

Investigation and Analysis of Children's IQ and Dental Fluorosis in a High Fluoride Area

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Objective: To understand the relationship of dental fluorosis and IQ among children in a high fluoride area and further study the harm of high fluoride to the human body.

Method: High fluoride areas (from drinking water) in Qi County were selected as the site of investigation. The subjects of the study were 7-to-10-year-old children. Dental fluorosis was diagnosed using the Dean Index, and IQ was determined with the Chinese combined Raven's test.

Results: The average IQ among the children in the high fluoride area was 98.06 and the rate of mental retardation was 5.47%. Intelligence distribution in the children with and without dental fluorosis did not show any difference, and no sex-specific differences in intelligence were found.

Conclusions: The long-term consumption of high fluoride water may adversely affect children's intellectual development.

Keywords: High fluoride, Children, IQ,

A small amount of fluoride is necessary for the human body as it is beneficial to the teeth and skeleton. Fluoride has a certain anticaries effect, but excess fluoride can harm the human body. Along with skeletal fluorosis and dental fluorosis, fluoride can cause broad damage to the non-skeletal system and organs. Excess fluoride can penetrate the blood brain barrier, enter brain vessels, affect the normal physiological functions of brain cells, damage the nervous system, and thereby affect learning and memorization capabilities[1-2]. In order to explore the effects of fluorosis on children's intelligence, we examined 7-to-10-year-old children in some high fluoride villages in Kai Feng Qi County. The results are as follows.

1. Investigation Subjects and Methods

1.1 Investigation Subjects

The area of investigation has become a known high-fluoride water area with endemic fluorosis. The area does not have a deficiency of iodine and there is no known pollution source. A primary school was selected in this area through use of a random sampling method. All in-school students at the selected school were studied.

1.2 Content and Method

Dental fluorosis examinations were performed on the 7-to-10-year-old children in the school. In addition, the drinking water used by each child's family was collected and intelligence tests were conducted.

1.3 Testing of Water Sample and Diagnosis of Dental Fluorosis

Water samples were tested for fluoride with the fluoride electrode method as set forth in WS/T106-1999 Testing Method of Fluoride in Drinking Water of Endemic Fluorosis Area. Dental fluorosis was diagnosed using Dean's diagnostic criteria.

1.4 Intelligence Test

Intelligence was tested and evaluated according to the "CRT-RC" method (Chinese combined Raven Testing Rural Area Revision Version). Intelligence scores were classified based on the normal range: ≤ 69 extremely low, 70-79 borderline, 80-89 low average, 90-109 average, 110-119 high average, 120-129 superior, ≥ 130 very superior.

1.5 Statistical Analysis of Data

All data was entered into the computer and analyzed with SPSS 13.0 statistical software.

2. Results and Analysis

2.1 General Information

676 children have been investigated. The content of fluoride in the drinking water was 2.47 ± 0.75 mg/L. Dental fluorosis and intelligence quotients (IQ) were determined in 374 males and 302 females. In total, 347 were diagnosed as having dental fluorosis, producing a prevalence rate of 51.33%.

Category	Cases	Value of IQ (x ± s)	Distribution of Frequency						
			Extremely low	Borderline	Low average	Average	High average	Superior	Very superior
Endemic Area	676	98.06 ±19.74	37	44	69	364	117	39	6
			5.47%	6.5%	10.21%	53.85%	17.31%	5.77%	0.89%

2.2 Distribution of Children's Intelligence Quotient Level (See Table 1)

In this investigation, the average IQ score of children in the high fluoride areas was 98.06, the rate of extremely low intelligence was 5.47%, the rate of borderline intelligence was 6.5%, and the rate of very superior intelligence was 0.89%.

2.3 Intelligence Comparison of Children of Different Gender (See Table 2)

Among the children tested, among which were 374 males and 302 females, the average IQ of male and female children were 97.00 and 99.37, respectively. The rate of extremely low intelligence (IQ < 69) for male and female children were 6.68% and 3.97%, respectively. This difference was not statistically significant ($\chi^2=11.32$, $P>0.05$). This indicates that high fluoride drinking water's impact on intelligence does not differ based on gender.

Gender	Cases	Intelligence Quotient IQ Value (-X ± s)	Borderline Intelligence	Test of Significance
Male children	374	97.00 ±21.93	25(6.68%)	$\chi^2=11.32$
Female children	302	99.37 ±16.59	12(3.97%)	$p>0.05$

2.4 Comparison of Intelligence Quotient of Children with and without Dental Fluorosis (See Table 3)

The average IQ scores of children with and without dental fluorosis were 98.73 and 97.36 respectively. The rate of extremely low intelligence among children with

dental fluorosis was 5.19%, while that of normal children without dental fluorosis was 5.78%, a difference that was not statistically significant (testing result is $\chi^2=7.48$, $P>0.05$). This indicates that under the same long-term exposure to high fluoride drinking water, there's no clear IQ difference between children with and without dental fluorosis.

Group	Cases	Intelligence Quotient IQ Value (-X ± s)	Borderline Intelligence	Test of Significance
Dental fluorosis children	347	98.73 ±21.07	18 (5.19%)	$\chi^2=7.48$
Non-dental fluorosis children	329	97.36 ±18.24	19 (5.7%)	$p>0.05$

3. Discussion

Since children are at the growth stage and sensitive to hazardous substances in the external environment, their health can be easily damaged. Studies have shown that excess fluoride can affect brain development and the secretion of neurotransmitters in different stages of the growth process by penetrating both the placental and blood-brain barriers; accordingly, fluoride can have a detrimental effect on the normal intellectual and nervous system development in children[3]. Animal testing[4] also indicates that high levels of fluoride damages the learning ability of rats to some extent.

Research is warranted, therefore, on the health problems of children in endemic fluorosis areas.

The results of this investigation show that, in the high fluoride area, the average IQ value was 98.06, while the rate of extremely low intelligence was 5.47%. The effects of high fluoride on children's intelligence had no gender difference ($P>0.05$), which is consistent with previous research[5]. The most distinct effect of excess fluoride on the human body is dental fluorosis. The rate of extremely low intelligence among children with dental fluorosis in this area was 5.19%, while that of the normal children was 5.7%. The difference between the average IQ values among the children with and without fluorosis was not significant, indicating that dental fluorosis is not relevant to the effect of fluoride on intelligence. This is different from the result of Li Yongping's [6] research. Further study should be conducted to assess the difference between the intelligence of children with dental fluorosis and those without.

As for the harm of high fluoride to children's growth, more attention should be given to the health care of children in high fluoride areas and greater efforts should be made to improve the water quality, reduce the absorption of fluoride, and accelerate the drainage of fluoride from the body, so as to guarantee the healthy growth of children in fluorosis areas. The seriousness of high fluoride's effect on children's intelligence needs additional thorough investigation. The present investigation has provided a scientific basis for further explanations on fluoride's effect on children's intelligence from long-term drinking water exposure.

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