

CONCENTRATIONS OF PERSISTENT ORGANIC CHEMICALS IN POOLED SERUM FROM CHILDREN PARTICIPATING IN NHANES 2001-2002

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Introduction

Previously, our laboratory reported concentrations of selected persistent chemicals in pooled serum in participants aged 12 years and older in the U.S. Centers for Disease Control and Prevention's (CDC) National Health and Nutrition Examination Survey 2001-2002 (NHANES 2001-2002). The pools were stratified based on the following demographics: age (12-19 years; 20-39 years; 40-59 years; 60 and over years); sex (male and female); and race/ethnicity (Mexican Americans, nonHispanic blacks, and nonHispanic whites). The pooling procedure, which used 0.75 mL of serum per person, resulted in 51 pools with 34 persons contributing to each pool (total of 1,734 people) and provided a total of 25.5 g of serum for each pool. We analyzed from each pool 2 g for polybrominated diphenyl ethers (PBDEs), polychlorinated biphenyls (PCBs), and selected organochlorine pesticides; 22 g for polychlorinated dibenzo-*p*-dioxins (PCDDs), polychlorinated dibenzofurans (PCDFs), coplanar PCBs, and polychlorinated naphthalenes (PCNs); 0.4 g for polyfluorinated chemicals (PFCs); and 0.5 g for total lipids. Twelve years of age was the minimum age for the collection of blood for organic chemical measurements in NHANES 2001-2002 with the exception of cotinine, which was measured in participants 3 years of age and older.

We have now prepared stratified serum pools on the excess serum remaining from the cotinine measurements in children aged 3- 11 years. In addition to the same race/ethnicity and sex groups as in the earlier pools, the age group was subdivided into children aged 3-5 years and 6- 11 years. We prepared 24 pools, 2 per each demographic group. To ensure that no individual sample overly influenced the results, samples included in any one pool were of equal volume. Pools included 42 (for the 3-5 year old pools) or 114 (for the 6-11 year old pools) individual serum samples, randomly selected.

Analytical Methods

All serum analyses for these chemicals were based on isotope dilution mass spectrometry. The chlorinated and brominated chemicals were measured by high resolution gas chromatography/high resolution mass spectrometry with selective ion monitoring; the fluorinated chemicals were measured using online solid-phase extraction coupled to reversed phase high performance liquid chromatography/tandem mass spectrometry.

Results and Discussion

The degree of exposure and the dominant exposure pathways to the chemicals measured in the various demographic groups may well differ. In general, for the persistent chlorinated chemicals in the various groups, dietary ingestion is the primary exposure route. The dietary ingestion can range from the influence of early infancy breast feeding to adult diet, especially dairy products and other high fat foods plus fish. Breast feeding can also contribute greatly to PBDE exposure but much less so for the PFCs. As infants age to later infancy, they spend a great deal of time on the floor, which may be carpeted. The floor and upholstered furniture can serve as a trap for dust, which may contain relatively high concentrations of PBDEs and PFCs, especially perfluorohexane sulfonate. The time spent in contact with these surfaces plus hand to mouth activity can lead to increased exposure to these chemicals. Thus, for many of the congeners of PBDEs and PFCs, the dominant exposure route may depend on the exposure scenario and particularly the age of the subjects, especially among children. Analytical measurements for and statistical analyses of the concentrations of each of these individual chemicals or chemical classes allow us to compare intra- and inter concentration differences in the various demographic groups. For the previous serum pools prepared in those aged 12 years and older, we can summarize the results as follows:

For dioxin TEQ¹:

Concentrations of individual chemicals, chemical classes, and the total TEQ increased with age.

For all age groups except the 12-19 year old group, females tended to have higher concentrations for total TEQ and higher chemical classes concentrations than males.

For the two oldest age groups only (40-59 years and 60+ years), Mexican Americans had lower concentrations and lower chemical classes concentrations than nonHispanic whites and nonHispanic blacks.

For PBDE congeners²:

Concentrations of the individual congeners did not statistically differ among the age range, sex, or race/ethnicity.

For PFCs³:

Concentrations did not differ among age groups except perfluorohexane sulfonate (PFHxS) was higher in nonHispanic whites in 12-19 year age group.

Concentrations of perfluorooctane sulfonate (PFOS) were greater in males than females, but only for nonHispanic whites.

Concentrations were higher for nonHispanic whites than for nonHispanic blacks (PFOS and perfluorooctanoate [PFOA] for males but only PFOS for females) and Mexicans Americans (both PFOS and PFOA).

In Figure I, the two younger age ranges (i.e., 3-5 years and 6-11 years) are added to the previous PFC data to compare these average pool concentrations with those of older age groups. In general for PFOS, PFOA, and PFHxS, the concentrations in the two younger age pools were similar and significantly higher than for adolescents and adults. Among the race/ethnic groups the concentrations of the PFCs were similar with the possible exception of PFHxS, which was much lower in the two pools of 3-5 year old Mexican American males and somewhat lower in Mexican Americans 6-11 years, males and females. Olsen et al. previously reported higher concentrations of selected PFCs from American children than in adults⁴. We will present similar comparison data for PBDE congeners and well as the dioxin TEQ. Also, where possible, we will compare for each chemical the concentrations found in the pools with those from individual samples (aged 12 years and older) to better understand differences that may arise in comparing pooled and individual data.

References

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Figure I. Concentrations of selected PFCs in serum pools from various demographic groups participating in NHANES 2001-2002

