

MATERNAL EXPOSURE TO DIOXIN AND MENTAL AND MOTOR DEVELOPMENT IN CHILDREN FROM CENTRAL TAIWAN.

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Introduction

Several studies have shown environmental hormone significantly affect children growth and development. In this study, we aimed to determine the direct or indirect influence of dioxin-like compounds 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. We followed up the children and evaluated the growth and development using Bayley II in 2003. Mental (MDI) and Motor Development Index (PDI) were both included.

Results and Discussion

Triiodothyronine (T₃), Insulin-like Growth Factor-1 (IGF-1), and IGF Binding Globulin-3 (BP3) in cord blood were significantly higher in female children (Table 1). Maternal social status was highly correlated with MDI (Table 2). Table 3 showed the correlation between Bayley scales, thyroid hormones and dioxin-like compounds. We used stepwise multiple linear regressions to determine the association between MDI, thyroid hormone and dioxin-like compounds (Table 4). Path analysis was used to evaluate the association in MDI, IGF-1 and Polychlorinated Dibenzo-p-Dioxin & Dibenzofuran (PCDD/F) (Fig. 1)

We found the social status was an important factor of MDI. IGF-1 was highly associated with the MDI by stepwise multiple linear regression (Table 4). Whereas PCDD/F was not associated with MDI. There was a positive association between PCDD/F and IGF-1, and IGF-1 was significantly associated with MDI. The diagram by path analysis showed the interactions (Fig 1). However, we don't find the similar result in PDI. The current study might be limited to sample size and low variation of Bayley scores. Nonetheless, it is suggested that children development evaluated by Bayley II is largely explained by parental social economic status in the general population. The effect on the growth hormone from dioxins is worth of noting and further study is recommended.

Acknowledgements

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Birth cohorts: What can be learned?

Table 1. Characteristics of subjects by gender.. (41 female and 29 male had their concentration of dioxin-like compound)

mean±SD or n (%)	Female (n=101)	Male (n=93)	<i>p</i>	Total (n=194)	
Age	2.25±0.27	2.20±0.28	0.156	2.23±0.28	
T ₃ (ng/dL)	166±24.3	176±29.3	0.030*	171±27.4	
T ₄ (ug/dL)	9.13±1.87	9.60±1.94	0.160	9.37±1.91	
TSH (uU/ml)	3.08±1.86	3.48±1.68	0.197	3.28±1.78	
T ₃ uptake (%)	28.7±3.27	27.9±3.37	0.227	28.3±3.33	
free T ₄ (ng/dL)	1.21±0.24	1.20±0.22	0.860	1.20±0.23	
TRAb (U/L)	1.90±0.75	1.72±0.629	0.183	1.81±0.70	
IGF1 (ng/dL)	146±64.4	111±36.3	0.001**	128±54.3	
BP3 (ng/dL)	3.41±1.30	2.96±0.64	0.015*	3.18±1.04	
TBG (ng/mL)	23.7±4.78	25.2±5.49	0.206	24.3±5.11	
TTR (mg/dL)	12.4±3.22	12.4±2.95	0.967	12.4±3.08	
MDI	97.8±12.1	94.1±14.6	0.061#	96.0±13.4	
PDI	99.8±11.0	97.1±11.6	0.108	98.5±11.4	
PCDD/F (TEq (ng/g lipid))	11.8±1.55	12.6±1.46	0.707	12.2±1.51	
PCB (TEq (ng/g lipid))	2.63±1.51	2.54±1.92	0.798	2.59±1.68	
non-ortho PCB (TEq (ng/g lipid))	1.61±1.50	1.18±3.26	0.863	1.42±2.29	
mono-ortho PCB (TEq (ng/g lipid))	0.97±1.69	1.04±1.72	0.456	1.00±1.70	
Premature (≤37 weeks)	No	77 (76.2%)	0.851	143 (73.7%)	
	Yes	12 (11.9%)		15 (16.1%)	27 (13.9%)
Parity	1	43 (42.6%)	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%)

Mann-Whitney Test or Chi-Square Test

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

Abbreviations: Triiodothyronine (T₃), Thyroxine (T₄), Thyroid Stimulating Hormone (TSH), Thyrotropin antibody (TRAb, also known as TSH receptor), Insulin-like Growth Factor-1 (IGF-1), IGF Binding Globulin-3 (BP3), Thyroid Biding Globulin (TBG), Transthyretin (TTR).

Birth cohorts: What can be learned?

Table 2. The distributions of children development factors in MDI and PDI.

mean±SD	Category (n)	MDI	<i>p</i>	<i>p</i> ^a	PDI	<i>p</i>	<i>p</i> ^a
Lactation	No (13)	90.6±15.7	0.207		89.5±16.9	0.007**	
	Yes (159)	95.8±13.5			98.8±10.8		
Premature (≤37 weeks)	No (143)	95.8±14.3	0.414		98.7±11.1	0.521	
	Yes (27)	98.2±10.1			100±8.8		
Maternal education	≤12 yrs (78)	93.0±10.7	0.024*	<0.001***	97.3±11.4	0.608	0.396
	13-15yrs (70)	96.8±17.4			99.2±12.1		
	≥16yrs (33)	100±8.9			98.0±10.6		
Paternal education	≤12 yrs (73)	90.4±15.9	<0.001***	<0.001***	97.5±12.0	0.751	0.450
	13-15yrs (61)	99.2±11.3			98.1±10.1		
	≥16yrs (47)	99.9±8.9			99.1±12.6		
Annual income (USD)	≤20000 (77)	90.4±11.8	<0.001***	<0.001***	96.1±12.1	0.006**	0.006**
	2-30000 (71)	99.0±14.9			97.6±10.2		
	≥30000 (31)	100±10.6			104±11.0		
Parity	1 (85)	97.1±14.1	0.432	0.286	98.7±11.2	0.986	0.759
	2 (63)	96.1±11.2			98.4±11.3		
	3 or up (46)	93.8±14.9			98.4±12.2		

Mann-Whitney Test or Chi-Square Test

^a: *p* value for the test for trends for three categories,

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

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

	MDI	PDI	Age	Maternal age	PCDD/F	non-ortho PCB	mono-ortho PCB	Blood Pb
MDI	---	0.317**	-0.020	0.037	0.083	-0.062	0.060	-0.121
PDI	0.317**	---	0.020	0.093	-0.102	-0.192	0.043	-0.133
Age	-0.020	0.020	---	-0.012	0.214#	-0.122	0.051	0.172*
T ₃	-0.002	-0.045	-0.022	-0.001	0.261#	-0.065	0.278#	-0.019
T ₄	-0.075	-0.092	0.011	-0.047	0.113	-0.293*	0.105	0.144
TSH	-0.035	0.004	-0.035	-0.108	0.231	-0.013	0.085	-0.001
TBG	0.024	-0.089	0.162	0.089	0.219#	0.178	0.248*	0.041
TTR	0.029	0.031	0.301*	0.075	0.277*	0.043	0.153	-0.245
IGF1	0.270**	-0.001	0.170#	0.044	0.397**	-0.055	0.110	-0.154

Birth cohorts: What can be learned?

BP3	0.125	0.043	0.152#	0.134	0.245#	0.009	0.057	-0.106
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#:P<0.1, *:P<0.05, **:P<0.01

Abbreviations were shown in Table 1.

Birth cohorts: What can be learned?

Table 4. Coefficients of stepwise multiple linear regression.

Dependent var.=MDI	β	p^a	R	p^b
Age	---	---		
Gender	---	---		
Annual income	0.258	0.006**	0.331	<0.001***
Blood Pb	---	---		
IGF-1	0.301	0.002**		

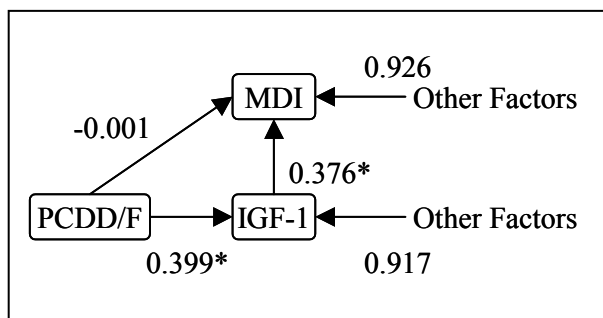
Dependent var.=PDI	β	p^a	R	p^b
Age	---	---		
Gender	---	---	0.398	0.013
Lactation	---	---		
PCDD/F	0.398	0.013*		

^a : p-vakue for β

^b : p-vakue for model.

*:P<0.05, **:P<0.01,***:P<0.001

Figure 1. Correlation diagram by path analysis



*:P<0.05