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## Topical Fluoride application among Pediatric outpatients - A retrospective study

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**Abstract:** Widespread use of fluoride has been a major factor towards the decline in both the prevalence and severity of dental caries in economically developed countries. Fluorides prevent tooth decay by promoting remineralization and inhibiting demineralization of enamel. It is recommended as part of a comprehensive tooth decay prevention program. The growing number of parents who refuse topical fluoride in clinical practice warrants attention from dental professionals and the scientific community. The goal of this research is to know the level of acceptance of fluoride treatment. The aim of this study was to evaluate the acceptance of topical fluoride application among pediatric dental patients. A retrospective study was conducted using the patient records from Saveetha Dental College, Chennai from June 2019 - April 2020. The study population included pediatric patients with dental caries, selected by non-probability purposive sampling. Data was collected and then subjected to statistical analysis. Microsoft Excel 2016 (Microsoft office 10) data spreadsheet was used to collect data and later exported to SPSS IBM (version 20.0). Descriptive statistics and chi square test were employed with a level of significance set at  $p < 0.05$ . It has been concluded that the overall acceptance of fluoride application was 20.72%, among which 80.34% of the patients preferred fluoride gel and 19.66% preferred fluoride varnish. Children between 6-13 years of age and children with higher dental caries, especially males, had a more favourable level of acceptance. Thus the most parental acceptance was noticed only after progression of decay in children. There is a paramount need to educate the parents and caregivers about the importance of topical fluoride application as a preventive measure in preventing caries and progression of decay in children.

**Keywords:** Acceptance; Caregivers; Dental caries; Fluoride application; Negligence

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### INTRODUCTION

Oral health is essential to an individual's general health and quality of life (Nair *et al.*, 2018). Dental caries is defined as a multi-factorial infectious disease caused by plaque bacteria (Panchal *et al.*, 2019). When food enters the mouth, bacteria metabolize fermentable carbohydrates, producing acids, which diffuse into hard dental tissue, and demineralize tooth enamel (Ravikumar, Jeevanandan and Subramanian, 2017). Dental caries currently represent the most common chronic disease among children; it is five times more common than asthma, and seven times more common than seasonal allergies (Govindaraju, Jeevanandan and E. Subramanian, 2017). The effects of childhood dental caries on quality of life can be profound, including chronic pain, tooth loss, difficulty hearing, eating, and sleeping, and failure to thrive, as well as substandard school performance, poor social relationships, and decreased success later in life (Jeevanandan and Govindaraju, 2018), (Govindaraju, Jeevanandan and E. M. G. Subramanian, 2017b).

The environmental risk factors for dental caries have been studied for decades, and include dietary behaviours, bacterial flora, transmission of bacteria among hosts, hygiene, salivary composition and flow rate, tooth positional and morphological features, fluoride exposure, socioeconomic status, and access to oral health care (Govindaraju, Jeevanandan and E. M. G. Subramanian, 2017a), (Jeevanandan, 2017). Early childhood caries remains a significant problem challenging our diagnostic, preventive, and restorative skills, affecting 60% to 90% of school children in industrialised countries (Govindaraju and Gurunathan, 2017). Often, caries in very young children involve the maxillary anterior teeth and the primary molars while the mandibular anterior teeth are generally not involved (Subramanyam *et al.*, 2018).

Widespread use of fluoride has been a major factor towards the decline in both the prevalence and severity of dental caries in economically developed countries((Gurunathan and Shanmugaavel, 2016)). In the early 1900s, Frederick McKay discovered the oral health benefits of fluoride when he observed that individuals exposed to naturally fluoridated drinking water in Colorado Springs, Colorado were significantly less likely to develop tooth decay. Since then, topical fluorides have become the cornerstone of prevention in dentistry((Packiri, Gurunathan and Selvarasu, 2017)). Fluoride is available in a variety of modalities each with varying concentrations: fluoridated drinking water; over-the-counter toothpastes and mouthwashes; foams, gels, and varnishes provided by health care professionals during dental and medical visits; and prescription-strength toothpastes, drops, or tablets((Christabel and Linda Christabel, 2015)). Fluorides prevent tooth decay by promoting remineralization and inhibiting demineralization of enamel((Somasundaram *et al.*, 2015)). It is recommended as part of a comprehensive tooth decay prevention program. Regular exposure to fluoride is safe, even for young infants(('Fluoride, Fluoridated Toothpaste Efficacy And Its Safety In Children - Review', 2018)).

Community water fluoridation is the most feasible and cost-effective strategy for reaching entire communities. Water fluoridation has resulted in children experiencing 35% fewer decayed, missing and filled baby teeth, along with 26% fewer decayed, missing and filled permanent teeth((Petersen and Lennon, 2004)). The Guideline on Fluoride Therapy, as revised by the American Academy of Pediatric Dentistry (AAPD), recommends professionally applied topical fluoride treatment as being efficacious in reducing caries in children who are at risk((Strohmer and Brambilla, 2001)). Fluoride reduces the incidence of dental caries, while also slowing or reversing the progression of existing lesions((Wright *et al.*, 2014)). The role that fluoride containing products play in the prevention of dental caries has been reported in many studies, and has also been confirmed through systematic reviews and meta-analysis((Featherstone, 1999)).

Even though fluoride is effective and safe, recent data showed that 13% of parents refused fluoride treatments for their child during a preventive dental or medical visit((D'Hoore and Van Nieuwenhuysen, 1992)). Even more parents are fluoride hesitant, meaning that they may accept fluoride for their children but have unresolved concerns((Humphris and Zhou, 2014)). These findings are of concern because fluoride is one of the few preventive treatments available for caries prevention((Zhou, Forbes and Humphris, 2013)). The growing phenomenon of fluoride refusal has implications for the way in which clinicians communicate with parents about fluoride so that parents can make optimal preventive health care decisions for their children((Chi, 2014)).

The growing number of parents who refuse topical fluoride in clinical practice warrants attention from dental professionals and the scientific community((Adams *et al.*, 2012)). In the short-term, there are clinical and community-based strategies available to improve communication with parents about fluoride and educate the public about the importance of fluoride. In the longer-term, there is a need to develop measures to identify parents who are likely to refuse topical fluoride and to uncover the reasons for topical fluoride refusal((Hyde *et al.*, 2009)). The goal of this research is to know their level of acceptance to the treatment. 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; Panchal, Jeevanandan and Subramanian, 2019; Rajendran *et al.*, 2019; Ramakrishnan, Dhanalakshmi and Subramanian, 2019; Sharma *et al.*, 2019; Varghese, Ramesh and Veeraiyan, 2019; Gomathi *et al.*, 2020; Samuel, Acharya and Rao, 2020)

The aim of this study is to evaluate the acceptance of topical fluoride application among pediatric dental patients.

## MATERIALS AND METHODS

### Study design and setting

This pilot retrospective study examined the records of pediatric patients who underwent treatment from June 2019 - April 2020 at a private dental college in Chennai. Ethical approval was obtained from the Institutional Ethics Committee of the University (SDC/SIHEC/2020/DIASDATA/0619-0320). Patients with only 3 to 18 yrs of age were included in the study. Medically compromised and physically challenged children, patients with dental fluorosis were excluded from the study.

### Data collection

Records of paediatric patients with a history of dental caries were reviewed and analysed. Relevant data such as patient age, sex, acceptance of fluoride application, fluoride gel / varnish, deft/ICDAS/DMFT scores were retrieved from the patient records. Repeated patient records and incomplete records were excluded. The final dataset consisted of 7364 paediatric patients who had all the relevant data gathered. Data was verified by an external reviewer.

### Statistical analysis

Data was recorded in Microsoft Excel 2016 (Microsoft office 10) and later exported to the Statistical Package for Social Science (SPSS IBM version 20.0) and subjected to statistical analysis. Descriptive statistics and chi square test were applied with the level of significance set at  $p < 0.05$ .

## RESULTS AND DISCUSSION

Children were grouped based on their age as follows, 3 to 5 years - 20.79%, 6 to 13 years - 45.38%, 14 to 17 years - 33.85% [Figure 1]. The overall acceptance of fluoride application among children with dental caries was 20.72% [Figure 2]. About, 80.34% of the patients preferred fluoride gel and 19.66% preferred fluoride varnish [Figure 3]. The acceptance of fluoride application among different age groups was as follows, 3 to 5 years - 3.82%, 6 to 13 years - 13.4%, 14 to 17 years - 3.44%. There was a significant association between age and the acceptance of fluoride treatment, with a higher level of acceptance among children between 6 to 13 years of age ( $p < 0.05$ ) [Figure 4, Table 1].

The level of acceptance in males (11.34%) was higher than that of females (9.31%), though there was no significant association ( $p > 0.05$ ) [Figure 5, Table 1]. There was a significant association between deft/ ICDAS criteria/ DMFT scores and the acceptance of fluoride treatment, ( $p < 0.05$ ) with a favourable level of acceptance in patients with higher deft/ ICDAS/ DMFT scores [Figure 6, Table 2].

In the present study, 7.47% of children between 3 to 5 years of age chosen fluoride gel and 16.64% preferred fluoride varnish. In children between the ages of 6 to 13 yrs, 47.51% preferred fluoride gel and 2.62% preferred fluoride varnish. Among children between 14 to 17 years of age, 25.36% preferred fluoride gel and 0.39% preferred fluoride varnish. Children above 6 years preferred application of fluoride gel over varnish, whereas the majority of children between 3 to 5 years opted for fluoride varnish. There was a significant association between age and the mode of topical fluoride application [Figure 7, Table 3].

About 35.98% of female children preferred fluoride gel and 9.11% preferred fluoride varnish. In males, 44.36% preferred fluoride gel and 10.55% opted for fluoride varnish. Male children preferred fluoride gel over fluoride varnish than females. However there was no significant association between gender and the mode of topical fluoride application [Figure 8, Table 3]. 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)

**Table 1: represents the acceptance of fluoride application among children of different age groups and among males and females. Chi square test shows that there was a significant association between age and the acceptance of fluoride treatment, with a higher level of acceptance among children between 6 to 13 years of age (13.4%) with the value 0.001 ( $< 0.05$ ). Boys had a more favourable level of acceptance (11.34%) when compared to girls (9.31%). However, there was no significant association.**

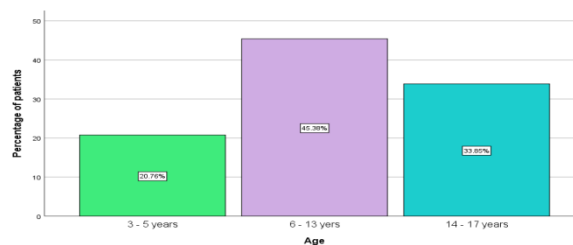
Variables	Acceptance of fluoride application		Statistical values
	Yes (%)	No (%)	
<b>Age :</b>			Pearson Chi square value = 62.047 P value = 0.001 ( $p < 0.05$ )
3 to 5 years	3.82%	10.87%	
6 to 13 years	13.4%	46.28%	
14 to 17 years	3.44%	22.2%	
<b>Gender :</b>			Pearson Chi square value = 0.028 P value = 0.868 ( $p > 0.05$ )
Male	11.34%	43.41%	
Female	9.31%	35.94%	

**Table 2: represents the acceptance of fluoride application among different age groups of children with deft/ ICDAS criteria DMFT scores for primary, mixed and permanent dentition respectively. Chi square test shows that there was a significant association between deft/ ICDAS criteria/ DMFT scores and the acceptance of fluoride treatment, with a favourable level of acceptance in patients with higher deft/ ICDAS/ DMFT scores with a value of 0.001 (<0.05).**

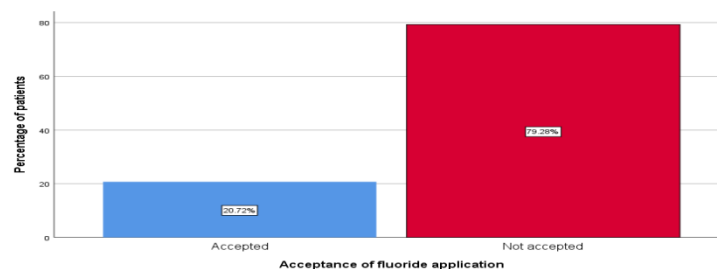
Age category		Acceptance of fluoride application		Statistical value
Age	Index recorded	Yes (%)	No (%)	
3 to 5 years (primary dentition)	<b>deft scores</b>			Pearson Chi square value = 88.945  P-value = 0.001 (p<0.05)
	0 - 10	1.8%	5.25%	
	11- 20	2.01%	5.63%	
6 to 13 years (mixed dentition)	<b>ICDAS scores</b>			
	0 - 3	7.8%	26.98%	
	4 - 6	5.59%	19.28%	
14 to 17 years (permanent dentition)	<b>DMFT scores</b>			
	0 - 10	7.02%	0.97%	
	11 - 20	7.07%	1.1%	
	21 - 32	8.08%	1.35%	

**Table 3: represents the preference of fluoride gel/ varnish among children of different age groups and among male and female children. Chi square test shows that there was a significant association between age and the mode of fluoride treatment, with a higher preference for fluoride gel among children between 6 to 13 years of age (47.51%) and a higher preference for fluoride varnish among 3 to 5 year old children (16.64%) with a value of 0.001 (<0.05). Male children had a greater preference for fluoride gel (44.36%) than varnish when compared to females (35.98%). 10.55% of males and 9.11% of females chosen fluoride varnish. However, there was no significant association.**

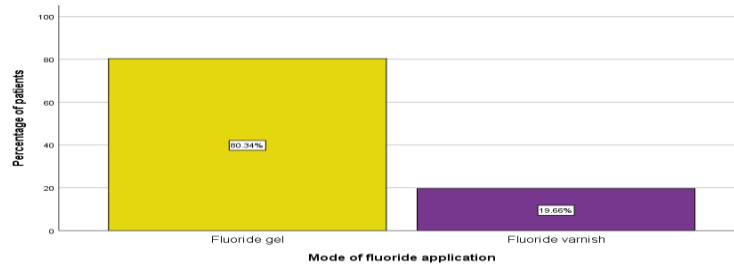
Age category	Acceptance of fluoride application		Statistical values
	Fluoride gel (%)	Fluoride varnish (%)	
<b>Age :</b>			Pearson Chi square value = 750.397 P value = 0.001 (p<0.05)
3 to 5 years	7.47%	16.64%	
6 to 13 years	47.51%	2.62%	
14 to 17 years	25.36%	0.39%	
<b>Gender :</b>			Pearson Chi square value = 0.235 P value = 0.628 (p>0.05)
Male	44.36%	10.55%	
Female	35.98%	9.11%	



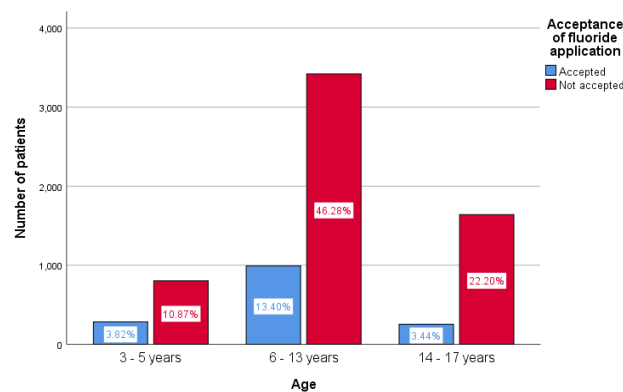
**Fig.1: Bar graph representing the age distribution of children included in the study. X axis represents the age of children and Y axis represents the percentage of pediatric patients included in this study. Children were grouped based on their age as follows, 3 to 5 years - 20.79%, 6 to 13 years - 45.38%, 14 to 17 years - 33.85%.**



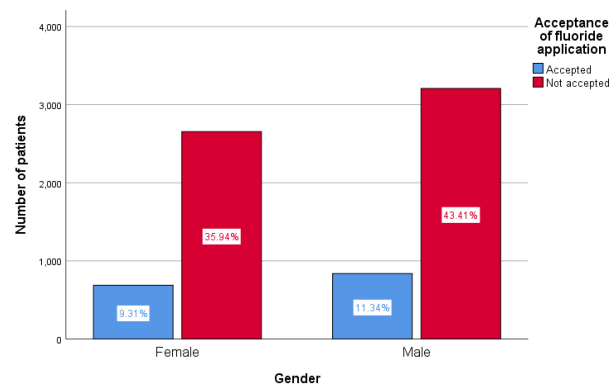
**Fig.2: Bar graph representing the overall acceptance of fluoride application among children. X axis represents the acceptance of fluoride application and Y axis represents the total percentage of pediatric patients included in this study. The overall acceptance of fluoride application among children with dental caries was 20.72%.**



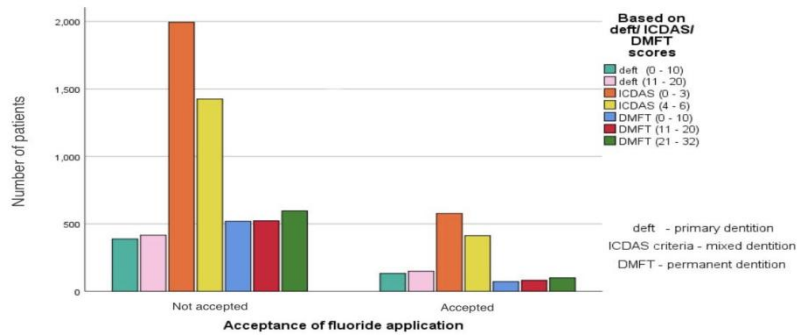
**Fig.3: Bar graph representing the preference of fluoride gel/varnish among pediatric dental patients. X axis represents the mode of fluoride application and Y axis represents the total percentage of pediatric patients included in this study. About 80.34% of the patients preferred fluoride gel .**



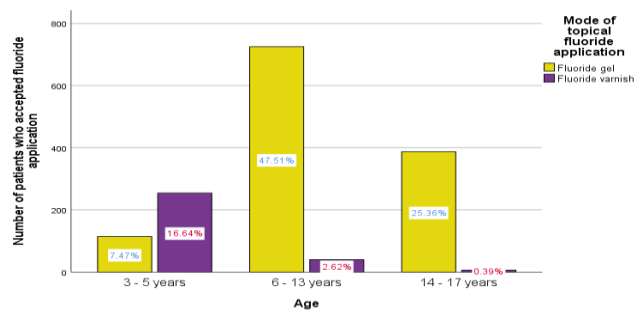
**Fig.4: Bar graph representing the correlation between age and the acceptance of fluoride application. X axis represents the age of children and Y axis represents the number of patients included in this study. Chi square test showed that there was a significant association between age and the acceptance of fluoride treatment, with a higher level of acceptance among children aged 6 to 13 years. Pearson Chi square value = 62.047; p-value = 0.001 ( $p < 0.05$ , \*statistically significant)**



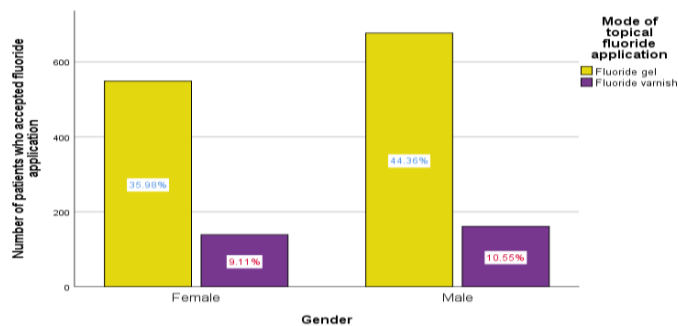
**Fig.5: Bar graph representing the association between gender and the acceptance of fluoride application. X axis represents the gender of children and Y axis represents the number of children who had accepted fluoride application. Boys had a higher level of acceptance for fluoride treatment (11.34%) when compared to girls (9.31%). However, there was no significant association. Pearson Chi square value = 0.028; p-value = 0.868 ( $p > 0.05$ , \*statistically insignificant)**



**Fig.6: Bar graph representing the association between deft/ ICDAS criteria DMFT scores for primary, mixed and permanent dentition respectively and the acceptance of fluoride application among pediatric dental patients. X axis represents the acceptance of fluoride application and Y axis represents the number of patients included in this study. There was a significant association between deft/ ICDAS criteria/ DMFT scores and the acceptance of fluoride treatment, with a favourable level of acceptance in patients with higher deft/ ICDAS/ DMFT scores. Pearson chi square value = 88.945; p-value = 0.001 (p<0.05, \*statistically significant)**



**Fig.7: Bar graph representing the preference of fluoride gel / varnish among different age groups. X axis represents the age of children and Y axis represents the number of patients who had accepted fluoride application. Children above 6 years preferred application of fluoride gel over varnish, whereas the majority of children between 3 to 5 years chosen fluoride varnish. Chi square test showed that there was a significant association between age and the mode of topical fluoride application. Pearson Chi square value = 750.397; p-value = 0.001 (p<0.05, \*statistically significant)**



**Fig.8: Bar graph representing the preference of fluoride gel / varnish among male and female children. X axis represents the gender of pediatric patients and Y axis represents the number of patients who accepted fluoride application. Male children preferred fluoride gel over fluoride varnish than females. However there was no significant association between gender and the mode of topical fluoride application. Pearson Chi square value = 0.235; p-value = 0.628 (p<0.05, \*statistically insignificant)**

The data for this retrospective study was based on residents of Chennai seeking treatment at a private institution. Currently there are no existing studies investigating the level of acceptance of fluoride application in the South Indian population. This study aims to elucidate the importance of topical fluoride application in early prevention and progression of dental caries.

In this study, the overall acceptance of fluoride application among children with dental caries was 20.72%. This low level of acceptance was in accordance with previous literature. As can be seen from the results of a study by Chia Ling-Hsu et al, the utilization of topical fluoride application was low, as less than 40% of children received professionally applied topical fluoride((Hsu *et al.*, 2018)). A study reported by Hu et al., estimated that only 3% of subjects had ever received a professional topical fluoride application((Hu *et al.*, 2020)). This lower professional topical fluoride application rate was also noted by Chen et al. in a 2005 study (16.67%)(Chen and Lin, 2009)). In a study by Slayton et al, it was revealed that 19% of children have received at least one fluoride treatment((Slayton *et al.*, 2002)).

Wong et al studied the attitudes of Chinese parents toward the oral health of their children with dental caries and found that parental lack of dental education, deficiency of social support in the pursuit of dental treatment and cultural belief that does not back the preservation of primary dentition were among the major barriers in the implementation of proper oral hygiene habits((Wong, Perez-Spiess and Julliard, 2005)). Chhabra et al concluded that the deficiency of awareness and knowledge and dental apprehension of parents were the most common obstacles to the prevention of dental caries in young children in Indian population((Chhabra and Chhabra, 2012)). The results of a study by Al-Omiri et al in Jordan population, revealed that parents were not enthusiastic about making sure that their children received frequent oral health care((Al-Omiri, Al-Wahadni and Saeed, 2006)). A majority of the patients preferred fluoride gel when compared to fluoride varnish as is inferred by the results of this study. Previous literature suggests that fluoride varnish is as effective as fluoride gel in preventing caries progression((Seppä, Leppänen and Hausen, 1995),(Ersin *et al.*, 2008)). However, in a study by Schwendickie F et al, it was concluded that fluoride varnish was more efficient and cost effective when compared to fluoride gel((Schwendicke and Stolpe, 2017)).

There was a significant correlation between age and the acceptance of fluoride application, with a higher level of acceptance among children between 6 to 13 years of age, in the present study. Hence it is seen that parents of primary and middle school children have a more positive attitude towards treatment. This is similar to a study by Anjali Kumar et al, where caregivers were most likely to accept SDF(Silver Diamine Fluoride) treatment for their children who were between 9 to 14 years and less likely to accept SDF treatment for pediatric patients below 6 years of age((Kumar *et al.*, 2019)). The American Academy of Pediatric Dentistry, the American Dental Association and many state programs recommend early dental visits. Their guidelines state that a child should be seen for their first dental exam within six months of their first tooth erupting or by one year of age((Nowak, 1997)). It is important to start topical fluoride application from primary dentition in order to avoid the formation of dental caries and further damage to the permanent dentition. A study by Arends et al, demonstrates that fluoride varnishes applied on primary dentition are clinically efficient in reducing dental caries by 20-50% in a two year study period, in the permanent dentition((Arends, Lodding and Petersson, 1980)). Also, another meta analysis by Helfeintein et al, shows a significant caries reduction of about 38% in proximal areas following application of fluoride varnish in primary school children((Helfenstein and Steiner, 1994)).

Fluoride applications in males were higher than that of females, in the present study. This may be due to the fact that males are generally more prone to dental caries than females as verified by previous literature. The mean DMFT/deft scores of boys was significantly higher than that of girls in a study by Rajesh et al((Rajesh, Sunitha and Joshi, 2005)). There was a higher prevalence of dental caries among male children in Saudi Arabian population in a study by Manal Ibrahim Al-Malik et al((Al-Malik and Rehbi, 2006)). Sudha et al states that the incidence of dental caries among male pre school children was 53.9%, while the females had 41.2% in the Hubli population((Sudha *et al.*, 2006)). In a study by Chu C et al, the prevalence of dental caries among male children was 55% and among female children was 45% , showing a male dominance((Chu, Fung and Lo, 1999)). Also in a study by Clarkson et al, it was concluded that males had regular dental checkups and were more likely to accept preventive treatments than females((Clarkson and Worthington, 1993)).

In the current study, there was a significant correlation between deft/ICDAS/DMFT scores in primary, mixed and permanent dentition respectively and in the acceptance of fluoride application. There was an increased need for fluoride application as a preventive measure, the parents are more concerned only after the progression of dental caries , as in the present study parental acceptance rate was seen to be among patients with higher DMFT scores. This is in accordance with the another study where caregivers were more likely to accept Silver Diamine Fluoride treatment for their children with substantial caries experience, i.e., high dmft / DMFT scores, done by Anjali Kumar et al((Kumar *et al.*, 2019)). Autio-Gold J.T. et al showed that the mean DMFT score was significantly lower nine months after fluoride treatment((Autio-Gold and Courts, 2001)). A decline of DMFT values was observed in all age groups and school years after the application of a fluoride varnish, in a study by Dohnke-Hohrmann et al((Dohnke-Hohrmann and Zimmer, 2004)). Hence as a preventive measure topical fluoride application is considered as mandate. The results of this study have to be interpreted with the geographic limitation of the study population and sample size selected. Hence it cannot be generalized to other pediatric populations of geographic and cultural variation. So, organising oral health camps, school oral health programs, campaigning, advertisement and education on preventive measure should be there to encourage the parents.

## CONCLUSION

Within the limits of this study, the overall acceptance of fluoride application was 20.72%, which was lower than expected. Children between 6-13 years of age and those with higher deft/ICDAS/DMFT scores, especially boys, had a more favourable level of acceptance towards topical fluoride application. Thus the most parental acceptance was noticed only after progression of decay in children. There is a paramount need to educate the parents and caregivers about the importance of topical fluoride application as a preventive measure in preventing caries and progression of decay in children. Understanding the acceptability of health interventions is a key component to achieving the goals of improved health and quality of life at a broad population level.

## ACKNOWLEDGEMENTS

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## AUTHORS CONTRIBUTION

J.P. contributed to the study conception and design, data collection, analysis and interpretation and drafted the work. T.A. contributed to data interpretation, study design and data collection. A.B. contributed to study conception, design and data collection. All authors critically reviewed the manuscript and approved the final version.

## CONFLICT OF INTEREST

The authors declare no conflict of interest.

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