

Supplemental Material

First trimester maternal exposures to endocrine disrupting chemicals and metals and fetal size in the Michigan Mother Infant Pairs study

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Table S1. Sex-Stratified Anthropometric Measures

	Females (n=29)		Males (n=27)	
	<i>Median</i>	<i>Range</i>	<i>Median</i>	<i>Range</i>
Birthweight (g)	3410	(2805 - 4070)	3640	(2860 - 4685)
Fenton z-score % tile	54.4	(6.6 - 85.2)	62.7	(12.8 - 95.1)
Fetal Anthropometry ^a				
Abdominal circ.	137	(111 – 161)	140	(127 – 242)
Biparietal diameter	43.4	(36 – 48)	44	(40 – 70.4)
Femur length	29.6	(23 – 36)	29.4	(24 – 51.4)
Head circ. ^b	161	(135 – 182)	164	(155 – 265)

^a Units= mm; ^b Circ: circumference

Table S2. Correlations of phthalate metabolites in first trimester maternal urine samples (n=56)

Phthalate	MnBP	MBzP	mCINP	MCOMHP	MCP	MeCPP	MEHHP	MEHP	MEOHP	MEP	MiBP
MnBP		0.79	0.65	0.79	0.68	0.78	0.77	0.74	0.79	0.54	0.81
MBzP	<0.001		0.59	1.00	0.58	0.73	0.72	0.70	0.71	0.29	0.72
mCINP	<0.001	<0.001		0.59	0.88	0.77	0.66	0.69	0.67	0.32	0.60
MCOMHP	<0.001	<0.001	<0.001		0.58	0.73	0.72	0.70	0.71	0.29	0.71
MCP	<0.001	<0.001	<0.001	<0.001		0.76	0.66	0.67	0.68	0.38	0.60
MeCPP	<0.001	<0.001	<0.001	<0.001	<0.001		0.92	0.85	0.92	0.40	0.76
MEHHP	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001		0.91	0.99	0.45	0.75
MEHP	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001		0.91	0.34	0.68
MEOHP	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001		0.48	0.76
MEP	<0.001	0.03	0.02	0.03	0.004	0.002	0.001	0.01	<0.001		0.48
MiBP	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.001	

Above diagonal denotes spearman correlation; Below diagonal denotes p-value associated with correlation value

Table S3. Correlations of phenols in first trimester maternal urine samples (n=56)

Phenol	2,4-DCP	2,5-DCP	BP-3	BPA	BPF	BPS	BuPB	EtPb	MePB	PrPB	TCS
2,4-DCP		0.64	0.43	0.65	0.30	0.5	0.04	0.50	0.46	0.19	0.60
2,5-DCP	<0.001		0.29	0.55	0.20	0.33	0.04	0.31	0.31	0.04	0.44
BP-3	0.001	0.03		0.30	0.30	0.26	0.06	0.44	0.43	0.33	0.44
BPA	<0.001	<0.001	0.02		0.31	0.46	0.08	0.41	0.36	0.13	0.40
BPF	0.03	0.14	0.03	0.02		0.12	-0.06	0.40	0.19	0.24	0.19
BPS	<0.001	0.01	0.05	<0.001	0.39		0.11	0.17	0.51	0.35	0.32
BuPB	0.79	0.75	0.67	0.55	0.64	0.41		0.15	0.05	0.07	-0.09
EtPB	<0.001	0.02	0.001	0.002	0.003	0.22	0.28		0.44	0.44	0.37
MePB	0.003	0.02	0.001	0.01	0.15	<0.001	0.72	0.001		0.81	0.45
PrPB	0.16	0.79	0.01	0.32	0.08	0.01	0.59	0.001	<0.001		0.21
TCS	<0.001	0.001	0.001	0.002	0.15	0.02	0.53	0.01	0.001	0.12	

Above diagonal denotes spearman correlation; Below diagonal denotes p-value associated with correlation value

Table S4. Correlations of metals in first trimester maternal urine samples (n=55)

Metal	As	Ba	Cd	Cr	Cu	Hg	Mn	Mo	Ni	Pb	Se	Sn	Tl	Zn
As		0.35	0.58	0.50	0.56	0.31	0.57	0.67	0.69	0.45	0.78	0.62	0.55	0.70
Ba	0.01		0.39	0.54	0.15	-0.10	0.13	0.20	0.28	0.29	0.30	0.36	0.28	0.15
Cd	<0.001	0.02		0.64	0.65	0.18	0.66	0.66	0.74	0.54	0.73	0.66	0.53	0.66
Cr	<0.001	<0.001	<0.001		0.55	-0.09	0.54	0.54	0.58	0.42	0.59	0.50	0.45	0.52
Cu	<0.001	0.28	<0.001	<0.001		0.24	0.72	0.60	0.80	0.64	0.71	0.69	0.47	0.72
Hg	0.02	0.45	0.19	0.51	0.07		0.22	0.29	0.24	0.20	0.21	0.24	0.19	0.30
Mn	<0.001	0.35	<0.001	<0.001	<0.001	0.11		0.60	0.75	0.53	0.76	0.71	0.52	0.66
Mo	<0.001	0.15	<0.001	<0.001	<0.001	0.03	<0.001		0.72	0.37	0.74	0.66	0.42	0.68
Ni	<0.001	0.04	<0.001	<0.001	<0.001	0.08	<0.001	<0.001		0.69	0.80	0.71	0.52	0.78
Pb	0.001	0.03	<0.001	0.001	<0.001	0.15	<0.001	0.01	<0.001		0.46	0.59	0.47	0.56
Se	<0.001	0.02	<0.001	<0.001	<0.001	0.13	<0.001	<0.001	<0.001	0.001		0.75	0.51	0.85
Sn	<0.001	0.01	<0.001	<0.001	<0.001	0.08	<0.001	<0.001	<0.001	<0.001	<0.001		0.56	0.67
Tl	<0.001	0.04	<0.001	0.001	<0.001	0.17	<0.001	0.001	<0.001	0.003	<0.001	<0.001		0.48
Zn	<0.001	0.27	<0.001	<0.001	<0.001	0.03	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	

Above diagonal denotes spearman correlation; Below diagonal denotes p-value associated with correlation value

Table S5. Distribution of summed chemicals among MMIP women (n=56)

Σ score	N ^a	Mean	SD	Min	P10	P25	P50	P75	P95	P99	Max
Phthalates	12	12.18	7.38	1	1	6	11	19	23	23	23
Phenols	12	12.45	5.31	3	6	8	12	17	22	22	22
Metals ^b	17	17.15	8.58	3	6	10	18	25	30	32	32
Total ^b	41	41.46	19.71	7	16	24	39.5	62	71	75	75

^aN=number of chemicals/elements measured; ^bn=55 women
 Concentration ranks assigned were 0, 1, and 2; Maximum possible score for phthalates and metals = 24, metals = 34, and total = 82

Table S6. Bivariate associations of phthalate metabolites and survey responses among MMIP women

	Metabolite																					
	MnBP		MBzP		MCOMHP		mCINP		MCP		meCPP		MEHHP		MEHP		MEOHP		MEP		MiBP	
	M	p	M	p	M	p	M	p	M	p	M	p	M	p	M	p	M	p	M	p	M	p
P&C ^a		0.14		0.76		0.75		0.90		0.50		0.50		0.26		0.23		0.18		0.10		0.36
No	1.55		7.52		7.51		2.70		4.07		8.94		8.27		2.01		3.92		22.46		6.45	
Yes	2.04		15.99		15.99		1.90		4.55		8.87		9.33		3.18		5.20		83.71		6.09	
Hair ^a		0.42		0.06		0.06		0.31		0.09		0.12		0.08		0.08		0.08		0.42		0.23
No	11.22		13.10		13.10		2.18		6.66		10.99		12.25		3.96		7.15		166.74		7.97	
Yes	11.60		14.31		14.30		2.07		3.77		8.24		8.12		2.58		4.22		40.09		5.63	
FF ^b		0.004		0.10		0.10		0.002		0.04		0.02		0.20		0.17		0.14		0.17		0.01
No	17.51		15.90		15.90		1.44		2.51		6.15		7.49		2.50		3.80		79.30		4.24	
Yes	8.19		10.66		10.66		3.24		7.91		13.81		11.95		3.63		6.68		51.84		9.65	

^a no (n=13) yes (n=43); ^b no (n=36) yes (n=20)

M: Median; p: p-value; P&C: Perfume and Cosmetics; Hair: Haircare Products; FF: Fast Food; FV: Fresh Vegetables

Table S7. Bivariate associations for phenols and survey responses among MMIP women

		Phenols											
		2,4-DCP		2,5-DCP		BP-3		BPA		BPF		BPS	
		M	P	M	P	M	P	M	P	M	P	M	P
Perfume & Cosmetic			0.31		0.30		0.80		0.63		0.84		0.06
	No	0.23		0.20		58.22		0.72		0.14		0.14	
	Yes	0.33		0.29		49.64		0.83		0.14		0.14	
Hair products			0.57		0.35		0.01		0.34		0.75		0.82
	No	0.24		0.22		51.24		0.70		0.14		0.14	
	Yes	0.74		0.61		47.12		1.06		0.14		0.14	
Canned Food			0.66		0.50		0.60		0.57		0.03		0.76
	No	0.25		0.22		39.52		0.83		0.14		0.14	
	Yes	0.34		0.31		58.22		0.64		0.14		0.14	
Fast food			0.11		0.03		0.75		0.40		0.50		0.37
	No	0.24		0.22		51.24		0.70		0.14		0.14	
	Yes	0.74		0.61		47.12		1.06		0.14		0.14	

Note: Equivalent medians may result from low detection rates

Table S7 cont'd. Bivariate associations for phenols and survey responses among MMIP women

	Phenols									
	BuPB		EtPb		MePB		PrPB		TCS	
	M	P	M	P	M	P	M	P	M	P
Perfume & Cosmetic		0.28		0.69		0.06		0.24		0.64
No	0.14		0.73		15.55		6.88		13.20	
Yes	0.14		0.42		93.60		15.32		17.05	
Hair products		0.64		0.86		0.21		0.35		0.21
No	0.14		0.28		25.27		7.51		11.18	
Yes	0.14		2.31		98.38		22.16		28.95	
Canned Food		0.72		0.66		0.71		0.81		0.87
No	0.14		1.00		75.87		7.96		15.47	
Yes	0.14		0.48		53.06		15.32		13.74	
Fast food		0.57		0.08		0.03		0.08		0.03
No	0.14		0.28		25.27		7.51		11.18	
Yes	0.14		2.31		98.38		22.16		28.95	

Table S8. Bivariate associations with bisphenol A, F, and S and canned food consumption (n=56)

	Bisphenol					
	BPA		BPF		BPS	
	M	p-value	M	p-value	M	p-value
Canned food consumption		0.57		0.03		0.76
No	0.83		0.14		0.14	
Yes	0.64		0.14		0.14	
Canned food frequency		0.21		0.02		0.58
None	1.20		0.32		0.25	
≤ 1 serving/day	1.34		1.39		0.32	
2-3 servings/day	4.58		6.52		0.26	
≥ 4 servings/day	-		-		-	

M: Median

Table S9. Bivariate associations for metals and survey responses among MMIP women

	Metals													
	As		Ba		Cd		Cr		Cu		Hg		Mn	
	M	P	M	P	M	P	M	P	M	P	M	P	M	P
Perfume & Cosmetic		0.26		0.82		0.14		0.37		0.93		0.33		0.27
No	2.75		5.96		0.04		0.59		7.76		0.09		1.24	
Yes	4.26		4.60		0.06		0.72		9.36		0.04		1.67	
Hair products		0.46		0.39		0.49		0.75		0.49		0.70		0.09
No	4.57		2.95		0.07		0.71		9.69		0.07		1.97	
Yes	3.68		4.91		0.04		0.71		9.13		0.06		1.40	
Canned Food		0.21		0.48		0.41		0.57		0.79		0.08		0.85
No	3.66		4.60		0.04		0.69		7.66		0.04		1.54	
Yes	4.47		4.73		0.51		0.72		10.40		0.08		1.54	
Fast food		0.40		0.28		0.02		0.34		0.07		0.64		0.15
No	3.68		4.10		0.04		0.68		7.33		0.04		1.28	
Yes	4.47		4.82		0.13		0.83		11.83		0.06		1.74	

M: Median; P: P-value

Table S9 cont'd. Bivariate associations for metals and survey responses among MMIP women

	Metals													
	Mo		Ni		Pb		Se		Sn		Tl		Zn	
	M	P	M	P	M	P	M	P	M	P	M	P	M	P
Perf. & Cosmetic		0.71		0.23		0.21		0.28		0.28		0.28		0.61
No	50.13		2.73		0.13		33.82		0.19		0.15		171.04	
Yes	47.27		4.80		0.25		51.85		0.38		0.19		235.48	
Hair products		0.13		0.55		0.42		0.29		0.58		0.11		0.52
No	68.30		4.94		0.23		52.82		0.45		0.20		200.82	
Yes	40.47		3.91		0.21		44.51		0.27		0.17		178.03	
Canned Food		0.06		0.48		0.11		0.30		0.09		0.60		0.32
No	41.25		3.91		0.17		42.13		0.29		0.15		169.82	
Yes	61.00		5.01		0.28		50.98		0.39		0.20		254.41	
Fast food		0.07		0.06		0.31		0.01		0.02		0.22		0.02
No	40.47		3.16		0.17		36.05		0.18		0.15		170.65	
Yes	81.86		4.92		0.28		66.06		0.50		0.19		332.71	

M: Median; P: P-value

Table S10. Associations between Bisphenol F and S dichotomized by detected vs. not detected and birth outcomes (n=56)

Phenol	Birth outcomes					
	Birth weight (g) ^a			Fenton z-score ^b		
	β	(95% CI)	p-value	B	(95% CI)	p-value
BPF	-7.88	(-270.32, 254.56)	0.95	-0.18	(-0.73, 0.37)	0.52
BPS	-220.10	(-424.94, -15.26)	0.04	-0.51	(-0.94, -0.07)	0.02

^a Adjusted for Specific gravity, gestational age, and gender; ^b Adjusted for Specific gravity;