Assistant Prof. Nozomi Tatsuta

○アブストラクトデータ

Adverse effects of prenatal exposure to methylmercury on intellectual ability of 42-month-old boys in Japan

Methylmercury (MeHg) is a well-known environmental neurotoxicant. Since MeHg readily crosses the placenta, the fetus is particularly sensitive to MeHg exposure. A delay of development of cognitive function in children caused by prenatal MeHg exposure was shown in some epidemiological studies. In the present study, we examined the associations between prenatal exposure to methylmecury and intellectual ability using the Kaufman Assessment Battery for Children (K-ABC) at 42 months of age.

The research field took place in two areas, an urban area and a coastal area in the Tohoku district of Japan. In this study, only the subjects in the costal area were employed. Participants were followed up from pregnancy through age 14. The K-ABC, comprised of four scales, was used to assess their intelligence and achievement. The relation ships between the MeHg and K-ABC scores were analyzed using multivariate analyses. Potential confounders include age at examination (months), testers variables, child gender, birth order, alcohol consumption/smoking habits during pregnancy. The maternal intelligence quotient was measured using the Raven standard progressive matrices and the results were analyzed using the raw score because it has not been standardized in Japan. The mother was asked to fill in the Raven standard progressive matrices when the children were 18 months old. The selenium level and docosahexaenoic acid (DHA) level were also used for confounders.

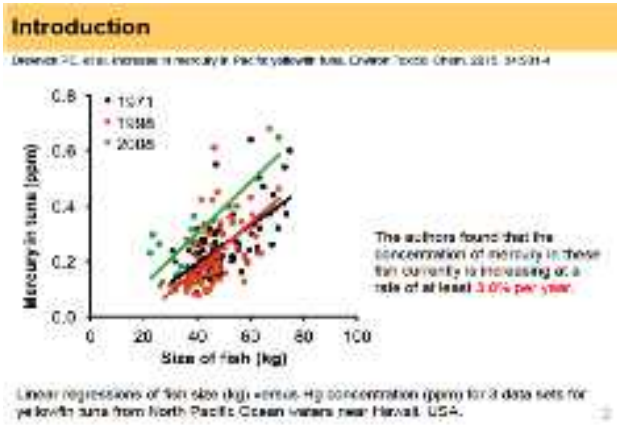
In a total of 542 mother-child pairs, the total mercury (THg) level (median, 2.5 μg/g) in maternal hair at parturition, the selenium level (65.9 ng/g) in cord blood and the DHA level 168.8 mg/mL in maternal blood were analyzed. There were no significant correlations between K-ABC score and THg after adjusting for possible confounders. The results of multiple regression analysis showed that gender had close relations to the K-ABC scores. The K-ABC scores were significantly lower in the boys (n=284) than in the girls (n=258). According to the result of gender-specific multiple regression analysis, THg was negatively related to the sequential processing score (p=0.029) only in the boys.

These findings suggest that intellectual ability in the developmental stage may be impaired by prenatal exposures to highly methylmercury, especially in boys.

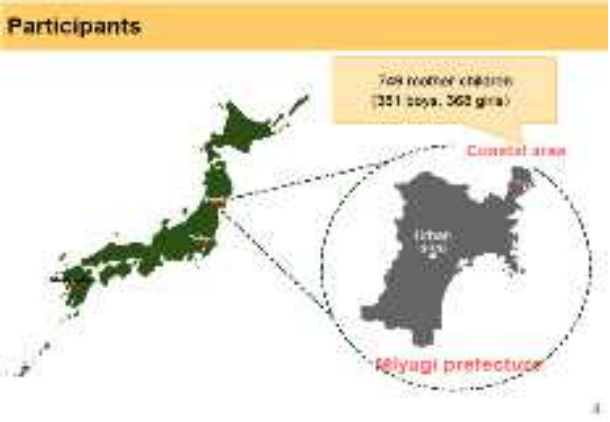
Nozomi Tatsuta, Kunihiko Nakai (Tohoku University Graduate School of Medicine), Katsuyuki Murata (Akita University Graduate School of Medicine), Mineshi Sakamoto (National Institute for Minamata Disease), Miyuki Iwai-Shimada, Hiroshi Satoh (Tohoku University Graduate School of Medicine)

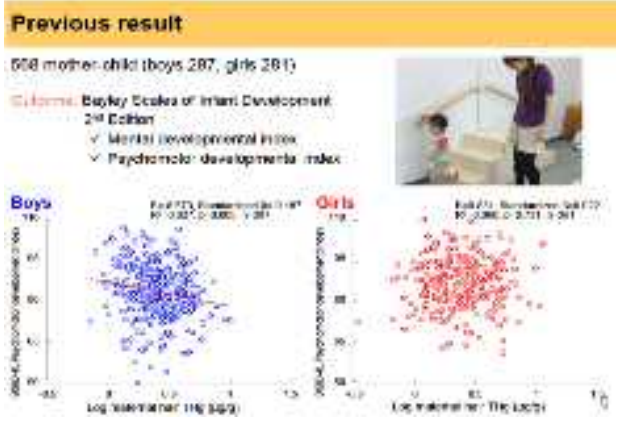
○発表データ

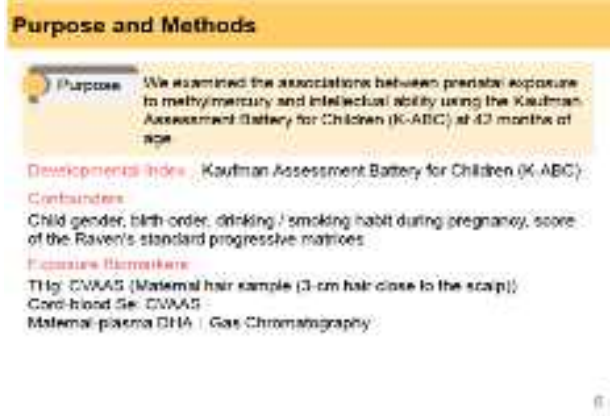

Adverse effects of prenatal exposure to methylmercury on intellectual ability of 42-month-old boys in Japan


Introduction
Mercury in tuna (ppm)
Size of fish (kg)
The authors found that the concentration of mercury in these fish currently is increasing at a rate of at least 3.0% per year.
Linear regressions of fish size (kg) versus Hg concentration (ppm) for 3 data sets for yellowfin tuna from North Pacific Ocean waters near Hawaii, USA.


Tohoku Study of Child Development


Participants
Coastal area
Urban area
Miyagi prefecture


Previous result
Boys
Girls


Purpose and Methods
Purpose
Developmental Index
Confounders
Exposure Biomarkers

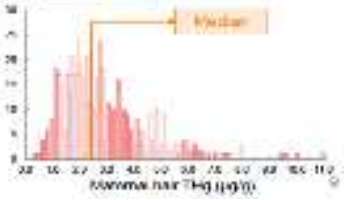

Kaufman Assessment Battery for Children (K-ABC)


Basal characteristics of mother-child pairs

Exposure levels

	Median	95%ile	99%ile
Maternal hair THg (µg/g)	[illegible]	[illegible]	[illegible]
Cord blood selenium (ng/g)	[illegible]	[illegible]	[illegible]
Maternal plasma DHA (mg/ml)	[illegible]	[illegible]	[illegible]

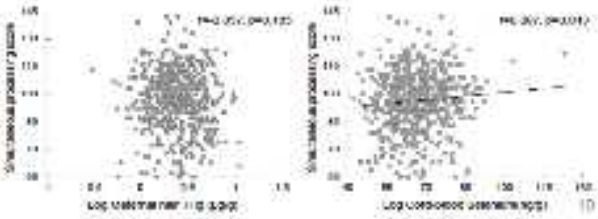
Maternal hair THg in comparison		
Faroe	4.3 µg/g	Am J Epidemiol. 160 (3): 253-308, 2003.
Seychelles	6.6 µg/g	JAMA. 283 (8): 701-707, 2000.
Japanese female	1.4 µg/g	Tokushima J Exp Med. 55, 181-188, 2008.



Simple correlation

	Mental processing		Sequential		Simultaneous		Achievement	
	r	p	r	p	r	p	r	p
Hair THg	-0.025	0.482	0.012	0.768	-0.037	0.185	0.013	0.710
Cord blood Se	0.058	0.130	0.020	0.541	[illegible]	0.040	0.013	0.758
Maternal DHA	0.007	0.849	0.007	0.849	-0.054	0.031	0.014	0.748

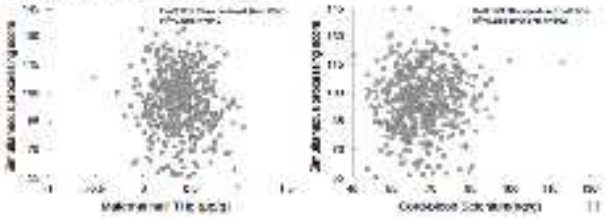
Pearson product-moment correlation coefficients



Multiple regression

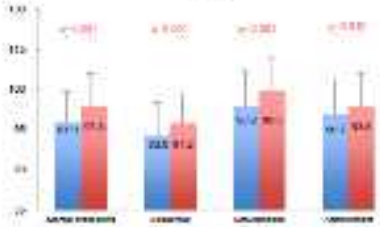
	Mental processing		Sequential		Simultaneous		Achievement	
	adjusted R^2	0.030	adjusted R^2	0.050	adjusted R^2	0.005	adjusted R^2	0.040
	Standard β	p value	Standard β	p value	Standard β	p value	Standard β	p value
Hair THg	-0.011	0.723	0.000	0.999	-0.037	0.208	0.000	0.011
Cord blood Se	0.050	0.157	0.058	0.094	[illegible]	[illegible]	0.037	0.199
Maternal DHA	0.046	0.204	0.018	0.661	[illegible]	[illegible]	0.017	0.711

Covariates variables: sex of the K-ABC, child gender, birth weight, drinking / smoking habit during pregnancy, score of the Raven's standard progressive matrices



Child gender difference 1

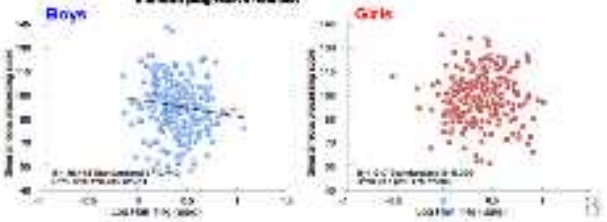
	Boys (n=274)		Girls (n=288)		t value	p value
	Mean	SD	Mean	SD		
Mental processing	[illegible]	14.5	[illegible]	13.8	4.794	p<0.001
Sequential	[illegible]	16.6	[illegible]	16.3	3.381	0.001
Simultaneous	99.8	16.4	96.5	15.1	4.678	p<0.001
Achievement	[illegible]	14.7	[illegible]	13.1	[illegible]	[illegible]



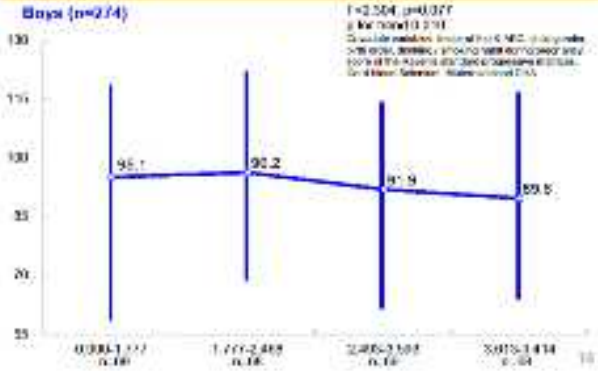
Child gender difference 2

	Boys		Girls	
	adjusted R^2	0.048	adjusted R^2	0.017
	Standard β	p value	Standard β	p value
Hair THg	-0.142	0.001	[illegible]	[illegible]
Cord blood Se	0.087	0.072	[illegible]	0.463
Maternal DHA	0.102	0.114	[illegible]	0.419

Covariates variables: sex of the K-ABC, child gender, drinking / smoking habit during pregnancy, score of the Raven's standard progressive matrices



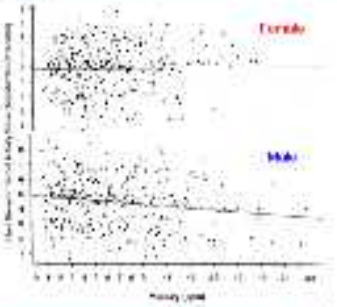
Child gender difference 3



Discussion 1

Seychelles child development study

Hair THg: median 5.9 ppm
(range 0.5 – 26.7 ppm)
Outcome: Bayley Infant Behavior Record (20-months)

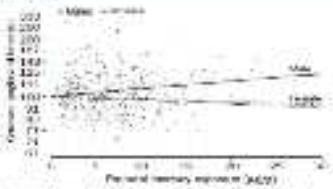


Davidson et al., Neurotoxicology (1995) 16(4):677-688 15

Discussion 2

Seychelles child development study

Hair THg: median 5.9 ppm
Outcome: Grooved pegboard time
(8 years old)



Myers et al., Lancet (1995) 345, 1989-1992. 16

Discussion 3

Acknowledgments

We thank all the families who participated in the cohort study.

We would like to acknowledge all the staff members of Development and Environmental Medicine, Tohoku University Graduate School of Medicine, for their help with the organization of data collection for cohort study.

The Japan Ministry of Health, Labour, and Welfare, Research on Risks of Chemical Substances funded this research.