

Supplemental Information

Maternal Urinary Metal and Metalloid levels in Association with Oxidative Stress Biomarkers in Northern Puerto Rico

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Table 1. Percent change in urinary 8-iso-PGF2 α , 8-iso-PGF2 α metabolite, PGF2 α , 8-iso-PGF2 α chemical fraction, and 8-iso-PGF2 α enzymatic fraction associated with exposure biomarker concentration. Effect estimates presented as percent changes for IQR increase in exposure biomarker concentration. Models were adjusted for specific gravity, study visit, maternal age, maternal education, marital status, pre-pregnancy BMI, and exposure to secondhand smoking.

Metals	8-iso-PGF2 α		8-iso-PGF2 α metabolite		PGF2 α		8-iso-PGF2 α chemical fraction		8-iso-PGF2 α enzymatic fraction	
	% Δ (95% CI)	p value	% Δ (95% CI)	p value	% Δ (95% CI)	p value	% Δ (95% CI)	p value	% Δ (95% CI)	p value
<i>Essential Metals</i>										
Co	7.8 (1.0, 15.1)	0.03*	3.7 (-3.5, 11.4)	0.32	6.8 (-2, 16.4)	0.14	9.3 (0.9, 18.3)	0.03*	7.6 (-23.6, 51.6)	0.67
Cs	11.1 (4.5, 18.2)	0.001*	6.6 (-0.5, 14.2)	0.07	9.4 (0.8, 18.7)	0.03*	14.5 (6.3, 23.4)	0.001*	41.6 (2.5, 95.7)	0.04*
Cu	14.9 (7.2, 23.2)	<0.001*	9.4 (1.1, 18.3)	0.03*	9.5 (-0.2, 20.1)	0.06	19.7 (10.0, 30.3)	<0.001*	-5.3 (-34.6, 37.1)	0.77
Mn	4.0 (-1.4, 9.6)	0.16	-0.7 (-6.3, 5.3)	0.82	-1.4 (-8.0, 5.7)	0.70	7.1 (0.4, 14.2)	0.04*	-20.0 (-39.2, 5.4)	0.12
Mo	6.0 (-1.5, 14.1)	0.12	5.4 (-2.7, 14.2)	0.20	5.8 (-3.9, 16.5)	0.25	6.9 (-2.2, 16.9)	0.14	15.1 (-21.5, 68.7)	0.47
Sb	7.3 (0.2, 14.8)	0.05*	6.5 (-1.1, 14.7)	0.10	4.8 (-4.1, 14.7)	0.30	10.4 (1.6, 19.8)	0.02*	19.2 (-16.5, 70.0)	0.34
Sn	6.3 (-0.5, 13.4)	0.07	-1.9 (-8.8, 5.6)	0.61	4.5 (-4.0, 13.7)	0.32	7.9 (-0.4, 16.8)	0.07	4.0 (-25.9, 46.1)	0.82
Zn	8.4 (1.2, 16.2)	0.02*	8.2 (0.3, 16.7)	0.04*	13.1 (3.4, 23.7)	0.01*	7.5 (-1.2, 16.9)	0.10	53.6 (7.4, 120)	0.02*
<i>Non-essential Metals</i>										
As	3.9 (-3.6, 12.0)	0.32	-0.2 (-8.1, 8.4)	0.97	3.8 (-5.9, 14.6)	0.46	4.1 (-5.0, 14.1)	0.39	2.9 (-30.4, 52.3)	0.88
Ba	2.7 (-3.7, 9.6)	0.42	-1.9 (-8.6, 5.3)	0.60	3.7 (-4.9, 13.0)	0.42	3.0 (-4.8, 11.5)	0.47	19.7 (-14.7, 68)	0.30
Cd	0.5 (-5.5, 6.8)	0.88	1.6 (-5.1, 8.7)	0.66	-1.5 (-9.2, 6.8)	0.71	1.9 (-5.4, 9.8)	0.62	-6.4 (-31.9, 28.7)	0.69
Hg	-0.5 (-7.4, 7)	0.90	-4.0 (-11.3, 3.9)	0.31	0.2 (-8.8, 10.0)	0.97	-0.3 (-8.7, 8.9)	0.95	15.8 (-20.4, 68.4)	0.44
Ni	8.2 (1.2, 15.6)	0.02*	2.3 (-4.9, 10.1)	0.54	5.5 (-3.3, 15.2)	0.23	11.0 (2.4, 20.3)	0.01*	8.8 (-23.2, 54.2)	0.64
Pb	4.6 (-5.0, 15.2)	0.36	-6.9 (-16.1, 3.3)	0.18	-2.5 (-14.1, 10.7)	0.70	9.4 (-2.7, 22.9)	0.14	-12.2 (-46.8, 45.0)	0.61

Abbreviations: cobalt (Co); cesium (Cs); copper (Cu); manganese (Mn); molybdenum (Mo); antimony (Sb); tin (Sn); zinc (Zn); arsenic (As); barium (Ba); cadmium (Cd); mercury (Hg); nickel (Ni); lead (Pb).

* denotes $p < 0.05$; *denotes $p < 0.05$ & q value (false discovery rate) < 0.05 .

Table 2. Percent change in urinary 8-iso-PGF2 α , 8-iso-PGF2 α metabolite, PGF2 α , 8-iso-PGF2 α chemical fraction, and 8-iso-PGF2 α enzymatic fraction associated with urinary metal biomarker concentration at each visit during pregnancy. Effect estimates presented as percent changes (%) for IQR increase in exposure biomarker concentration^a. Models were adjusted for study visit, maternal age, maternal education, marital status, pre-pregnancy BMI, and exposure to secondhand smoking.

Metals	8-iso-PGF2 α						8-iso-PGF2 α metabolite					
	Visit 1		Visit 2		Visit 3		Visit 1		Visit 2		Visit 3	
	% Δ (95% CI)	<i>p</i> value	% Δ (95% CI)	<i>p</i> value	% Δ (95% CI)	<i>p</i> value	% Δ (95% CI)	<i>p</i> value	% Δ (95% CI)	<i>p</i> value	% Δ (95% CI)	<i>p</i> value
<i>Essential metals</i>												
Co	3.7 (-4.7, 12.9)	0.40	11.1 (0.3, 23.2)	0.05*	10.6 (-2.4, 25.3)	0.12	0.5 (-8.4, 10.2)	0.92	10.4 (-1.3, 23.5)	0.09	-0.5 (-13.5, 14.3)	0.94
Cs	7.7 (-0.8, 16.8)	0.08	12.0 (2.9, 21.8)	0.01*	10.9 (2.1, 20.5)	0.02*	1.4 (-7.2, 10.7)	0.77	13.3 (3.4, 24.2)	0.01*	4.8 (-4.9, 15.4)	0.34
Cu	12.2 (1.7, 23.7)	0.02*	15.3 (4.8, 26.8)	0.004*	18.8 (4.9, 34.4)	0.01*	0.7 (-9.5, 12.1)	0.90	15.2 (3.9, 27.8)	0.01*	15.6 (-0.5, 34.1)	0.06
Mn	0.6 (-6.3, 8.0)	0.87	9.7 (0.6, 19.7)	0.04*	6.5 (-2.7, 16.6)	0.17	-4.2 (-11.3, 3.4)	0.27	5.4 (-4.1, 16.0)	0.28	2.3 (-7.7, 13.2)	0.67
Mo	6.1 (-5.5, 19.2)	0.32	5.8 (-4.0, 16.5)	0.26	4.4 (-5.0, 14.8)	0.37	2.4 (-9.7, 16.0)	0.72	8.4 (-2.5, 20.4)	0.14	3.7 (-6.6, 15.2)	0.49
Sb	10.6 (-0.5, 22.9)	0.06	4.0 (-4.9, 13.7)	0.40	5.4 (-3.5, 15.2)	0.25	5.3 (-6.1, 18.2)	0.38	7.7 (-2.3, 18.7)	0.14	4.1 (-5.6, 14.8)	0.42
Sn	2.1 (-6.6, 11.8)	0.64	6.1 (-2.8, 15.8)	0.19	11.6 (-0.1, 24.6)	0.05	-5.4 (-14.3, 4.4)	0.27	1.3 (-8.7, 12.3)	0.81	0.8 (-10.9, 14.0)	0.90
Zn	11.4 (0.8, 23.1)	0.04*	6.0 (-4.1, 17.2)	0.26	5.5 (-5.7, 17.9)	0.35	0.7 (-9.6, 12.2)	0.90	13.6 (2.0, 26.6)	0.02*	11.6 (-1.6, 26.7)	0.09
<i>Non-essential metals</i>												
As	4.3 (-6.3, 16.0)	0.44	0.2 (-10.4, 12.0)	0.98	6.3 (-4.8, 18.7)	0.28	-3.9 (-14.4, 7.8)	0.50	8.0 (-4.4, 22.0)	0.22	-3.6 (-14.9, 9.2)	0.56
Ba	7.7 (-4, 20.8)	0.21	4.6 (-5.2, 15.4)	0.37	-5.2 (-16.0, 7.0)	0.39	3.6 (-8.4, 17.3)	0.57	3.1 (-7.3, 14.6)	0.58	-14.4 (-24.9, -2.4)	0.02*
Cd	8.0 (-3.7, 21.2)	0.19	-0.2 (-9.8, 10.5)	0.97	-6.1 (-18.8, 8.5)	0.39	-0.5 (-12.2, 12.8)	0.94	3.9 (-7.0, 16.1)	0.50	-0.1 (-15.5, 18.2)	0.99
Hg	0.2 (-10.5, 12.1)	0.98	4.1 (-6.5, 15.9)	0.47	-5.9 (-16.1, 5.7)	0.31	-2.7 (-13.9, 9.9)	0.66	-1.6 (-12.7, 10.8)	0.78	-7.7 (-18.6, 4.8)	0.22
Ni	6.9 (-2.8, 17.6)	0.17	9.0 (-1.5, 20.7)	0.10	7.1 (-2.9, 18.2)	0.17	-1.2 (-11.0, 9.7)	0.82	4.4 (-6.7, 16.7)	0.45	4.0 (-7.0, 16.3)	0.49
Pb	3.6 (-9.7, 18.9)	0.62	4.6 (-10.5, 22.2)	0.57	6.1 (-11.6, 27.4)	0.53	-12.6 (-24.6, 1.4)	0.08	4.2 (-11.9, 23.2)	0.63	-10.7 (-26.7, 8.8)	0.27
	PGF2 α						8-iso-PGF2 α chemical fraction					
	Visit 1		Visit 2		Visit 3		Visit 1		Visit 2		Visit 3	
	% Δ (95% CI)	<i>p</i> value	% Δ (95% CI)	<i>p</i> value	% Δ (95% CI)	<i>p</i> value	% Δ (95% CI)	<i>p</i> value	% Δ (95% CI)	<i>p</i> value	% Δ (95% CI)	<i>p</i> value
<i>Essential metals</i>												
Co	0.0 (-10.6, 11.8)	1.00	12.5 (-1.7, 28.9)	0.09	11.6 (-5.5, 31.9)	0.20	7.2 (-3.3, 18.8)	0.19	10.7 (-2.3, 25.5)	0.11	11.2 (-4.5, 29.5)	0.18
Cs	2.3 (-8.3, 14.0)	0.69	13.2 (1.2, 26.6)	0.03*	11.6 (0.0, 24.7)	0.05	13.5 (2.8, 25.2)	0.01*	12.9 (2.0, 25.0)	0.02*	12.3 (1.6, 24.1)	0.02*
Cu	2.5 (-10.0, 16.9)	0.71	14.2 (0.6, 29.8)	0.04*	13.1 (-4.2, 33.4)	0.15	19.9 (6.5, 35.0)	0.003*	16.9 (4.2, 31.1)	0.01*	24.1 (6.9, 44.0)	0.01*
Mn	-6.1 (-14.6, 3.2)	0.19	5.2 (-6.2, 17.9)	0.39	3.6 (-8.1, 16.8)	0.57	4.9 (-3.8, 14.4)	0.28	11.4 (0.2, 23.8)	0.05*	7.9 (-3.3, 20.4)	0.18
Mo	6.0 (-9.0, 23.5)	0.46	10.9 (-2.3, 26.0)	0.11	-0.7 (-12.5, 12.6)	0.91	5.2 (-8.5, 21.1)	0.48	3.9 (-7.6, 16.8)	0.52	9.5 (-2.4, 22.8)	0.12
Sb	-0.9 (-13.8, 14.0)	0.90	6.5 (-5.5, 20.0)	0.31	6.7 (-5.1, 20.1)	0.28	20.6 (6.2, 36.9)	0.005*	3.3 (-7.3, 15.0)	0.56	6.3 (-4.5, 18.2)	0.26
Sn	-3.9 (-14.6, 8.1)	0.51	4.4 (-7.0, 17.1)	0.47	19.3 (3.1, 38.1)	0.02*	7.8 (-3.4, 20.3)	0.18	6.5 (-4.3, 18.4)	0.25	7.3 (-6.2, 22.7)	0.31
Zn	12.1 (-1.6, 27.7)	0.09	14.2 (0.1, 30.3)	0.05*	10.5 (-4.7, 28.1)	0.19	12.9 (0.0, 27.4)	0.05	2.3 (-9.5, 15.5)	0.72	5.0 (-8.3, 20.2)	0.48
<i>Non-essential metals</i>												
As	5.2 (-8.6, 21.1)	0.48	2.2 (-11.7, 18.4)	0.77	2.9 (-11.2, 19.2)	0.71	3.4 (-9.2, 17.7)	0.61	-0.9 (-13.5, 13.5)	0.90	9.0 (-4.6, 24.7)	0.21
Ba	-0.7 (-14.7, 15.6)	0.92	9.5 (-3.8, 24.7)	0.17	-0.4 (-15.2, 16.9)	0.96	13.7 (-1.1, 30.7)	0.07	2.8 (-8.7, 15.9)	0.65	-7.5 (-20.2, 7.1)	0.30
Cd	2.6 (-11.9, 19.4)	0.74	1.2 (-11.6, 15.9)	0.86	-11.6 (-27, 7.0)	0.21	13.0 (-1.7, 29.9)	0.09	-0.9 (-12.4, 12.0)	0.88	-3.5 (-19.0, 15.0)	0.69
Hg	-3.9 (-17.2, 11.5)	0.60	5.3 (-8.6, 21.3)	0.48	-0.7 (-14.8, 15.7)	0.92	3.9 (-9.3, 19.0)	0.59	5.0 (-7.9, 19.6)	0.47	-9.7 (-21.5, 3.8)	0.15
Ni	-2.8 (-14.2, 10.1)	0.66	15.2 (0.7, 31.7)	0.04*	5.4 (-7.4, 20.0)	0.43	14.5 (2.0, 28.5)	0.02*	6.2 (-6.1, 20.1)	0.34	9.4 (-2.8, 23.2)	0.14
Pb	-9.1 (-24.1, 8.9)	0.30	6.2 (-13.4, 30.4)	0.56	-2.0 (-23, 24.8)	0.87	12.1 (-5.1, 32.5)	0.18	3.4 (-14.4, 24.9)	0.73	12.4 (-9.9, 40.2)	0.30

8-iso-PGF2 α enzymatic fraction						
	Visit 1		Visit 2		Visit 3	
	% Δ (95% CI)	<i>p</i> value	% Δ (95% CI)	<i>p</i> value	% Δ (95% CI)	<i>p</i> value
<i>Essential metals</i>						
Co	-11.2 (-43, 38.2)	0.60	8.5 (-36.6, 85.8)	0.77	55.8 (-19.3, 201)	0.19
Cs	8.8 (-29.0, 66.8)	0.70	53.6 (-1.2, 139)	0.06	62.1 (5.1, 150)	0.03*
Cu	-22.8 (-54.1, 29.8)	0.33	0.8 (-39.1, 66.9)	0.98	23.9 (-35.5, 138)	0.52
Mn	-20.5 (-45.2, 15.4)	0.23	-20.0 (-49.2, 25.8)	0.34	-18.7 (-49.2, 30.2)	0.39
Mo	-28.5 (-60.6, 29.8)	0.27	57.4 (-4.2, 157)	0.08	22.6 (-24.6, 99.5)	0.41
Sb	-11.4 (-49.0, 53.8)	0.67	24 (-22.4, 98.2)	0.37	38.1 (-13.1, 120)	0.18
Sn	4.0 (-35.0, 66.4)	0.87	-12.9 (-44.9, 37.6)	0.56	36.9 (-23.3, 144)	0.29
Zn	24.6 (-25.6, 109)	0.40	83.7 (9.5, 208)	0.02*	52.7 (-14.1, 172)	0.15
<i>Non-essential metals</i>						
As	-12.1 (-49.6, 53.4)	0.65	7.6 (-39.8, 92.4)	0.81	16.8 (-34.3, 108)	0.60
Ba	-21.5 (-56.8, 42.6)	0.43	47.8 (-11.3, 146)	0.14	35.3 (-28.0, 154)	0.35
Cd	-20.4 (-56.2, 44.8)	0.46	18.2 (-30.4, 101)	0.54	-30.7 (-67.4, 47.1)	0.34
Hg	21.7 (-32.3, 119)	0.51	15.2 (-34.2, 102)	0.62	9.6 (-40.1, 100)	0.77
Ni	-22.4 (-52.8, 27.5)	0.32	30.9 (-22.9, 122)	0.32	30.7 (-21.6, 118)	0.31
Pb	-32.8 (-67.1, 37.4)	0.28	11.5 (-50.4, 151)	0.79	2.3 (-60.5, 165)	0.96

Abbreviations: cobalt (Co); cesium (Cs); copper (Cu); manganese (Mn); molybdenum (Mo); antimony (Sb); tin (Sn); zinc (Zn); arsenic (As); barium (Ba); cadmium (Cd); mercury (Hg); nickel (Ni); lead (Pb).

* denotes $p < 0.05$

*denotes $p < 0.05$ & q value (false discovery rate) < 0.05