

The effect of high levels of arsenic and fluoride on the development of children's intelligence*

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In the fields of toxicology, histology, physiology and biochemistry, numerous research and reports have already been conducted on the poisonous effect of arsenic poisoning, fluoride poisoning, as well as the combined effect of arsenic and fluoride poisoning. Progress has been made likewise in relevant medical treatment, clinical diagnosis and water clean-up prevention schemes. In order to better understand the long-term effects of arsenic poisoning, fluoride poisoning and its combined poisoning, we have conducted research on the level of intelligence in children aged 4-10, who were born after water clean-up prevention schemes were put into place, and report our results as follows.

Subjects and methodology. 1. *Subjects:* in accordance to the level of water fluoride consumed in Kuitun region, and the amount of arsenic contained therein, we have divided the townhouses which have used the improved water for 10 years to several teams as the subject for a high fluoride high arsenic observational group, among which team 12 and team 2 are chosen as the high fluoride observational group. We then used the teams under the 125th group and selected children between the ages of 4 to 10 from these 3 groups. 61, 51 and 52 children have been selected, respectively. Each observation group (has been exposed to water samples containing) arsenic and fluoride measuring at 0.016 mg/L and 0.8 mg/L, 0.049 mg/L and 0.81 mg/L, 0.03 mg/L and 0.58 mg/L respectively. 2. *Methodology:* we have used drawing tests administered and edited by the Research Institute of Pediatrics of the Capital, and the 50-point evaluation tests created by Shigeo Kobayashi of Japan, so to evaluate the subjects. The tests were carried out by specialists and were conducted in a quiet, non-disruptive setting.

Results and analysis. The results of the level of intelligence across the different observational groups are presented in the following table.

Age (year)	High arsenic high fluoride group		High fluoride group		Comparative group		P value
	No. of people	X +/- s	No. of people	X +/- s	No. of people	X +/- s	
4	9	94.44 +/- 7.63	5	112.20 +/- 13.54	5	94.00 +/- 5.33	>0.05
5	10	82.80 +/- 10.52	6	90.67 +/- 8.64	10	87.20 +/- 10.98	>0.05
6	9	82.18 +/- 6.98	13	83.62 +/- 7.29	7	82.28 +/- 7.20	>0.05

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7	6	80.89 +/- 7.57	8	86.62 +/- 4.66	6	87.00 +/- 6.90	>0.05
8	9	80.11 +/- 7.72	7	88.14 +/- 12.33	5	87.33 +/- 7.31	>0.05
9	6	75.83 +/- 10.34	7	82.00 +/- 13.01	11	84.18 +/- 9.23	<0.05
10	12	70.92 +/- 8.58	4	70.66 +/- 7.50	8	94.88 +/- 15.08	<0.01
TOTAL	61	80.91 +/- 10.81	51	85.62 +/- 13.23	52	87.69 +/- 11.04	

Upon analysis, there are significant differences on the levels of intelligence between the age groups of 9 and 10 years old across every observational group. In comparison, differences are not significant amongst other age groups ($P>0.05$). Using Q tests to perform pairing comparisons, there exists significant differences between the 9 year age group from the high arsenic high fluoride group, and their counterparts from the high fluoride group and comparative group ($P<0.05$), whereas there is no significant difference in the results of the high fluoride group and the comparative group ($P>0.05$). As for the 10-year old age bracket, there exists significant differences in the results of the high arsenic high fluoride group, the high fluoride group and the comparative group ($P<0.01$), whereas there is no significant difference in the results of the high arsenic high fluoride group and that of the high fluoride group ($P>0.05$).

Discussion. Upon our research of the level of intelligence in children who were born after the water improvement schemes have been put in place, children who were born 1 year or 2 years after the improvement schemes took place have a significantly lower level of intelligence than the normal comparative group. However, results from the 9-year old age group have shown that a high level of fluoride and low level of arsenic have little effect on the subjects' level of intelligence, whereas a high level of arsenic does affect the subject's intellectual development. Even though there were differences in the results from the 10 year-old subjects from the normal comparative group, in contrast to subjects from the high fluoride high arsenic group and the high fluoride group, these results might not be overtly representative as less number of subjects from the high fluoride group has been tested. This might be representative, however, of the fact that a high level of arsenic was primarily responsible for the negative effect on the level of intelligence in subjects from the high arsenic high fluoride group.

A potential cause for the relatively lower level of intelligence in subjects from the 9 and 10 year-old age group (in comparison against those from the comparative group) could be due to the high level of arsenic contained in their parents after the water improvement schemes have been put in place. The arsenic could have travelled to the fetus' body via the placenta, which then has taken on a negative impact on the development of the fetus' nervous system. It could also be due to the existence of a generally higher than average level of arsenic in the area of research (despite being subjected to water clean-up schemes), which means that a higher amount of arsenic has entered the body, which then affected the development of brain tissues and resulted in the abnormal secretion of neurotransmitters in the nervous system.

The drawing tests used in this research are reflective of the child's attention span, memory, observational skills, imagination, perception of space and orientation, as well as allowing one to observe the level of development of fine-tuned skills such as coordination and motor skills. It is

also reflective of the child's level of intellect and the evolvement of a child's cognition patterns (from image/definite shapes-specific to abstract, logical thinking). These are all demonstrative of the condition of intellectual development and level of maturity in the subject tested. The results from this research corresponds to results derived from similar research conducted on animal subjects, which are therefore conclusive of the fact that arsenic poisoning has a long-term, latent but negative effect on a child's neural behaviour and intellectual development. All of these effects and impact are yet to be completely understood and merit more in-depth research in the future.

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