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Association between Dietary behaviours and Dental Fluorosis- a Retrospective study

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Abstract: Dental fluorosis is considered a major public health problem. Consumption of excess fluoride will lead to conditions like skeletal fluorosis and dental fluorosis. The aim of this study is to determine the association between dietary intake and fluorosis. The present study was conducted among patients who had reported to Saveetha Dental College, from the time period of June 2019 to March 2020. Case records of about 15,000 patients were reviewed and 561 patients were recruited who fulfilled the inclusion and exclusion criteria.Patients with dental fluorosis were included in the study. Patient age ,gender and the diet history and dean fluorosis index score were collected from the case records.Descriptive statistics, cross tabulation and chi-square test were done by SPSS IBM software 20.0. The results of the study showed that 49% of fluorosis patients are with a vegetarian diet and 51% of fluorosis patients are with a mixed diet. In patients with mixed diets the severity of fluorosis was slightly higher compared to vegetarian diet, with a Dean's fluorosis index score of 4 - severe (5.3%). However it is statistically not significant. [Pearson's Chi Square value: 4.685^{a} df = 4, p value = 0.321 (>0.05)] Within the limits of the study no significant association was found between diet and fluorosis,however severity of fluorosis in mixed diet seems to be higher.

Keywords: Dental fluorosis; Dean fluorosis index; diet; association

INTRODUCTION

Dental fluorosis is caused due to excessive intake of fluoride. This causes hypomineralization of the enamel, making it defective during the period of enamel formation.('From the Centers for Disease Control and Prevention. Achievements in public health, 1900-1999: fluoridation of drinking water to prevent dental caries', 2000) This occurs during birth and lasts till 5 years of age for anterior permanent teeth and upto 13 years of age for all permanent teeth.(Aoba and Fejerskov, 2002) A World Health Organization report stated that drinking water, foods, fluoridated toothpaste and air pollution with fluoride are some of the sources of fluoride exposure.('WHO | Water-related diseases', 2016) It was pointed out that there is a potential link between breastfeeding and decreased risk of dental fluorosis.(Buzalaf et al., 2004) (Brothwell and Limeback, 2003) (Marshall et al., 2004) (Teixeira et al., 2010) Some studies have also suggested that malnutrition could be one of the risk factors for an increase in the prevalence and severity of dental fluorosis.('WHO | Water-related diseases', 2016) (Brothwell and Limeback, 2003) (Marshall et al., 2004) (Teixeira et al., 2010) (Rugg-Gunn, Al-Mohammadi and Butler, 1997)

Studies done in Iran have found that certain foods have a considerable amount of contribution to the total dietary fluoride intake (Rugg-Gunn, Zohouri and Rugg-Gunn, 2000) and some studies conducted in Brazil stated that food sources were identified as one of the main sources of fluoride along with water to total dietary fluoride intake.(Rodrigues et al., 2009) This study (Wondwossen et al., 2006) has also found that drinking tea and consuming fish may increase the risk of dental fluorosis. Some authors have also stated that a considerable amount of exposure risk may also be associated with the consumption of local salt, canned meat, grains, vegetables, drinks, fish bones and prepared foods.('Fluorides and oral health. Report of a WHO Expert Committee on Oral Health Status and Fluoride Use', 1994) (Malde et al., 2003) (Malde et al., 1997) (Malde et al., 2004) In certain communities of some countries, total dietary intake of fluoride from prepared food has been found to be greater than that of intake of water.(Malde et al., 2011)

The absorbed fluoride gets rapidly distributed throughout the body. It gets incorporated into calcified tissue, but not in the soft tissue.('WHO | Guidelines for drinking-water quality, fourth edition', 2015) Distribution of

fluoride takes place through plasma.(Whitford, 1996) The substitution of fluoride for hydroxyl groups in apatite leads to the formation of fluorapatite. This fluorapatite alters the mineral structure. Fluorapatite is more regular and less soluble in acid than compound apatite.(Featherstone et al., 1983) (Okazaki, Takahashi and Kimura, 1985) The presence of excessive levels of fluoride in drinking water and food is accompanied by a characteristic sequence of changes in teeth and bone, known as fluorosis. Dental fluorosis can lead to the eventual loss of tooth surface, attrition and pitting (Kebede, Negussie Retta, et al., 2016) Neurological impairment may also occur due to fluorosis.(Kebede, Negussie Retta, et al., 2016) Foods rich in antioxidants, calcium and magnesium are known to decrease the bioavailability of fluoride and may improve the progression of fluorosis.(Kebede, Nigussie Retta, et al., 2016)

Overexposure or overconsumption of fluoride during tooth formation, even if it is for a short period of time, leads to disorder in ameloblastic function and hypomineralization of enamel leading to fluorosis (Honarmand et al., 2012). This dental lesion is caused by the destructive effect of fluoride on the tooth forming cells in the formation and mineralization stages. The affected enamel is also known as mottled enamel (Basir et al., 2006). Severity of fluorosis depends on the duration of exposure to fluoride. Weight, specific body response, diet, activity, and bone growth factors result in variable severity of dental fluorosis in response to similar doses of fluoride (Martinez-Mier, 2018). Roman in a study on adolescents showed that dental fluorosis has social and psychological effects, leading to discontent with appearance as the severity of dental fluorosis increases (Roman, 2010). In a study by Rustagi et al. feeling of being unbeautiful and other unpleasant perceptions were said to be associated with dental fluorosis (Rustagi et al., 2017) In a study on Colombian students with dental fluorosis, sixty percent of these children hesitated to smile because of the appearance of their teeth (Tellez et al., 2012)

Previously our team had conducted numerous clinical trials (Govindaraju, Jeevanandan and E. M. G. Subramanian, 2017a) (Govindaraju, Jeevanandan and E. Subramanian, 2017) (Govindaraju and Gurunathan, 2017) (Jeevanandan and Govindaraju, 2018) (Nair et al., 2018) (Veerale Panchal, Jeevanandan and Subramanian, 2019) (Somasundaram et al., 2015) (Subramanyam et al., 2018) (Christabel and Gurunathan, 2015) and systematic reviews (Jeevanandan, 2017) (Packiri, Gurunathan and Selvarasu, 2017) ('Fluoride, Fluoridated Toothpaste Efficacy And Its Safety In Children - Review', 2018) and surveys (Gurunathan and Shanmugaavel, 2016) (Ravikumar, Jeevanandan and Subramanian, 2017) (Govindaraju, Jeevanandan and E. M. G. Subramanian, 2017b) over the past five years. Now we are focussing on epidemiological surveys. The idea for this research stemmed from the current interest in our community. Our team has rich experience in research and we have collaborated with numerous authors over various topics in the past decade (Deogade, Gupta and Ariga, 2018; Ezhilarasan, 2018; Ezhilarasan, Sokal and Najimi, 2018; Jeevanandan and Govindaraju, 2018; J et al., 2018; Menon et al., 2018; Prabakar et al., 2018; Rajeshkumar et al., 2018, 2019; Vishnu Prasad et al., 2018; Wahab et al., 2018; Dua et al., 2019; Duraisamy et al., 2019; Ezhilarasan, Apoorva and Ashok Vardhan, 2019; Gheena and Ezhilarasan, 2019; Malli Sureshbabu et al., 2019; Mehta et al., 2019; Rajendran et al., 2019; Ramakrishnan, Dhanalakshmi and Subramanian, 2019; Sharma et al., 2019; Varghese, Ramesh and Veeraiyan, 2019; V. Panchal, Jeevanandan and Subramanian, 2019; Gomathi et al., 2020; Samuel, Acharya and Rao, 2020)

Thus the aim of this study is to determine the association between diet and fluorosis.

MATERIALS AND METHODS

This study reviewed the case sheet of 561 subjects who visited Saveetha Dental College, between the period of June 2019 to March 2020. The patients with dental fluorosis were included in the study. Ethical approval was obtained from the Institutional ethics committee - SDC/SIHEC/2020/DIASDATA/0619-0320. Each subject's case sheet was reviewed and the Dean's Fluorosis Index (1942) score was verified. For each interpretation of the score, the respective diet followed by the patient was reviewed.

Inclusion criteria:

Patients with dental fluorosis
Patients from 8 to 18 years of age were included

Exclusion criteria:

Medically compromised patients
Patients with other developmental anomalies
Special needs children

Data Collection and analysis

Demographic data of the patient, such as age, gender, diet ,Dean's fluorosis index was retrieved from the case records of those patients. The collected data was entered in Microsoft Excel, following which the data was segregated and variables were defined using SPSS IBM version 20.0. Data verification was done by 2 external reviewers.

Statistical analysis

The data that was collected and entered in excel sheet was then transferred to SPSS IBM version 20.0 for statistical analysis. After the definition of variable, frequency analysis was performed. Chi-square test was used to test associations between categorical variables. P value < 0.05 was considered statistically significant.

RESULTS AND DISCUSSION

The following results were obtained from our study. Out of 561 case sheets that were reviewed, 49% of fluorosis patients are with a vegetarian diet and 51% of fluorosis patients are with a mixed diet (Figure 1). 71.3% of the fluorosis patients were males and 28.7% of them were females. The prevalence of fluorosis was higher in males (Figure 2). 38.5% of the fluorosis patients had a Dean's fluorosis index score of 2 - Mild, while 28.9% had a score of 4 - Moderate, followed by 21.6% had a score of 1 - Very mild, 8.9% had a score of 4 - Severe and 2.1% had a score of 0.5 - Questionable (Figure 3). Male fluorosis patients had a similar prevalence in both diets whereas females had a higher prevalence in mixed diet. However this association is statistically not significant. [Pearson's Chi Square value: 0.617^a df = 1, p value = 0.432 (>0.05)] (Figure 4). Patients with a mixed diet had a higher prevalence in each of Dean's fluorosis index scores, except in score 1 - Very mild. However this association was statistically not significant. [Pearson's Chi Square value: 4.685^a df = 4, p value = 0.321 (>0.05)] (Figure 5).

From the results of our study we can see that 49% of the fluorosis patients follow a vegetarian diet and 51% of fluorosis patients follow a mixed diet. This shows that both diets give a similar value and there is no greater difference between the two diets. This is similar to the study by Karthikeyan et al (Karthikeyan, Pius and Apparao, 1996), in which he states that there was no correlation between fluoride levels and food grains. His study also stated that the role of fluoride from drinking water was more dominant when compared with that from food. This is because individuals depend on water for cooking and drinking contributing to the increased overall fluoride levels Our study shows similar results of Miziara et al (Miziara et al., 2009) and Mahantesha et al (Mahantesha et al., 2016). Miziara et al states that the main contributor for fluoride levels is through ingestion of dentifrice more than the diet.She also stated that based on the fluoride intake from diet, the main contributor was water which accounted for 39% of the fluoride intake from diet. Mizizara's study is also similar to the study by Almeida et al (De Almeida, da Silva Cardoso and Buzalaf, 2007), in which he states that water and milk were the main dietary contributors for the fluoride intake. Mahantesha et al states that fluoride concentration in drinking water was found significant with the prevalence of fluorosis. Once present, its severity was determined by the nutritional status. Only the fluoride concentration in water was significant and only nutritional status showed significant association with severity of fluorosis. Diet has an influence on the prevalence of fluorosis, but does not act as a main cause for fluorosis.

In certain developing countries, the type of diet has been mentioned to be associated with the increased risk for fluorosis, even in communities that have less than optimal concentration of fluoride in drinking water.(Rugg-Gunn, Al-Mohammadi and Butler, 1997) (Awadia et al., 1999) (Cao, Zhao and Liu, 1997) (Choubisa et al., 2009) Certain foods that are rich in fluoride and locally grown food items in areas where the fluoride concentration is high in water used for irrigation, play a vital role in the development of fluorosis (Cao, Zhao and Liu, 1997) (Goyal, Gauba and Tewari, 1988) (Rao and Mahajan, 1990)

Our study findings seem to be in contradiction with the findings of Awadia AK et al (Awadia et al., 1999) and L Abuhaloob et al (Abuhaloob and Abed, 2013). Awadia et al states that lower prevalence of fluorosis was seen among the vegetarian group than the non vegetarian group. Another study report conducted on children between age 6 and 18 years that the risk of developing dental fluorosis was seven times higher among non vegetarians than among vegetarians. The prevalence of fluorosis in the non vegetarian group was 95% and in the vegetarian group was 67%which is quite acceptable to our study where in patients with severe fluorosis were found to have a mixed diet.Abuhaloob et al states that the intake of plant protein and animal protein have a negative association with the prevalence and severity of dental fluorosis.A higher consumption of animal proteins or plant proteins during the first 7 years of life significantly decreased the prevalence and severity of dental fluorosis. It has been stated by Wondwossen et al (Wondwossen et al., 2006) that fish and tea are rich in fluoride. Gikunju et al stated that high fluoride content present in fish muscle may be the reason for the development of dental fluorosis among those who live in Lake Naivasha in Kenya,(Gikunju et al., 1992) while in Rift Valley region fluoride content of fish fillets were not responsible for the presence and severity of dental fluorosis among those residents. The findings of Gikunji et al. may partly support the results of our study in which we found that there was no significant association between non vegetarian food and fluorosis. Our study results may vary as subjects consumed more vegetarian food with occasional non vegetarian food or vice versa.

In our study, the prevalence of dental fluorosis was higher in males than in females. Kotecha et al. states similar results in his study. Dental fluorosis prevalence was more among males (61.3%) as compared to females (38.7%) in his study (Kotecha et al., 2012). Motebennur et al. also stated similar results in his study which said the prevalence of fluorosis was significantly higher in males (65.0%) compared to females (57.9%)

(Motebennur et al., 2012). Similarly, Haritash et al. also stated that cases of moderate to severe dental fluorosis are more prevalent among males (44%) compared to females (29%) (Haritash et al., 2018). In contrast studies by Gopalakrishnan et al. (Gopalakrishnan et al., 1999) and Arvind et al. (Arvind et al., 2012) have shown a higher prevalence of dental fluorosis among females than males. (Arvind et al., 2012). This difference in gender may be due to higher physical activity by males leading to a higher consumption of food and water, hence fluoride (Siddiqui, 1972) (Tavss et al., 1997)

The limitations of our study include fluoride ingestion from other sources, socioeconomic status, education levels of the patient. For future scope, extensive research along with a larger sample size and estimation of plasma fluoride levels.Our institution is passionate about high quality evidence based research and has excelled in various fields ((Pc, Marimuthu and Devadoss, 2018; Ramesh et al., 2018; Ezhilarasan, Apoorva and Ashok Vardhan, 2019; Ramadurai et al., 2019; Sridharan et al., 2019; Vijayashree Priyadharsini, 2019; Mathew et al., 2020)

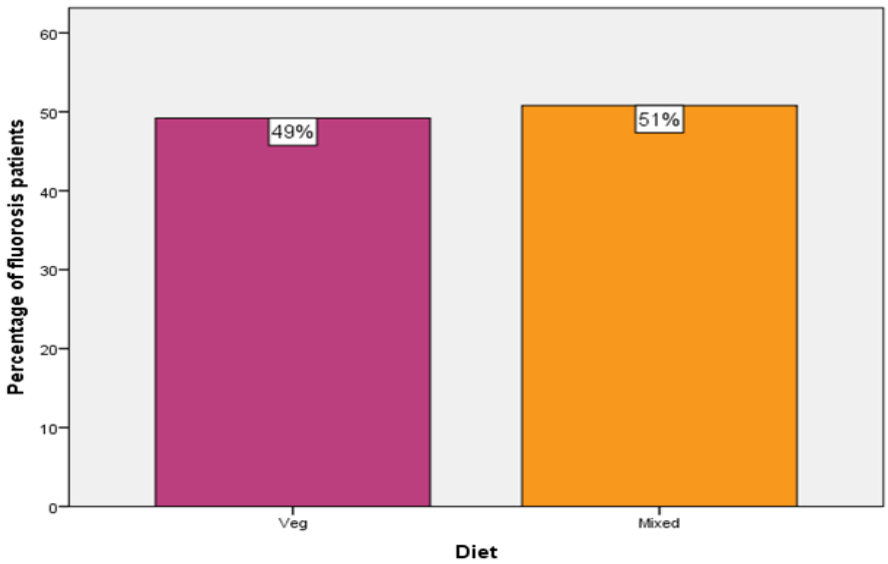

Fig.1 This bar chart represents the prevalence of fluorosis with diet.. (X axis represents the vegetarian diet or the mixed diet and Y axis represents the percentage of fluorosis patients). 49% of fluorosis patients are with a vegetarian diet and 51% of fluorosis patients are with a mixed diet. Both diets give an almost similar percentage.

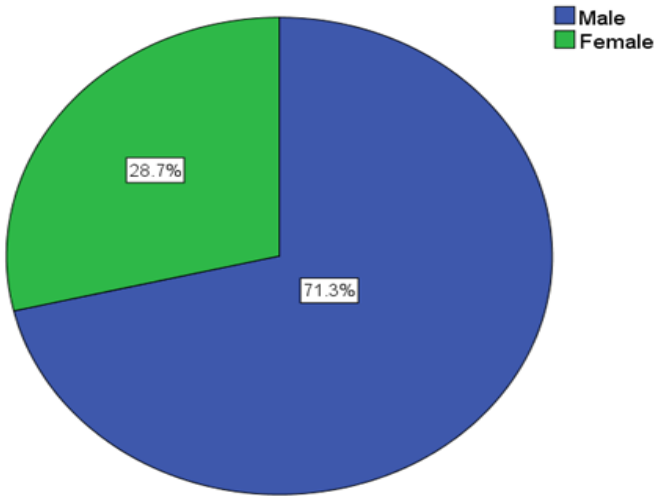

Fig.2: This pie chart represents the prevalence of fluorosis in both genders that participated in the study. Blue colour represents the males and green represents the females. 71.3% of the fluorosis patients were males and 28.7% of them were females. The prevalence of fluorosis was higher in males.

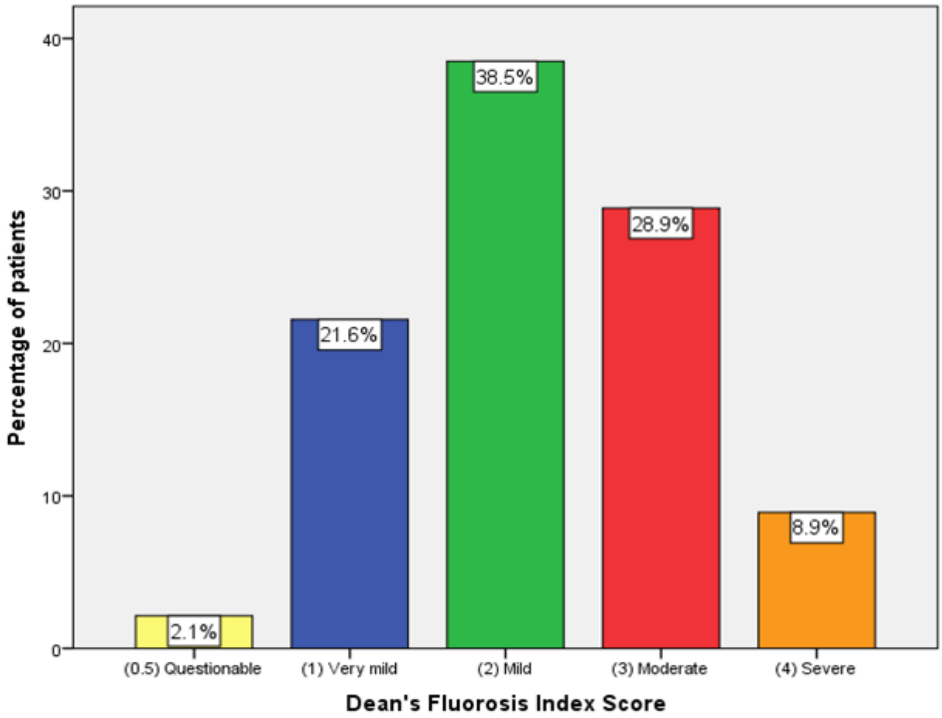

Fig.3:This bar chart represents the prevalence of fluorosis patients with Dean's Fluorosis Index Score. (X axis represents the Dean's Fluorosis Index Score (0.5-Questionable, 1-Very mild, 2-Mild, 3-Moderate, 4-Severe) and Y axis represents the percentage of fluorosis patients). Most of the fluorosis patients had a score of 2 - Mild (38.5%) when compared to other scores.

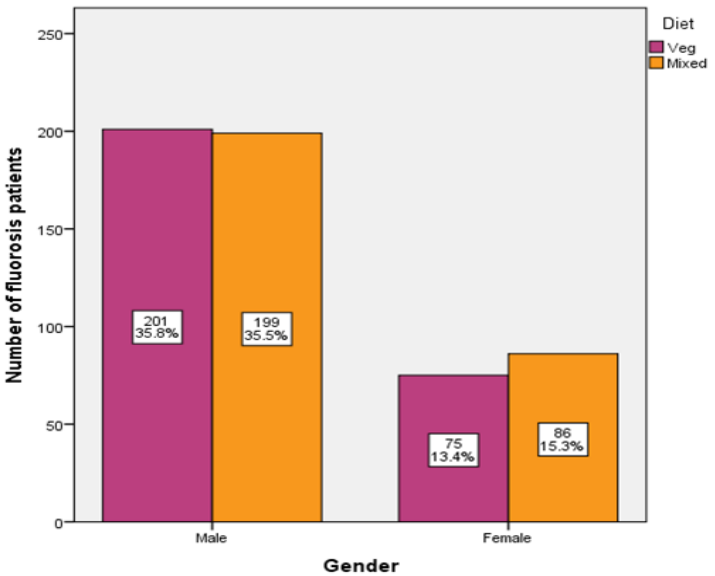

Fig.4:This bar chart represents the association between gender and the prevalence of diet on fluorosis patients. X axis represents the gender and Y axis represents the number of fluorosis patients. Male fluorosis patients had a similar prevalence in both diets whereas females had a slightly higher prevalence in mixed diets. However this association is statistically not significant. [Pearson's Chi Square value: 0.617[a] df = 1, p value = 0.432 (>0.05)].

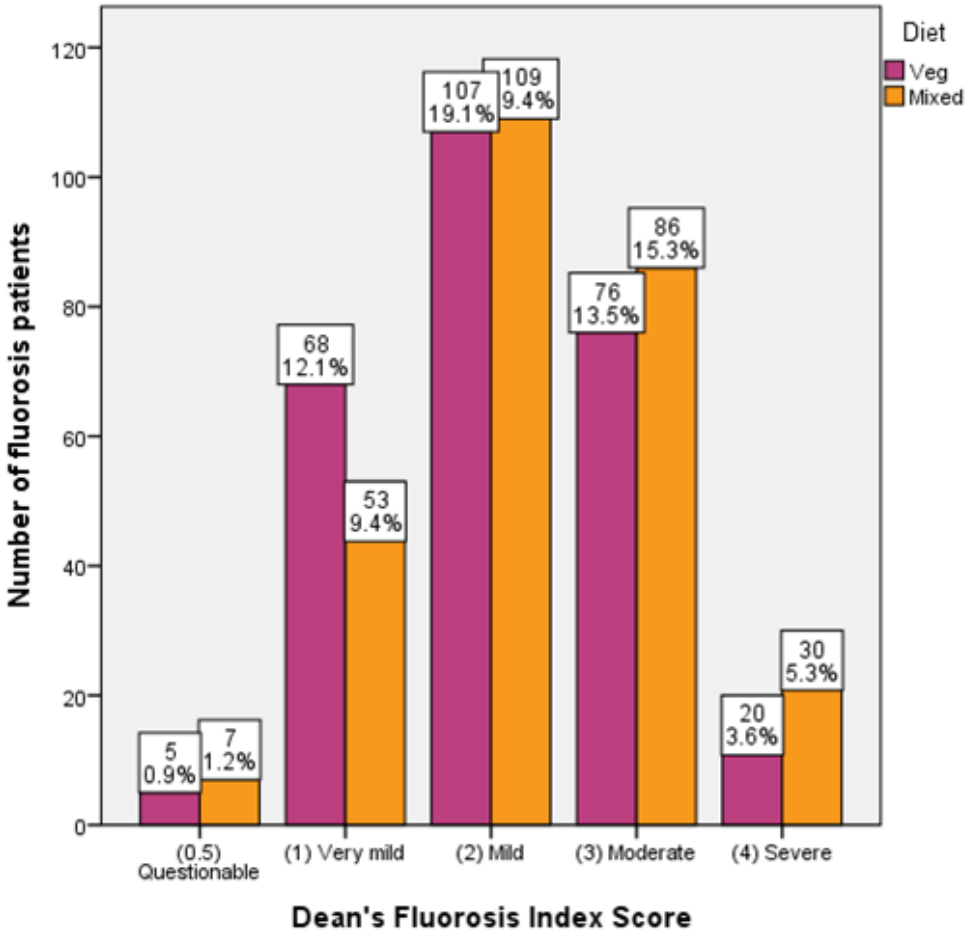

Fig.5:This bar chart represents the association between fluorosis score and diet. (X axis represents the Dean's Fluorosis Index Score (0.5-Questionable, 1-Very mild, 2-Mild, 3-Moderate, 4-Severe) and Y axis represents the number of fluorosis patients) Purple colour represents vegetarian diet and orange colour represents mixed diet. Patients with a mixed diet had a higher prevalence in each of Dean's fluorosis index scores, except in score 1 - Very mild. However this association was statistically not significant. [Pearson's Chi Square value: 4.685[a] df = 4, p value = 0.321 (>0.05)].

CONCLUSION

Within the limits of the study, the prevalence of fluorosis was higher in males. Patients with a mixed diet had a higher prevalence in most of Dean's fluorosis index scores, but however this association was statistically not significant.Dietary practices that increases the risk of infants and young children being overexposed to fluoride from all sources should be identified and appropriate action should be taken to reduce fluoride exposure to an optimal level.

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Authors Contribution

First author (Fathima Bareera Rezvi) performed the analysis, and interpretation and wrote the manuscript. Second author (Dr. Jessy P) contributed to conception, data design, analysis, interpretation and critically revised the manuscript. Third author(Dr.Manjari Chaudhary) participated in the study and revised the manuscript. All the three authors have discussed the results and contributed to the final manuscript.

Conflicts of interest
Nil

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