Relationships between obesity parameters and urinary concentrations of phthalates and phenols in in Korean girls

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Background and Objective

- Humans are exposed to a variety of endocrine disruptors (EDs), including phthalates and phenol substitutes, in daily life. Previous studies have suggested the association between individual EDs and the risk of obesity, however, studies on the effects of multiple EDs have been extremely limited. We investigated the associations of urinary 15 phthalates and 26 phenol substitutes with adiposity measures in Korean girls.

Subjects and Methods

- A total of 75 girls, aged 7 to 8 years old (28 obese and 47 controls), were recruited. Anthropometric indices, such as body mass index (BMI) and waist circumferences (WC), were also determined. The urinary concentrations of phthalates and phenol substitutes were measured using column switching coupled to liquid chromatography-tandem mass spectrometry (LC-MS/MS).

Results

Table 1. General Characteristics

	Total (n=75)	Control (n=47)	Obesity (n=28)	P -value
Age (years)	8.4 ± 0.6	8.4 ± 0.5	8.3 ± 0.7	0.463
Height (cm)	132.5 ± 7.2	131.6 ± 6.1	134.1 ± 8.6	0.187
Weight (kg)	34.0 ± 7.6	30.2 ± 5.0	40.3 ± 6.9	0.000
BMI (kg/m^2)	19.2 ± 3.0	17.3 ± 1.9	22.3 ± 1.9	0.000
WC (cm)	64.1 ± 7.7	59.8 ± 5.0	71.2 ± 6.0	0.000
Height percentile	72.4 ± 26.2	68.4 ± 26.9	79.2 ± 23.9	0.085
Weight percentile	74.9 ± 27.4	63.4 ± 28.6	94.0 ± 11.6	0.000
BMI percentile	73.8 ± 28.6	59.9 ± 29.0	97.0 ± 2.4	0.000
Sample time				0.000
<10:00	9 (12.0%)	1 (2.1%)	8 (28.6%)	
10:00-13:59	44 (58.7%)	27 (57.4%)	17 (60.7%)	
≥14:00	22 (29.3%)	19 (40.4%)	3 (10.7%)	
Regular PA				0.611
No	43 (57.3%)	28 (59.6%)	15 (53.6%)	
Yes	32 (42.7%)	19 (40.4%)	13 (46.4%)	
Calorie intake				0.000
<80% of EER	14 (18.7%)	14 (29.8%)	0 (0%)	
80~119% of EER	31 (41.3%)	29 (61.7%)	2 (7.1%)	
≥120% of EER	30 (40.0%)	4 (8.4%)	26 (92.9%)	
Household income				0.735
<300 KRW	11 (14.7%)	7 (14.9%)	4 (14.3%)	
300~499 KRW	56 (74.7%)	36 (76.6%)	20 (71.4%)	
≥500 KRW	8 (10.7%)	4 (8.5%)	4 (14.3%)	

Table 2. Percentiles of urinary phenols, phthalate and PAH levels (ng/mL)

				Selected percentiles (95% CI)				
		LOD	>LOD(%)	10th	25th	50th	75th	90th
Alkyl phenols	t-butylphenol	0.165	38.7	<LOD	<LOD	<LOD	0.683	2.147
	t-octylphenol	0.165	93.3	0.195	0.242	0.323	0.436	0.567
	nonylphenol	0.165	85.3	<LOD	0.207	0.348	0.475	0.592
	n-butylphenol	0.023	5.3	LOD	LOD	LOD	LOD	LOD
	n-pentylphenol	0.013	4.0	LOD	LOD	LOD	LOD	LOD
	n-hexylphenol	0.023	5.3	LOD	LOD	LOD	LOD	LOD
	n-heptylphenol	0.040	2.7	LOD	LOD	LOD	LOD	LOD
	n-octylphenol	0.102	1.3	LOD	LOD	LOD	LOD	LOD
Chloro phenols	2,4-dichlorophenol	0.017	100.0	0.239	0.317	0.462	0.639	0.983
	2,5-dichlorophenol	0.050	98.7	0.181	0.245	0.421	0.775	1.494
	2,4,5-trichlorophenol	0.013	40.0	<LOD	<LOD	0.06	0.179	0.214
	2,4,6-trichlorophenol	0.026	22.7	<LOD	<LOD	0.042	0.26	0.72
Benzo phenones	benzophenone-1	0.026	97.3	0.220	0.280	0.503	0.945	2.031
	benzophenone-2	0.003	5.3	LOD	LOD	LOD	LOD	LOD
	benzophenone-3	0.033	100.0	0.281	0.551	0.996	2.123	4.381
	benzophenone-4	0.023	0.0	LOD	LOD	LOD	LOD	LOD
	benzophenone-8	0.010	61.3	<LOD	0.018	0.322	0.458	0.58
	4-OH-benzophenone	0.013	100.0	0.167	0.274	0.403	0.681	0.961
Bisphenols	bisphenol-A	0.086	100.0	0.444	0.942	1.844	3.444	5.495
	bisphenol-F	0.099	17.3	<LOD	<LOD	<LOD	0.248	0.884
	bisphenol-S	0.026	100.0	0.176	0.222	0.294	0.398	0.692
Detergent	triclosan	0.056	94.7	0.156	0.230	0.408	1.097	2.093
Parabens	methyl-4-hydroxybenzoate	0.063	100.0	1.411	3.905	11.090	55.86	255.1
	ethyl-4-hydroxybenzoate	0.010	100.0	0.599	2.097	13.050	61.40	162.5
	propyl-4-hydroxybenzoate	0.023	94.7	0.267	0.440	1.100	6.052	22.93
	butyl-4-hydroxybenzoate	0.007	61.3	<LOD	<LOD	0.179	0.204	0.262
Phthalates	MBzP	0.010	80.0	<LOD	0.511	1.564	4.340	11.05
	MCNP	0.007	54.7	<LOD	<LOD	0.093	0.670	1.884
	MCOP	0.007	96.0	0.728	1.915	4.234	8.879	20.83
	MCPP	0.010	50.7	<LOD	<LOD	<LOD	4.041	9.591
	MECPP	0.007	97.3	5.779	10.47	20.84	35.40	55.39
	MEHHP	0.030	94.7	4.076	9.282	16.79	29.34	62.43
	MEOHP	0.010	94.7	2.862	5.796	10.39	18.21	32.78
	MnBP	0.033	89.3	<LOD	7.183	19.73	35.10	63.12
	MMP	0.165	94.7	11.50	27.46	53.71	118.2	178.9
	MEP	0.116	25.3	<LOD	<LOD	<LOD	1.526	7.013
	MiBP	0.165	81.3	<LOD	2.497	30.50	61.48	157.8
	MINP	0.073	21.3	<LOD	<LOD	<LOD	<LOD	2.672
PAHs	1-Hydroxynaphthalene	0.059	57.3	<LOD	<LOD	0.385	1.047	2.326
	2-Hydroxynaphthalene	0.013	97.3	0.371	1.190	3.154	7.267	17.15
	1-Hydroxypyrene	0.017	88.0	<LOD	0.055	0.095	0.169	0.236

Table 3. Adjusted urinary concentrations (least square geometric mean and 95% CI) of phenol, phthalate, and PAH levels by obesity status (adjusted for urinary creatinine, sample time, physical activity, calorie intake, and household income).

	Control	Obesity	P -value
t-octylphenol	0.356 (0.267-0.474)	0.424 (0.314-0.574)	0.214
nonylphenol	0.195 (0.142-0.248)	0.361 (0.249-0.503)	<0.001
2,4-dichlorophenol	0.509 (0.363-0.715)	0.517 (0.363-0.739)	0.926
2,5-dichlorophenol	0.308 (0.162-0.589)	0.562 (0.284-1.111)	0.064
benzophenone-1	0.569 (0.311-1.041)	0.552 (0.292-1.041)	0.917
benzophenone-3	0.979 (0.500-1.920)	1.297 (0.639-2.633)	0.397
benzophenone-8	0.116 (0.032-0.419)	0.027 (0.007-0.104)	0.025
4-OH-benzophenone	0.343 (0.232-0.507)	0.356 (0.236-0.537)	0.845
bisphenol-A	1.406 (0.806-2456)	1.828 (1.016-3.282)	0.343
bisphenol-S	0.398 (0.272-0.582)	0.337 (0.226-0.504)	0.382
triclosan	0.4246 (0.214-0.843)	0.435 (0.212-0.896)	0.940
methyl-4-hydroxybenzoate	15.99 (4.503-56.91)	8.629 (2.272-32.75)	0.323
ethyl-4-hydroxybenzoate	10.37 (3.025-35.50)	16.63 (4.554-60.72)	0.435
propyl-4-hydroxybenzoate	1.610 (0.390-6.656)	0.942 (0.212-4.191)	0.443
butyl-4-hydroxybenzoate	0.039 (0.011-0.132)	0.030 (0.008-0.108)	0.659
MBzP	0.700 (0.147-3.449)	1.570 (0.293-8.424)	0.304
MCNP	0.010 (0.002-0.049)	0.012 (0.002-0.062)	0.851
MCOP	1.276 (0.399-4.081)	0.813 (0.239-2.759)	0.430
MCPP	0.124 (0.014-1.065)	0.091 (0.009-0.873)	0.768
MECPP	9.375 (3.081-28.57)	23.49 (7.277-75.76)	0.098
MEHHP	12.08 (3.806-38.31)	11.86 (3.520-39.94)	0.974
MEOHP	3.420 (1.041-11.24)	9.099 (2.602-31.77)	0.099
MnBP	14.19 (3.026-66.39)	32.43 (6.388-164.5)	0.278
MMP	25.70 (8.423-78.39)	42.75 (13.21-138.1)	0.355
MiBP	4.018 (0.758-21.33)	19.86 (3.436-114.9)	0.056
1-Hydroxynaphthalene	0.184 (0.057-0.593)	0.3041 (0.089-1.036)	0.386
2-Hydroxynaphthalene	2.042 (0.777-5.373)	2.270 (0.821-6.279)	0.824
1-Hydroxypyrene	0.087 (0.054-0.142)	0.074 (0.045-0.124)	0.499

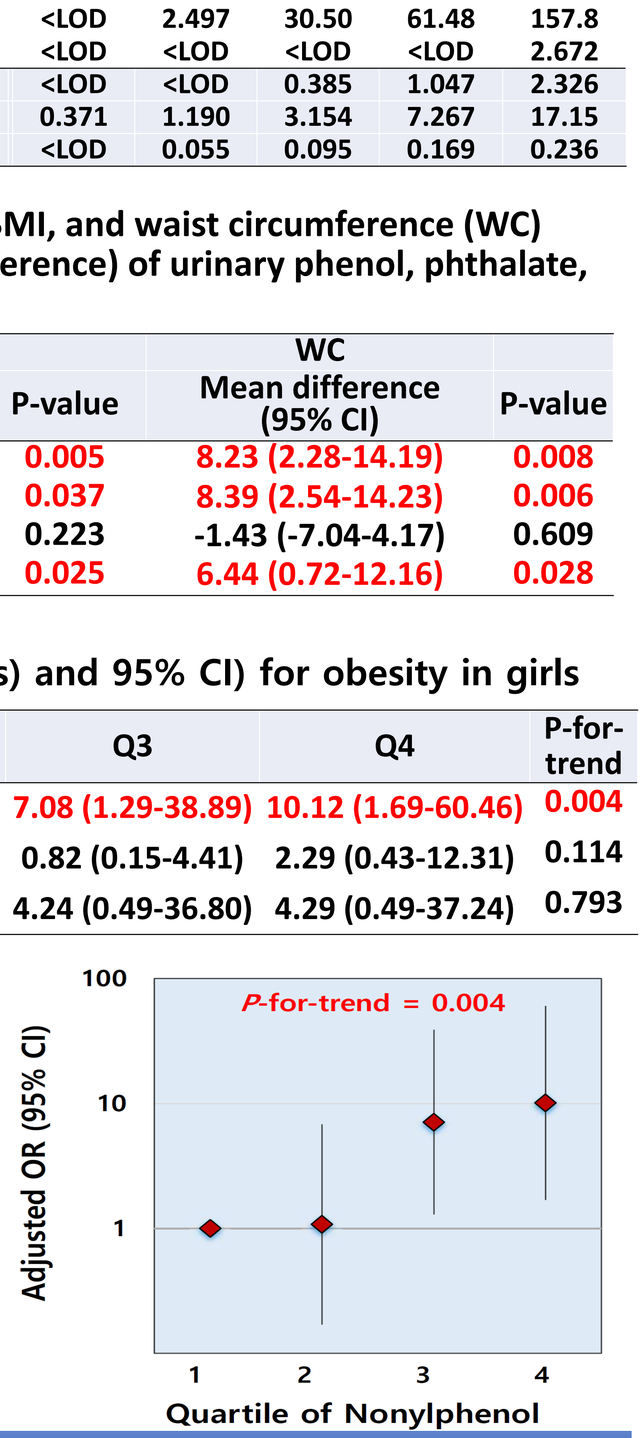
Table 4. Mean difference (95% CI) in BMI, and waist circumference (WC) between quartile 4 and quartile 1 (reference) of urinary phenol, phthalate, and PAH concentrations

	BMI		WC	
	Mean difference (95% CI)	P-value	Mean difference (95% CI)	P-value
nonylphenol	3.24 (1.03-5.45)	0.005	8.23 (2.28-14.19)	0.008
2,5-dichlorophenol	2.45 (0.15-4.74)	0.037	8.39 (2.54-14.23)	0.006
benzophenone-8	1.31 (-3.46-0.83)	0.223	-1.43 (-7.04-4.17)	0.609
MiBP	2.51 (0.34-4.67)	0.025	6.44 (0.72-12.16)	0.028

Table 5. Adjusted odds ratios (ORs) and 95% CI) for obesity in girls

	Q1	Q2	Q3	Q4	P-for-trend
nonylphenol	ref	1.08 (0.17-6.81)	7.08 (1.29-38.89)	10.12 (1.69-60.46)	0.004
2,5-dichlorophenol	ref	0.35 (0.06-2.04)	0.82 (0.15-4.41)	2.29 (0.43-12.31)	0.114
MiBP	ref	10.63 (1.14-99.54)	4.24 (0.49-36.80)	4.29 (0.49-37.24)	0.793

Figure. Adjusted OR (95% CI) for obesity according to the quartiles of urinary nonylphenol concentrations (adjusted for urinary creatinine, physical activity, calorie intake, and household income.



Conclusion

We demonstrated a positive association between urinary nonylphenol and obesity in girls.
Longitudinal studies are needed to confirm our results.