Prevalence and Comparison of Dental Caries Experience Using DMFT and Significant Index Caries (SIC): A Hospital Based Cross-Sectional Study

Jerusha Santa Packyanathan[1], Jayashri Prabakar[1*] and Ganesh Jeevanandan[2]

[1]*Department of Public health dentistry, Saveetha Dental College and Hospitals, Saveetha Institute of Medical and Technical Sciences, Saveetha University, Chennai, India;* [2]*Department of Paediatric and Preventive dentistry, Saveetha Dental College and Hospitals, Saveetha Institute of Medical and Technical Sciences, Saveetha University, Chennai, India*

Corresponding author: Jayashri Prabakar, Senior Lecturer, Department of Public health dentistry, Saveetha Dental College and Hospitals, Saveetha Institute of Medical and Technical Sciences, Saveetha University, Chennai, India, Tel: +919841788803; Email: jayashri.sdc@saveetha.com

Abstract

The most common chronic disease of young adults is dental caries. It affects nutritional intake, speech and other activities. It is a multifactorial disease influenced by diet microorganisms, tooth morphology and genetics. The main aim of this cross-sectional study is to determine prevalence and comparison of dental caries experience among 18-21 years old using DMFT abs SIC index. This is a record based study with a sample size of 566, irrespective of the gender. The present study was conducted among 18 to 23 yearold patients who visited the outpatient department at the institution and the data was collected from the patient records. The data was categorized into age groups, gender and DMFT index. The coding was done in MS excel. The data was transferred to a host computer and processed using SPSS software version 21.0 (SPSS Inc., Chicago, IL, USA) by tabulation and graphical illustration. Descriptive statistics was used to study the data collected and to analyse frequency distribution. DMFT and SIC index scores were continuous variables. Hence, it was presented as mean and standard deviation values. Independent T test was used to find the difference between different age groups and Gender with respect to mean DMFT. The results showed that prevalence of dental caries was found to be highest in 21 to 23 years old age group and among male population. The mean number of decayed teeth is 4. The SIC index score was found to be 8.95. The mean DMFT score of the population was 6.2. Comparison between the DMFT and the SIC index scores indicate that there is a sub-group with higher caries rate.

Keywords

Adolescents; Dental caries; DMFT index; Oral health; Significantcaries index

Introduction

Dental caries is one of the most prevalent oral diseases of public health concern affecting adolescents. [1]

Dental caries forms through a complex interaction over time between acid-producing bacteria and fermentable carbohydrate, and many host factors including teeth and saliva. [2]

Adolescence is the period in human life when the relationships between biological, behavioral, socioeconomic, and psychological conditions have a very strong effect on caries etiology. [3]

The American Academy of Pediatrics divides adolescence into three stages: early adolescence (11 to 14 year old), middle adolescence (15 to 17 years old), and late adolescence (18 to 21 years old). [4]

Late adolescence is very important for oral health because an individual's personality, diet-related choices, oral hygiene behavior, and motivations formed during this period. [5] Behaviors and attitudes formed during adolescence usually last into adulthood. [6]

This is an open access article distributed under the terms of the Creative Commons Attribution-NonCommercial-ShareAlike 3.0 License, which allows others to remix, tweak, and build upon the work non-commercially, as long as the author is credited and the new creations are licensed under the identical terms.

How to cite this article: Packyanathan JS, Prabakar J, Jeevanandan G. Prevalence and Comparison of Dental Caries Experience Using DMFT and Significant Index Caries (SIC): A Hospital Based Cross-Sectional Study. Ann Med Health Sci Res. 2021;11:405-411

The clinical observation of dental caries can be translated into numerical formats using the DMFT index. It is a tool that helps quantify dental health status. It is used in dental epidemiology to calculate the number of teeth affected by caries. [7]

Significant caries index also known as SIC index is calculated based on the DMFT index score of the 1/3rd of the highest caries risk population. The SIC index has been proposed to bring attention to the individuals who have the highest caries scores in every population and address their oral health concerns. [8]

Epidemiological information about caries experience in older adolescent groups is scarce because these adolescents are frequently omitted from oral health survey reports. DMFT index is a useful predictor of caries risk. [9]

It is easy to implement the preventive program at this stage as it is the last chance before adulthood begins. Therefore, the aim of this present study is to assess the prevalence of dental caries and to compare the dental Caries experience using DMFT and Significant Index Caries (SIC).

Previously our team has a rich experience in working on various research projects across multiple disciplines. [10-24] Now the growing trend in this area motivated us to pursue this project.

Materials and Methods

Study setting

Case sheets of all the Patients of OP Department of the institution were reviewed for a period of 6 months (June 2019 and December 2019). Simple Random Sampling was carried out to select a total of 566 patients. The study was commenced after approval from the institutional review board. The ethical approval number for the study was SDC/SIHEC/2020/DIASDATA/0619-0320.

Data collection and tabulation

To fulfill the inclusion criteria, patients who reported with dental caries, missing or filled teeth between the age of 18 and 23 were included in the study. The prevalence of dental caries experience is calculated based on D (decayed) M (missing) and F (filled) T (teeth) index.

Patients below 18 years or those above 23 years and those unwilling for the study have been excluded from the study. Cross verification of data for errors was done photographically.

Sampling

Data were collected from June 2019 to March 2020 for 566 patients who had dental caries, missing or filled teeth between the age of 18 and 21 of varying numbers.

The following data were retrieved from the dental records: patient age, gender, number of decayed, missing or filled teeth and their DMFT scores were tabulated.

Ethical clearance and Informed consent

The study was commenced after approval from the institutional review board. The ethical approval number for the study was SDC/SIHEC/2020/DIASDATA/0619-0320. A written informed consent was obtained from all the study subjects.

DMFT and SIC index

Dental caries were assessed using DMFT index by Klein, Palmer, Knutson for permanent dentition. The tooth was considered carious (D component) if there was visible evidence of a cavity, including untreated dental caries.

The missing (M component) included teeth with indications for extractions or teeth extracted due to caries. The filled (F component) included filled teeth.

The Significant Index Caries (SIC) was calculated by adding the highest one-third of DMFT scores and dividing it by one-third of the total sample size. [25]

Statistical analysis

- Data was entered in Microsoft excel spread sheet and analysed using IBM SPSS software version 20.0 (Armonk, NY: IBM. Corp).
- Numerical data were presented as mean and standard deviation values. For test, a p value<0.05 is to be considered statistically significant.
- Shapiro Wilks test used to test the normality of the data set.
- DMFT and SIC index scores were continuous variables. Hence, it was presented as mean and standard deviation values.
- Independent T test was used to find the difference between different age groups and Gender with respect to mean DMFT.

Results

A total of 566 18-23 year-old adolescents (352 male and 214 female) were enrolled in the study. The total number of teeth in the study that were decayed were 2612, 411 teeth were missing and 432 were filled. Table 1 and 2 depicts the Shapiro-Wilks test used to test the normality of the data set between DMFT and SIC Index based on age and gender. The test was found to be statistically not significant which signifies the data follows the normal distribution (Bell curve). Distribution of study subjects according to age showed 37%of the population was between 18-20 years and 63% were 21-23 years [Figure 1]. Distribution of study subjects according to Gender showed that 62% were male and 38%female [Figure 2].

Independent t test was used to find the difference between the gender and the mean DMFT (t value=1.78; p=0.18; p>0.05) and SIC index score (t value=0.36; p=0.54; p>0.05) of patients and was found to be statistically not significant. Even though the test was statistically not significant, it is seen that the SIC index score was highest (8.96 ± 3.34) among males and the DMFT score was found to be highest (3.58 ± 3.48) among females [Table 3 and Figure 3]. Table 4 independent T test was used to find the difference between the age and the mean DMFT (t value=60.52; p=0.00; p>0.05) and SIC index score (t value=2.05; p=0.15, p>0.05) of patients and was found to be statistically not significant. It is seen that SIC index score was highest (9.10 ± 3.12) among the 21-23 years age group and the DMFT score was found to be highest (3.56 ± 1.82) among 18-20 years age group [Table 4 and Figure 4].

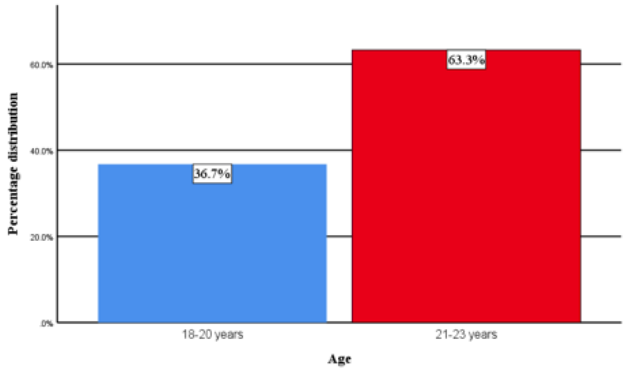

Figure 1: Bar diagram representing distribution of study subjects according to age. X-Axis represents the age group distribution and Y axis represents the percentage distribution of different age groups. The percentage distribution shows 36.7% were 18-20 years (blue), 63.3% were between 21-23 (red).

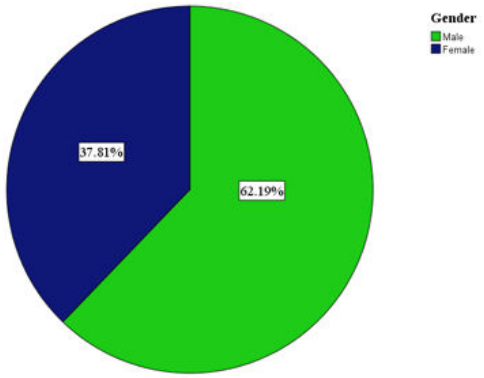

Figure 2: Pie chart representing gender distribution of patients. It shows 37.81% were females (dark blue) and the remaining 62.19% were males (green).

Table 1: Depicts the Shapiro-Wilks test used to test the normality of the data set between DMFT and SIC Index based on age. The test was found to be statistically not significant which signifies the data follows the normal distribution (Bell curve).

Tests of normality	Age	Shapiro-Wilk test	
		Statistic	Sig.
DMFT index score	18-20 years	0.88	0.07
	21-23 years	0.89	0.08
SIC index score	18-20 years	0.70	0.06
	21-23 years	0.60	0.07

Table 2: Depicts the Shapiro-Wilks test used to test the normality of the data set between DMFT and SIC Index based on gender. The test was found to be statistically not significant which signifies the data follows the normal distribution (Bell curve).

Tests of normality	Gender	Shapiro-Wilk test	
		Statistic	Sig.
DMFT index score	Males	0.89	0.08
	Females	0.87	0.06
SIC index score	Males	0.54	0.07
	Females	0.82	0.07

Table 3: Independent t test was used to find the difference between the gender and the mean DMFT (t value=1.78;p=0.18 ;p>0.05) and SIC index score (t value=0.36 ;p=0.54; p>0.05) of patients and was found to be statistically not significant. Even though the test was statistically not significant, it is seen that the SIC index score was highest (8.96 ± 3.34) among males and the DMFT score was found to be highest (3.58 ± 3.48) among females.

Variable	Gender	Mean	Std. Deviation	Independent t test	P value
DMFT index score	Males	3.31	2.51	1.78	0.18
	Females	3.58	3.48		
SICindex score	Males	8.96	3.34	0.36	0.54
	Females	8.94	2.00		

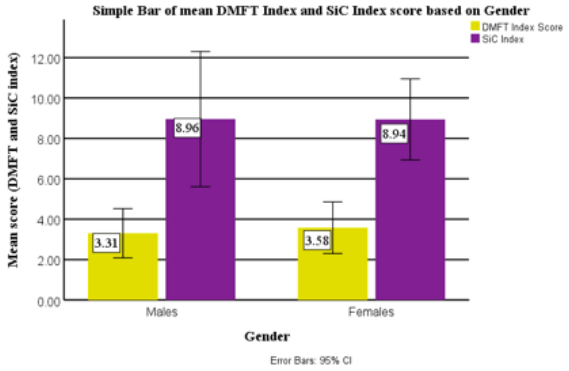

Figure 3: Bar diagram representing the comparison between the gender and the mean DMFT and SIC index score of patients. X-Axis represents the gender and Y axis represents the mean DMFT and SIC score.

Independent t test was used to find the difference between the gender and the mean DMFT (t value=1.78; p=0.18; p>0.05) and SIC index score (t value=0.36; p=0.54; p>0.05) of patients and was found to be statistically not significant. Even though the test was statistically not significant, it is seen that the SIC index score was highest (8.96 ± 3.34) among males and the DMFT score was found to be highest (3.58 ± 3.48) among females.

Table 4: Independent T test was used to find the difference between the age and the mean DMFT (t value=60.52; p=0.00, p>0.05 and SIC index score (t value=2.05; p=0.15, p>0.05 of patients and was found to be statistically not significant. It is seen that SIC index score was highest (9.10 ± 3.12 among 21-23 years age group and the DMFT score was found to be highest (3.56 ± 1.82 among 18-20 years age group.

Variable	Age	Mean	Std. Deviation	Independent T test	P value
DMFT index score	18-20 years	3.56	1.82	60.52	0.06
	21-23 years	3.37	2.40		
SICindex score	18-20 years	8.29	1.58	2.05	0.15
	21-23 years	9.10	3.12		

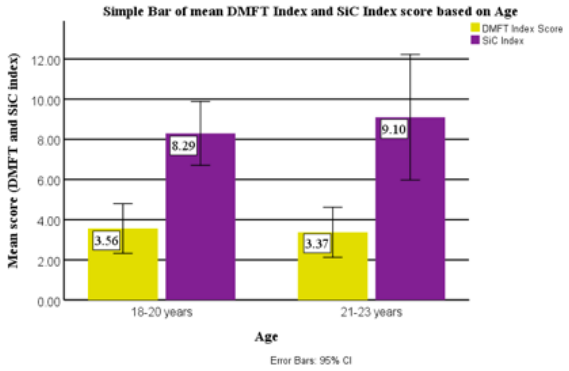

Figure 4: Bar diagram representing the comparison between the age group and the mean DMFT and SIC index score of patients. X-Axis represents the age and Y axis represents the mean DMFT and SIC score.

Independent T test was used to find the difference between the age and the mean DMFT (t value=60.52 ; p=0.00, p>0.05) and SIC index score (t value=2.05; p=0.15, p>0.05) of patients and was found to be statistically not significant. It is seen that the SIC index score was highest (9.10 ± 3.12) among the 21-23 years age group and the DMFT score was found to be the highest (3.56 ± 1.82) among 18-20 years age group.

Discussion

Public health is an important aspect of dentistry and its concerns must be addressed. [26] The well-known fact is that the regular use of fluoride toothpaste is associated with a clear reduction in caries increment. [27,28] Despite these changes, the prevalence of dental caries among 18-23 year-olds is high with an average. The mean DMFT score of the population was 6.2. The SIC index score was found to be 8.95. Factors that cause Decay is bad oral hygiene owing to incorrect brushing technique, use of tobacco product, [29] lack of fluoridated toothpaste, [30] effect of drinking water with high fluoride content thereby leading to fluorosis leading to hypomineralisation [31,32] and lack of nutrition couselling for patients. [33] Patients with high caries risk can be advised to used remineralizing tooth paste [34] to combat the dissolution of the tooth by acid released from bacterial by products. Streptococcus mutans is a common microorganism that causes decay. [35] There are certain naturally occurring phytochemicals that help fight oral diseases. [36] Young patients with deep pits and fissures can be advised to use sealants to prevent caries. [37] Nowadays moisture resistant, hydrophilic, fluoride releasing sealants are available. [38,39] Carbonated drinks cause erosion of the enamel layer. This wear of enamel makes it easier for microorganisms to attack the tooth structure. [40]

Assessment of the distribution of DMFT components individually showed that the Filling (F) component was least accounted for and the prevalence of decayed teeth was 6 times greater. This implies that dental services are not available or being underutilized. This also means that there is the lack of the primary focus on dental caries prevention. Our study showed that the DMFT score was highest in the female population. This could be explained by the fact that teeth erupt earlier in girls than boys; therefore, they are for a longer time exposed to the environment. [41] However, the SIC index scores were higher among males. Dietary habits between girls and boys are different biochemical composition of saliva and saliva flow rate may differ as well. [42] The social role of a girl in a family also could contribute to possible differences in oral health between boys and girls. [41]

Bratthall et al. suggested that the SIC index should be less than 3 in 12-year olds and less than 5 in 15-year olds [25] thus indicating the acceptable limits of dental caries polarization in populations. If we follow this algorithm, we could make a hypothetical statement that for 18-year-old adolescents, it should be less than 7. But in our study the SIC index was 8.95 which is higher than expected.

In Italy, the DMFT score was 3.60 among 17-19 years old adolescents. [43] In the United States, 3.25 among 16 to 19 year-old adolescents; in Sweden, 3.10 among 19 year old adolescents. [44,45] In Jewish school children the DMFT score was 3.62 and Arab school children was 4.01. [46] These worldwide differences are based on economic and political situations, government influence on health-related programs, and eating and oral hygiene habits in each country. Our institution is passionate about high quality evidence based research and has excelled in various fields. [47-53] We hope this study adds to this rich legacy.

Limitations of this study include a cross-sectional study design that does not allow observing trends in the prevalence and severity of dental caries in this age group over time. Geographic isolation and small sample size was another limiting factor.

The participants in the study were not asked about family history. The caries distribution in their dentition was also not recorded tooth wise. Also patients enrolled in the present study had a minimum of 2 decay, failing which the DMFT index was not recorded.

The data presented in this study can serve as a baseline for planning oral health promotion programs. The relatively high burden of dental decay in this population indicates the need for more preventive actions to be taken at earlier stages of life. [38,54]

The implementation of community-based health promotion could aid the control of dental caries. SIC index is an indicator that reflects the situation among the most caries-exposed individuals and could be included in future population-based oral health surveys together with the mean DMFT. [55] It is recommended to pay attention at high caries risk groups, aiming to reach those individuals with the most urgent need for dental care.

Conclusion

Within the limitations of the study, it can be concluded that the prevalence of dental caries using DMFT index was found to be highly prevalent among females and between 18-20 years age group. SIC index score was highest among males and was highly prevalent among 21-23 years age group. The SIC index score was higher in all comparisons with DMFT. A comparison between DMFT and SIC indices indicated a subgroup that presented with a higher caries rate.

Author contributions

Jerusha Santa Packyanathan carried out the retrospective study by collecting data and drafted the manuscript after performing the necessary statistical analysis. Jayashri P aided in the conception of the topic, participated in the study design, statistical analysis, supervised in the preparation of the manuscript and Ganesh Jeevanandan helped in study design and coordinated in developing the manuscript. All the authors have equally contributed in developing the manuscript.

Acknowledgement

The authors would like to acknowledge the support rendered by the department of public health dentistry and Information and technology of Saveetha dental college and hospitals and the management for their constant assistance with the research.

Conflict of interest

The authors state no conflict of interest.

References

1. Petersen PE, Baez RJ, Ogawa H. Global application of oral disease prevention and health promotion as measured 10 years after the 2007 world health assembly statement on oral health. Community Dent Oral Epidemiol. 2020;48(4):338-348.
2. Selwitz RH, Ismail AI, Pitts NB. Dental caries. The Lancet. 2007;369(9555):51–59.
3. Peres MA, Peres KG, De Barros AJD. The relation between family socioeconomic trajectories from childhood to adolescence and dental caries and associated oral behaviors. Int J Epidemiol. 2007;61(2):141.
4. American Academy of Pediatrics. Stages of adolescence. Healthychildren.org. 2020.
5. Grace TW. Health problems of late adolescence. Prim Care. 1998;S95:70335-343.
6. Gomez RD. Oxford textbook of public health 4th edition. J Epidemiol Community Health. 2002;56(10):800.
7. Knutson JW. An index of the prevalence of dental caries in school children. Public Health Rep.1944 25;59(8):253–280.
8. Marthaler T, Menghini G. Use of the Significant Caries Index (SCI) in quantifying the changes in caries in Switzerland from 1964 to 2000. Community Dent Oral Epidemiol. 2005;33(3): 159-166.
9. Motohashi M, Yamada H, Genkai F, Kato H, Imai T, Sato S, et al. Employing DMFT score as a risk predictor for caries development in the permanent teeth in Japanese primary school girls. J Oral Sci. 2006;48(4):233-237.
10. Chen F, Tang Y, Sun Y, Veeraraghavan VP, Mohan SK, Cui C.6-shogaol, an active constituents of ginger prevents UVB radiation mediated inflammation and oxidative stress through modulating NrF2 signaling in human epidermal keratinocytes (HaCaT cells). J Photochem Photobiol B. 2019;197:111518.
11. Ma Y, Karunakaran T, Veeraraghavan VP, Mohan SK, Li S. Sesame inhibits cell proliferation and induces apoptosis through inhibition of STAT-3 translocation in thyroid cancer cell lines (FTC-133). Biotechnol Bioprocess Eng. 2019;24(4):646-652.
12. Manickam A, Devarasan E, Manogaran G, Priyan MK, Varatharajan R, Hsu CH, et al. (2019) 'Score level based latent fingerprint enhancement and matching using SIFT feature. Multimed Tools Appl. 2019;78(3):3065–3085.
13. Ponnanikajamideen M, Rajeshkumar S, Vanaja M, Annadurai G. *In vivo* type 2 diabetes and wound-healing effects of antioxidant gold nanoparticles synthesized using the insulin plant *Chamaecostus cuspidatus* in albino rats. Can J Diabetes. 2019;43(2):82–89.
14. Ponnulakshmi R, Shyamaladevi B, Vijayalakshmi P, Selvaraj J. In silico and *in vivo* analysis to identify the antidiabetic activity of beta sitosterol in adipose tissue of high fat diet and sucrose induced type-2 diabetic experimental rats. Toxicol Mech Methods. 2019;29(4): 276–290.
15. Subramaniam N, Muthukrishnan A. Oral mucositis and microbial colonization in oral cancer patients undergoing radiotherapy and chemotherapy: A prospective analysis in a tertiary care dental hospital. J Investig Clin Dent. 2019;10(4):e12454.
16. Vadivel J, Govindarajan M, Somasundaram E, Muthukrishnan A. Mast cell expression in oral lichen planus: A systematic review. J Investig Clin Dent. 2019;10(4), p:e12457.
17. Wu F, Zhu J, Li G, Wang J, Veeraraghavan VP, Mohan SK, Zhang Q. Biologically synthesized green gold nanoparticles from induce growth-inhibitory effect on melanoma cells (B16). Artif Cells Nanomed Biotechnol. 2019; 47(1):3297–3305.
18. Dinesh S, Kumaran P, Mohanamurugan S, Vijay R, Singaravelu DL, Vinod A, et al. Influence of wood dust fillers on the mechanical, thermal, water absorption and biodegradation characteristics of jute fiber epoxy composites. J Polym Res. 2020;27(1).
19. Girija ASS, Shankar EM, Larsson M. Could SARS-CoV-2-Induced hyperinflammation magnify the severity of coronavirus disease (covid-19) leading to acute respiratory distress syndrome? Front Immunol. 2020;1206.
20. Mathew MG, Samuel SR, Ashu JS, Korishettar BR. Evaluation of adhesion of *Streptococcus mutans*, plaque accumulation on zirconia and stainless steel crowns, and surrounding gingival inflammation in primary molars: randomized controlled trial. Clin Oral Investig. (2020a);24(9):3275–3280.
21. Murugan MA, Jayaseelan V, Jayabalakrishnan D, Maridurai T, Selva Kumar S, Ramesh G, et al. Low velocity impact and mechanical behaviour of shot blasted SiC wire-mesh and silane-treated aloevera/hemp/flax-reinforced SiC whisker modified epoxy resin composites. Silicon Chem. 2020;12(8):1847–1856.
22. Paramasivam A, Vijayashree PJ, Raghunandhakumar S. N6-adenosine methylation (m6A): a promising new molecular target in hypertension and cardiovascular diseases. Hypertens Res. 2020;43(2):153–154.
23. Thanikodi S, Singaravelu DK, Devarajan C, Venkatraman V, Rathinavelu V. Teaching learning optimization and neural

network for the effective prediction of heat transfer rates in tube heat exchangers. Thermal Science. 2020;24(1B):575–581.

24. Vairavel M, Devaraj E, Shanmugam R. An eco-friendly synthesis of Enterococcus sp.-mediated gold nanoparticle induces cytotoxicity in human colorectal cancer cells. Environ Sci Pollut Res. 2020;27(8):8166–8175.
25. Bratthall D. Introducing the significant caries index together with a proposal for a new global oral health goal for 12-year-olds. Int Dent J. 2000;50(6):378–384.
26. Kannan SSD, Vyshiali SK, Rathinavelu PK, Meignana AI. Awareness and attitude towards mass disaster and its management among house surgeons in a dental college and hospital in Chennai, India. Int J Disaster Risk Reduct. 2017;173(9):121-129.
27. Marinho VCC, Higgins J, Logan S. Fluoride toothpastes for preventing dental caries in children and adolescents. Cochrane Database Syst Rev. 2003;10:1002.
28. Prabakar J, John J, Arumugham I, Kumar R, Srisakthi D. Comparative evaluation of retention, cariostatic effect and discoloration of conventional and hydrophilic sealants-A single blinded randomized split mouth clinical trial. Contemp Clin Dent. 2018;9(6):233-239.
29. Harini G, Leelavathi L. Nicotine replacement therapy for smoking cessation-An overview. Indian J Public Health. 2019;10(11):3588-3592.
30. Prabakar J, John J, Arumugham I, Kumar R, Sakthi D. Comparing the effectiveness of probiotic, green tea, and chlorhexidine-and fluoride-containing dentifrices on oral microbial flora: A double-blind, randomized clinical trial. Contemp. Clin Dent. 2018;9(4):560-569.
31. Kumar RP, Pradeep KR, Preethi R. Assessment of water quality and pollution of porur, Chembarambakkam and Puzhal Lake. Res J Pharm Technol. 2017;10(11): 3761-3767.
32. Kumar RP, Pradeep KR, Vijayalakshmi B. Assessment of fluoride concentration in ground water in Madurai District, Tamil Nadu. IndiaRes J Pharm Technol. 2017;10(1):309-310.
33. Neralla M, George R, Kumar MP, Balasubramaniam A, Jayabalan J, Rajan J, et al. Role of nutrition in rehabilitation of patients following surgery for oral squamous cell carcinoma. Int J Pharm Sci Res. 2019;10(4):3197–3203.
34. Mohapatra S, Kumar PR, Arumugham M, Sakth DS, Jayashri P. Assessment of microhardness of enamel carious like lesions after treatment with nova min, bio min and remin pro containing toothpastes: An *in vitro* study. Indian J Public Health. 2019;10(10):375-380.
35. Mathew MG, Samuel SR, Soni AJ, Roopa KB. Evaluation of adhesion of *Streptococcus mutans*, plaque accumulation on zirconia and stainless steel crowns, and surrounding gingival inflammation in primary molars: randomized controlled trial. Clin Oral Investig. 2020b; 24:3275–3280.
36. Pavithra RP, Preethi PR, Jayashri P. Influence of naturally occurring phytochemicals on oral health. Res J Pharm Technol. 2019;12(8):3979-3983.
37. Prabhakar AR, Murthy S, Sugandhan S. Comparative evaluation of the length of resin tags, viscosity and microleakage of pit and fissure sealants: An *in vitro* scanning electron microscope study. Contemp Clin Dent. 2011;2(4): 324–330.
38. Prabakar J, John J, Srisakthi D. Prevalence of dental caries and treatment needs among school going children of Chandigarh. Indian JDent Res 2016;27(5):547-552.
39. Khatri S, Madan KA, Srinivasan SR, Acharya S. Retention of moisture-tolerant fluoride-releasing sealant and amorphous calcium phosphate-containing sealant in 6–9-year-old children: A randomized controlled trial. J Indian Soc Pedod Prev Dent. 2019;37(1):92-98.
40. Pratha AA, Ashwatha PA, Prabakar J. Comparing the effect of carbonated and energy drinks on salivary Ph. *In vivo* randomized controlled trial. Res J Pharm Technol. 2019;12(10): 4699-4702.
41. Lukacs JR, Largaespada LL. Explaining sex differences in dental caries prevalence: Saliva, hormones, and "life-history" etiologies. Am J Hum Biol. 2006;18(4):540–555.
42. Dodds MWJ, Johnson DA, Yeh CK. Health benefits of saliva: A review. J Dent. 2005;33(3):223-233.
43. Arcella D, Ottolenghi L, Polimeni A. The relationship between frequency of carbohydrates intake and dental caries: A cross-sectional study in Italian teenagers. Public Health Nutr. 2002;5(4):1-14.
44. Beltrán A, Eugenio D, Laurie K, Teresa M, Bruce A, Barbara F, et al. Surveillance for dental caries, dental sealants, tooth retention, edentulism, and enamel fluorosis; United States, 1988-1994 and 1999-2002. Stacks Home. 2005;54(S1):1-3
45. Johansson V, Söderfeldt B, Axtelius B. Oral B's Nordic report on oral health: Caries prevalence among children, adolescents and adults, and periodontal conditions among adults in Denmark, Finland. 2008.
46. Anaise JZ. Decayed, missing, and filled teeth among Jewish and Arab schoolchildren in Israel. Community Dent Oral Epidemiol. 1980;8(1):61-65.
47. Pc J, Marimuthu T, Devadoss P. Prevalence and measurement of anterior loop of the mandibular canal using CBCT: A cross sectional study. Clin Implant Dent Relat Res. 2018;20(4): 531-534.
48. Ramesh A, Varghese S, Nadathur DJ, Malaiappan S. Comparative estimation of sulfiredoxin levels between chronic periodontitis and healthy patients-A case-control study. J Periodontol. 2018;89(10):1241–1248.
49. Ezhilarasan D, Apoorva VS, Ashok VN. *Syzygium cumini* extract induced reactive oxygen species-mediated apoptosis in human oral squamous carcinoma cells. J Oral Pathol Med. 2019;48(2):115–121.
50. Ramadurai N, Gurunathan D, Samuel AV, Subramanian E, Rodrigues SJL. Effectiveness of 2% Articaine as an anesthetic agent in children: randomized controlled trial. Clin Oral Investig. 2019;23(9), pp. 3543–3550.
51. Sridharan, G. Evaluation of salivary metabolomics in oral leukoplakia and oral squamous cell carcinoma. J Oral Pathol Med. 2019;48(4):299–306.
52. Vijayashree PJ. In silico validation of the non-antibiotic drugs acetaminophen and ibuprofen as antibacterial agents against red complex pathogens. J Periodontol. 2019;90(12): 1441–1448.
53. Mathew MG, Samuel SR, Soni AJ, Roopa KB. Evaluation of adhesion of *Streptococcus mutans*, plaque accumulation on zirconia and stainless steel crowns, and surrounding gingival inflammation in primary molars: randomized controlled trial. Clin Oral Investig. 2020; 24:3275–3280.
54. Samuel SR, Acharya S,Rao JC. School interventions–based prevention of early-childhood caries among 3–5-year-old children from very low socioeconomic status: Two-year randomized trial. J Public Health Dent. 2020;80(1):51–60.
55. Nishi M, Stjernswärd J, Carlsson P, Bratthall D. Caries experience of some countries and areas expressed by the significant caries index. Community Dent Oral Epidemiol. 2002;30(4):296-301.