

memorandum



Division of Health and Environment

Date January 7, 2019

To Tom Neltner, EDF

From Ryan Klein and Meghan Lynch, Abt Associates

Subject Results of NHANES/TDS Lead Analysis using Xue et al. (2010) Method (revised)

Introduction

Abt Associates conducted an analysis to determine demographic characteristics of children under the age of seven that are consuming lead in their food. In order to characterize the demographics of children exposed to lead in food, Abt Associates combined data from the data sources described below:

- The National Health and Nutrition Examination Survey (NHANES), run by the CDC's National Center for Health Statistics (NCHS). NHANES was designed to collect information on the health and nutritional status of the U.S. civilian, non-institutionalized population through in-home interviews and physical examinations.
- What We Eat in America (WWEIA) data, which are 24-hour food diary data collected as part of NHANES, and serve as the dietary intake measurement component of the survey. Dietary data are collected for up to two days for each respondent.
- FDA's Total Diet Study (TDS), an ongoing FDA program that collects information on levels of various contaminants, including lead, that occur in food and beverages commonly consumed by the U.S. population. To estimate the levels of contaminants in these food products, the FDA buys these foods as a consumer would, prepares them as directed,¹ and then analyzes the prepared foods for levels of the contaminants of interest. This process yields nationally representative estimates of contaminant levels in more than 280 kinds of food and beverages.

In short, the analysis plan we followed can be broken down into eight main steps:

1. Aggregate TDS data cycles from 2014 to 2016 to maximize samples of lead contaminants in food.

¹ FDA prepares its samples using deionized water.

2. Perform Xue et al. (2010) method to TDS data in order to account for values of lead that fall below the level of detection (LOD).
3. Aggregate WWEIA data cycles from 2003-2014 to maximize number of children under age seven with consumption data.
4. Match Xue et al. (2010) method summarized TDS lead exposure data (mean lead levels in each food) to WWEIA consumption data for those foods using updated matching file obtained on March 20th, 2018 from FDA.
5. Create summary lead consumption information from WWEIA/TDS data file, based on those children with two days of dietary data.
6. Aggregate NHANES demographic data to correspond with the WWEIA participants.
7. Merge summary lead consumption information onto demographic variables from NHANES.
8. Estimate relevant summary statistics.

The Xue et al. (2010) method of estimating values below the LOD assigns half the LOD to values below the LOD if there was at least one detection among the many samples taken of each particular food; otherwise a value of 0 is assigned.

The updated TDS-WWEIA matching file mentioned in step 4 specifically matches data from 2003-2014 WWEIA to data from 2014-2016 TDS.

Exhibit 1 and Exhibit 2 below summarize key results from our analysis, including daily lead consumption percentiles and the percentage of children with lead consumption above key exposure thresholds. Exhibit 1 shows daily lead consumption and bodyweight adjusted daily lead consumption distributional information for the entire sample of children age 0 to 83 months. Exhibit 2 shows the proportion of children in age groups 0 to 23 months and 24 to 83 months with daily lead consumption above 2 µg/day, 3 µg/day, and 6 µg/day, as well as the estimated number of children above each threshold.

Results

Exhibit 1. Daily Lead Consumption Percentiles for Children age 0 to 83 months

	Daily Lead Consumption
Daily lead consumption (µg/day)	
50 th Percentile	1.34
90 th Percentile	2.49
95 th Percentile	2.95
97.5 th Percentile	3.37
99 th Percentile	3.80

Daily bodyweight adjusted lead consumption ($\mu\text{g}/\text{kg}/\text{day}$)	
50 th Percentile	0.09
90 th Percentile	0.17
95 th Percentile	0.20
97.5 th Percentile	0.23
99 th Percentile	0.27

Exhibit 2. Row Percentages of Children with Lead Consumption Levels above Key Thresholds

	Percent of Children Above Threshold	Number of Children Above Threshold
All children age 0 to 83 months		
2 $\mu\text{g}/\text{day}$ consumption	20%	5.6 million
3 $\mu\text{g}/\text{day}$ consumption	5%	1.3 million
6 $\mu\text{g}/\text{day}$ consumption	0.06%	0.02 million
2 $\mu\text{g}/\text{day}$ consumption by age		
Age 0-23 months	9%	0.7 million
Age 24-83 months	25%	4.9 million
3 $\mu\text{g}/\text{day}$ consumption by age		
Age 0-23 months	1%	0.10 million
Age 24-83 months	6%	1.2 million
6 $\mu\text{g}/\text{day}$ consumption by age		
Age 0-23 months	0%	0
Age 24-83 months	0.08%	0.02 million

References

Xue, J., Zartarian, V., Wang, S.-W., Liu, S. V., & Georgopoulos, P. (2010). Probabilistic modeling of dietary arsenic exposure and dose and evaluation with 2003-2004 NHANES data. *Environmental Health Perspectives*, 118(3), 345.