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COMPARATIVE STUDY OF DENTAL FLUOROSIS WITH INTELLIGENT QUOTIENT (IQ) IN SCHOOL CHILDREN IN CHITTOOR DISTRICT

Dental Science

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ABSTRACT

Objectives: The objective of the study was to assess the relationship between fluoride levels and intelligence quotient in children aged between 7 - 11 years in Chittoor district. Andhra Pradesh, India

Materials and methods: Ground water from Madanapalli and Tirupathi was collected and fluoride levels were measured using colorimeter test. 960 subjects in the age group 7-11 years were included in the study. Dental fluorosis status was measured using Dean's fluorosis index 1945. The intellectual ability of each child was calculated using Raven's colored progressive Matrices (RCPM) and results were analysed.

Results: Fluoride levels in drinking water in Madanapalliranged from 2.5 -3.5 ppm and in Tirupathi 1-2 ppm. When both the regions were compared, IQ levels decreased from 21.1198 to 16.5052, which showed a statistically significant difference (p=0.007)

Conclusion: From this study it was concluded that there is a significant relationship between fluoride levels in drinking water and intelligent quotient

KEYWORDS

IQ, Fluoride levels, Drinking water

INTRODUCTION:

Fluorine is often called as double-edged sword. Inadequate intake of fluoride in drinking water is associated with dental caries. Similarly, prolonged ingestion of fluoride through drinking water in excess of the daily requirement is associated with dental and skeletal Fluorosis[1]. Also the existing literature reports the neurological consequences associated with excessive exposure to fluoride.

In view of reports of high fluoride levels in water supplies worldwide, studies were conducted to prove whether there is a link between fluoride and intelligence quotient levels in children. Majority of studies were conducted in China, Iran, and Iraq. There is a paucity of studies in India to establish this fact, and has Chittoor district in Andhra Pradesh is endemically affected with fluorosis, this study was undertaken to evaluate the relationship between fluoride levels and intelligent quotient of children.

MATERIALS AND METHODS:

Children were selected from various educational institutions. 960 subjects participated in the study after taking prior consent from teachers, parents and care takers. Of these 960 subjects 480 were from Madanapalli and 480 from Tirupathi. All subjects in the age group of 7-11years were included from both sexes.

Subjects with normal birth history, who were permanent residents in the region and with no history of trauma to the head, were selected for the study. Subjects,who were mentally retarded, physically disabled and with questionable fluorosis were excluded from the study.All the children were examined for the dental fluorosis status according to the Dean's fluorosis index 1945. Intelligent quotient (IQ) test was conducted individually for every child using the coloured progressive matrices component of Raven's educational test. The scores were compared using Ravan's manual and the collected observational data was subjected to statistical analysis using Chisquare test, Post hoc tukeys test and t test.

RESULTS:

The region evaluated was classified into no fluorosis area and fluorosis areas based on the level of fluoride in drinking water. In Tirupathi fluoride levels in drinking water showed about 1-2 ppm and in Madanapalli it showed about 2.5 – 3.5 ppm. Table 1 shows mean IQ in fluorosis group is about 16.5052 and in no fluorosis it was about 21.1198 which was statistically significant (p = 0.007) (Graph 1).

Table 2 shows that difference in the proportion of children with various IQ categories which revealed that 79% of children with dental fluorosis had low/Borderline IQ scores whereas 74% of children without fluorosis had low/ borderline IQ scores and there was no significant difference between the two groups. About 4.80% of children in fluorosis area had below average IQ scores whereas 8.80% of children in no fluorosis area had below average IQ scores.8% of children in fluorosis area had average IQ and 14% of children in no fluorosis area had average IQ. High IQ scores were seen in 44% of children in fluorosis area and 22% of children in no fluorosis area. Although there were more number of children with high IQ in fluorosis region the overall IQ scores reveal that fluorosis area had significantly lower IQ ($p<0.001$) than region with no fluorosis (Graph 2)

Table 3shows that the average IQ of children in each age group in Tirupathi was higher than in Madanapalli. For 7 year old subjects the mean IQ score of children in Madanapalli was 47.50 and in Tirupathi it was 10.00 which show a statistically significant difference (0.003) between two groups. In 8 year old subjects mean IQ scores in Madanapalli and Tirupathi were 42.50 and 13.06 which were statistically significant (0.000). In 9 years old children mean IQ scores of two groups were 22.57 and 23.61 which were not statistically significant (0.776). Mean IQ scores of 10 years old children in the two groups was 15.80 and 13.29 which did not reveal significant difference (0.454).most of the children in the study belong to 11 years age group and the mean IQ scores of the children in Madanapalli and Tirupathi were17.56 and 12.46 and there was significant difference (0.031)

between both the groups. (Graph 3)

DISCUSSION:

80% of Indian population is dependent on ground water which is highly contaminated with various pollutants one of it is high fluoride levels.[2]

Fluoride can pass through the placenta by maternal exposure to elevated fluoride levels during the prenatal period or it may be ingested through the child's diet. High levels of absorbed fluoride in children (80- 90%) and adults (60%) are retained in the body. Once absorbed in the blood, fluoride forms lipid soluble complexes which cross the blood-brain barrier and accumulate in cerebral tissues causing neurotoxic and excitotoxic mechanisms. The structural and functional alterations In CNS, specifically in the fetal period and the first 8 years of life, may lead to learning and intellectual deficits and cognitive dysfunctions.[3,4]

There are many standard tests for measuring intelligence quotient like Raymond B Cattell test, Standard Binet intelligence scale, Seguin form board test was performed to test the intelligence but they have limited practical application. Saxena et al has used Raven's Standard progressive matrices. Raven's coloured progressive matrices were also used by Seraj[6]and Sivaprakash[7] et al.

Hence in the present study Ravan 's coloured progressive matrices was used because it is validated test for basic cognitive abilities and widely used to evaluate the normal development of brain functions. Due to the non- verbal characteristics of the test, it is successfully administered in preschool children as it does not require any verbalization or reading and vernacular skills. Owing to the high correlation of this test in evaluating children's IQ (ranging from 0.7-0.92) compared to the conventional IQ test, RCPM is highly recommended for measuring the intellectual and conceptual ability of young children.[8]

The present study found a significant inverse response relationship between fluoride levels in drinking water and IQ of the children. As the fluoride level in drinking water increased, the intelligence decreased and the rates of children with low intelligence increased. This is supported by the meta-analysis conducted in China between 1988-2008 which reported thatchildren who live in fluoride area have 3-5 times higher odds of developing a low IQ than those who live in non –fluorosis area[9]

In a study done by Li[10] et al when fluoride is given before 6 years of age the human brain is in the fastest stage of development and that around 7 - 8 years basic structural development is completed, therefore the brain is most vulnerable from excess fluoride intake before this age. This is evident from the present study where 7-8 years old children had lower IQ than other age group (Table:3)

In the present study subjects with moderate and severe fluorosis had significantly lower IQ than subjects with mild fluorosis.It is because the severe the condition of dental fluorosis, the higher the exposure to fluoride in the environment, the higher the deficits in the development of intelligence. This statement is in line with the study done by Fomon[14].

Similarly In the present study percentage of children ranked in average and above average was higher in area with low fluorosis than in fluorosis area. This is in line with the studies done by Poureslami[12] and Trivedi[3]. Likewise the percentage of children in low/ borderline group was higher in Madanapalli than in Tirupathi.

The neurobehavioual development may also be influenced by many genetic, socioeconomic, geographical and other environmental factors. In contrast according to the study done by Seraj[6] et al they explained that parents educational level had no co-relation with children IQ scores, this is because they were of opinion that fetal and early childhood periods are more susceptible stages in brain development and any induced neurological impairment can occur during these periods and it does not depend on parents educational level or income.

Hence to preclude these factors in the present study subjects were selected from government schools whose parents had same levels of educational standards and identical socio-economic status Our results support the possibility of adverse effects of fluoride exposures on children's intelligence ability. Future research should be directed to evaluate dose-response relations based on individual-level measures of exposure over time, including prenatal exposure and control of other parameters.

CONCLUSION:

The data from this research supports the hypothesis that excess fluoride in drinking water has neurological toxic effects. Therefore, a close monitoring of fluoride levels in local water- supplies with endemic areas and implementing public health measures to reduce the fluoride exposure levels in high fluoridated regions deemed necessary.

Table 1: Comparison of fluorosis and non-fluorosis groups with respect to IQ

	Group	N	Mean	P –value
Total sample	No fluorosis	480	21.1198	0.007
	Fluorosis	480	16.5052	

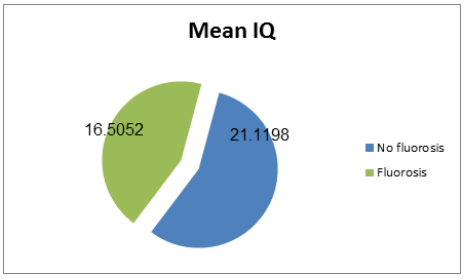
Table 2:Distribution of frequencies according to IQ

			Non Florosis	Florosis	Total	p-value
IQ code	Low	N	355	379	734	0.001
		%	74.00%	79.00%	76.50%	
	Below Average	N	42	23	65	
		%	8.80%	4.80%	6.80%	
	Average	N	14	8	22	
		%	2.90%	1.70%	2.30%	
	Above Average	N	47	26	73	
		%	9.80%	5.40%	7.60%	
	High	N	22	44	66	
		%	4.60%	9.20%	6.90%	
Total		N	480	480	960	
		%	100.00%	100.00%	100.00%	

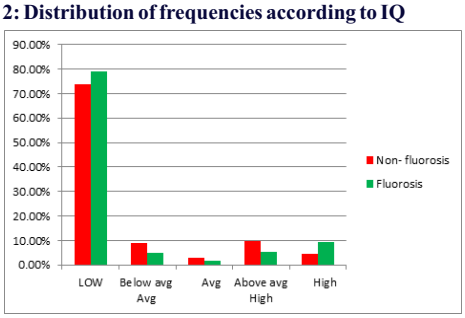
Table 3: Comparision of age and IQ in Tirupathi and Madanapalli

Age	Florisis	N	Mean	Std. Deviation	Std. Error Mean	t-value	p value
7	No florosis	17	47.50	18.24	4.42	1.998	0.003
	Florisis	1	10.00	.	.		
8	No florosis	34	42.50	25.47	4.37	4.806	0.000
	Florisis	31	13.06	23.75	4.27		
9	No florosis	111	22.57	22.83	2.17	0.285	0.776
	Florisis	165	23.61	33.55	2.61		
10	No florosis	116	15.80	24.12	2.24	0.750	0.454
	Florisis	105	13.29	25.69	2.51		
11	No florosis	202	17.56	23.39	1.65	2.168	0.031
	Florisis	178	12.46	22.33	1.67		

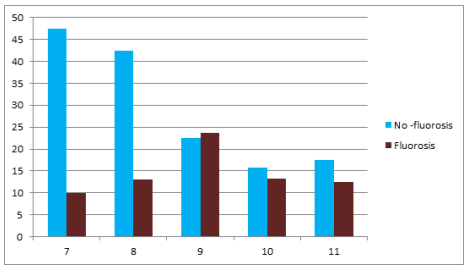
Graph 1: Mean IQ of children in fluorosis and Non-fluorosis area



Graph 2: Distribution of frequencies according to IQ



Graph 3: Comparison of age and IQ in Tirupathi and Madanapalli



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