MATERNAL EXPOSUR TO DIOXIN AND INTELLIGENCE DEVELOPMENT IN CHILDREN: A 5-YEAR FOLLOW-UP STUDY

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Abstract
This is a longitudinal study. We evaluated total of 194 children intelligence development in 2006 and collected the placentas and cord blood at birth in 2001. The Wechsler Preschool and Primary Scale of Intelligence-Revised (WPPSI-R) in Chinese version was be used to determine child intelligence development. In backward selection multiple linear regression, dioxin concentration of placenta, growth hormone concentration of cord blood and blood lead were used to predict the WPPSI-R scales. We found there was a negative correlation between blood lead and children intelligence development. But we did not find a similar result in dioxin. The current study might be limited to sample size and low variation of WPPSI-R scales. Nonetheless, it is suggested that children development evaluated by WSSPI-R is largely explained by thyroid hormone and blood lead in the general population.

Introduction
Several studies have shown environmental hormone significantly affect children growth and development. In this study, we aimed to determine the influence of dioxin-like compounds and thyroid hormones on children development.

Materials and Methods
The study subjects were children who were born in a medical center located in Taichung of Taiwan, during Dec. 1, 2000 and Nov. 30, 2001. A total of 194 subjects were included for this study. We collected the placenta and cord blood to analyze the concentration of dioxin-like compounds and thyroid hormones. Intelligence development in children was assessed with the Wechsler Preschool and Primary Scale of Intelligence-Revised (WPPSI-R) in Chinese version. The WPPSI-R was included two items, i.e., Verbal and Performance scales.

Results and Discussion
There was no significantly different in the concentration of thyroid hormones and dioxin in gender (Table 1). Social status was highly correlated with verbal scale. Lactation behavior has a positive correlation with performance scale (Table 2). Table 3 showed the correlation between WPPSI-R scales, thyroid hormones and dioxin-like compounds. The backward selection multiple linear regressions were performed to determine the association between WPPSI-R scales, and dioxin-like compounds (Table 4).

In the table 4, we found blood lead has a negative correlation between performance and verbal scales by backward selection multiple linear regressions. But we didn't find the similar result in dioxin-like compounds. It means blood lead had more strong effect of children intelligence development than dioxin in this study.

The current study might be limited to sample size and low variation of WPPSI-R scales. Nonetheless, it is suggested that children development evaluated by WSSPI-R is largely explained by thyroid hormone and blood lead in the general population.

Table 1. The concentrations of thyroid hormones in cord blood and dioxins in placenta by gender. (41 female and 29 male had their concentration of dioxin-like compound)

mean±SD or n (%)		Female (n=101)	Male (n=93)	*p*	Total (n=194)
Age		4.70 ±1.53	4.85 ±1.10	0.575	4.77 ±1.35
Bone age/ current age		1.01 ±0.19	0.93 ±0.17	0.010*	0.97 ±0.18
T_3 (ng/dL)		57.88 ±18.03	55.19 ±13.57	0.733	56.65 ±16.13
T_4 (ug/dL)		8.28 ±1.66	8.23 ±2.19	0.827	8.26 ±1.91
TSH (uU/ml)		8.70 ±6.34	10.78 ±7.80	0.079#	9.65 ±7.08
T_3 uptake (%)		30.16 ±4.35	29.95 ±4.20	0.682	30.06 ±4.26
free T_4 (ng/dL)		0.69 ±0.17	0.76 ±0.27	0.269	0.73 ±0.22
IGF1 (ng/dL)		87.73 ±31.12	85.06 ±29.72	0.718	86.51 ±30.37
BP3 (ng/dL)		1.46 ±0.64	1.44 ±0.50	0.901	1.45 ±0.58
TBG (ng/mL)		76.21 ±61.19	80.89 ±43.53	0.302	78.34 ±53.64
TTR (mg/dL)		12.38±3.22	12.42±2.95	0.925	12.40 ±3.08
Total PCDD/F (pg-TEQ/g-lipid)		12.94±5.39	13.52±5.22	0.707	13.18±5.29
Total PCB (pg-TEQ/g-lipid)		2.86±1.20	3.04±2.00	0.798	2.94±1.57
PCDD/F+PCBs (pg-TEQ/g-lipid)		15.79±6.15	16.57±6.01	0.629	16.11±6.06
Performance scale		108.1±12.4	10.7.1±14.5	0.729	107.6±13.3
Verbal scale		103.4±10.5	104.1±13.2	0.798	103.7±11.8
Premature (≦37 weeks)	No	77 (76.2%)	66 (71.0%)	0.851	143 (73.7%)
	Yes	12 (11.9%)	15 (16.1%)		27 (13.9%)
	unknown	12 (11.9%)	12 (12.9%)		24 (12.4%)
Parity	1	43 (42.6%)	42 (45.2%)	0.590	85 (43.8%)
	2	36 (35.6%)	27 (29.0%)		63 (32.5%)
	3 or up	22 (21.8%)	24 (25.8%)		46 (23.7%)

Student T test or Mann-Whitney Test or Chi-Square Test

#: p <0.1, *: p <0.05, **: p <0.01

Table 2. The distributions of children development factors in Performance scale and Verbal scale

mean±SD	Category	N	Performance scale	*p*	*p* [a]	Verbal scale	*p*	*p* [a]
Lactation	No	13	86.5±13.6	0.001**		100.5±6.6	0.608	
	Yes	159	109.1±12.6			103.6±11.9		
Premature (≦37 weeks)	No	143	108.3±12.7	0.594		103.9±12.2	0.900	
	Yes	27	106.2±12.1			104.3±10.3		
Maternal education	≦12 yrs	78	106.5±13.5	0.135	0.454	100.1±10.5	0.009**	0.007**
	13-15yrs	70	105.7±11.5			106.1±9.4		
	≧16yrs	33	113.4±14.8			109.6±14.8		
Paternal education	≦12 yrs	73	108.5±12.8	0.552	0.467	99.7±11.1	0.051#	0.012*
	13-15yrs	61	106.1±11.8			105.1±9.4		
	≧16yrs	47	108.3±16.3			108.8±13.3		
Annual income (USD)	≦20000	77	105.7±14.0	0.294	0.174	100.7±11.4	0.047*	0.031*
	2-30000	71	108.5±13.7			106.8±10.9		
	≧30000	31	111.8±10.5			107.4±12.4		
Parity	1	85	110.8±13.4	0.110	0.126	107.3±12.0	0.030*	0.013*
	2	63	104.1±11.8			101.3±9.4		
	3 or more	46	106.4±14.8			100.4±12.9		

Mann-Whitney Test or Chi-Square Test, *: p <0.05, **: p <0.01, ***: p <0.001
[a]: p value for the test for trends for three categories,

Table 3. Spearman correlation between concentrations thyroid hormone and dioxin-like compounds.

	Performance scale		Verbal scale	
	F	M	F	M
Age	0.115	-0.119	0.081	-0.077
PCDD/F+PCBs	0.072	-0.504#	-0.164	-0.117
Total PCDD/F	0.052	-0.372	-0.243	-0.205
Total PCB	0.128	-0.427	0.024	-0.029
Blood Pb	-0.571***	-0.01	-0.239	-0.313#
TTR	0.215	0.292	-0.232	-0.229
T3	0.044	0.315	-0.022	0.107
T4	0.031	0.04	-0.144	0.226
TSH	-0.24	-0.113	-0.138	-0.03
T3U	0.055	-0.056	0.17	-0.017
FreeT4	-0.178	-0.296	-0.269	-0.22
TBG	-0.462	-0.538*	-0.268	-0.449#
IGFI	0.315	0.399#	0.039	0.117
BP3	-0.034	0.371	-0.095	-0.245

#: p<0.1, *: p <0.05, **: p <0.01, ***: p <0.001

Table 4. Coefficients of multiple linear regressions by backward selection.

	Performance scale					Verbal scale				
	β	p [a]	R	R^2	p [b]	β	p [a]	R	R^2	p [b]
Age	---	---				---	---			
Gender	0.440	0.013				0.582	0.005**			
Lactation	---	---	0.609	0.371	0.003**	-0.380	0.053#	0.611	0.374	0.024
Annual income	---	---				0.329	0.072#			
Log (lead)	-0.540	0.003**				-0.546	0.009**			
Log (PCDD/F+PCBs)	---	---				---	---			

[a] : p-value for β

[b]: p-value for model.

#: p<0.1, *: p <0.05, **: p <0.01, ***: p <0.001

Acknowledgements

This study was funded by a grand (EO-095-PP-06) from National Health Research Institutes (NHRI), Taiwan.

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