



COMPARATIVE EVALUATION OF DENTAL FLUOROSIS AND INTELLIGENCE QUOTIENT (IQ) IN JHARKHAND POPULATION

Dental Science

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ABSTRACT

Aim: Fluorosis, caused by ingestion of excessive amount of fluoride through food or water, is a major public health problem in India. This study was conducted to evaluate any relation between dental fluorosis and Intelligence Quotient (IQ).

Study design: A prospective study was conducted over 40 subjects selected randomly in the age group of 6 to 10 year old school going children. Seguin Form Board Test was used to assess the IQ level of children. Means of groups were compared by independent Student t-test.

Result: Mean scores for average time were found to be significantly higher ($P < 0.05$) among children with dental fluorosis than without dental fluorosis.

Conclusion: Present study showed clear differences in IQ which supports the hypothesis that excess fluoride in drinking water has neurological toxic effects. Therefore, a close monitoring of fluoride levels in local water supplies is necessary.

KEYWORDS

Fluorosis, Intelligent Quotient, Seguin Form Board Test.

INTRODUCTION

Intelligence has been defined in many different ways including, but not limited to, abstract thought, understanding, self-awareness, communication, reasoning, learning, having emotional knowledge, retaining, planning and problem solving. An intelligence quotient (IQ) is a score derived from one of several standardized tests designed to assess intelligence. IQ scores are used as predictors of educational achievement, special needs, job performance and income. There is considerable relationship between a person's degree of intelligence and range of activities, the level of achievement and the depth of understanding possible to him.¹

Fluoride, a double-edged sword, embraces beneficial effect, but excessive exposure can give rise to number of adverse effects. Fluoride has beneficial effects on teeth at low concentrations in drinking water, but excessive exposure to fluoride in drinking water, or in combination with exposure to fluoride from other sources, can give rise to a number of adverse effects. These range from mild dental fluorosis to crippling skeletal fluorosis as the level and period of exposure increases.²

Apart from these, there are reports that excess fluoride consumption promotes cancer, hip fracture, leads to still births or birth defects and has detrimental neurological effects.³ People of 19 states in India are drinking fluoride contaminated water above WHO's maximum allowed concentration of 1.5 mg/L.⁴

In children, the most reported effect is on cognitive capacities, particularly intelligence reduction. Children who live in a fluorosis area were found to have five times higher odds of developing low IQ than those who live in a non fluorosis area or a slight fluorosis area.⁵ Alerted by such reports, this study was conducted with the aim to investigate that if there is a link between the intellectual ability of child and exposure of the child to excess fluoride by looking at the IQ scores and dental fluorosis status of the children of Garhwa district of Jharkhand.

MATERIALS AND METHODS

A prospective study was conducted among 6 to 10 years old, 40 school

going children. The study group consists of 20 patients diagnosed with dental fluorosis and 20 healthy subjects used as control group. Before the beginning of the study, ethical approval was obtained from the ethical committee of the institute. Official permission to examine the school children was obtained from the school authorities and written informed consent was obtained from parents of children who participated in the study.

Inclusion criteria fulfilled the children who were born and brought up in the study areas. Exclusion criteria included genetic, congenital or acquired diseases related to nervous systems in the past or at present. A self-prepared questionnaire was used to obtain information regarding source of drinking water, demographic details and time of residing in the present area or if migrated from any other area. Dean's fluorosis index was used for clinical assessment of dental fluorosis.⁶

IQ was tested using Seguin Form Board Test (SFBT) to assess visual discrimination, matching and eye-hand coordination. Test materials consisted of ten differently shaped wooden blocks and a large form board with recesses corresponding to these shapes (SFB). Children had to set the wooden blocks into the respective recesses into the board. The time taken by each child was recorded in seconds.⁷

Statistical analysis

The data was collected and entered into Microsoft excel spreadsheet. Analysis was done using statistical package for social science (SPSS) version 22 (SPSS Inc. Chicago, IL, USA) Windows software program. Statistical analysis was carried out using Student t-test with level of significance $p < 0.05$.

STATISTICS AND RESULTS

A total of 40 students of age group 6–10 years were included in the study. The study population comprised 21 females and 19 males. The study group includes 7 males and 13 females whereas control group includes 12 males and 8 females. Table 1 shows Dean's fluorosis index and mean scores for average timing of study participants to complete the task.

Regarding drinking water sources, 9 people were drinking groundwater, 5 were drinking from aquaguard, 1 was drinking from reverse osmosis and 5 were using tap water. Among control group, 3 were using ground water, 6 were using aquaguard, 5 were using reverse osmosis and 6 were dependent on tap water.

Mean scores for average time was found to be significantly higher ($p < 0.05$) among the children of study group (with dental fluorosis) with 28 ± 2.18 seconds than control group (without dental fluorosis) 25 ± 2.04 seconds.

Table 1: Dean's fluorosis index and mean scores for average timing of study participants

Variables		Study group (With Dental Fluorosis) (n=20)	Control group (Without Dental Fluorosis) (n=20)
Gender	Male	7	12
	Female	13	8
Dean's fluorosis Index	Normal	0	20
	Questionable	5	
	Very mild	7	
	Moderate	5	
	Severe	3	
Drinking water Source	Groundwater	9	3
	Aquaguard	5	6
	Reverse Osmosis	1	5
	Tap water (Water supply)	5	6
	Overall Group	28 ± 2.18	25 ± 2.04
Mean \pm SD (For average Time- in seconds)			
p value		<0.05	

DISCUSSION

Elevated concentration of naturally occurring fluoride (F) in drinking water is a worldwide problem. Many Asian and Latin American countries have reported concentrations of F often exceeding the World Health Organization (WHO) guideline values of 1.5mg/L or their prevailing national standards.⁸ India lies in a geographical fluoride belt, which extends from Turkey to China and Japan through Iraq, Iran, and Afghanistan. Of the 85 million tons of fluoride estimated in the earth's crust, nearly 12 million tons are in India.⁹

About sixty million people are living in 200 districts of 20 states which are endemic of fluorosis and around two percent children suffer from dental fluorosis.¹⁰ Fifty to hundred percent districts are affected by fluorosis in Andhra Pradesh, Gujarat and Rajasthan.¹¹

IQ has been used to measure intellectual ability for almost one hundred years, and there are many standards of measuring IQ.⁵ In the present study, Seguin Form Board Test has been used which finds application in assessment of general intelligence of children in pre-primary and primary school years.¹²

In aborted human fetuses collected from endemic fluorosis area it was found that accumulation of fluoride in brain tissue causes disruption of certain neurotransmitters and receptors in nerve cells and also increased numerical density of volume of neurons and undifferentiated neuroblasts.^{13,14} These neurotoxic effects of fluoride also presents as impaired development of intelligence in children.¹⁵

Present study shows that mean scores for average time was found to be significantly higher ($p < 0.05$) among the children of study group (with dental fluorosis) with 28 ± 2.18 seconds than control group (without dental fluorosis) 25 ± 2.04 seconds. It signifies the low IQ among the fluoride affected children. The results correspond with the previous studies.

In a meta-analysis performed in China to review studies on fluoride and IQ between 1988 and 2008, a consistent and a strong association between exposure to fluoride and low IQ was found and it was also noted that children who live in fluorosis area have five times higher odds of developing a low IQ than those who live in non fluorosis area.¹⁶ Similar results have been found in other studies done separately by Y Lu, Shulin Liu, QW Xiang, Seraj B and Guojian Wang as well.¹⁷⁻²¹

A descriptive cross-sectional study was conducted among 8 to 10 years

old School children living in Kutch District, Gujarat, India, from January to February 2013. It suggested that a low IQ among fishermen school children community. The major factors which influenced their IQ were dental fluorosis, low education level of parents and high body mass index.²²

CONCLUSION

The present study showed clear differences in IQ and confirms that excess fluoride in drinking water has neurological toxic effects. Therefore, a close monitoring of fluoride levels in local water supplies from areas with endemic fluorosis and implementing public health measures to reduce the fluoride exposure levels in high fluoridated regions seem necessary.

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