

Analysis on the Correlation Between TSH and Intelligence in Children with Dental Fluorosis from Endemic Fluorosis Regions

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Fluoride is one of the indispensable elements for the living being. Excess amounts of fluoride, however, may damage the teeth and bones. Fluoride may also injure the body's soft tissues, resulting in nonskeletal fluorosis. To further investigate the influence of endemic fluorosis on childhood thyroid function and intelligence, we have selected school-aged children inflicted with dental fluorosis as the subject of our study. These children are from a region impacted with endemic fluorosis: Chaoyang City of Liaoning Province. The children in the study were tested for TSH (Thyroid Stimulating Hormone) and intelligence, and meaningful results were found. The results are reported in the following text.

1. Subjects and Methods

1.1 Subjects

School children between 8 to 12 years old, who were born in the affected area and are exposed to drinking water from sources containing 2.0 mg/L and 11.0 mg/L of fluoride, have been tested. These children suffer from dental fluorosis but not from goiter, and are living in two neighboring villages, one which is slightly affected by a relatively low level of endemic fluorosis and the other with severe fluorosis. Another group of children were chosen as the control group. The control group lives in a non-endemic area with a water source containing 1.0 mg/L of fluoride.

1.2 Methods

The TSH methods draws blood from the ear of the subject, which is then applied onto the filter paper. These items were supplied by the TSH Quantitative Assay Kit (TMK-433), and the filter paper was provided by the China Institute of Atomic Energy. The method used for this investigation was in compliance with the protocol set forth in the Assay kit. The inspection of thyroid and dental fluorosis was conducted in accordance with the *Control Standard of Endemic Goiter* and the *Control Standard of Endemic Fluorosis*, as issued by the CPC

Central Committee's Leading Group Office of Endemic Diseases. Intelligence levels were tested with the *Raven test - Associative Atlas* (Chinese agricultural village version). The period of testing was limited to 40 minutes. The test results are represented by intelligence quotients (IQ).

2. Results

2.1 Determination of TSH Values

The mean value of TSH in the dental fluorosis group from the endemic area was significantly higher than that of the control group from the non-endemic area. A significant difference was also found when comparing the test results of the dental fluorosis group in the low versus severely affected endemic fluorosis area (See Table 1).

Table 1: Comparison of TSH level found in children from the severely endemic area and the non-endemic area

Group	No. of Cases	X±S	T
Severely endemic area (A)	63	3.94±2.75	A,B P<0.01
Slightly endemic area (B)	66	2.29±1.54	B,CP<0.01
Non-endemic area (C)	72	0.55 ±0.12	A,CP<0.01

2.2 Intelligence Test Results

The mean intelligence quotient of the children suffering from dental fluorosis in the two endemic areas is significantly lower than that of the children in the non-endemic area. Furthermore, subjects from the severely endemic region are found to have much lower IQ levels than their counterparts in the slightly endemic regions. (See Table 2). Half of the subjects suffering from dental

fluorosis in the endemic regions were found to have IQ levels in the average and below-average range of the chart, while half of the subjects from the non-endemic and slightly endemic regions were found to have IQ levels in the average and above-average range (See Table 3). From Table 3, we can see that the rate of high IQ levels (superior and excellent) from the non-endemic group is 10.74%. This is higher than the lightly endemic area group (6.91%) and the severely endemic area group (3.85%). Those with lower IQ levels are dispersed on the charts in a linear fashion, where the more endemic a region, the greater the % of subjects with lower IQ.

Group	No. of Cases	X±S	t Test
Severely endemic area (A)	78	92.53 ±12.34	A,B P<0.05
Slightly endemic area (B)	188	94.89 ±11.15	B,C P<0.01
Non-endemic area (C)	270	98.46 ±13.21	A,C P<0.01

3. Discussion

Both iodine deficiency and fluorosis can influence the level of intelligence[1-3] in children. The TSH level is a sensitive index which both reflects the state of the body's thyroid function, and screens the level of iodine (lack thereof) in a population. TSH is also a sensitive indicator in terms of making timely discoveries of people suffering from poor thyroid function or below-average intelligence. The results from this test show that TSH values of children with dental fluorosis from the two endemic areas is at a remarkably higher level than those from the non-endemic area. Children from the endemic areas were also found to have a lower level of intelligence than the non-endemic group. The heavier the level/concentration of fluoride found in the region, the more significant the difference in the results. It leads one to wonder the cause to this result: Could it be the sole responsibility of iodine deficiency, or could it be a result of the high levels of fluoride found in the region? To answer this question, we focused this investigation on a geographical area that have reached the control standard for iodine deficiency thanks to a 27-year period of continuous iodine salt usage. Currently, the daily intake of iodine of residents in the area is 329 $\mu\text{g/L}$, which exceeds the physiological demand (100-200 $\mu\text{g/L}$).

IQ	Heavy Endemic Area		Light Endemic Area		Non-endemic Area	
	Cases	%	Cases	%	Cases	%
Super High 130~	0	0.00	3	1.60	6	2.22
High 120~	3	3.85	10	5.32	23	8.52
Average High 110~	9	11.54	32	17.02	58	21.48
Average 90~	36	46.15	95	50.53	132	48.89
Average Low 80~	18	23.08	27	14.36	34	12.59
Borderline 70~	7	8.97	13	6.91	12	4.45
Backward ≤69	5	6.41	8	4.26	5	1.85
Total	78	100	188	100	270	100

The mean value of urinary iodine was found to be 131.5 $\mu\text{g/L}$ and measurements of T3 and T4 in the subjects' serum were within the normal range. As per these results it is safe to conclude that the influence of iodine deficiency on children can be removed as an explanation of the results in this study. In addition, the local economy, size of the schools, quality of teachers' education, and the status of iodine nutrition are relatively the same in the exposed and control groups. This is particularly significant in the results from the two neighboring villages who were actually located in the same town (with one being the lightly endemic region and the other being the severely endemic region). The water fluoride level in the former village is 2.0 mg/L, while the water fluoride level in the latter village is up to 11mg/L. The severity of dental fluorosis from these two areas are deemed to be "serious" and "severe", respectively, which reflects the fact that there is a comparable, yet different, degree of fluoride harm between these two endemic area groups.

The results of the intelligence tests show that a high level of fluoride influences children's IQ, which is consistent with some previous data[4]. It is worth mentioning that the higher the degree of dental fluorosis, the more negative the impact on the children's intelligence level. This is an issue which merits utmost attention. We believe that the low intelligence of children has no relation to the level of TSH. Although there are differences found in TSH values between the endemic area and non-endemic area groups, and between the lightly endemic and severely endemic groups, the individual values are all within the normal range. The endemic and non-endemic area groups are all control areas of iodine deficiency. Although the subjects were found to suffer from dental fluorosis, no thyroid goiter were found on them. The TSH value rises with the level of the fluoride endemic area (from light to heavy degree) and is the result of interference by high fluoride. Further exploration on the influence or harm of this interference on the children's body is required.

References

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