Blood Metals in Pregnant Women Enrolled in the Vanguard Study

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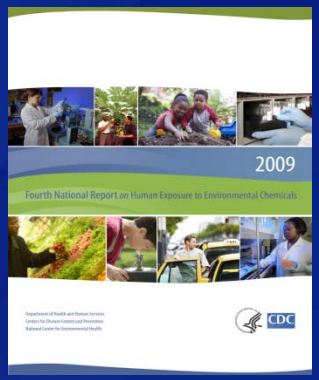
Background

- Environmental chemical exposure information for pregnant women and young children (< 5 years old) is limited.
- Environmental chemicals are usually present at very low levels in human specimens, requiring special consideration and collection and handling procedures.
- NCEH/DLS proposed to measure a broad array of environmental chemicals and nutritional biomarkers in Vanguard Study participants
- Goals of the NCS-NCEH/DLS collaboration include:
  - Characterize exposures in pregnant women and infants to aid Main Study planning
  - Evaluate biospecimen collection, processing, and shipping, and Repository retrieval procedures
- Blood metals in a sample of pregnant women are early available results

Methodology

- Convenience sample of about 450 participants at 7 Vanguard Centers
- Analyze a broad array of environmental chemicals and nutritional biomarkers using:
  - Blood /serum and urine (third trimester)
  - Cord blood, and urine (infant)
  - Breast milk
- Technical assistance and review of biospecimen protocols provided by experienced CDC laboratory scientists



http://www.cdc.gov/exposurereport/

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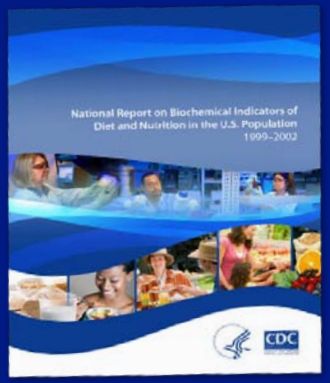

http://www.cdc.gov/nutritionreport/

NCS Total Blood Lead
Geometric means and selected percentiles (in µg/L)

Selected Percentiles (95% confidence interval)					
Category	Geometric Mean (95% CI)	50th	75th	90th	95th
All Women	**0.431** (0.408-0.456)	0.410 (0.390-0.440)	0.580 (0.560-0.640)	0.910 (0.780-1.100)	1.340 (1.030-1.680)
Age Group					
<= 29 years	**0.416** (0.387-0.448)	0.400 (0.370-0.430)	0.550 (0.500-0.610)	0.860 (0.690-1.200)	1.340 (0.970-2.140)
> 29 years	0.451 (0.414-0.491)	0.440 (0.390-0.470)	0.640 (0.580-0.720)	0.940 (0.780-1.290)	1.310 (1.100-2.100)
Race / Ethnicity					
Non-Hispanic black	**0.590** (0.475-0.734)	0.560 (0.460-0.660)	0.860 (0.590-1.340)	1.320 (0.930-1.630)	1.340 (1.320-1.630)
Non-Hispanic white	**0.370** (0.349-0.393)	0.370 (0.350-0.390)	0.500 (0.460-0.520)	0.680 (0.600-0.730)	0.790 (0.720-1.020)
Other	**0.592** (0.527-0.666)	0.565 (0.450-0.630)	0.910 (0.710-1.110)	1.600 (1.110-2.070)	2.070 (1.610-3.090)

Limit of detection 0.25

NHANES 2007-2008 Blood Lead
Population weighted geometric means and selected percentiles (in µg/dL)

Selected Percentiles (95% confidence interval)						
Category	Geometric Mean (95% CI)	50th	75th	90th	95th	Sample Size
Total	**1.27** (1.21-1.34)	1.22 (1.18-1.30)	1.90 (1.80-2.00)	2.80 (2.67-2.96)	3.70 (3.50-3.90)	8266
Females	**1.11** (1.06-1.16)	1.09 (1.00-1.14)	1.64 (1.54-1.74)	2.41 (2.35-2.50)	3.00 (2.85-3.20)	4119
≥ 20 years	**1.38** (1.31-1.46)	1.34 (1.26-1.42)	2.06 (1.94-2.18)	3.00 (2.80-3.14)	3.90 (3.68-4.23)	5364

Limit of detection 0.25

NCS sample values were 2 -3 times lower than U.S. reference ranges for all females (ages 1 year and older) and for all adults older than 20 years.

NCS Total Blood Mercury
Geometric means and selected percentiles (in µg/L)

Selected Percentiles (95% confidence interval)					
Category	Geometric Mean (95% CI)	50th	75th	90th	95th
All Women	**0.580** (0.533-0.631)	0.580 (0.530-0.640)	1.010 (0.930-1.170)	1.780 (1.540-2.280)	2.920 (2.270-3.760)
Age Group					
<= 29 years	**0.495** (0.446-0.550)	0.490 (0.420-0.570)	0.880 (0.770-1.020)	1.330 (1.170-1.630)	1.880 (1.550-3.900)
> 29 years	0.708 (0.619-0.808)	0.745 (0.630-0.860)	1.250 (1.100-1.540)	2.500 (1.840-3.400)	3.610 (2.820-5.330)
Race / Ethnicity					
Non-Hispanic black	**0.586** (0.427-0.805)	0.550 (0.320-1.100)	1.180 (0.560-1.630)	1.570 (1.330-2.270)	1.630 (1.570-2.270)
Non-Hispanic white	**0.529** (0.478-0.587)	0.540 (0.470-0.610)	0.955 (0.850-1.080)	1.550 (1.280-2.000)	2.510 (1.880-3.400)
Other	**0.726** (0.616-0.855)	0.700 (0.610-0.890)	1.170 (0.990-1.560)	2.820 (1.620-4.170)	4.170 (3.120-6.720)

Limit of detection 0.16

NHANES Total Blood Mercury
Population weighted geometric means and selected percentiles (in µg/L)

2007-2008 NHANES Blood Total Mercury in Females 16-49 Years, Population Weighted Results						
Category	Geometric Mean (95% CI)	50th	75th	90th	95th	Sample Size
Total	**0.769** (0.689-0.859)	0.740 (0.660-0.830)	1.48 (1.29-1.69)	2.95 (2.46-3.59)	4.84 (3.74-5.79)	8266
Females	**0.748** (0.667-0.827)	0.720 (0.660-0.810)	1.42 (1.24-1.60)	2.70 (2.27-3.27)	3.93 (3.17-5.16)	4119
≥ 20 years	**0.944** (0.833-1.07)	0.890 (0.780-1.03)	1.73 (1.47-2.09)	3.41 (2.82-4.17)	5.32 (4.32-6.72)	5364
2005-2006 NHANES Blood Total Mercury in Females 16-49 Years, Population Weighted Results						
Females 16-49 years	**0.920** (0.826-1.03)	0.900 (0.810-1.020)	1.64 (1.45-2.00)	3.15 (2.77-3.64)	4.48 (3.88-5.60)	1709
Non-Hispanic black	**0.958** (0.810-1.14)	0.930 (0.790-1.17)	1.63 (1.31-2.01)	2.72 (2.17-3.55)	4.09 (3.15-4.66)	477
Non-Hispanic white	**0.440** (0.360-0.500)	0.890 (0.740-1.09)	1.65 (1.35-2.25)	3.39 (2.69-4.21)	4.92 (3.73-5.82)	725

Limit of detection 0.33

NCS sample values were generally similar to the U.S. reference ranges for all females (ages 1 year and older) and for all adults older than 20 years; however, levels in U.S. females 16-49 years were about 2 times higher than levels in the NCS sample.

NHANES 2007-2008 Blood Cadmium
Population weighted geometric means and selected percentiles (in µg/L)

Selected Percentiles (95% confidence interval)						
Category	Geometric Mean (95% CI)	50th	75th	90th	95th	Sample Size
Total	**0.315** (0.300-0.331)	0.270 (0.260-0.280)	0.500 (0.460-0.560)	1.00 (0.900-1.13)	1.52 (1.30-1.77)	7970
Females	**0.331** (0.316-0.348)	0.290 (0.280-0.310)	0.530 (0.480-0.570)	0.980 (0.860-1.10)	1.430 (1.29-1.63)	4119
≥ 20 years	**0.376** (0.354-0.399)	0.330 (0.310-0.350)	0.600 (0.550-0.670)	1.16 (1.02-1.30)	1.70 (1.50-1.96)	5364

Limit of detection 0.20

NCS sample values were generally similar to the U.S. reference ranges for all females (ages 1 year and older) and for all adults older than 20 years.

NCS Total Blood Manganese
Geometric means and selected percentiles (in µg/L)

Selected Percentiles (95% confidence interval)					
Category	Geometric Mean(95% CI)	50th	75th	90th	95th
All Women	**10.77** (10.45-11.10)	10.63 (10.29-10.92)	12.96 (12.42-13.76)	16.11 (15.51-17.29)	18.41 (17.15-19.82)
Age Group					
<= 29 years	**11.01** (10.58-11.46)	10.71 (10.48-11.29)	12.97 (12.30-14.23)	16.77 (15.60-17.92)	18.41 (17.53-24.94)
> 29 years	**10.48** (10.01-10.96)	10.17 (9.68-10.92)	12.81 (12.21-14.18)	15.74 (14.74-17.89)	17.93 (16.25-20.70)
Race / Ethnicity					
Non-Hispanic black	**10.09** (8.90-11.44)	10.10 (9.29-11.52)	11.71 (10.57-15.66)	15.64 (11.84-19.92)	15.66 (15.64-19.92)
Non-Hispanic white	**10.13** (9.79-10.48)	10.13 (9.67-10.48)	11.97 (11.58-12.65)	14.87 (13.87-16.25)	16.78 (15.87-18.95)
Other	**12.70** (12.00-13.44)	12.67 (11.88-13.65)	15.30 (14.41-17.15)	18.46 (17.29-20.72)	20.72 (18.84-36.20)

Limit of detection 1.06

Reference range in whole blood = 5-14 µg/L and is derived mainly from occupational studies, so may not be appropriate for pregnant women

NCS Total Blood Selenium
Geometric means and selected percentiles (in µg/L)

Selected Percentiles (95% confidence interval)					
Category	Geometric Mean(95% CI)	50th	75th	90th	95th
All Women	**178.7** (176.6-180.9)	180.7 (177.1-183.7)	194.4 (192.2-197.7)	208.0 (205.4-211.4)	215.5 (211.2-222.1)
Age Group					
<= 29 years	**177.8** (174.9-180.7)	181.3 (174.9-184.9)	193.3 (190.6-198.6)	208.1 (204.8-213.5)	215.1 (211.0-222.5)
> 29 years	**180.0** (176.9-183.1)	180.6 (174.4-184.7)	195.6 (192.8-200.5)	207.5 (204.8-214.5)	216.2 (209.0-232.8)
Race / Ethnicity					
Non-Hispanic black	**169.1** (161.1-177.4)	165.2 (156.2-183.1)	184.2 (165.3-203.9)	194.2 (191.4-210.8)	203.9 (194.2-210.8)
Non-Hispanic white	**182.9** (180.5-185.4)	184.8 (182.0-187.7)	198.6 (194.2-201.8)	210.2 (207.5-215.1)	219.6 (213.0-229.9)
Other	**170.6** (166.5-174.8)	172.0 (167.4-177.7)	188.4 (182.6-195.4)	203.9 (195.7-206.6)	206.6 (203.9-246.6)

Limit of detection 30

Reference range in whole blood = 157-265 µg/L*

*Carson BL, et al. Selenium, in Toxicology and Biological Monitoring of Metals in Humans. BL Carson, HVE Ill, JL McCann, eds., 1986 Lewis Publishers Inc., Chelsea, MI p. 213.

NCS Blood Cadmium
Geometric means and selected percentiles (in µg/L)

Selected Percentiles (95% confidence interval)					
Category	Geometric Mean (95% CI)	50th	75th	90th	95th
All Women	**0.209** (0.196-0.222)	0.190 (0.180-0.210)	0.310 (0.290-0.340)	0.500 (0.420-0.600)	0.770 (0.510-1.000)
Age Group					
<= 29 years	*	0.180 (0.170-0.200)	0.310 (0.270-0.340)	0.440 (0.380-0.600)	0.860 (0.530-1.500)
> 29 years	**0.214** (0.196-0.233)	0.200 (0.180-0.230)	0.315 (0.270-0.360)	0.540 (0.430-0.720)	0.760 (0.600-0.840)
Race / Ethnicity					
Non-Hispanic black	**0.240** (0.180-0.319)	0.220 (0.170-0.310)	0.320 (0.230-0.610)	0.590 (0.340-1.500)	0.610 (0.590-1.500)
Non-Hispanic white	*	0.180 (0.170-0.200)	0.300 (0.250-0.330)	0.490 (0.390-0.650)	0.780 (0.570-1.200)
Other	**0.220** (0.196-0.247)	0.205 (0.180-0.250)	0.340 (0.290-0.400)	0.520 (0.420-0.720)	0.720 (0.540-1.500)

Limit of detection 0.16

*Not calculated; proportion of results below limit of detection was too high to provide a valid result.

Conclusions

- **In this convenience sample of pregnant women:**
  - Blood lead levels were about 2-3 times lower than reference ranges for U.S. females age 1 year and older
  - Blood total mercury and cadmium levels were generally similar to reference ranges for U.S. females age 1 year and older and also all adults age 20 years and older
  - Blood total mercury levels were about 2 times lower than for U..S. females age 16-49 years*
- **Information on manganese and selenium blood levels in pregnancy are limited, so these results serve as preliminary reference ranges until population-based data are available.**
- **NHANES data may be useful to examine the representativeness of the NCS participants.**

*Caldwell KL, et al. Total blood mercury concentrations in the U.S. popoulation:1999-2006. Int J Hyg Environ Health 2009;212:588.

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Questions?

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