Third National Report on Human Exposure to Environmetnal Chemicals -- PCB Levels fro NHANES 2001-2002

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Introduction

The *Third National Report on Human Exposure to Environmental Chemicals (3rd Report)*[1] is one of a series of reports of an ongoing biomonitoring exposure assessment of the U.S. population to environmental chemicals. Data in the *3rd Report* are from the 2001-2002 National Health and Nutrition Examination Survey (NHANES) conducted by the National Center for Health Statistics of the Center for Disease Control and Prevention (CDC). The sampling plan for NHANES is a complex, stratified, multistage, probability-cluster design that selects a representative sample of the civilian, noninstitutionalized U.S. population. Presented here are serum ortho-substituted polychlorinated biphenyl (PCB) levels measured in a random one-third sample of people aged 12 years and older. The *3rd Report* presents PCB data in both whole weight (ppb, ng/g serum) and lipid adjusted (ppb, ng/g lipid) units and includes PCB data from NHANES 1999-2000 for comparison. PCB data from this series of surveys can be used to establish reference ranges and track, over time, trends in levels of exposure.

Materials and Methods

Sample Preparation

Serum specimens (1-1.5 mL) were prepared by a modification of the procedure in Burse *et al*.[2] Samples were spiked with $^{13}C_{12}$-labeled internal standards followed by C_{18} solid phase extraction (SPE) and extraction through neutral silica and Florisil SPE columns. After the addition of 2 µL of dodecane "keeper" excess solvent was evaporated. An analytical run consisted of nine unknown specimens, one method blank, and two quality control samples.

Mass Spectrometry

Before quantification, the extracts were reconstituted with 10µL external standard (25 pg/µL $^{13}C_6$ -1,2,3,4 TCDD). Using a GC Pal (Leap Technology) auto sampler, 1µL of reconstituted extract is injected into an Agilent Technologies 6890 Gas Chromatograph operated in the splitless injection mode with a flow of 1 mL/min helium through a DB-5ms capillary column (30m x 0.25 mm x 0.25 µm film thickness). The pesticides were quantified by a Thermo Finnigan MAT95 XP (5kV) magnetic sector mass spectrometer operated in EI mode at 40 eV, using selected ion monitoring (SIM) at 10,000 resolving power (10% valley).[3]

The total lipid content of each specimen was estimated from its total cholesterol and triglycerides values using a "summation" method.[4]

Results and Discussion

Because the NHANES sample design is, complex, statistical sample weights must be used to account for the unequal probability of selection into the survey. Sample weights also are used to adjust for possible bias resulting from non-response and are post-stratified to U.S. Census Bureau estimates of the U.S. population. The *3rd Report* presents PCB data for the total population and by age group, gender, and race/ethnicity. For these analyses, race/ethnicity is categorized as Mexican American (MA), non-Hispanic black (NHB), and non-Hispanic white (NHW). Concentrations less than the limit of detection (LOD) were assigned a value equal to the LOD/$\sqrt{2}$ for calculation of geometric means.

Table 1 shows the 50th, 75th, 90th and 95th percentiles for total PCBs from NHANES 2002-2002 based on whole weight (ng/g) and lipid adjusted (ng/g lipid) data. We computed the sum of PCBs for individual samples using the 12 out of 35 congeners from the 3rd Report having 95th percentiles (PCBs 52, 74, 99, 105, 118, 138+158, 146, 153, 156, 170, 180 and 187). In the computation, we did not use data from samples for which there was any missing data for PCB 118, 138+158, 153 or 180; and we substituted LOD/$\sqrt{2}$ for results below the LOD. Following calculation of individual total PCBs, NHANES sampling weights were applied to estimate population percentiles using SUDAAN software[5] as described in the *3rd Report*. The 95th percentile of total PCBs for 2287 samples (aged 12 years and older) was 3.4945 ng/g serum and 517.1 ng/g lipid. Needham et al.[6] reported a 95th percentile for age 20+ of 2.81 ng/g serum and 452 ng/g lipid from NHANES 1999-2000 using 11 congeners, substituting zero for results below the

LOD. Table 1 shows differences in total PCBs at each percentile for the 12-19 year and 20+ age groups. Total PCBs for males and females are comparable. Total PCBs for MA are lower than either NHW or NHB and total PCBs are the highest for NHB at the 95th percentile.

Table 1. Total PCBs from NHANES 2001-2002

Group	Total PCBs Concentration	50th Percentile	75th Percentile	90th Percentile	95th Percentile	Sample Size
ALL	ng/g	0.807	1.532	2.515	3.494	2287
	ng/g (lipid)	131.2	241.4	391.2	517.1	2287
12-19 yr	ng/g	0.283	0.352	0.509	0.635	744
	ng/g (lipid)	58.1	71.9	100.1	136.0	744
20+	ng/g	0.948	1.674	2.789	3.711	1543
	ng/g (lipid)	149.8	258.0	412.4	532.7	1543
Male	ng/g	0.821	1.518	2.446	3.414	1063
	ng/g (lipid)	136.4	236.1	385.8	504.7	1063
Female	ng/g	0.760	1.565	2.545	3.619	1224
	ng/g (lipid)	126.6	249.7	394.3	531.7	1244
NHW	ng/g	0.895	1.618	2.611	3.475	1055
	ng/g (lipid)	142.3	254.0	401.5	517.8	1055
NHB	ng/g	0.735	1.602	3.130	4.194	512
	ng/g (lipid)	130.7	259.7	494.7	694.6	512
MA	ng/g	0.384	0.693	1.489	2.081	558
	ng/g (lipid)	65.7	113.5	209.3	292.8	558

PCB 118 , 138+158, 153 and 180 were the most frequently detected congeners in NHANES 2001-2002 and, on average, the sum of these four congeners contributed 65-70% to the total PCBs. Table 2 shows the geometric means and percentiles for PCB 153 from NHANES 1999-2000 and 2001-2002. As with total PCBs, there are also apparent differences in PCB 153 at each percentile between the 12-19 year and 20+ age groups. PCB 153 for males and females are comparable. However, PCB 153 for MA is lower than for either NHW or NHB. The concentrations of PCB 118, 138+158 and 180 are highly correlated to PCB 153 (r=0.738 for PCB 118, r=0.956 for PCB 138+158, r=0.898 for PCB 180). Using only data above the LOD, the ratios of the concentration of PCB 118, 138+158 and PCB 180 to PCB 153 were: [PCB 118/153, mean=0.34 (SD=0.174); PCB 138+158/153, mean=0.74 (SD=0.144), and PCB 180/153, mean=0.72 (SD=0.233)].

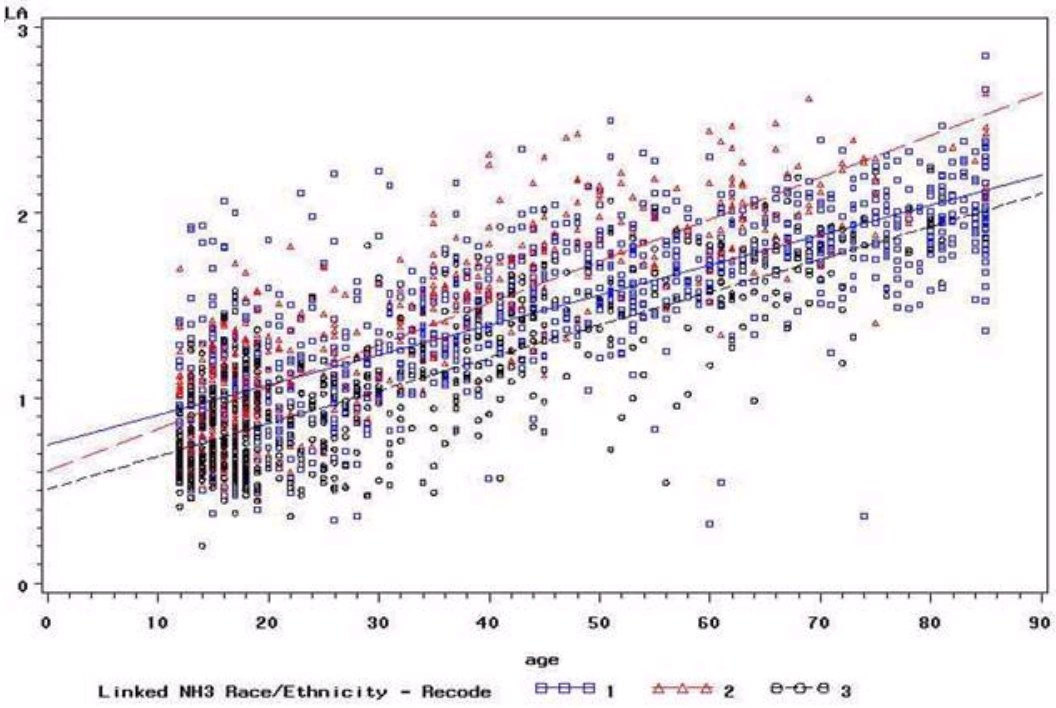
Table 2. Serum PCB 153 Levels from NHANES 2001-2002.

Group	PCB153 Year	Geometric Mean	50th Percentile	75th Percentile	90th Percentile	95th Percentile	Sample Size
ALL	99-00		<28.6	<28.6	77.8	112	1926
	01-02	27.2	30.1	57.5	94.7	126	2306
12-19	99-00		<28.6	<28.6	<28.6	<28.6	668
	01-02		<5.1	12.4	21.2	30.3	757
20+	99-00		<28.6	<28.6	83.2	122	1258
	01-02	32.6	35.0	62.8	99.5	132	1549
Male	99-00		<28.6	<28.6	75.0	111	917
	01-02	28.5	31.5	57.7	97.5	124	1074
Female	99-00		<28.6	<28.6	79.0	118	1009
	01-02	26.1	29.0	57.8	94.2	126	1232
NHW	99-00		<28.6	<28.6	76.4	102	725
	01-02	29.9	32.9	61.2	96.3	126	1061
NHB	99-00		<28.6	59.1	121	176	412
	01-02	30.0	31.0	64.5	126	170	515

MA	99-00		<28.6	<28.6	<28.6	67.5	634
	01-02	12.5	10.9	24.2	47.4	66.7	567

Figure 1 is a plot of Log_{10} PCB 153 (ng/g lipid) vs. age by race/ethnicity (NHW=1, HB=2 and MA=3) in which age is a continuous variable from 12 to 85+ years on the x-axis. In general, the concentration of PCB 153 increases significantly as age increases, but age explains only about 30% of the variation in the proportion of PCB 153 to total PCB for individual samples for both males and females. PCB 153 also increases with age for each of the three race/ethnicity groups, but overall MA compared to NHW or NHB appear lower as a group regardless of age.

Figure 1. LOG_{10} of PCB 153 (ng/g lipid) vs. Age by Race: 1=NHW, 2=NHB and 3=MA



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