Prenatal Exposure to Metals and Development of Child Behavior at Age 3 to 4 Years – Taiwan Maternal and Infant Cohort Study

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Introduction

About 10%–20% of children and adolescents suffered from mental health problems worldwide, and it may be increasing the global burden of disease. Some neurotoxic metals (such as As, Co, and Pb) were reported to associate with inflammation or cytotoxicity in the brain. Thereby these environmental pollutants are also considered being risk factors of child behavior development. However, the effect of co-exposure to metals and the association with child behavior is less well studied. We aimed to investigate prenatal co-exposure to metals and the consequent outcome of early childhood behavior.

Method

A total of 358 subjects from the central area of Taiwan Maternal and Infant Cohort Study were followed-up with 2015–2017. We collected questionnaires and specimens from each mother-infant pair. Child behavior problems were according to caregiver-reported Achenbach System of Empirically Based Assessment (ASEBA), and metal concentration in cord blood was defined as the prenatal metal exposure (V, Cr, Mn, Co, Ni, Cu, Zn, Ga, As, Se, Cd, and Pb). Finally, 159 subjects were included in further statistical analysis.

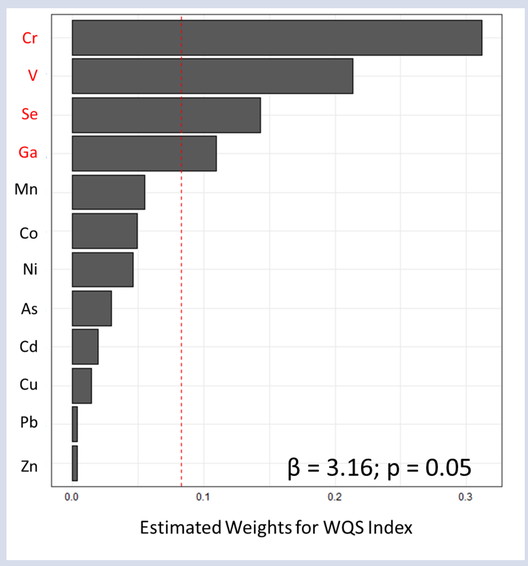
Results

Table 1. The association between the concentration of cord blood metals and child behavior (T-scores) in children (n=159)

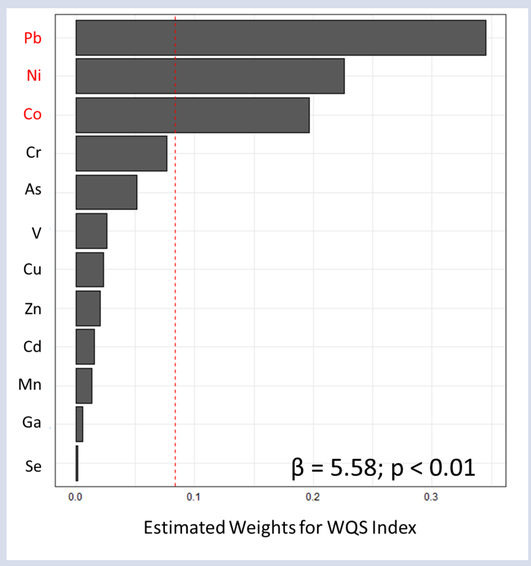
	Aggressive behavior			Attention problems			Withdrawn			Anxious–depressed			Emotional reactivity			Somatic complaints			Sleep problems		
Cord blood (μg/L)	β (SE)	p value	q value	β (SE)	p value	q value	β (SE)	p value	q value	β (SE)	p value	q value	β (SE)	p value	q value	β (SE)	p value	q value	β (SE)	p value	q value
	n=126			n=126			n=126			n=126			n=126			n=126			n=126		
V	**2.07 (0.97)**	**0.03**	**0.36**	0.36 (1.11)	0.75	0.77	0.42 (1.03)	0.68	0.76	**2.12 (1.05)**	**0.05**	**0.44**	1.65 (1.10)	0.14	0.14	-0.45 (1.03)	0.66	0.66	**3.15 (1.02)**	**< 0.01**	**0.03**
Cr	0.88 (0.73)	0.23	0.99	0.38 (0.83)	0.64	0.77	0.36 (0.77)	0.64	076	0.94 (0.79)	0.24	0.44	-0.13 (0.83)	0.87	0.87	0.52 (0.76)	0.49	0.49	1.08 (0.78)	0.17	0.32
Mn	0.03 (1.62)	0.99	0.99	2.25 (1.81)	0.22	0.77	3.05 (1.67)	0.07	0.28	1.31 (1.76)	0.46	0.61	1.26 (1.82)	0.49	0.49	0.91 (1.69)	0.59	0.59	**3.78 (1.71)**	**0.03**	**0.12**
Co	-0.35 (1.45)	0.81	0.99	0.32 (1.64)	0.85	0.85	**3.60 (1.48)**	**0.02**	**0.12**	2.43 (1.56)	0.12	0.44	2.11 (1.62)	0.20	0.20	**3.01 (1.48)**	**0.05**	**0.05**	-0.51 (1.57)	0.74	0.74
Ni	0.29 (0.52)	0.57	0.99	-0.14 (0.59)	0.81	0.81	0.29 (0.54)	0.59	0.76	-0.05 (0.57)	0.93	0.93	0.30 (0.58)	0.61	0.61	0.09 (0.54)	0.87	0.87	0.37 (0.56)	0.51	0.58
Cu	0.02 (3.23)	0.99	0.99	-1.63 (3.62)	0.65	0.77	2.03 (3.36)	0.55	0.76	0.11 (3.51)	0.98	0.98	0.74 (3.63)	0.84	0.84	1.83 (3.36)	0.59	0.59	**7.52 (3.41)**	**0.03**	**0.12**
Zn	-1.21 (2.52)	0.63	0.99	-0.24 (2.83)	0.93	0.93	0.51 (2.62)	0.85	0.85	-0.97 (2.73)	0.72	0.74	2.77 (2.83)	0.33	0.33	1.11 (2.62)	0.67	0.67	2.49 (2.71)	0.36	0.48
Ga	0.46 (1.05)	0.66	0.99	-0.30 (1.18)	0.80	0.80	0.66 (1.09)	0.55	0.76	1.57 (1.14)	0.17	0.44	0.76 (1.19)	0.52	0.52	-1.31 (1.09)	0.23	0.23	**2.20 (1.12)**	**0.05**	**0.15**
As	-0.05 (0.76)	0.94	0.99	0.11 (0.85)	0.90	0.90	1.30 (0.78)	0.10	0.30	0.42 (0.82)	0.61	0.71	0.67 (0.85)	0.43	0.43	0.43 (0.79)	0.59	0.59	1.34 (0.81)	0.10	0.24
Se	-2.79 (2.96)	0.35	0.99	-3.39 (3.33)	0.31	0.77	-1.18 (3.10)	0.70	0.76	-4.02 (3.21)	0.21	0.44	-3.99 (3.33)	0.23	0.23	-3.03 (3.08)	0.33	0.33	-1.96 (3.21)	0.54	0.58
Cd	0.49 (0.63)	0.44	0.99	0.58 (0.71)	0.41	0.77	0.27 (0.66)	0.68	0.76	-0.02 (0.68)	0.98	0.98	0.35 (0.71)	0.63	0.63	1.21 (0.65)	0.06	0.06	0.84 (0.67)	0.22	0.33
Pb	0.23 (1.13)	0.84	0.99	0.76 (1.27)	0.55	0.77	**3.28 (1.14)**	**< 0.01**	**0.03**	1.21 (1.22)	0.32	0.49	0.79 (1.27)	0.54	0.54	1.64 (1.17)	0.16	0.16	1.58 (1.21)	0.19	0.32

Adjustment for child's age, sex, household income, maternal education, and prenatal ETS exposure

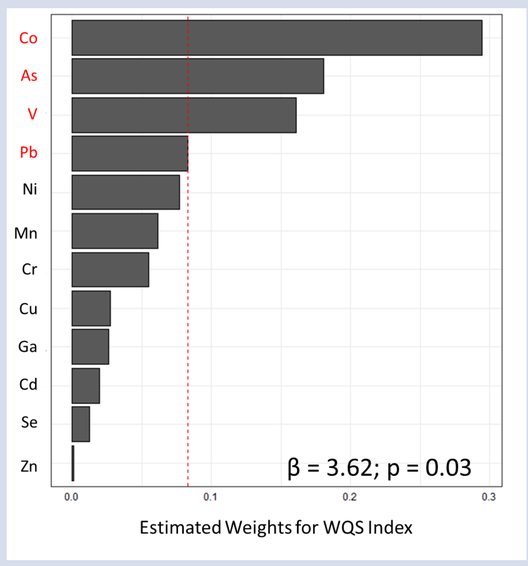
A. Aggressive behavior



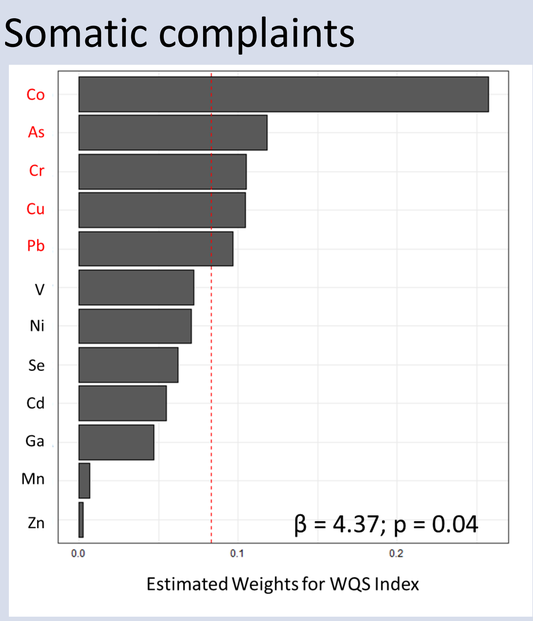
B. Withdrawn



C. Anxious–depressed



D. Somatic complaints



E. Sleep problems

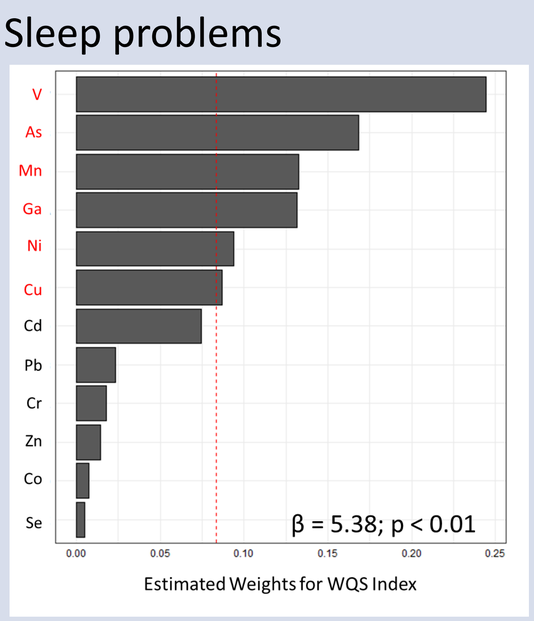


Figure 1. The association between the WQS index from mixture of cord blood metals and child behavior (T-scores) in children at 3 to 4 years of age. Estimated weights of the WQS index for metals (prenatal co-exposure to V, Cr, Mn, Co, Ni, Cu, Zn, Ga, As, Se, Cd, and Pb); adjustment for child's age, sex, household income, maternal education, and prenatal ETS exposure

Conclusion

We observed that prenatal exposure to V, Co, and Pb and co-exposure to metals were significantly associated with some patterns in child behavior problems. Reduction of exposure to metals in pregnancy is suggested for the prevention of increased behavior problems in childhood. Considering the potential neurological effects of endocrine-disrupting chemicals (EDCs), our future work will investigate the co-exposure from metals and EDCs (such as phthalates) on child behavior.