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# PREVALENCE OF DENTAL CARIES AND DENTAL FLUOROSIS IN RELATION TO DIFFERENT FLUORIDE CONCENTRATION IN DRINKING WATER AMONG 14-15 YEARS OLD SCHOOL CHILDREN IN RURAL AREAS OF PATNA DISTRICT, BIHAR

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## ABSTRACT:

**AIM:** The aim of the study to determine the relationship between dental caries prevalence, degree of dental fluorosis with different concentration of fluoride in the drinking water among 14-15 years old school children in rural areas of Patna.

**METHODOLOGY:** Cross-sectional descriptive study. SPSS version 16 is use for the analysis of data. Karl Pearson's Coefficient of correlations is use to measure correlation between dental caries, dental fluorosis with varying concentration of fluoride in drinking water. P <0.05 was considered as statistically significant.

**RESULTS:** The overall prevalence of dental caries was 181 (30.17%). Among males it was 54 (9%) and in females it was 127 (21.17%). Among 14 years old school children, the prevalence of dental caries was 119 (19.83%) and in 15 years old school children, it was 62 (10.33%).

**CONCLUSION:** Present study was based on selected children and selected villages of Patna District, the results warrant a fully fledged epidemiological study to get a clear picture of the extent of problem

**Keywords:** Dental caries, Fluoride, Rural areas, Drinking water

## INTRODUCTION:

World Health Organization has defined Health as "a state of complete physical, mental and social well being and not merely an absence of disease or infirmity". In recent years, this statement has been amplified to include the ability to lead a "socially and economically productive life".[1] Oral health is an integral part of general health and any deviation would reflect the health of the individual in a significant way. Many dental diseases or conditions like dental caries, periodontal diseases, developmental variation in dento-facial structures, halitosis, dental fluorosis etc, will result in poor oral health. Among all the disease, dental caries is one of the most common oral disease affecting children in many underdeveloped and developing countries of Africa and Asia including India due to lack of public awareness and motivation, inadequate resources for sophisticated dental treatments and changing dietary habits. National oral health survey and fluoride mapping in India, found the prevalence of dental caries among 12 and 15-year-old children to be 53.8% and 63.1%

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respectively.[2-3] The consequence of dental caries are of a major concern today as it leads to dental pain, loss of tooth structure, improper masticatory efficiency, nutritional deficiencies leading to poor growth and development of the individual, esthetic concerns and even difficulty in phonetics. It has also resulted in loss of school days with diminished ability to learn.[5] A significant association has been shown to exist between odontogenic infection due to untreated dental caries and low body mass index in children.[6] A great forward stride in the era of preventive dentistry was ushered with the classical epidemiological survey of 1930s among children of 21 cities of U.S.A conducted by T.H. Dean which established the crucial link between dental caries experience & ingestion of fluoride in drinking water. His results reaffirmed the hypothesis of McKay that there is inverse relationship between dental caries and fluoride concentrations.[9] Even the WHO in Oral Health Report (2003) has stated fluoride as most effective agent in dental caries prevention.[10] Indeed, the use of fluorides is recognized as one of the most successful measures for caries prevention in the history of public health.[2] But, "fluoride is often termed as double edged weapon"- the optimal and judicious use of which offers maximum caries protection, whereas injudicious and excessive systemic consumption may lead to chronic fluoride toxicity, which manifest as dental and skeletal fluorosis.[2] Dental fluorosis may be more than a cosmetic defect as sometimes enough fluorotic enamel is fractured and lost, causing pain, adversely affecting food choices, compromising chewing efficiency, and requiring complex dental treatment.[12] India lies within the geographical fluoride belt that extends from Turkey to China. Nearly 12 millions of the 85 million tones of fluoride deposits on earth's crust are found in India.[15] Endemic fluorosis resulting from high fluoride concentration in groundwater is a public health problem in India.[10] In recent years, the prevalence of dental and skeletal fluorosis in India is increasing due to population overgrowth necessitating for more and more water, indiscriminate digging of tube wells leading to more usage of fluoridated water and total unawareness of the importance of water quality assessment and drinking water from any and every source.[16] The available data suggest that more than 15 States in India are endemic for dental fluorosis (fluoride level in drinking water >1.5 mg/l), five of these have category III (>50% of the districts affected) which is quite alarming. The main fluoride bearing areas are Gujarat, Rajasthan & Andhra Pradesh where 50-100% districts are affected. 10-30% districts are affected in the states of Jammu and Kashmir, Kerala, and Chhattisgarh & Eastern India. In Bihar, 30-50% districts are affected.[17]

**AIM:** The aim of the present study is to determine the relationship between dental caries prevalence, degree of dental fluorosis with different concentration of fluoride in the drinking

water among 14-15 years old school children in rural areas of Patna district.

**OBJECTIVES:**

1. To assess the prevalence of dental caries among 14 – 15 years old school going children in rural areas of Patna district.
2. To assess the prevalence of dental fluorosis among 14 – 15 years old school going children in rural areas of Patna district.
3. To determine the fluoride concentration in the drinking water in the study areas.
4. To find out the association if any, between caries prevalence, degree of dental fluorosis, with varying concentration of fluoride in drinking water.

## MATERIAL AND METHODS:

This is a cross-sectional study. A total of 600 school children aged 14-15 years were included in the study. A total of 12 schools were selected for the study purpose. A maximum of 50 available students from each school were included in the study, constituting a total of 600 students. Ethical clearance is taken from the Institutional Review Board of Buddha Institute of Dental Sciences and Hospital, Patna (Bihar). A survey was systematically scheduled to spread over a period of 6 months from October 2014 to March 2015. Informed consent was taken.

*INCLUSION CRITERIA:*

- Village should have at least one high school.
- Village should have a common and stable public drinking water supply from ground water source
- Resident children of the village must have been using water for drinking from one source since birth.
- 12 villages was randomly selected zone wise from 206 short listed villages by lottery method.

*EXCLUSION CRITERIA:*

- Students belonging to other villages but studying in the same school will not be included in the study.
- Medically compromised students will not be included.
- Those who do not consent for the study will be excluded.

***STATISTICAL ANALYSIS:*** Data comparison was done by applying specific statistical tests to find out the statistical significance of the comparisons. The various parameters used for the purpose of analysis were arithmetic mean, standard deviation and standard error. For the comparison of proportions, a chi-square test, Correlation (r), unpaired t test, Fisher's Exact Test, was used with continuity correction whenever appropriate. 'p' value of $< 0.05$ was taken to be statistically significant for the purpose of analysis.

## RESULTS:

Out of 600 subjects, 390 (65%) subjects were in 14 years age group while 210 (35%) subjects, were in 15 years age group.

The overall prevalence of dental caries was 181 (30.17%). Among males it was 54 (9%) and in females, it was 127 (21.17%). The results were statistically not significant with P-value (0.7713). (Table 2) The overall DMFT score distributions are as follows. A majority of 419 (69.83%) students had score 0, followed by 92 (15.3%) and 63 (10.5%) who are with score 1 and 2 respectively. Score 3 was seen among 16 (2.67%) and the least 10 (1.67%) had the maximum score of 4. The mean DMFT (SD) was 0.3016 (0.8892). Among males, 130 (21.67%) had score 0, while 24 (4%) had score 1. Score 2 was observed in 19 (3.16%) of the school children. 8 (1.3%) and 3 (0.5%) had the score of 3 and 4 respectively. Among females, 289 (48.16%) had the score of 0, while 68 (11.3%) had score 1. Score 2, 3 and 4 were seen among 44 (7.3%), 8 (1.3%) and 7 (1.17%) of the school children respectively. The results were not statistically significant in relation to gender with P-value 0.6848. (Table 3) Among 14 years old school children, 271 (45.16%) had score 0, while 57 (9.5%) had score 1. Score 2 was observed in 41 (6.8%) of the school children. 14 (2.3%) and 7 (1.16%) had the score of 3 and 4 respectively. Among 15 years old school children, 148 (24.66%) had the score of 0, while 35 (5.8%) had the score 1. Score 2, 3 and 4 were seen among 22 (3.66%), 2 (0.3%) and 3 (0.5%) respectively. The results were not statistically significant in relation to 14 and 15 years age group with P- value 0.3405. (Graph 2)The prevalence of dental fluorosis was zero. Hence gender wise and age wise comparison could not be made. (Table 4) Table 5 shows the correlation between different fluoride concentration in drinking water and DMFT scores. This study shows a positive correlation. This shows definite association between fluoride concentration in drinking water and dental caries with R- value 0.047.

## DISCUSSION:

According to WHO (1994) the recommended fluoride concentration of drinking water is 0.5 – 1.0mg/L.[56] The Ministry of health, Government of India, has prescribed 1.0mg/L as the permissive limits and 2.0mg/L as the excessive limits for fluoride in drinking water. The Indian standard Specification for drinking water gives a desirable limit of 0.6-1.2mg/L (Indian Standards Institute, 1983; Nanoti and Nawlahke, 1988).[57] In the present study, the fluoride concentration in drinking water from the study areas of Patna district (rural areas) ranged from 0.43 ppm to 0.59 ppm, which is less than the recommended optimal fluoride concentration.

ORAL HYGIENE PRACTICES:

The oral hygiene aids commonly used by the school children for cleaning their teeth are tooth brush (83.17%), followed by sticks (14.66%) and finger (2%). A majority of them used commercial available tooth paste (75.17%), followed by tooth powder (12.17%). Though majority of the rural study population are using tooth brush and tooth paste or powder, some of them are also using

traditional methods of oral hygiene practices. The influence of use of traditional methods may be related to the customs or social or cultural strata practiced by the elders in that region. High percentage use of oral hygiene aids by school children reflects good awareness of the products availability and also better purchasing power of the school children. This may not be the case with all school children elsewhere because due to economic reasons, the use of tooth brush and tooth paste is still considered expensive in terms of purchasing power of the poor.[48] Similar findings were seen in other studies of Jurgensen et al.[62] Majority of the school children brushed their teeth once a day (92%) and most of them followed the horizontal method of brushing their teeth (94.67%). These findings of brushing teeth once a day were higher when compared with findings of Shailee et al (64%),[51] Nurelhuda et al[63] Petersen et al (88%)[64] and Bhayyya et al (90%).[65] Increased awareness can be one of the main reason for this increase in frequency of brushing among school children.

The frequency of brushing the teeth was more among females (69.33%) when compared to males (30.67%). It can be justified from various reports that females are more concerned about their oral health when compared to males.[66, 48, & 67] interestingly none of students used any other oral hygiene aids like dental floss or inter dental brushes or mouth rinses. In a country like India, it is generally observed that parents who are social economically weak tend to put their wards to government schools and the affordability of health care needs are very poor. And also lack of awareness synergizes the effect. This observation is in agreement with reports of National Oral Health Survey and Fluoride mapping (2004) in India.[68- 69]

DENTAL CARIES:

Dental caries is a common dental disease affecting children. Despite incredible advances and the fact that caries is preventable, the diseases continue to be a major public health problem. Dental caries continues to be major oral health problem for children in Southeast Asian region because DMFT increased steadily from 1.12 in 2004 to 1.87 in 2011 living in South East Asian countries. This observation is expected to increase with time in this region. Dental caries affect humans of all ages and in all regions of the world. These diseases may never be eradicated because of the complex interplay of social, behavioral, cultural, dietary and biological risk factors that are associated with their initiation and progression.[48] In the present study it has been reported that an overall prevalence of dental caries was 30.67 %, of which 9% were males and 21.17 % were females. Among 14 years it was 19.83% and 10.3 % were among 15 year old school children. The mean overall DMFT was 0.3016. The results are statistically not significant with p >0.77. Similar results were observed in studies done by Shourie in 1947 with a caries prevalence of 33.7% among Ajmer

children.[17] The prevalence of dental caries was lower than the Global and SEARO (Mean DMFT 1.67 and 1.87 respectively). In India, the data from the national oral health survey (2002-2003) states that in children, the caries prevalence was 53.8 % and the mean DMFT was 1.8 which was comparatively higher when compared to our study. Other Indian studies where high prevalence of dental caries observed are Bhat and Shetty (1946) 75.77%; Chaudhury and Chawla (1957) DMFT 1.9; Nagaraj Rao (1980) DMFT 4.54; Das JK et al (2002) DMFT 2.38; Dhar V et al (2007) 46.75 %;[17] Bagramian et al (2009) 63.1%. Other studies with higher results include Al Haddad et al, Avinash J et al. In contrary studies which show less prevalence of caries include Nodzak (1990) 25%; Jaili VP (1993) 27%; Rao SP (1993) 22.8%; David J (2005) 27%.[70] The low prevalence of dental caries among school children was mainly attributed to fluoride content in drinking water (though it was less than the recommended optimal level) and increased use of commercially available toothpaste containing fluoride and also better oral hygiene practice made children develop less dental caries. It is also reasoned that lack of availability of cariogenic diet, poor access to refined sugar and sugar products can result in less caries.[48]

Females had significantly higher prevalence of caries than males. This is in line with the findings of Al Shammery and Gulie, Dummer et al., Sogi and Bhaskar, and Singh et al. This may be due to the fact that teeth erupt earlier in females than males which lead to prolong exposure of the teeth to the oral environment in females.[51] And it is also possible that boys were better looked after than girls . It may also be due to the food habits of taking snacks between meals for their longer indoor stay in comparison to that of males, who mostly spend their time outdoors.[48] Recently some evidence suggest that higher caries susceptibility among females may also be attributed to changes in salivary rates and composition induced by hormonal fluctuations among females.[67] In Contrast a study conducted by Moses J et al, in Chidambaram among 5-15 years old children found an increased prevalence in caries among males (51.42%) compared to females (48.58%).[70] Among different age groups, 14 years old school children had the caries prevalence of 19.83% while among 15 years school children had 10.33%. There was no literature available to compare with the results of this study among the age groups.

The prevalence of dental caries at varying fluoride levels had been extensively studied during the last 50 years to know the safe and acceptable levels of fluoride in drinking water for maximum caries protection and aesthetically acceptable probable dental fluorosis. In India some studies to establish the relationship between dental caries at varying fluoride levels in drinking water have been reported.[47] In this study with little variation in the concentration of fluoride in drinking

water (Ranging between 0.43 - 0.59ppm) there was positive correlation between dental caries and fluoride concentration in drinking water, i.e. with increase in fluoride concentration in drinking water, the prevalence of dental caries decreased. This observation has been in observed in many classical studies done on fluoride and dental caries.

DENTAL FLUOROSIS:

Endemic fluorosis continues to remain a challenging national dental health problem. The effect of fluoride on dentition is dose dependent and is not confined to increase caries resistance. Although being a "late" measure of fluoride exposure, dental fluorosis is the most sensitive sign of prolonged high fluoride exposure.[14] It is evident from many literatures that increased consumption of fluoride, more than the recommended optimal fluoride concentration in drinking water over prolong period can result in dental fluorosis. In this study the prevalence of dental fluorosis was zero. It is reasoned that the concentration of the drinking water estimated in all study areas were less than the recommended optimal fluoride level of 0.7 ppm (Lower end of the recommended concentration 0.7 - 1.2 ppm (WHO), thus no prevalence of dental fluorosis was observed. The correlation between the occurrence of dental fluorosis and increased consumption of more than optimal level of fluoride in drinking water is a well documented. The present finding of the study justifies the above statement.

## CONCLUSION:

It is concluded from the present study that,

- Dental caries were commonly observed among school children in rural areas of Patna District.
- The concentration of fluoride in drinking water showed less than (0.53ppm) the recommended optimal fluoride concentration (WHO), as a result no dental fluorosis cases were observed.
- There was a positive correlation between dental caries and fluoride concentration in drinking water.
- Since the present study was based on selected children and selected villages of Patna District, the results warrant a fully fledged epidemiological study to get a clear picture of the extent of problem.

**SUMMARY:** The present study on school children aged 14-15 years in rural school of Patna district was aimed to assess the prevalence of dental caries, dental fluorosis and the possible relationship of fluoride concentration in drinking water with dental caries and dental fluorosis. The study results are summarized as follows.

- A total of 600 school children aged 14-15 years from 12 schools were included in the study.
- 30.67% were males and 69.33% were females.
- 65% were among 14 years age group and 35% were among 15 years age group.

- The overall prevalence of dental caries was 30.17%.
- The overall prevalence of dental fluorosis was zero.
- The fluoride concentration in drinking water varied between 0.43-0.59. The mean fluoride concentration in drinking water was 0.53 ppm.
- Regarding the association. The fluoride concentration in drinking water was below the recommended optimal fluoride concentration (0.7 ppm WHO), hence no dental fluorosis cases were observed.
- Association between dental caries and different fluoride concentrations in drinking water showed positive correlation.

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## TABLES:

**Table 1 shows the distribution of study population from each study area**

| Study Area | No of children examined | Gender | | | |
|---|---|---|---|---|---|
| | | Males | | Females | |
| | | 14 Years | 15 Years | 14 Years | 15 Years |
| Barh | 50 | 45 | 5 | 0 | 0 |
| Parasa | 50 | 11 | 2 | 26 | 11 |
| Dumari | 50 | 28 | 0 | 22 | 0 |
| Punpun | 50 | 22 | 1 | 23 | 4 |
| Patna city | 50 | 37 | 13 | 0 | 0 |
| Danapur | 50 | 1 | 0 | 45 | 4 |
| Maner | 50 | 3 | 1 | 17 | 29 |
| Sorampur | 50 | 0 | 0 | 35 | 15 |
| Khagaul | 50 | 0 | 0 | 24 | 26 |
| Athmalgola | 50 | 0 | 0 | 17 | 33 |
| Digha | 50 | 0 | 0 | 12 | 38 |
| Anouli | 50 | 6 | 9 | 16 | 19 |
| Total | 600 | 153 | 31 | 237 | 179 |
| Total | | 184 | | 416 | |

**Table 2 shows the gender wise distribution of dental caries among the study population.**

| Gender | Caries Present n(%) | Caries Absent n(%) | Total n(%) |
|---|---|---|---|
| Male | 54(9) | 130(21.67) | 184(30.67) |
| Female | 127(21.17) | 289(48.16) | 416(69.33) |
| Total | 181(30.17) | 419(69.83) | 600(100.00) |

| Chi-Square Value | df | 'p' Value |
|---|---|---|
| 0.08447 | 1 | 0.7713 |

**Table 3 shows the gender wise distribution of the study subjects according to DMFT Score.**

| DMFT Score | Gender | | |
|---|---|---|---|
| | Male n(%) | Female n(%) | Total n(%) |
| 0 | 130 (21.67) | 289(48.16) | 419 (69.83) |
| 1 | 24(4) | 68(11.33) | 92 (15.33) |
| 2 | 19(3.17) | 44(7.33) | 63 (10.50) |
| 3 | 8(1.33) | 8(1.33) | 16 (2.67) |
| 4 | 3 (0.5) | 7 (1.17) | 10 ( 1.67) |
| Total | 184(30.67) | 416(69.33) | 600 (100) |

| DMFT Score | Gender | | Total |
|---|---|---|---|
| | Male | Female | |
| Mean DMFT (SD) | 0.5326 (0.9576) | 0.5000 (0.8836) | 0.3016 (0.8892) |
| P value | 0.6848 (NS) | | |

**Table 4.Gender wise distribution of dental fluorosis in the study population**

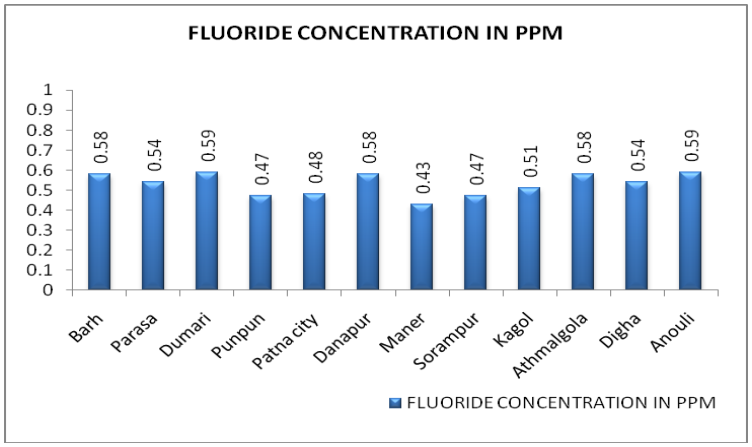
| Gender | Dental Fluorosis Present n(%) | Dental Fluorosis Absent n(%) | Total n(%) |
|---|---|---|---|
| Male | 0 | 184(30.67) | 184(30.67) |
| Female | 0 | 416(69.33) | 416(69.33) |
| Total | 0 | 600(100) | 600(100) |

**Table 5 Shows the correlation between different fluoride concentration in drinking water and DMFT Score.**

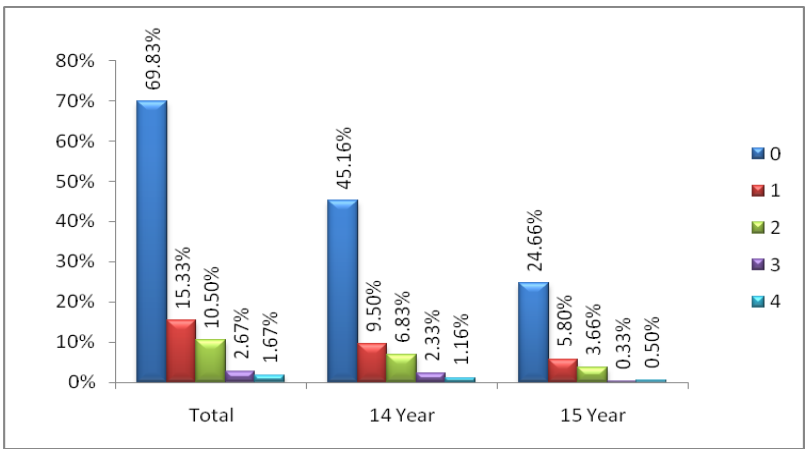
| Correlation | R value | P value | $R^2$ |
|---|---|---|---|
| Fluoride concentration v/s DMFT Score | 0.047 | 0.25 | 0.002212 |

## GRAPHS:

**Graph 1 shows the fluoride concentration of drinking water in different study areas.**




**Graph 2 shows the age wise distribution of the study subjects according to DMFT Score.**



**Graph 3 Shows the correlation between different fluoride concentration in drinking water and DMFT Score.**