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Metro Toronto Convention Centre Exhibit Hall D-E (Ontario, Canada)
Poster 2205 - PTT Poster Session #2
http://iadr.confex.com/iadr/2008Toronto/techprogram/abstract_105335.htm

Title: **Fluoride and its effect on human intelligence. A systematic review.**

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Objectives: A systematic review was undertaken to examine if fluoride (F^-) exposure is associated with a decline in human intelligence (IQ).

Materials and Methods: Ovid MEDLINE and its allied versions, CINAHL, AMED, EMBASE, Cochrane DSR, ACP Journal Club, DARE, CCTR, CMR, HTA, and NHSEED, Health and Psychosocial Instruments, HealthSTAR, International Pharmaceutical Abstracts were searched from the earliest record until January 2008. Only original human studies examining the effect of F^- on IQ were selected. Elevated F^- in drinking water was the primary variable but studies where F^- was elevated in the urine as a result of pollution were also included. Hand-searching of the bibliographies of the selected studies, as well as a separate search strategy in Cab Direct and online Chinese databases (Chinese version of Google Scholar and several others) were performed and the relevant Chinese studies were translated into English.

Results: Of a total of 224 papers searched for relevancy from their titles, abstracts, and full copy, 20 original studies met our inclusion criteria, were read in full and critiqued by the authors. Only 6 of the studies were reviewed by the 2006 US NRC Subcommittee on Fluoride in Drinking Water and 4 studies were published after 2006. The extent of F^- exposure was reported in all but one study and 9 studies reported urinary F^-. Most papers omitted important details (e.g. blinding, managing confounders). All but 2 reported statistically significant (t-tests) declines in IQ in children exposed to elevated levels of F^-. One study reported a bivariate analysis and another did multiregression analysis. Three studies were conducted outside of China, suggesting that this is not just a relationship that is limited to one country.

Conclusions: While the evidence is not conclusive, we identified 18 ecological studies that purport an association between high fluoride exposure and decreased human intelligence.

Author (yr.)	Group compared	Water [F-] ppm	n	Urine [F-]	IQ test	IQ Results	S.D. +/-	p	conclusion	Method Search
Hu (’89)	Low F High F	<0.70 >7.0	181 198	ND ND		84.9 85.15	NR NR	>0.05	“the effect of fluoride poisoning on intellectual ability is negligible”	Manual (translate
Ren (’89)	Low I High F, low I	Not reported	169 160	ND	Wechsler	85 64.8	22.3 20.4	<0.01	“Disrupted child intellectual development” is “clearly much more serious” from a “ harmful environment containing both high fluoride and low iodine …than the effects of iodine deficiency alone”	Manual (translate
Qin (‘90)	Low F Normal F High F	0.1-0.2 0.5-1.0 2.1-4.0	147 59 141	ND ND ND	Raven	23.03 28.14 21.17	NR NR NR	 >0.05 <0.01	“A child whose drinking water is above 2.0 mg/L or below 0.2 mg/L manifest intellectual deficits as compared to ‘normal’ control group.”	Manual (translate
Guo (’91)	 Control Endemic fluorosis	Serum F 0.10 0.15	 61 60	 ND ND	Chinese Binet	 83.95 77.30	 8.93 8.52	(7-9 yr.) <0.05	“children living in high fluoride areas have lower IQs”	Manual (translate
Lin (’91)	Low F, (Low I) High F (high I)	0.34 (0.96 ppb) 0.88 (5.21 ppb	256 250	1.52 2.56		78 71	NR NR	<0.01	“Low iodine intake coupled with high fluoride intake exacerbates the central nervous lesions and the somatic developmental disturbance of iodine deficiency:	Universit of Toron
Chen (’91)	Low F High F	0.89 4.55	320 320	ND ND	Raven	104.03 100.24	14.96 14.52	<0.01	“fluoride has a direct connection with intellectual development of children”	Manual (translate
Yang (’94)	Low F, (Low I) High F (high I)	0.5 (0.13 mg/L) 2.97 (1.1 mg/L)	416 1102	0.82 2.03	Chinese Compara-tive Scale of Intelli-gence Test	81.97 76.67	11.97 7.75	>0.05	IQ ‘somewhat’ lower but not significant	Universit of Toron
Li (’94)	Low F	0.3 in all water 0.5 ppm (grain)	51	ND ND	Work capacity	Two com-ponents of		<0.05 and	“early prolonged high fluoride intake causes a decrease an a	Universit of Toron

	HF I no fluorosis HF II fluorosis HF III flurosis	4.7 ppm (grain) 5.3 ppm (grain) 31.6 ppm(grain)	33 37 36	ND ND ND	(reaction time, short-term memory, etc.	mental capacity decreased		<0.01	child's mental work capacity"	
Li ('95)	 Low F High F	fluorosis low-mild severe	 226 230	 1.02 2.69	Rui Wen	 89.9 80.3	 10.4 12.9	 <0.01	High fluoride environment can adversely affect the development of intelligence in children	Universit of Toron
Wang ('96)	Low F High F	<1.0 >1.0 – 8.6	83 147	ND ND	Wechsler	101.23 95.64	15.84 14.34	<0.05	"high fluoride intake has a clear influence on the IQ of preschool children"	Manual (translate
Zhao ('96)	Low F High F	0.91 4.12	160 160	ND ND	Pau Wan	105.21 97.69	14.99 13.00	<0.01	"The intake of high fluoride drinking water before birth had a significant deleterious influence on children's IQ. "	Universit of Toron
Lu ('00)	Low F High F	0.37 3.15	58 60	1.43 4.99	Raven	103.5 92.2	13.86 20.45	<0.005	"exposure of children to high levels of fluoride may therefore carry the risk of impaired development of intelligence"	Universit of Toron
Hong ('01)	Low F High F High F, low I	0.75 2.90 2.94	32 85 28	ND ND ND	Raven	82.79 80.58 68.38	8.98 2.28 19.12	 >0.05 <0.01	F makes I-deficiency worse, lowering IQ more than just with low I	Manual (translate
Li ('03)	Non-fluorosis fluorosis	ND ND	301 419	ND ND	Raven	96.97 88.67	18.43 15.26	<0.01	Fluoride disrupts intellectual development	Manual (translate
Xiang ('03)	Low F High F	0.36 2.47	135 155	1.11 3.47	Combined raven	100.41 92.02		0.003	"drinking water fluoride levels greater than 1.0 mg/L may adversely affect the development of children's intelligence"	Universit of Toron
Wang ('05)	 Control dental fluorosis skeletal fluorosis		 49 97 57	 1.61 1.35	Raven	percentiles 5-25 >75 4 14 24 8 12 2		 <0.01	"..Negative correlation between urine fluoride and intelligence"	Manual (translate
Seraj ('07)	Low F High F	0.4 2.5	85 41	ND ND	Raven	98.9 87.9	12.9 11.0	0.000	"High F may be associated with impaired development of intelligence"	Manual (translate

Rocha-Amador (’07)	Low F Mod F High F	0.8 5.3 9.4	52 20 60	1.5 6.0 5.5	Wechsler	β values -6.7 -11.2 -10.2		<0.001 <0.001 <0.001	“Children exposed to either F or As have increased risks of reduced IQ scores”	Manual
Trivedi (’07)	Low F High F	2.01 5.55	101 89	2.30 6.13	Stanford-Binet	100.04 91.72	1.23 1.13	<0.001	“..the mean IQ level of students exposed to high F drinking water was significantly lower than that of the students to a lower F level drinking water”	Universit of Toron
Wang (’07)	Low F High F	0.5 8.3	110 106	1.5 5.1	Raven	105 101	15 16	<0.05	“Children’s intelligence and growth can be affected by high concentrations of As or fluoride.”	Universit of Toron

Grey= reviewed by the NRC
Yellow = not found in the U of T search