

STATISTICAL COMPARISONS OF PCB NHANES DATA FROM 1999-2000, 2001-2002, AND 2003-2004

Nguyen U¹, Mills W^{1,2}

¹Mills Consulting, Inc, 1010 Lake Street, Suite 402, Oak Park, Illinois, USA; ²Center for the Environment, Clarkson University, 8 Clarkson Avenue, Potsdam, New York, USA

Introduction:

The purposes of this paper are (1) to compare the levels of polychlorinated biphenyls (PCBs) found in blood serum collected during the National Health and Nutrition Evaluation Surveys (NHANES) from 1999-2000 (NH99), NHANES 2001-2002 (NH01), and NHANES 2003-2004 (NH03) datasets; (2) to observe the concentration and ratio trends of different PCBs over age and gender; and (3) to evaluate the impact of the changes to the PCBs congener lists for each NHANES group on the conclusions reached about these trends across NH99 to NH03.

Materials and Methods:

The data for PCBs for NH99, NH01, and NH03 were obtained from the Centers for Disease Control (CDC) NHANES website¹. The NH99 and NH01 (NH9901) datasets were also combined using the four year weighting supplied by CDC to provide NH9901 data. The data were analyzed using SAS 9.2 (SAS institute, Cary, NC) for all samples, and subgrouped into i) two gender groups (male, female), ii) five different age groups (0-19, 20-29, 30-44, 45-59, > 60 year old), and iii) five different race groups (Mexican American, Other Hispanic, Non-Hispanic White, Non-Hispanic Black, Other Race-Including Multi-Racial). The following PCB groups were calculated: i) total PCBs (as reported for each of the NH99 - NH03 datasets), ii) total common PCBs across the NH99 - NH03 (chlorobiphenyl (CB) congeners no. 52, 66, 74, 81, 101, 105, 118, 126, 128, 153 (132), 138 (158/160/163/164), 146, 156, 157, 167, 169, 170 (190), 172, 177, 178, 180, 183, 187), iii) ratio of CB 180 to CB 153, iv) ratio of total four biomarkers (CB 118, 138, 153, 180) to total PCBs, and v) total four biomarkers to total common PCBs. These PCB groups were then log-transformed for each of the NH99, NH01 and NH03 data sets as recommended by CDC². Means and 95% confidence intervals for all data and for data stratified by age or gender were calculated using Proc Surveymeans on those log-transformed data. Geometric means with 95% confidence were obtained from converting the means and 95% confidence back to normal scale. The data analysis approach used was validated against previously published results to ensure the algorithms were working properly.

The list of PCBs congeners analyzed was not completely consistent among NH99, NH01, and NH03. The total number of congeners in NH99 was 25 and 31 (accounting for coelutions), in NH01 was 34 and 41 (accounting for coelutions), and in NH03 was 38 and 45 (accounting for coelutions). There were 24 (or 30 coeluted) common congeners across all years with the same coelutions^{3,4}.

Results and Discussion:

For total PCBs between NHANES groups (Figure 1), NH01 has the highest levels and NH03 is the lowest in all cases. When comparing only total common PCBs (Figure 1), the conclusions are the same for NH03 relative to NH01 and NH99, except that NH03 is not statistically different from NH99 for the age group over 60 (instead of age over 45). Other changes in the conclusions from using the common PCB list include the finding that NH01, which was higher than NH99, is now not statistically different for all samples, both genders and age 30-59, and is lower for age 20-29.

Within each NHANES group there is no statistical difference for total PCBs, or total common PCBs for all samples or data stratified by gender; however, there is a general trend of increased concentration with age for all NHANES groups, except for NH99 age 0-19 (Figure 1).

In Figure 2, the ratio of four biomarkers to total PCBs and to total common PCBs are compared. The use of common PCBs congener list provided a clearer analysis. For the between NHANES group analysis, NH03 and NH99 are generally similar and have the highest levels, while NH01 has the lowest levels. For the ratio of four biomarkers to total common PCBs, there is a clearer difference and increase from NH99 to NH01 to NH03.

In Figure 3, the ratio of CB 180 to 153 are compared between and within NHANES datasets. This ratio has been used by some investigators as indicative of recent or ongoing exposure to Aroclor[™] 1260 or 1262, when the ratio is greater than one. Between NHANES groups, NH03 data is generally highest. Conclusions for NH03 relative to NH9901 are generally the same as NH03 relative to NH01 (NH03>NH01 and NH03>NH9901), except for gender groups where there is no statistical difference between NH03 and NH01. Within each NHANES group, there is no statistical difference for the ratio for all data, or data stratified by gender; however, there is a clear trend of increased ratio by age within all the NHANES groups. Within specific subgroups, there were found to be cases where this ratio exceeded one, for example, African American males over 60 years of age (Figure 4). This confirms preliminary findings that were first presented at Dioxins 2005⁵.

Although NH03 has the lowest levels of total common PCBs and total four biomarkers, it has the highest ratio of total four biomarkers to total common PCBs and the highest ratio of CB 180 to CB 153 in most cases (Figure 1, 2, 3). These trends are indicative of lowering exposures to PCBs in general, but a longer retention of PCB congeners in the body (including the biomarkers). Similar trends were seen for total dioxin-like PCBs (DL-PCBs) and PCB-126.

Acknowledgements:

Some of this work was preliminarily funded through litigation work. However, the final analysis and conclusions presented here have not be funded by any party, or reviewed by the parties to the litigation.

References:

1. CDC National Health and Nutrition Examination Survey: Questionnaires, Datasets, and Related Documentation. http://www.cdc.gov/nchs/nhanes/nhanes_questionnaires.htm (accessed June 13).
2. CDC NHANES Web Tutorials, Key Concepts About Confidence Intervals. <http://www.cdc.gov/nchs/tutorials/Nhanes/NHANESAnalyses/HypothesisTesting/Info2.htm>.
3. Patterson, D. G.; Turner, W., Laboratory Procedure Manual, PCBs and Persistent Pesticides (NHANES 2001–2002). Organic Toxicology Branch, D. o. L. S., National Center for Environmental Health, CDC, Ed., http://www.cdc.gov/nchs/data/nhanes/nhanes_01_02/128poc_b_met_pcb_pesticides.pdf.
4. Turner, W., Laboratory Procedure Manual, PCBs and Persistent Pesticides (NHANES 2003-2004). Organic Toxicology Branch, D. o. L. S., National Center for Environmental Health, CDC, Ed. CDC: Atlanta, GA, 2006. http://www.cdc.gov/nchs/data/nhanes/nhanes_03_04/128_c_met_%20PCBs_and_Persistent_Pesticides.pdf.
5. Simpson, C.; Sandau, C. D.; Mills, W. (2005); *Organohalogen Compounds*: 1760-1762.

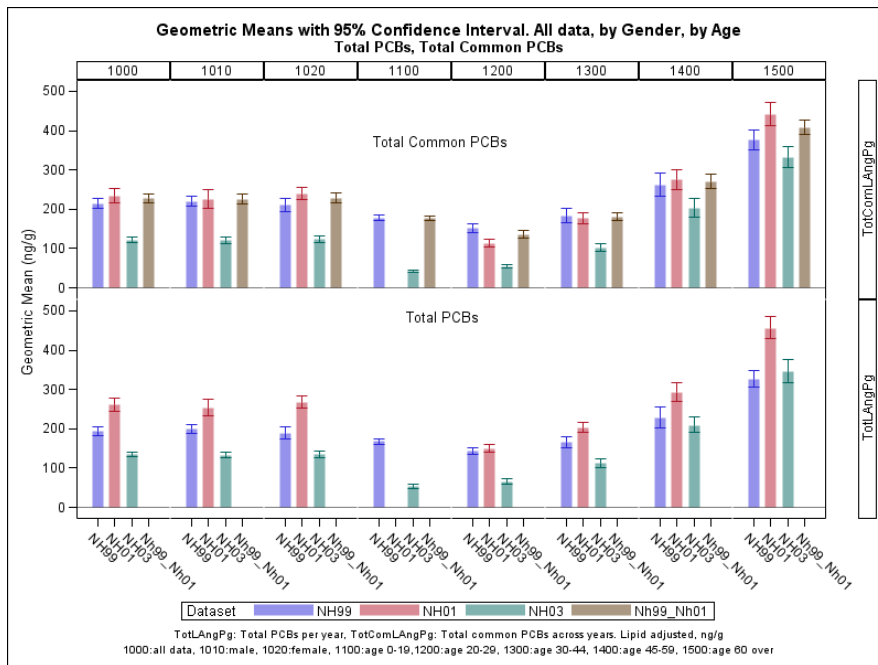


Figure 1: Total PCBs and Total Common PCBs

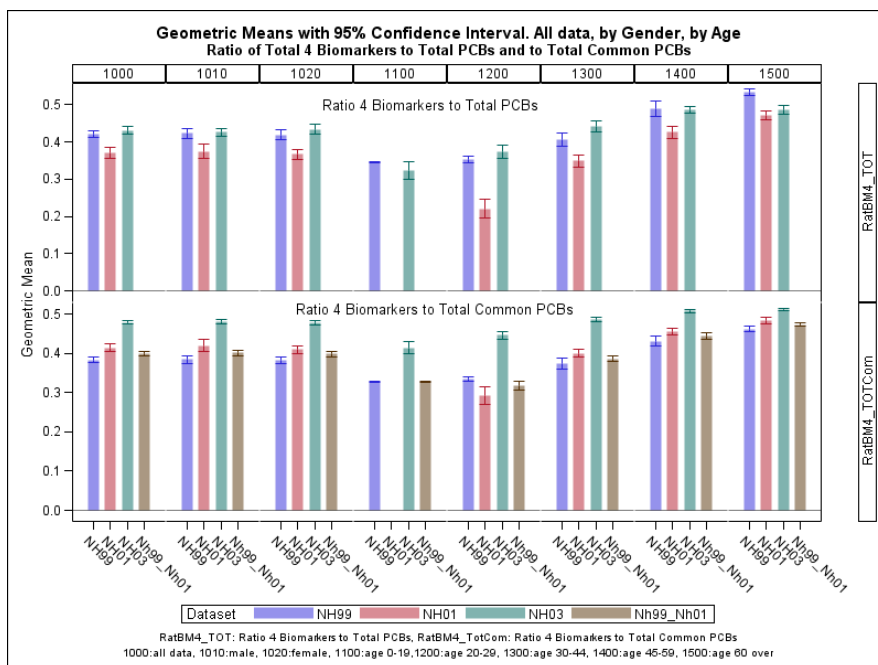


Figure 2: Ratio of Total 4 Biomarkers to Total PCBs and to Total Common PCBs

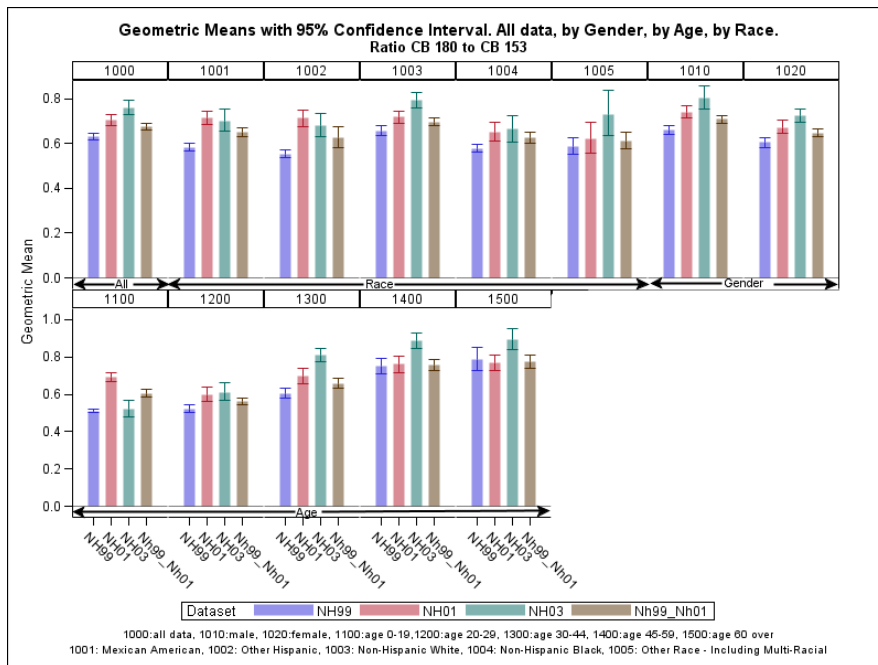


Figure 3: Ratio CB 180 TO CB 153 with All Data, By Gender, By Age and By Race

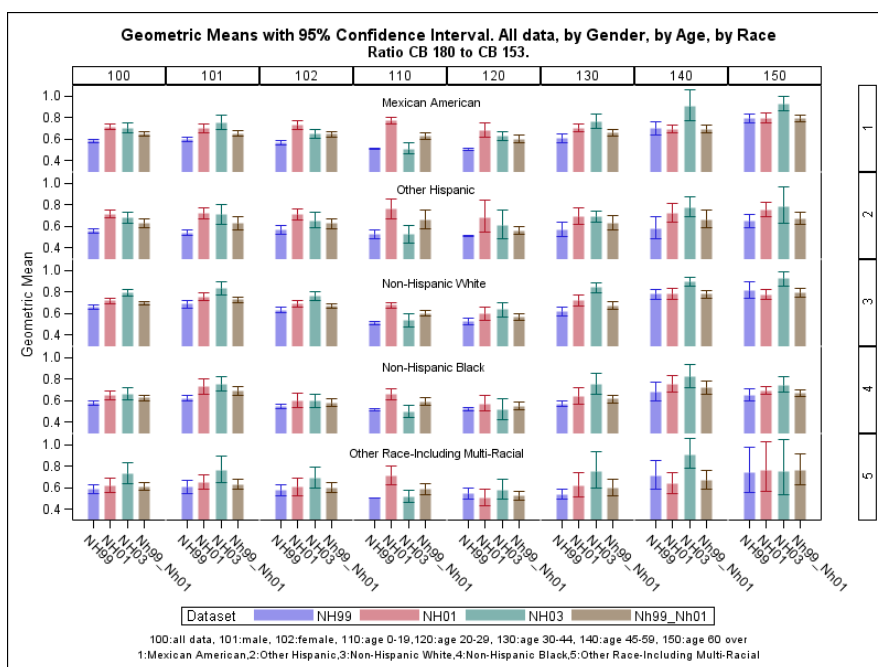


Figure 4: Ratio CB 180 TO CB 153 with All Data, By Gender, By Age of Each Race