

REVIEW ARTICLE

PREVALENCE AND RISK FACTORS OF FLUOROSIS IN PEDIATRIC PATIENTS

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ABSTRACT:

Exposure to excessive fluoride intake during the early childhood years can disrupt the normal development of enamel, resulting in dental fluorosis. The increasing prevalence of dental fluorosis in pediatric age group and the associated risk factors of fluorosis have become a source of concern for the dentists as well as the parents. The purpose of this review article is to throw a light on the current trends in prevalence and risk factors of fluorosis in pediatric age group.

Key words: Dental fluorosis; epidemiology; prevalence; risk factors.

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This article may be cited as: Makne SG, Singla N, Karamchandani J, Vanjari S, Wagatkar J. Prevalence and Risk Factors of Fluorosis In Pediatric Patients. J Adv Med Dent Scie Res 2016;4(1):33-37.

INTRODUCTION

To prevent caries in children is one of the major concerns of contemporary pediatric dental practice. In spite of the existence of varied options as a part of preventive dental programs for pediatric dental patients, perhaps none is as important and effective as the appropriate use of fluoride.^[1] The availability and the utilization of fluoride have constantly increased during the last five decades. Though this increased prevalence of fluoride in different forms has proven to be beneficial to the oral well-being of the mankind, however, on the other hand, there has been a constant increase in the prevalence of dental fluorosis in fluoridated as well as in non-fluoridated areas throughout the world. Even though this increase comprises mainly mild fluorosis, there are indications of a slight increase in the moderate forms of this disturbance.^[2-7] As per the need of the hour, the understanding of fluoride exposures has been on rise over the last few years and recommendations have been made to limit the fluoride intake to those levels which will provide the greatest benefits and least risk to human beings. Focus has shifted towards lowering toothpaste consumption in young children, limiting the fluoride supplement dosage,

and to use various fluoride products according to the published guidelines.^[8-11]

BASICS OF FLUOROSIS

Dental fluorosis is defined as a chronic, fluoride-induced condition, in which enamel development is disrupted and the enamel is hypomineralized. It represents a specific disturbance in tooth formation and an esthetic condition.^{[12],[13]} Clinically, dental fluorosis presents as white spots/opaque lines/striations on the surface of enamel. In cases of severe fluorosis, pitting of the enamel surface is seen. Sometimes brown stains can be appreciated, especially in cases of moderate to severe fluorosis, however, these stains are actually extrinsic stains mainly from the diet.^[12] On microscopic examination of fluorosed enamel, structural arrangement of the enamel crystals appears normal; however the width of the intercrystalline spaces is increased, resulting in porosities in enamel. The degree and extent of the porosity depends on The concentration of fluoride in the tissue fluids during tooth development determines the quantum of porosity in the enamel structure.^{[13],[14]} The fluoride concentration throughout the enamel, the depth of enamel involvement, and the degree of porosity of the enamel are directly proportional to the degree and

extent of fluorosis.^{[13],[15]} The most critical period for development of fluorosis is from birth to 8 years of age, which actually corresponds to post-secretory or early maturation stage of tooth development.^{[12],[14],[16-20]}

PREVALENCE OF FLUOROSIS IN CHILDREN

Dental fluorosis can occur as a result of disruption of normal development of enamel as a consequence of constant exposure to excessive levels of fluoride during the early childhood years. This varies in severity, ranging from white opacities in mild cases to more severe black and brown discoloration or enamel pitting.^[21] Although, there has been a constant decline in the prevalence of dental caries as a result of widespread use of fluoride in different forms, there has been a constant increase in the prevalence of dental fluorosis.^[12] Fluorosis is increasingly becoming an alarming problem globally as it is endemic in at least 25 countries.^[22] The U.S. Centers for Disease Control found a 9% higher prevalence of dental fluorosis in a 1999-2002 study of American children than was found in a similar survey from 1986-1987. In addition, the survey provides further evidence that African Americans suffer from higher rates of fluorosis than Caucasian Americans.^[23]

The major concern for people of India is that India lies in geographical fluoride belt. With nearly 12 million of the 85 million tons of fluoride deposits on the earth's crust occurring in India, it is not surprising that dental fluorosis is endemic in 15 states of India.^[24] The condition is more prevalent in rural areas where drinking water is derived from shallow wells or hand pumps. It is also more likely to occur in areas where the drinking water has a fluoride content greater than 1 ppm (part per million), and in children who have a poor intake of calcium.^[23] If the water supply is fluoridated at the level of 1 ppm, one must consume one litre of water in order to take in 1 mg of fluoride. It is thus improbable a person will receive more than the tolerable upper limit from consuming optimally fluoridated water alone. Fluoride consumption can exceed the tolerable upper limit when someone drinks a lot of fluoride containing water in combination with other fluoride sources, such as swallowing fluoridated toothpaste, consuming food with high fluoride content, or consuming fluoride supplements. The use of fluoride supplements as a prevention for tooth decay is rare in areas with water

fluoridation, but was recommended by many dentists in the UK until the early 1990s. Dental fluorosis can be prevented by lowering the amount of fluoride intake to below the tolerable upper limit.^[23]

Thus, the assessment of prevalence of fluorosis severity in children is very important. Equally important is assessing the severity of fluorosis in children. Furthermore, epidemiological studies carefully delineating and defining the risk factors for increasing prevalence of fluorosis in pediatric patients also constitute a very important parameter.^[8] Rising concern for the increase in the prevalence of dental fluorosis among pediatric patients have led to studies designed to identify the various risk factors for fluorosis. Different study designs have been used to identify and study these risk factors including case-control studies^[25-30], cross-sectional studies.^[31-33] Most of the studies are cross-sectional in nature, however, cross-sectional study design is not ideal for studying risk indicators or factors, thus cross-sectional study design has been an area of criticism in the scientific literature. Furthermore, there is another of concern and criticism in the fluoride risk factor studies conducted in the past i.e. use of retrospective assessment of fluoride exposures, and thus the inherent recall bias. Also, different studies have used different indices, thus making it difficult to compare the results of different studies with each other.^[12]

RISK FACTORS FOR FLUOROSIS IN PEDIATRIC PATIENTS

The most important risk factor in determining fluorosis occurrence and severity is the total amount of fluoride consumed from all sources during the critical period of tooth development i.e. from birth to 8 years of age.^{[34],[35]} Apart from this most important risk factor there are various other important risk factors which affect prevalence and incidence of fluorosis. Some of these risk factors are discussed below.

FLUORIDATED DRINKING WATER AS A RISK FACTOR

As a result of well known and widely appreciated fact that fluoride plays a pertinent role in prevention of dental caries, water fluoridation has become a very popular practice throughout the world. As per the recommendations, fluoride level in water can vary from 0.7 to 1.0 ppm. However, it has been observed that fluoridated water is responsible for a majority of cases of dental fluorosis, through water intake or children's formula and food prepared with

drinking water.^[36] Dean, in his early studies recommending fluoridation of water, estimated a 10 percent prevalence of mild or very mild fluorosis in the permanent teeth at water fluoride levels of 1.0 ppm.^[37] McDonagh et al.^[38] in their systematic review on 214 studies observed a decrease in the number of caries-affected teeth and an increase in dental fluorosis, depending on the fluoride intake. They also observed that dental fluorosis is endemic in regions where drinking water is obtained directly from deep wells. They also stated that the deeper the wells, the higher the fluoride concentration in drinking water.^[36]

It becomes the duty of pediatric dentist to give instructions to the parents about the fluoride content in the drinking water and when it is not known, look for this information in the local water supply service. Further, it is imperative for the pediatric dentist to guide the parents in getting the analysis done of the water which child is drinking for its fluoride content. This analysis will help to determine and decide whether child requires fluoride supplements or not.^[36]

FLUORIDE SUPPLEMENTS AS A RISK FACTOR

Fluoride supplements come into play in case of children who are residing in areas which are deficient in fluoride.^[36] However, numerous studies have shown that supplements are also prescribed to children in fluoridated areas, albeit inappropriately.^{[39],[40]} It has been observed that the risk of fluorosis from use of fluoride supplements is four times higher in fluoridated areas as compared to nonfluoridated areas.^[33] It is well established inadvertent use of fluoride supplements is associated with increased risk of dental fluorosis. In order to prevent fluorosis in pediatric population, it becomes imperative for dentists and parents to be aware of and to follow the recent guidelines for fluoride supplements.^[36] Thus, to prevent fluorosis, it is recommended that before fluoride supplements are prescribed, clinicians should consider the concentration of fluoride in drinking water, children's age and the caries risk of the child.^[12]

FLUORIDATED TOOTHPASTE AS A RISK FACTOR

The role of fluoridated toothpaste in causing fluorosis is controversial. In a review done by Ripa^[41] in 1999, author observed that in nine out of ten studies did not reveal any association between the use of fluoridated toothpaste and development of

fluorosis. However, it has been observed that children below the age of 5 years swallow as much as 30% of the amount of toothpaste while brushing teeth, and if fluoridated water is consumed at the same time, a potential risk of dental fluorosis occurs. In order to reduce the consumption of fluoride associated with use of fluoridated toothpaste, it has been suggested to reduce the amount of toothpaste to a small and safe quantity.^[42] It has also been suggested to use toothpastes with low fluoride content. However, there are conflicting reports about the effectiveness of use of toothpastes with low fluoride content.^[43-45] Also the results may be variable for deciduous and permanent teeth; and also for different age groups of children.^[46]

SELF-APPLIED FLUORIDE GELS AS A RISK FACTOR

Whenever topical fluoride is applied, we should stick to some guidelines to prevent or reduce the potential ingestion of fluoride: to reduce the concentration of fluoride in the product and decrease the application time; to confection individuals trays recovered with foam and trimmed; to maintain the seat in a vertical position so that the patient remain seated; to always use a saliva ejector; to remove the excess of fluoride with a gauze; and to request the patient to spit as much as possible after the fluoride application.^[36] Also certain recommendations for the use of prescription-strength fluoride gels should be followed: should be recommended for patients in fluoride-deficient communities who are at high risk for caries; parents of pediatric patients should supervise placement of the product in the custom tray or on the toothbrush; application regimens should be limited to the minimum time period deemed necessary for control of dental caries, and patients should be evaluated periodically to determine when self-application can be terminated.^[1]

INFANT FORMULAS

Before 1979, infant formulas contained high fluoride concentration, however, after 1979 manufacturers of infant formula voluntarily reduced and controlled the concentration of fluoride in their products. Literature also supports this fact as studies of risk factors for fluorosis involving children who were born before 1979 have shown infant formula to be a risk factor for fluorosis in fluoridated and non-fluoridated areas.^{[16],[26]} Results of studies conducted by Pendrys and colleagues studies showed that in nonfluoridated communities, infant formula use was no longer a risk factor for fluorosis, but in the

fluoridated areas it was still a significant risk factor.^[29] It is therefore recommended that in order to reduce the risk of fluorosis from the use of infant formulas we should use ready-to feed formulas, or use non-fluoride containing bottled water to dilute formula concentrate.^[12]

FLUORIDE MOUTHRINSES AS A RISK FACTOR

Fluoride mouthrinses are available as solutions containing either NaF in different concentrations, or acidulated phosphate fluoride (APF). The major concern is swallowing of mouthrinses in children who have not yet mastered their swallowing reflex.^[47] Hence, fluoride mouthrinses are recommended for use in only those children who demonstrate the ability to swish and expectorate without swallowing. Following recommendations are observed regarding use of fluoride mouthrinses: should be reserved for use with children judged to be at moderate or high risk for dental caries; little additional benefit should be expected from fluoride mouthrinses in low-caries-risk children who are already using a fluoridated dentifrice; should be recommended only for those children who have demonstrated mastery of their swallowing reflex; and where available, alcohol-free preparations should be recommended over those containing alcohol.^[1]

MISCELLANEOUS RISK FACTORS

The other factors that can affect risk of fluorosis in pediatric patients are child's age, gender, race, socio-economic status of parents, feeding practices. Male children, caucasians, children whose parents have higher socio-economic status are more prone to be affected with fluorosis. These factors are not considered as directly responsible for causing fluorosis, instead they exert an indirect effect by affecting other factors.^[12]

CONCLUSION

In a nutshell it can be said that use of fluoride is a double-edged sword. Thus, fluoride products should be used in proven, approved regimens, and steps should be taken to reduce the unnecessary ingestion of fluoride by young children. Also, dentists should keep in mind that the risk for fluorosis increases with use of multiple fluoride products at a time. It is the duty of dentists to increase awareness of the general public about the use of fluoride products.

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