

Table 1. Urinary phthalate metabolites in Polish mother–child pairs

Phthalate metabolites	Mother (n=134)		Child (n=123)	
	Detection rate	median (IQR)	Detection rate	median (IQR)
MEP	100	19.4 (10.7-39.5)	90	9.4 (5.05-21.53)
MBzP	56	0.039 (0.015-0.18)	84	0.39 (0.16-0.72)
MiBP	89	15.0 (1.7-124.5)	89	2.3 (0.99-6.31)
MnBP	95	4.1 (1.8-12.2)	90	3.9 (2.45-9.05)
OH-MnBP	98	5.3 (1.9-10.8)	83	4.15 (1.88-13.68)
MEHP	66	0.19 (0.015-0.53)	13	0.02 (0.015-0.015)
OH-MEHP	77	5.1 (0.3-16.7)	90	2.41 (1.24-5.14)
oxo-MEHP	95	1.6 (0.7-5.0)	77	1.25 (0.57-2.81)
OH -MiNP	90	0.76 (0.5-2.3)	92	3.07 (0.99- 9.55)
oxo-MiNP	56	0.42 (0.015-0.57)	65	0.20 (0.015-0.56)
MnOP	66	0.20 (0.015-0.41)	33	0.02 (0.015-0.23)

IQR – interquartile range

mono-ethyl phthalate (MEP), mono-isobutyl phthalate (MiBP), mono-n-butyl phthalate (MnBP), 3OH-mono-n-butyl phthalate (OH-MnBP), mono-benzyl phthalate (MBzP), mono-2-ethylhexyl phthalate (MEHP), mono-2-ethyl-5-hydroxyhexyl phthalate (OH-MEHP), mono-2-ethyl-5-oxo-hexyl phthalate (oxo-MEHP), 7-OH-mono-methyloctyl phthalate (OH-MiNP), 7-oxo-mono-methyloctyl phthalate (oxo-MiNP), mono-n-octyl phthalate (MnOP).

Table 2. Children within normal, borderline and clinical range from SDQ (N=132)

<b>Problem scales</b>	<b>Normal</b>	<b>Borderline</b>	<b>Clinical</b>
	<b>n (%)</b>		
Conduct problems	90 (68.2)	28 (21.2)	14 (10.6)
Emotional symptoms	99 (75.0)	17 (12.9)	16 (12.1)
Hyperactivity/Inattention problems	97 (73.5)	15 (11.4)	20 (15.2)
Peer relationship problems	109 (82.6)	11 (8.3)	12 (9.1)
Total difficulties	108 (81.8)	11 (8.3)	13 (9.8)
Prosocial behavior	120 (90.9)	10 (7.6)	2 (1.5)

Table 3. Child IDS scores (N=129)

<b>Intellectual ability</b>	<b>Mean (<math>\pm</math>SD)</b>	<b>Range</b>
Fluid Intelligence (IQ)	104.8 (13.8)	62-135
Crystallized Intelligence (IQ)	105.0 (14.7)	67-135
Cognition	73.8 (11.2)	39-98
Mathematical skills	11.1 (3.0)	5-19
Psychomotor skills	30.4 (5.4)	11-43
Language skills	21.2 (4.8)	9-32

Table 4. Multivariate logistic regression analysis for the association between prenatal and early childhood phthalate exposure and child behavior at early school age based on Strengths and Difficulties Questionnaire (SDQ)

Phthalate metabolites <sup>a</sup>		Conduct problems	Emotional symptoms	Hyperactivity/Inattention problems	Prosocial behavior	Peer relationship problems	Total difficulties
MEP	Mother	0.85 (0.39: 1.82)	0.67 (0.28: 1.60)	1.00 (0.43: 2.34)	2.96 (0.81: 10.83)	2.66 ** (1.09: 6.48)	0.78 (0.31: 1.97)
	Child	0.60 (0.26: 1.37)	2.01 (0.78 :5.18)	2.10 (0.81: 5.43)	0.95 (0.23: 3.88)	1.11 (0.47: 2.65)	1.36 (0.49 :3.75)
MBzP	Child	1.12 (0.52: 2.39)	0.90 (0.40: 2.02)	0.92 (0.41: 2.06)	0.83 (0.22: 3.19)	0.53 (0.23: 1.20)	0.66 (0.26: 1.67)
MiBP	Mother	1.01 (0.71: 1.43)	0.80 (0.54: 1.19)	0.97 (0.66: 1.41)	2.21 * (0.94: 5.19)	0.93 (0.62: 1.40)	0.90 (0.58: 1.39)
	Child	0.97 (0.49: 1.89)	1.95 (0.79: 4.81)	1.26 (0.60: 2.68)	0.64 (0.21: 1.95)	1.63 (0.69: 3.85)	1.04 (0.44: 2.46)
MnBP	Mother	1.11 (0.65: 1.91)	1.08 (0.58:2.01)	1.20 (0.66: 2.17)	1.37 (0.57: 3.25)	1.28 (0.68: 2.40)	0.86 (0.45: 1.64)
	Child	1.87 (0.76: 4.64)	1.79 (0.65: 4.94)	2.58 * (0.91: 7.31)	1.07 (0.24: 4.78)	0.72 (0.29: 1.81)	1.50 (0.49: 4.58)

OH-MnBP	Mother	1.58 (0.78: 3.20)	1.09 (0.49: 2.41)	0.90 (0.44: 1.87)	3.88 (0.66: 22.78)	0.68 (0.32: 1.43)	0.82 (0.33: 2.04)
	Child	0.66 (0.37: 1.20)	0.96 (0.52: 1.77)	1.00 (0.53: 1.87)	1.53 (0.55: 4.26)	1.12 (0.58: 2.17)	1.24 (0.60: 2.58)
OH-MEHP	Mother	0.71 (0.46: 1.09)	1.09 (0.69: 1.70)	1.08 (0.68: 1.71)	1.57 (0.74: 3.35)	1.02 (0.64: 1.63)	1.11 (0.66: 1.87)
	Child	1.02 (0.98: 1.07)	0.99 (0.95: 1.04)	1.01 (0.98: 1.03)	1.01 (0.98: 1.04)	0.97 (0.91: 1.04)	0.99 (0.95: 1.04)
oxo-MEHP	Mother	0.90 (0.48: 1.70)	0.61 (0.30: 1.22)	0.97 (0.50: 1.88)	2.59 * (0.89: 7.54)	0.93 (0.49: 1.79)	0.74 (0.35: 1.59)
	Child	1.10 (0.96: 1.27)	1.01 (0.98: 1.04)	1.02 (0.98: 1.06)	1.00 (0.90: 1.11)	1.00 (0.97: 1.03)	1.02 (0.98: 1.05)
OH-MiNP	Mother	0.63 (0.32: 1.23)	0.77 (0.38: 1.54)	1.44 (0.71: 2.93)	0.91 (0.31: 2.63)	0.78 (0.36: 1.68)	0.65 (0.29: 1.44)
	Child	1.33 (0.68: 2.57)	1.25 (0.57: 2.76)	1.79 (0.87: 3.67)	0.84 (0.28: 2.58)	0.82 (0.39: 1.70)	1.54 (0.69: 3.42)

\*\* p-value <0.05; \* p-value <0.1

Adjusted for: child's sex, child's age at the neurodevelopmental assessment, birth weight (g), socio-economic status (SES) of the family, prenatal tobacco smoke exposure (based on the cotinine level in maternal saliva), postnatal tobacco smoke exposure (based on cotinine level in child)

urine), maternal educational levels at child examination, breastfeeding duration, maternal pre-pregnancy BMI. Both prenatal and postnatal phthalate exposures were included in one model.

<sup>a</sup> maternal and child phthalate concentrations were natural log-transformed (mothers  $\mu\text{g/g}$  creatine, children  $\mu\text{g/l}$ ), only the phthalate metabolites with detection rate above 70 were included in analysis

Table 5. Multivariate linear regression analysis for the association between prenatal and early childhood phthalate exposure and child cognition and psychomotor development at early school age based on Intelligence and Development Scales (IDS)

Phthalate metabolites <sup>a</sup>		Fluid int. (IQ)	Crystalized int. (IQ)	Cognition	Mathematica l skills	Psychomotor skills	Language skills
MEP	Mother	3.46 * (-0.35:7.26)	2.26 (-2.07:6.59)	2.86 * (-0.23: 5.94)	-0.36 (-1.27: 0 .55)	1.25 (-0.27: 2.77)	1.37 * (-0.03: 2.78)
	Child	-5.17 ** (-8.79:-1.55)	-0.29 (-4.41: 3.82)	-4.16 ** (-7.09:-1.23)	-0.09 (-0.96 : 0.78)	0.2 (-1.26 :1.65)	-0.05 (-1.38: 1.29)
MBzP	Child	-0.63 (-4.72: 3.47)	1.23 (-3.18: 5.64)	-0.51 (-3.82: 2.80)	0.15 (-0.78: 1.08)	0.44 (-1.11: 1.99)	0.39 (-1.06: 1.84)
MiBP	Mother	1.46 (-0.45: 3.38)	-0.40 (-2.51: 1.71)	1.19 (-0.37: 2.74)	-0.36 (-0.79: 0.08)	0.01 (-0.74: 0.76)	0.16 (-0.54: 0.85)
	Child	-2.71 (-6.35: 0.93)	1.9 (-2.11: 5.91)	-2.14 (-5.08: 0.81)	0.69 (-0.13:1.51)	-0.52 (-1.95: 0.91)	0.17 (-1.16: 1.49)
MnBP	Mother	1.17 (-1.72: 4.05)	1.00 (-2.21: 4.21)	0.98 (-1.35: 3.31)	-0.18 (-0.85: 0.50)	0.27 (-0.87: 1.40)	0.61 (-0.44: 1.66)
	Child	-4.91 ** (-9.32: -0.50)	0.09 (-4.82: 4.99)	-3.95 ** (-7.53: -0.38)	0.42 (-0.61: 1.45)	-1.11 (-2.84: 0.62)	-0.39 (-1.99: 1.22)

OH-MnBP	Mother	2.95 (-0.78: 6.68)	0.25 (-3.84: 4.34)	2.42 (-0.60: 5.44)	-0.56 (-1.41: 0.29)	0.34 (-1.12: 1.79)	0.74 (-0.60: 2.08)
	Child	-1.20 (-4.14: 1.75)	0.38 (-2.86: 3.61)	-0.96 (-3.34: 1.43)	-0.02 (-0.69: 0.65)	0.34 (-0.83: 1.51)	0.18 (-0.88: 1.24)
OH-MEHP	Mother	1.96 * (-0.28: 4.2)	0.73 (-1.73: 3.19)	1.58 * (-0.24: 3.39)	-0.3 (-0.8: 0.22)	0.23 (-0.64: 1.11)	0.62 (-0.18: 1.42)
	Child	-0.04 (-0.17: 0.09)	-0.02 (-0.16: 0.12)	-0.03 (-0.14: 0.07)	0.02 (-0.01: 0.05)	0.01 (-0.04: 0.07)	-0.03 (-0.07: 0.02)
oxo-MEHP	Mother	3.59 ** (0.30: 6.87)	2.57 (-1.05: 6.18)	2.87 ** (0.21: 5.54)	0.26 (-0.5: 1.02)	1.16 * (-0.13: 2.44)	0.90 (-0.29: 2.1)
	Child	-0.06 (-0.19: 0.070)	-0.06 (-0.20: 0.09)	-0.05 (-0.16: 0.06)	-0.02 (-0.05: 0.01)	-0.001 (-0.05: 0.05)	-0.005 (-0.05: 0.04)
OH-MiNP	Mother	-0.68 (-4.18: 2.82)	-1.79 (-5.59: 2.01)	-0.50 (-3.34: 2.33)	-0.56 (-1.36: 0.23)	-1.04 (-2.35: 0.27)	-0.20 (-1.46: 1.05)
	Child	-2.02 (-5.58: 1.55)	-0.41 (-4.28: 3.46)	-1.63 (-4.51: 1.26)	-0.13 (-0.94: 0.68)	-1.23 * (-2.57: 0.11)	-0.06 (-1.34: 1.22)

\*\* p-value <0.05; \* p-value <0.1

Adjusted for: child's sex, child's age at the neurodevelopmental assessment, prenatal tobacco smoke exposure (based on the cotinine level in maternal saliva), postnatal tobacco smoke exposure (based on cotinine level in child urine), maternal educational levels at child examination, place of residence, birth weight (g), psychologist who have performed child neurodevelopmental examination. Both prenatal and postnatal phthalate exposures were included in one model.



<sup>a</sup>maternal and child phthalate concentrations were natural log-transformed (mothers  $\mu\text{g/g}$  creatine, children  $\mu\text{g/l}$ ), only the phthalate metabolites with detection rate above 70 were included in analysis