003
Location*	- 0.088	0.073	.23	- 0.233	0.056
Entry Period**	0.329	0.054	< .0001	0.222	0.436
Baseline Years Worked	0.001	0.005	.84	- 0.010	0.012
Triglycerides#	0.159	0.040	.0001	0.079	0.238

#natural log
*Antwerp vs Decatur
**1994/95 vs 1997

3M_MN02482217

Table 23. Mixed Model Coefficient Estimates, Standard Errors (SE), P-Values and 95% Confidence Limits from Testing Potential Determinants of ALT# Change Including PFOA and the Interaction with Number of Years of Observation of Antwerp and Decatur Male Employees

				95% Confidence Limits	
	Coefficient	SE	p-value	Lower	Upper
Intercept	2.479	0.272	< .0001	1.942	3.016
PFOA	0.015	0.020	.46	- 0.025	0.054
Years Observation	- 0.107	0.010	< .0001	- 0.126	- 0.087
PFOA x Years Obs	0.005	0.004	.19	- 0.003	0.013
Age	- 0.0001	0.006	.98	- 0.011	0.011
BMI	0.011	0.007	.13	- 0.003	0.025
Drinks/day	- 0.009	0.025	.72	- 0.058	0.040
Cigarettes/day	- 0.007	0.002	.001	- 0.012	- 0.003
Location*	- 0.079	0.072	.28	- 0.222	0.064
Entry Period**	0.330	0.053	< .0001	0.225	0.434
Baseline Years Worked	0.0008	0.005	.89	- 0.010	0.011
Triglycerides#	0.151	0.041	.0003	0.071	0.231

#natural log
*Antwerp vs Decatur
**1994/95 vs 1997

3M_MN02482218

Table 24. Mixed Model Coefficient Estimates, Standard Errors (SE), P-Values and 95% Confidence Limits from Testing Potential Determinants of ALT[#] Change Including TOF and the Interaction with Number of Years of Observation of Antwerp and Decatur Male Employees

				95% Confidence Limits	
	Coefficient	SE	p-value	Lower	Upper
Intercept	2.476	0.273	< .0001	1.936	3.015
TOF	0.020	0.016	.21	- 0.011	0.051
Years Observation	- 0.102	0.011	< .0001	- 0.123	- 0.082
TOF x Years Obs	0.002	0.003	.50	- 0.004	0.008
Age	- 0.0005	0.006	.93	- 0.011	0.010
BMI	0.011	0.007	.11	- 0.003	0.026
Drinks/day	- 0.013	0.025	.62	- 0.062	0.037
Cigarettes/day	- 0.008	0.002	.001	- 0.012	- 0.003
Location*	- 0.073	0.073	.32	- 0.217	0.072
Entry Period**	0.325	0.053	< .0001	0.220	0.430
Baseline Years Worked	0.0008	0.005	.88	- 0.010	0.011
Triglycerides[#]	0.148	0.040	.0003	0.069	0.228

[#]natural log
*Antwerp vs Decatur
**1994/95 vs 1997

3M_MN02482219

Table 25. Mixed Model Coefficient Estimates, Standard Errors (SE), P-Values and 95% Confidence Limits from Testing Potential Determinants of Total Bilirubin# Change Including PFOS and the Interaction with Number of Years of Observation of Antwerp and Decatur Male Employees

				95% Confidence Limits	
	Coefficient	SE	p-value	Lower	Upper
Intercept	- 0.334	0.241	.17	- 0.811	0.142
PFOS	- 0.018	0.014	.22	- 0.046	0.011
Years Observation	0.033	0.009	.0005	0.0148	0.052
PFOS x Years Obs	- 0.002	0.004	.94	- 0.007	0.007
Age	0.011	0.005	.02	0.001	0.020
BMI	- 0.003	0.007	.67	- 0.016	0.010
Drinks/day	0.016	0.024	.50	- 0.030	0.062
Cigarettes/day	- 0.008	0.002	< .0001	- 0.012	- 0.004
Location*	0.315	0.064	< .0001	0.189	0.441
Entry Period**	- 0.114	0.047	.02	- 0.206	- 0.022
Baseline Years Worked	- 0.002	0.005	.64	- 0.011	0.007
Triglycerides#	- 0.088	0.037	.02	- 0.161	- 0.015

#natural log
*Antwerp vs Decatur
**1994/95 vs 1997

3M_MN02482220

Table 26. Mixed Model Coefficient Estimates, Standard Errors (SE), P-Values and 95% Confidence Limits from Testing Potential Determinants of Total Bilirubin# Change Including PFOA and the Interaction with Number of Years of Observation of Antwerp and Decatur Male Employees

				95% Confidence Limits	
	Coefficient	SE	p-value	Lower	Upper
Intercept	- 0.315	0.242	.19	- 0.793	0.162
PFOA	- 0.030	0.019	.16	0.066	0.007
Years Observation	0.028	0.009	.003	0.001	0.046
PFOA x Years Obs	0.005	0.004	.18	- 0.002	0.013
Age	0.010	0.005	.04	0.0007	0.020
BMI	- 0.003	0.007	.61	- 0.016	0.010
Drinks/day	0.014	0.023	.55	- 0.032	0.060
Cigarettes/day	- 0.008	0.002	< .0001	- 0.013	- 0.004
Location*	0.318	0.064	< .0001	0.193	0.444
Entry Period**	- 0.124	0.046	.007	- 0.215	- 0.034
Baseline Years Worked	- 0.002	0.005	.71	- 0.011	0.007
Triglycerides#	- 0.082	0.037	.03	- 0.156	- 0.008

#natural log
*Antwerp vs Decatur
**1994/95 vs 1997

3M_MN02482221

Table 27. Mixed Model Coefficient Estimates, Standard Errors (SE), P-Values and 95% Confidence Limits from Testing Potential Determinants of Total Bilirubin# Change Including TOF and the Interaction with Number of Years of Observation of Antwerp and Decatur Male Employees

				95% Confidence Limits	
	Coefficient	SE	p-value	Lower	Upper
Intercept	-0.318	0.242	.19	-0.796	0.160
TOF	-0.020	0.014	.16	-0.049	0.008
Years Observation	0.029	0.010	.005	0.009	0.049
TOF x Years Obs	0.003	0.003	.36	-0.003	0.009
Age	0.011	0.005	.03	0.001	0.020
BMI	-0.003	0.007	.65	-0.016	0.010
Drinks/day	0.016	0.023	.51	-0.031	0.062
Cigarettes/day	-0.008	0.002	<.0001	-0.012	-0.004
Location*	0.316	0.064	<.0001	0.190	0.442
Entry Period**	0.120	0.046	.01	-0.210	-0.029
Baseline Years Worked	-0.002	0.005	.68	-0.011	0.007
Triglycerides#	-0.085	0.037	.02	-0.158	-0.012

#natural log
*Antwerp vs Decatur
**1994/95 vs 1997

3M_MN02482222

Table 28. Mixed Model Coefficient Estimates, Standard Errors (SE), P-Values and 95% Confidence Limits from Testing Potential Determinants of Direct Bilirubin# Change Including PFOS and the Interaction with Number of Years of Observation of Antwerp and Decatur Male Employees

				95% Confidence Limits	
	Coefficient	SE	p-value	Lower	Upper
Intercept	- 1.756	0.204	< .0001	- 2.160	- 1.355
PFOS	- 0.013	0.013	.29	- 0.039	0.012
Years Observation	- 0.097	0.009	< .0001	- 0.116	- 0.079
PFOS x Years Obs	- 0.006	0.004	.18	- 0.014	0.003
Age	0.007	0.004	.06	- 0.0003	0.015
BMI	- 0.003	0.006	.58	- 0.015	0.008
Drinks/day	0.018	0.020	.37	- 0.022	0.058
Cigarettes/day	- 0.0005	0.002	.79	- 0.004	0.003
Location*	0.076	0.053	.15	- 0.028	0.180
Entry Period**	0.353	0.038	< .0001	0.277	0.428
Baseline Years Worked	- 0.001	0.004	.74	- 0.009	0.006
Triglycerides#	- 0.090	0.033	.006	- 0.155	- 0.026

#natural log
*Antwerp vs Decatur
**1994/95 vs 1997

3M_MN02482223

Table 29. Mixed Model Coefficient Estimates, Standard Errors (SE), P-Values and 95% Confidence Limits from Testing Potential Determinants of Direct Bilirubin# Change Including PFOA and the Interaction with Number of Years of Observation of Antwerp and Decatur Male Employees

				95% Confidence Limits	
	Coefficient	SE	p-value	Lower	Upper
Intercept	- 1.753	0.207	< .0001	- 2.161	- 1.345
PFOA	- 0.012	0.017	.47	- 0.045	0.021
Years Observation	- 0.095	0.009	< .0001	- 0.113	- 0.077
PFOA x Years Obs	- 0.004	0.004	.27	- 0.012	0.003
Age	0.006	0.004	.11	- 0.001	0.014
BMI	- 0.003	0.006	.66	- 0.014	0.009
Drinks/day	0.014	0.020	.50	- 0.026	0.053
Cigarettes/day	- 0.0005	0.002	.80	- 0.004	0.003
Location*	0.083	0.053	.12	- 0.022	0.188
Entry Period**	0.345	0.038	< .0001	0.271	0.420
Baseline Years Worked	- 0.0008	0.004	.83	- 0.008	0.007
Triglycerides#	- 0.089	0.033	.009	- 0.155	- 0.023

#natural log
*Antwerp vs Decatur
**1994/95 vs 1997

3M_MN02482224

Table 30. Mixed Model Coefficient Estimates, Standard Errors (SE), P-Values and 95% Confidence Limits from Testing Potential Determinants of Direct Bilirubin# Change Including TOF and the Interaction with Number of Years of Observation of Antwerp and Decatur Male Employees

				95% Confidence Limits	
	Coefficient	SE	p-value	Lower	Upper
Intercept	- 1.748	0.205	< .0001	- 2.154	- 1.343
TOF	- 0.013	0.013	.33	- 0.038	0.013
Years Observation	- 0.093	0.010	< .0001	- 0.113	- 0.073
TOF x Years Obs	- 0.004	0.003	.21	- 0.011	0.002
Age	0.007	0.004	.08	- 0.0008	0.014
BMI	- 0.003	0.006	.57	- 0.015	0.008
Drinks/day	0.017	0.020	.39	- 0.022	0.057
Cigarettes/day	- 0.0004	0.002	.84	- 0.004	0.003
Location*	0.074	0.053	.16	- 0.031	0.179
Entry Period**	0.349	0.038	< .0001	0.274	0.424
Baseline Years Worked	- 0.001	0.004	.77	- 0.008	0.006
Triglycerides#	- 0.087	0.033	.009	- 0.152	- 0.022

#natural log
*Antwerp vs Decatur
**1994/95 vs 1997

3M_MN02482225