

Infant Phthalate Exposures and Potential Developmental Impacts

Study For Future Families:

Cohort of Mother/Baby Pairs from Missouri, California, and Minnesota

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Research Questions



- Is Infant Personal Care Product Use Associated with Urine Phthalate Concentrations?
- Is Maternal Phthalate Exposure Associated with Developmental Outcomes in Infants?

Demographic Characteristics

Cohort: 163 Infants

Sex

Females 52%
Males 48%

Geographic

Minnesota 48%
California 26%
Missouri 26%

Ages (mo)

2-8 25%
9-16 50%
17 – 24 25%

Race

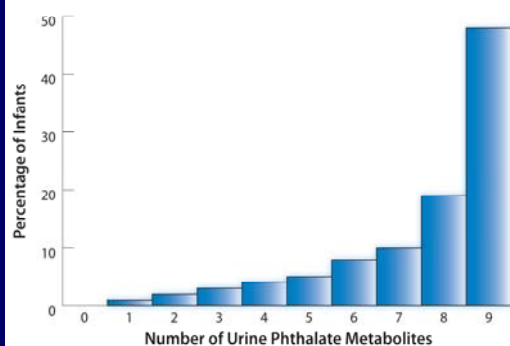
White 80%
Hispanic/Latino 11%
Asian 5%
African American 3%
Native American 1%

Socio-Economic Status

Health Insurance 91%
No Health Insurance 9%

Results

Number of Phthalate Metabolites Found in Infant Urine Samples (N=163)



Results

Distribution of Phthalates (mcg/L)

Phthalate (N = 163)	% > LOD	Geometric Mean
Monoethyl (MEP)	98	64.5
Monobutyl (MBP)	99	19.3
Monomethyl (MMP)	66	1.8
Mono-3-carboxypropyl (MCPP)	83	4.0
Monobenzyl (MBZP)	94	14.9
Monoisobutyl (MiBP)	85	3.5
Mono-2-ethyl-5-oxohexyl (MEOHP)	94	11.4
Mono-2-ethylhexyl (MEHP)	76	2.9
Mono-2-ethyl-5-hydroxyhexyl (MEHHP)	93	13.7

LOD = Limit of Detection

** These levels are similar or lower to those of age 6-11 children in NHANES

Results

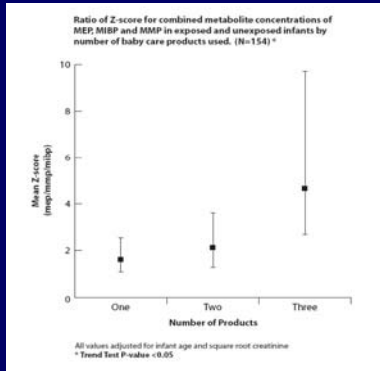
Ratio of Z-Score Combined Phthalate Metabolite Concentration (mep/mmp/mibp) by Age in Exposed and Unexposed Infants

	Product Type	Mean Z-score			Mean Z-score			Mean Z-score		
		Subgroup	N	%	Subgroup	N	%	Subgroup	N	%
Strong/ Significant	Baby Powder	2.7*	1.3	5.9	2.0*	1.02	4.0	2.1*	1.3	3.6
	Baby Lotion	5.6*	1.7	18.3	1.5	0.8	2.6	2.1*	1.3	3.4
	Baby Shampoo	2.1	0.6	7.4	1.4	0.4	4.3	1.6*	1.03	2.4
Weak/Not Significant	Desitin/Diaper Cream	1.4	0.5	3.9	0.7	0.6	1.6	1.1	0.7	1.7
	Baby Wipes	2.1	0.4	11.1	1.4	0.4	4.3	1.4	0.5	3.6

All values adjusted for infant age, and square root creatinine, nine infants had missing creatinine values and were not included in analysis

*p-value <0.05

Results



Conclusions

- Phthalate exposure is widespread and distribution varied in infants
- Reported infant exposure to lotion, powder, and shampoo significantly increased urinary concentrations of MEP, MMP, and MiBP and associations are strongest in younger infants
- Dermally applied baby products significantly contribute to infant phthalate body burden

Research Question



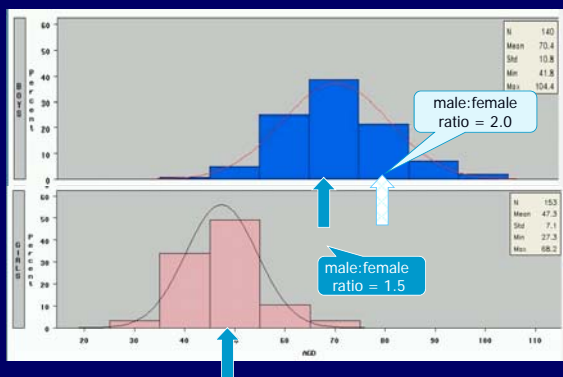
- Is Maternal Phthalate Exposure Associated with Developmental Outcomes in Infants?

Anogenital Distance



- Significance – marker of masculinization in animals
- length ratio 2:1 for Males : Females in rats
- shortened AGD associated with genital tract abnormalities

AGD by Sex



Analysis of Male Anogenital Distance

- AGD increases with both age and weight
- These are strongly correlated ($R^2 = 0.88$, $p < 0.0001$)
- We used standard growth curves to adjust for body size (CDC, 2000)
- Weight percentile (WT%) calculated for each boy at each visit
- Expected AGD modeled for male infants:
 - Using all visits (mixed model)
 - WT% and age were the only significant predictors
- Residual AGD = Observed - Expected → categorized into short, intermediate, and longer

Results of Regression Analysis*:

Significant (p-value)

MBP (0.048)
MEP (0.005)
DEHP metabolites
MEHP (0.017)
MEOHP (0.001)
MEHHP (0.002)

Borderline

MMP (0.053)
MiBP (0.097)

Not Significant

MBzP (0.826)
MCPPE (0.591)

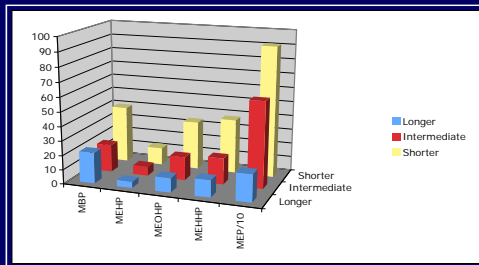
* Mixed model including 106 boys and 165 visits

Odds Ratio (95% CI) for Shorter AGD

Exposure	Medium : Low *	High : Low *
MBP	5.7 (1.2, 27.3)	9.2 (1.8, 46.2)
MEHP	1.7 (0.5, 5.2)	3.2 (0.9, 11.5)
MEOHP	10.2 (1.3, 82.5)	29.1 (3.4, 245.6)
MEHHP	4.8 (1.0, 22.9)	13.0 (2.6, 66.4)
MEP	4.6 (1.0, 21.6)	7.9 (1.5, 41.3)

*Low < 25th %, High >=75th%, Medium, other

Mean Phthalate Concentration by AGD Category



AGD Category

Phthalate Score	Shorter	Longer	P-value*
Low	0	11	Referent
Medium	16	14	0.0014
High	13	1	< 0.0000

* Fisher's Exact Test

Clinical Implications

In Rodents

- At birth: Shorter AGD, impaired testicular descent, hypospadias
- Later: Low sperm count, rarely testicular tumors

Our Study of Humans Suggests

- At birth: Shorter AGD (some, but most NS, decrease in testicular descent, smaller penile volume)

Future studies needed to determine clinical correlates in humans

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