

National Health and Nutrition Examination Survey 1999–2000

Documentation, Codebook, and Frequencies

**Surplus Specimen Laboratory Component:
Perfluorinated Chemicals (Surplus Sera)**

**Survey Years:
1999 to 2000**

**SAS Export File:
SSPFC_a.XPT**



First Published: October 2006
Last revised: N/A

NHANES 1999–2000 Data Release
October 2006
Documentation for Laboratory Results
Surplus Sera Perfluorinated Chemicals

(1) Documentation File Date – October 2006

(2) Documentation File Name – SSPFC_A Surplus Sera Perfluorinated Chemicals

(3) Survey Years Included in this File Release – 1999–2000

(4) Component Description

The primary objective of this study was to characterize serum concentrations of selected perfluorinated chemicals (PFCs), including perfluorooctanoate (PFOA) and perfluorooctanesulfonate (PFOS), in a representative random 1/3 subset of the non-occupationally exposed US population from NHANES 1999-2000, so that we could obtain national population levels for these compounds over this two-year period.

(5) Sample Description:

5.1 Eligible Sample

Participants aged 12 years and older who do not meet any of the exclusion criteria were eligible.

(6) Description of the Laboratory Methodology

The measurements of PFCs were performed at the Division of Laboratory Sciences (DLS), National Center for Environmental Health (NCEH), Centers for Disease Control and Prevention (CDC). Through a multiple reaction monitoring experiment, the following analytes were measured: perfluorooctane sulfonamide (PFOSA), 2-(N-ethyl-perfluorooctane sulfonamido) acetic acid (Et-PFOSA-AcOH), 2-(N-methyl-perfluorooctane sulfonamido) acetic acid (Me-PFOSA-AcOH), perfluorohexane sulfonic acid (PFHxS), PFOS, PFOA, perfluorohexanoic acid (PFHxA), perfluorononanoic acid (PFNA), perfluorodecanoic acid (PFDeA), perfluoroundecanoic acid (PFUA), and perfluorododecanoic acid (PFDoA). The analytical method used has been described in detail (Kuklenyik et al. 2005). Briefly, without protein precipitation, only dilution with 0.1 M formic acid, one aliquot of 100 µL of serum was injected into a commercial column switching system allowing for concentration of the analytes on a C18 solid-phase extraction column. This column was placed automatically in front of a C8 analytical high-performance liquid chromatography column for chromatographic separation of the analytes. Detection and quantification were done using negative-ion TurbolonSpray ionization, a variant of electrospray ionization, tandem mass spectrometry. Three isotope-labeled internal standards were used for quantification: ¹⁸O₂-PFOSA, ¹⁸O₂-PFOS, and ¹³C₂-PFOA. To compensate for the lack of isotope-labeled internal standards for the other analytes and account for matrix effects, the calibration standards

were spiked into calf serum. Spiked serum was analyzed repeatedly to determine the limit of detection (LOD), accuracy, and precision of the method. LOD was calculated as $3S_0$, where S_0 is the standard deviation as the concentration approaches zero (Taylor 1987). LOD was 0.2 nanograms per milliliter (ng/mL), except for PFHxS (0.1 ng/mL) and PFOSA (0.05 ng/mL). The standard accuracies (77%-109%) and their relative standard deviations (5%-24%) were obtained at three spike levels (LOD, 1.25 ng/mL and 12.5 ng/mL) (Kuklennyik et al. 2005). To correct for the endogenous PFOS present in the calf serum, we increased the calculated PFOS concentrations by 0.6 ng/mL. No corrections were applied to the other PFC concentrations (Kuklennyik et al. 2005).

(7) Laboratory Quality Control and Monitoring

CDC's laboratory is CLIA '88 certified and practices all quality control (QC) and assurance procedures dictated by this certification. Serum concentrations of PFCs currently have no known clinical significance other than indicating exposure to PFCs prior to specimen collection in 1999-2000. Therefore, no reports will be forwarded to NHANES survey participants.

QC procedures included the daily analysis of characterized serum pools and the periodic analysis of proficiency testing materials. Low-concentration (QCL; ~3 ng/mL to ~9 ng/mL, depending upon the analyte) and high-concentration (QCH; ~10 ng/mL to ~30 ng/mL, depending upon the analyte) QC materials were prepared from a base calf serum pool, dispensed in 3-mL aliquots and stored at $-20\text{ }^{\circ}\text{C}$. QC materials were characterized through repeated measurements spanning at least 3 weeks, to define the mean concentrations and the 95% and 99% control limits of PFCs. The coefficients of variation of 30 repeated measurements for each serum pool ranged between 6% and 16% for all analytes (Kuklennyik et al. 2005). Each analytical batch of NHANES samples also included 9 calibration standards, 2 QCH, 2 QCL, 2 reagent blanks, and 1 serum blank. The concentrations of the two QCH and the two QCL were averaged to obtain one measurement of QCH and of QCL per batch; these concentrations were evaluated using standard statistical probability rules.

(8) Data Processing and Editing

Specimens were processed, stored, and shipped to DLS, NCEH, CDC (Atlanta, Georgia). Detailed specimen collection and processing instructions are discussed in the NHANES LPM. Read the LABDOC file for detailed data processing and editing protocols. The analytical method is described in detail in a peer-reviewed publication (Kuklennyik et al. 2005).

(9) Data Access:

All data are publicly available.

(10) Analytic Notes for Data Users:

The analysis of NHANES 1999–2000 PFCs data must be conducted with the key survey design and basic demographic variables. The NHANES 1999–2000 Household

Questionnaire Data files contain demographic data, health indicators, and other related information collected during household interviews. They also contain all survey design variables and sample weights. The phlebotomy file includes auxiliary information such as the conditions precluding venipuncture. The household questionnaire and phlebotomy files may be linked to the laboratory data file using the unique survey participant identifier SEQN.

(11) References

Kuklennyik Z, Needham LL, Calafat AM. 2005. Measurement of 18 perfluorinated organic acids and amides in human serum using on-line solid-phase extraction. *Anal Chem* 77:6085-6091.

Taylor JK. 1987. *Quality Assurance of Chemical Measurements*. Chelsea, MI:Lewis Publishers.

**National Health and Nutrition Examination Survey
Codebook for Data Production (1999-2000)**

**Surplus Sera Perfluorinated Chemicals (SSPFC_A)
Person Level Data**

First Published: October 2006

Last Updated: N/A



SEQN	Target
	B(1 Yrs. to 150 Yrs.)
Hard Edits	SAS Label
	Respondent sequence number
English Text: Respondent sequence number.	
English Instructions:	

SEPAH	Target
	B(1 Yrs. to 150 Yrs.)
Hard Edits	SAS Label
	Surplus sera EPAH result (ng/ml)
English Text: Surplus sera 2-(N-ethyl-perfluorooctane sulfonamido) acetate (EPAH) result (ng/ml)	
English Instructions:	

Code or Value	Description	Count	Cumulative	Skip to Item
0.2 to 24.6	Range of Values	1591	1591	
.	Missing	0	1591	

SMPAH	Target
	B(1 Yrs. to 150 Yrs.)
Hard Edits	SAS Label
	Surplus sera MPAH result (ng/ml)
English Text: Surplus sera 2-(N-methyl-perfluorooctane sulfonamido) acetate (MPAH) result (ng/ml)	
English Instructions:	

Code or Value	Description	Count	Cumulative	Skip to Item
0.2 to 44	Range of Values	1591	1591	
.	Missing	0	1591	

SPFDE		Target		
		B(1 Yrs. to 150 Yrs.)		
Hard Edits		SAS Label		
		Surplus sera PFDE result (ng/ml)		
English Text: Surplus sera perfluorodecanoate (PFDE) result (ng/ml)				
English Instructions:				
Code or Value	Description	Count	Cumulative	Skip to Item
0.2 to 7.8	Range of Values	1591	1591	
.	Missing	0	1591	

SPFDO		Target		
		B(1 Yrs. to 150 Yrs.)		
Hard Edits		SAS Label		
		Surplus sera PFDO result (ng/ml)		
English Text: Surplus sera perfluorododecanoate (PFDO) result (ng/ml)				
English Instructions:				
Code or Value	Description	Count	Cumulative	Skip to Item
0.2 to 1	Range of Values	1591	1591	
.	Missing	0	1591	

SPFHP		Target		
		B(1 Yrs. to 150 Yrs.)		
Hard Edits		SAS Label		
		Surplus sera PFHP result (ng/ml)		
English Text: Surplus sera perfluoroheptanoate (PFHP) result (ng/ml)				
English Instructions:				
Code or Value	Description	Count	Cumulative	Skip to Item
0.4 to 4.2	Range of Values	1591	1591	
.	Missing	0	1591	

SPFHS		Target		
		B(1 Yrs. to 150 Yrs.)		
Hard Edits		SAS Label		
		Surplus sera PFHS result (ng/ml)		
English Text: Surplus sera perfluorohexane sulfonate (PFHS) result (ng/ml)				
English Instructions:				
Code or Value	Description	Count	Cumulative	Skip to Item
0.1 to 46.5	Range of Values	1591	1591	
.	Missing	0	1591	

SPFNA		Target		
		B(1 Yrs. to 150 Yrs.)		
Hard Edits		SAS Label		
		Surplus sera PFNA result (ng/ml)		
English Text: Surplus sera perfluorononanoate (PFNA) result (ng/ml)				
English Instructions:				
Code or Value	Description	Count	Cumulative	Skip to Item
0.1 to 13.7	Range of Values	1591	1591	
.	Missing	0	1591	

SPFOA		Target		
		B(1 Yrs. to 150 Yrs.)		
Hard Edits		SAS Label		
		Surplus sera PFOA result (ng/ml)		
English Text: Surplus sera perfluorooctanoate (PFOA) result (ng/ml)				
English Instructions:				
Code or Value	Description	Count	Cumulative	Skip to Item
0.1 to 123	Range of Values	1591	1591	
.	Missing	0	1591	

SPFOS		Target		
		B(1 Yrs. to 150 Yrs.)		
Hard Edits		SAS Label		
		Surplus sera PFOS result (ng/ml)		
English Text: Surplus sera perfluorooctane sulfonate (PFOS) result (ng/ml)				
English Instructions:				
Code or Value	Description	Count	Cumulative	Skip to Item
0.3 to 298	Range of Values	1591	1591	
.	Missing	0	1591	

SPFSA		Target		
		B(1 Yrs. to 150 Yrs.)		
Hard Edits		SAS Label		
		Surplus sera PFSA result (ng/ml)		
English Text: Surplus sera perfluorooctane sulfonamide (PFSA) result (ng/ml)				
English Instructions:				
Code or Value	Description	Count	Cumulative	Skip to Item
0.1 to 9.6	Range of Values	1591	1591	
.	Missing	0	1591	

SPFUA		Target		
		B(1 Yrs. to 150 Yrs.)		
Hard Edits		SAS Label		
		Surplus sera PFUA result (ng/ml)		
English Text: Surplus sera perfluoroundecanoate (PFUA) result (ng/ml)				
English Instructions:				
Code or Value	Description	Count	Cumulative	Skip to Item
0.2 to 4	Range of Values	1591	1591	
.	Missing	0	1591	