Using Drawing tests to Measure Intelligence in Children from Areas Impacted by Combined Al-F Endemic Toxicosis (shuicheng, Guizhou)

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Abstract: Measurements of intelligence via drawing tests have been conducted to examine the intelligence development of children from regions affected by combined AI-F endemic toxicosis. A selected number of 196 children between 6.5 and 12 years of age participated in the testing. Across all age groups, the average IQ level of children from the endemic zones was lower than their counterparts in the non-endemic region. With the exception of the ≤7-year-old age group, significant differences in intelligence were found across all age groups when comparing the results between the endemic and the non-endemic group. From these results, it can be concluded that excessive consumption of fluorine and aluminum in the early stage of development directly impacts the development of the human brain, which causes the delayed intellectual development seen in children living in the endemic areas.

Keywords: Fluoride poisoning; Aluminum; Intelligence test

Many studies have shown that fluorosis is a disease that damages various organs within the body. Little research, however, is available on the correlation between high levels of fluoride and aluminum present in the environment and the development of human intelligence. To further investigate this issue, IQ tests have been conducted on school children living in endemic areas where high exposures to both fluoride and aluminum have been found. The area that we tested was Shuicheng, a city in Guizhou. The testing period was from July to December of 1989.

Objectives and Methods

1 Subjects

Endemic area group: 196 children between 6.5 and 12 years of age from Cichong Central Primary School of Liupanshui City (130 boys, 66 girls), were all found to not have any symptoms related to the deformation of bone and joint structures, nor any symptoms related to nervous system damage. The local rate of dental fluorosis was 98.36%, with 99.51% of the students from the school diagnosed with the disease. These children primarily came from farmers' families who were dwelling in urban areas or alongside the highway, and whose standard of living is deemed to be average.

Non-endemic area group: One class was randomly selected from each grade, from grade one to grade five, in Xinhong Primary School of Xintianzhai, a suburban neighborhood located at the outskirts of Guiyang City. 224 children between 6.5 and 12 years of age participated in the testing. 113 of this group were boys and 111 were girls, and 95% of these children are from families of farmers or agricultural workers.

2 Methods

2.1 Intelligence Test Measurement: Intelligence was assessed through drawing tests. The subjects were asked to draw a picture of a human being in 20 minutes.

2.2 Calculation of Intelligence Quotients (IQ): IQ was calculated using Japan's Shigeo Kobayashi's 50-point scoring method. One person was responsible for conducting and grading the tests.

Results

The results of this investigation of level of intelligence of children from endemic areas and non-endemic areas are shown in Schedule 2. The investigation results show that:

1. The average IQ levels of all age groups in the endemic area are lower than that of the same age groups in the non-endemic area, with the exception of the ≤7 year-old group. All other age groups were found to have differences in intelligence between the endemic and the non-endemic group that were significant ($P<0.05$).
2. The average IQ level of all age groups in the endemic area decreased as the subjects' age increased. In comparison to the ≤7 year-old groups and with the exception of the 8 year-old group, the average IQ level of the other age groups is dramatically decreased ($P<0.05$).

Schedule 2. Comparison of the Intelligence Quotients between Children from the Endemic Area and those from the Non-endemic Area							
Age Group (Years old)	Endemic Area			Non-Endemic Area			P Value
	No. of Cases	Average IQ	Standard Deviation	No. of Cases	Average IQ	Standard Deviation	
≤7	18	80.72	6.58	41	85.85	10.72	< 0.05
8	23	77.17	9.87	48	82.96	8.32	< 0.05
9	30	71.80	11.62	26	79.31	9.59	< 0.05
10	41	71.76	12.50	51	84.41	12.87	< 0.05
11	32	69.28	8.76	36	81.92	10.79	< 0.05
12	52	70.00	11.98	22	77.41	11.00	< 0.05

3. The drawing ability of the children has been compared, and this was done in accordance to the number of children (aged 6.5 to 12 years old) who have finished the drawing, and who were from the endemic area and non-endemic area. These results are specified in percentile as per the following:

   (1) The percentage of children who managed to draw the head, eyes and limbs of the human body was relatively high, with the completion rate of all age groups reaching above 90%. By contrast, the number of children who managed to draw a face (0-23.1%), lines (0-5.7%), or sketches of sides (0-1.9%) was relatively low.

   (2) The completion rate for parts of the human body relevant to the senses and to movement, such as eyes (94.4%-100%), ears (66.7%-95.7%), mouth (77.8% -92.3%), nose (66.7% -94.2%), upper limbs (88.9%-98.1%), lower limbs (94.4%-100%), etc., was not all too low on the charts.

   (3) The bodily parts related to recognition and thinking, such as hair (65.2%-93.3%), neck (46.7%-78.8%), and clothes (27.8%-71.2%), drawn by children from the endemic area was relatively low.

Discussion

I. Children from endemic areas where a high level of fluoride has been found have been proven to experience a challenged or delayed development in their mental or intellectual capacity. Results gathered from the Binet IQ test[1] and brain electrical activity mapping analysis have further attested to this point[2]. It has not been reported to date that aluminum poisoning influences children's intelligence. However, there is a lot of research to indicate that when aluminum enters the human body, damage to the brain's nerve cells can occur, which may lead to encephalopathic dialysis or even brain atrophy. Therefore, even if being poisoned with fluoride or aluminum alone, the development of the nervous system could be impacted which could cause low intelligence levels. Past research have proved that small amounts of aluminide (items containing small amounts of aluminum) can effectively subdue the body's intestinal absorption of fluoride. Aluminum salt has been used worldwide, therefore, as a way to combat, remove, and purify fluoride in drinking water. This raises a question about the influence of large amounts of aluminide on the intestine's absorption of fluoride. What exactly would be the scale or scope of this impact? Presently, research on the joint effect of fluoride and aluminide on the human body has developed rapidly in China and has drawn attention from researchers around the world. In 1987, Li Fulin, Zhou Linye, et al., have found in animal experiments that fluoride and aluminide can interact with the other's absorption into the human body. The two elements both accumulate in the body[4]. Cichong Village examined in this study was an endemic area with high levels of fluoride and aluminum present in

its environment. The local residents consistently consumed large amounts of fluorine and aluminum, as they were exposed to air and food items polluted by fuel and smoke generated from the burning of coal. Judging from this evidence, we believe that the low intelligence of children in the endemic area is caused by the joint poisoning of fluorine and aluminum.

II. There may be multiple factors which influence the development of intelligence. With the exception of genetics, the environmental factor has a critical influence on this development. In the endemic area, children from the ≤7 year-old group were fed with breast milk, and from this they consumed a small amount of fluorine and aluminum. However, the breast has the ability to filter out some of these harmful substances, which thus prevents the children from over-consuming fluoride and aluminum while in their infancy. Additionally, as the local government continued to launch different types of environmental improvement measures, the younger children were exposed to air and dietary sources which were much less polluted than their predecessors. Therefore, these children were actually less impacted by fluorine and aluminum as compared to their predecessors and previous generations. Their average IQ was not significantly different from their counterparts in the non-endemic area, and comparatively, the development of intelligence in these children was not as negatively impacted as it could have been.

III. The critical period for the development of brain cells is from the 18th week of pregnancy up to 2 years of age. Children younger than 2 should therefore be prevented from being exposed to contaminants and other factors which could negatively impact the development of the brain. They should also receive enough nutrition from their daily food intake. The average IQ of children from the 8-12 year-old group in the endemic area continued to reduce as they aged, and the results were significantly different from their counterparts in the non-endemic area. This indicates that these children were experiencing various forms of intellectual disabilities. Such results are also indicative of the fact that these children were influenced by high amounts of fluorine and high aluminum while they were in the critical period of intellectual development. The development and growth of their brain cells had been adversely affected, and therefore a low level of IQ was generally seen in this group of children.

IV. When comparing the drawing ability of children from the endemic area with that of children from the non-endemic area, the completion rate in regards to drawing the bodily parts related to sensation, perception and motor movement was not all too low for the former group. This is indicative of the human body's constant exposure to regular external stimulations. However, the completion rate was low for the drawing of bodily parts related to detail and imagination, which suggests that some form of obstacle was present in the recognition and thinking capacity of children from the endemic area. It likewise proves that the positive reinforcement of environmental stimulations may lead to improving the development of intelligence in children from the endemic area.

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