

The Effects of High Fluoride on the Intelligence Level of Primary and Secondary Students

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The harm of long-term intake of excessive fluoride on the human skeletal system has been proved. There are also reports about the effects of high fluoride on the human nervous system and mental development [1, 2]. Some studies have proved that if the mother has taken in an excessively high amount of fluoride, she can transmit that through the placenta to the fetus [3]. Fluorosis has certain effects on the mental development of children. However, how this high level of fluoride can influence the mental development of children has yet to be reported. In May of 1991, we did some investigation and hereby report the results as follows.

Subjects and Methods

1 Subjects

121 primary and secondary students were selected from the high fluoride area, which includes four neighboring natural villages that are centered around Wubu Ziyao of Xingshunxi Town of Guyang County of Inner Mongolia. The population was about 1152, and the water fluoride was 2.1 ± 7.6 mg/L, the prevalence rate of skeletal fluorosis was 11%, and the prevalence rate of dental fluorosis among the students who were examined was 90.9%. 121 primary and secondary students were selected from the non-high fluoride area, which includes six neighboring natural villages which are centered around Hada Heshao Village of the same town. The population was about 1205, the water fluoride was 0.6-1.0 mg/L, no patients with skeletal fluorosis were found, and the prevalence rate of dental fluorosis among the students who were examined was 21.5%. The two areas, which are both located in the countryside and amongst the Han ethnic group, are 15 km away from each other. The geography, culture and education, living standard, social economic conditions and other aspects of these two areas are very similar. Therefore, they were comparable. All of the primary and secondary students from 7 to 16 years old of these two areas were mentally tested. Additionally, physical examination was done to

exclude those that have diseases that would affect the IQ.

2 Testing Methods

Wechsler Intelligence Scale for Children was adopted according to the provisions and methods in the Testing Guidelines of Chinese Wechsler Intelligence Scale for Children written mainly by CHUANDING LIN [5]. The test's measuring tools have been provided by the Department of Physiology of Beijing Normal University. IQ \leq 69 is regarded as mental retardation, 70-79 is critical state, 80-89 is lower level, 90- 109 is moderate, 110-119 is higher level, 120-129 is excellent, 130+ is very excellent. The examiners did a centralized study and unified the methods. They strictly followed the instructions. And the same group of examiners did the tests in these two areas.

Results of Investigation

1 Intelligence tests results of 7- 16 year old primary and secondary students from high fluoride area and non-endemic fluoride area (See table 1)

The results showed that the intelligence of different age groups of primary and secondary students from the high fluoride area and non- high fluoride area had significant differences ($P < 0.01$). The intelligence of subjects from these two areas had a tendency of increasing with the age.

Table 1: IQ Comparison of Children of different age groups in these two areas

Age Groups	High Fluoride Area			Non-high Fluoride Area			P-value
	n	X	S	N	X	S	
7~	53	74.2	12.0	57	80.5	13.7	P<0.02
11~	39	76.7	13.6	39	86.2	14.5	P<0.01
14~16	29	77.8	16.3	25	86.2	8.7	P<0.03
7~16	121	75.9~	13.6	121	84.0	12.1	P<0.01

Comparing different groups that were divided by the different percentage of fluoride in the drinking water, the intelligence scale of students in each group and the water fluoride showed a dose-response relationship (see table 2).

Table 2: Effects of different water fluoride on the IQ of Students

Testing Areas	Water Fluoride (mg/L)	N	X	S	P value
High Fluoride Area	5.2 - 7.6	65	75.6	13.3	
Secondary High Fluoride Area	2.1 - 3.2	56	76.1	13.9	P<0.05
Non-high Fluoride Area	0.6 - 1.0	121	84.0	12.1	P<0.01

From Table 2, we can see that the level of intelligence of primary students from the high fluoride area and the intelligence of primary students from the secondary high fluoride area had significant differences (P<0.05), and the intelligence of students from the high fluoride area and non- epidemic area are also significantly different (P<0.01). The average IQ of males was 85.8 and the average IQ of females was 81.8; there were no significant gender differences according to the statistical test.

2 IQ level of primary and secondary students from high fluoride area and non- high fluoride area (See table 3)

From Table 3, it can be seen that there were students at a critical state or with mental retardation in both of these two areas, but there were more in the high fluoride area than in the non- high fluoride area. There were significant differences (P<0.01) according to the Chi-square test. There was not even one case where the subject's level of intelligence reached a higher level in the high fluoride area, but there were two cases whose intelligence reached a higher level in the non- high fluoride area. The percentage of students whose intelligence reached a moderate level or lower level in the non- high fluoride area was significantly greater than the percentage in high fluoride area. Combining the number of cases of higher level, moderate level, lower level, there were significant differences (P<0.01) in these two areas according to the Chi-square test.

Table 3 Students' IQ in these two areas

IQ	Level	High Fluoride Area		Non-high Fluoride Area		P-value
		N	%	N	%	
110-119	Higher Level	0	0.0	2	1.7	
90-109	Moderate Level	19	15.7	34	28.1	P<0.01
80-89	Lower Level	30	24.8	45	37.2	
70-79	Critical State	32	26.4	23	19.0	P<0.01
≤69	Mental Retardation	40	33.1	17	14.0	

Discussion

The results show that the level of intelligence of primary and secondary students from the high fluoride area and that of primary and secondary students from the non- high fluoride area had very significant differences, proving that high fluoride has adverse effects on the mental development of students. The higher the water fluoride is, the lower the level of IQ. Before 6 years of age

is a critical period for children's mental development, and it is meaningful to choose students older than 7 years old as subjects. Although intelligence is influenced by many factors, the people of these two areas who were examined are very comparable. The students' years of education, the size of the primary and secondary schools, and the quality of teaching are very similar. The middle school students of these two areas studied at the same secondary school, and their intelligence had significant differences, mainly caused by water fluoride. These results are basically the same with the results from investigations in other provinces [4, 6]. The regular materials of normal intelligence tests are made according to the testing results of students from urban areas. Therefore, it is not very proper to use the regular standards of IQ classification among the people from remote and rural areas. It is necessary to make corresponding IQ classification standards.

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