Prevalence of Untreated Dental Caries in Chennai City: An Institutional Study

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Abstract

Dental caries is the most common chronic disease among younger individuals. Dental caries and periodontal disease are considered to be pandemic diseases affecting all populations irrespective of gender, age or socioeconomic status. Dental caries is one of the global health issues in both industrial and developing countries. Untreated caries can cause severe pain and serious infections. Monitoring the prevalence of untreated as well as treated caries is a key to preventing and controlling oral disease. The aim of this study is to assess the prevalence of untreated caries in Chennai city. This is a retrospective, institutional based study. Datas of patients visiting the dental outpatient were collected. The study was conducted from June 2019 to March 2020. The sample size was calculated to be 2000. Excel tabulation was done and the data was transferred to SPSS software. The prevalence of untreated dental caries was assessed using the DMFT index. One way ANOVA test was done, to assess the mean difference in DMFT and mean D scores among different age groups in the study. The mean DMFT increased from 6.19 in the first age group 17 to 25 years to 11.39 in the last age group above 65 years. However, the D score of 4.52 among 17-25 years was significantly greater than the other and trend declined as age increased in our population (P<0.05). In conclusion the prevalence of untreated caries was greater in younger individuals who visited our dental institution as compared to older adults.

Keywords:

Dental caries; Indexing; Restoration; DMFT

Introduction

Oral health positively affects the physical and mental well being, appearance and even the interpersonal relationship of an individual. Thus, it is the vital component of overall health, which contributes to an individual's well being and influences their quality of life.

Oral hygiene affects one's esthetics and has strong biological, psychological and social projections. Dental caries and periodontal disease are considered to be pandemic diseases affecting all populations irrespective of gender, age or socioeconomic status.

Dental caries is one of the global health issues in both industrial and developing countries. A study conducted in Lithunia shows that the overall prevalence of dental caries was 78.3%. It was found that the prevalence rate was 75% in Brazil. In Sudan, the prevalence rate was reported to be 30.5%. [1]

We could see, the situation is more alarming in most of the developing countries which is due to inadequate access to oral health care services and preventive measures.

An increase in the utilization of sweet foods, poor oral hygiene practices and lack of awareness are some of factors that influence the prevalence of caries.

In addition to this an individual's lifestyle, eating habits, social status and demographic factors also play an important role in the development of caries.

India is a developing country with a mixed economy and with a population of 1.3 billion approximately. It is one of the fastest growing and the 5th largest economies (in terms of gross domestic product-GDP) in the world. [2] The prevalence of dental caries is more pronounced in India ranging from 31.5%

to 89%. [3] Dental caries is an outcome of several interplaying factors. [4] Caries can be prevented by reducing the sugar consumption, proper oral hygiene practices; regular dental checkups and prompt treatment. Untreated caries especially when associated with pain may influence an individual's physical and psychological well being. [5] Awareness about dental caries and its prevention is one of the important influencing factors. A study conducted in Bulgaria, states that there was an association between tooth decay and education. Higher education had lower chance of tooth decay, missing and proper oral hygiene habits. [6]

Clinically, dental caries can manifest as a faint white lesion to a frank cavitation and asymptomatic to severe pain. There are several dental indices which are used for measuring dental caries such as DMFT index, Caries severity index, Nyvads criteria, International caries detection and assessment system-I (ICDAS-I), ICDAS-II, Caries Assessment Spectrum And Treatment (CAST). [7]

The standard DMFT/deft index indices have been used most frequently in epidemiological studies. DMFT index is a quantitative expression of a person's lifetime caries experience in the permanent teeth. It considers dental caries to be an unmistakable cavitated lesion into dentin. [8] With augmenting knowledge in preventive aspects, it has been observed in recent epidemiological studies that there is an immense decrease in dental caries. Although there is a downward trend in prevalence, the initial lesion may go anonymous, which further may create a greater health concern in later stages. Hence, a proper diagnostic criterion has to be considered for identifying and measuring both the cavitated and non cavitated lesions of dental caries. [9] Early detection, assessment and correct diagnosis of these lesions are fundamental targets to move away from curative to preventive dentistry. [10]

Previously, our team has conducted various studies that include reviews, [11] surveys, [12] Clinical trials, [13-23] in vitro studies. [24,25] Previously our team has a rich experience in working on various research projects across multiple disciplines. [26-40] Now the growing trend in this area motivated us to pursue this project.

We are now focusing on retrospective studies. So, the aim of this study is to assess the prevalence of untreated caries in Chennai city.

Materials and Methods

Study setting

This is a retrospective, institutional based study. The patients visiting Saveetha dental college from June 2019 to March 2020 were included in the study. Ethical approval was obtained from the institutional ethical committee Saveetha dental college. (SDC/SIHEC/2020/DIASDATA/0619-0320).

Sampling

Datas of patients visiting the op retrieved. Cases with incomplete data and repeated cases were excluded from the

study. The final sample size calculated to be 2000. The data was cross verified by another reviewer to minimise sampling bias. The age of the patients included in our study varied from 10 years to 80 years with a mean value 38.11. So, the patients in our study were grouped into 4 different categories with respect to age. Category 1: 10 years to 25 years of age group, Category 2: 26 years to 45 years of age group, Category 3: 45 years to 65 years of age group, Category 4: Above 65 years of age.

Data collection and tabulation

The data were obtained from the patients visiting the department of public health dentistry, in our dental institution. Case records were obtained from digital entries and were cross verified prior to being tabulated in microsoft excel sheet. The caries experience of each individual was assessed by trained examiners and decayed, missing and filled tooth index. Decayed is any tooth affected by dental caries (cavitated or non cavitated detected upon the examination using ball ended probe), missing is any tooth lost because of dental caries or those that are indicated for extraction due to dental caries, Filled refers to those teeth which are treated to restore function in the teeth affected by dental caries. The DMFT modification of 1997 provided by WHO was used for recorder the caries experience and consent was obtained while recording the index, that the data will be used for academic purposes and those consented were included in the study. The D (Decay) status of the DMFT index represents the untreated decay or burden of dental caries in the population who visited our dental institution. The score for DMFT ranges from 0-32 and D can also range from 0-32. The mean DMFT and D was calculated and used for statistical analysis.

Statistical analysis

The excel sheet was transferred to the host computer and processed in SPSS software v20, with age and gender as independent variables and dental caries as dependent variables. One way ANOVA test was done to assess the association between age groups and DMFT value. The statistical significance was set at 5%.

Results and Discussion

The mean value and standard deviation of decay and DMFT values were calculated [Table 1]. The patients in our study were categorized into 4 groups Category 1 denotes 10 years to 25 years of age group, Category 2 denotes 26 years to 45 years of age group, Category 3 denotes 45 years to 65 years of age group, Category 4 denotes above 65 years of age. One-way ANOVA test was done to find the association between mean Decay value and different age groups, also to find the association between mean DMFT values and age groups. Statistically significant correlation was found between decay and DMFT values and different age groups with p value=0.000 (<0.005). The mean difference between decay value and age group is presented in Graph 1. The mean decay value for category 1 is 4.52, for category 2 is 4.11 for category 3 is 3.43 and category 4 is 2.88. The mean decay value was higher in

category 1 (age group 10-25 years). The association between DMFT values and age groups was assessed [Graph 2]. The mean DMFT value for category 1 is 6.19, category 2 is 7.08, category 3 is 8.76 and category 4 is 11.39. The mean DMFT value was higher in category 4 (above 65 years) and this mean difference was statistically significant.

| Table 1: Shows the descriptive for ANOVA test for DMFT value and Decay value (D) when compared between age categories.								
Age	**N**	**DMFTmean**	**Std. Deviation**	**P value**	**95% Confidence interval for mean**		**Minimum**	**Maximum**
					Lower bound	**Upper bound**		
Cat. 1.00	361	6.19	3.099	<0.001	5.87	6.51	0	23
2.00	877	7.08	3.631		6.84	7.32	0	24
3.00	692	8.76	5.177		8.37	9.15	0	51
4.00	66	11.39	6.663		9.76	13.03	1	32
Total	1996	7.64	4.435		7.45	7.84	0	51
Age	**N**	**D**	**Std. Dev**	**P value**	**Lower bound**	**Upper bound**	**Minimum**	**Maximum**
Cat. 1.00	361	4.52	2.819	<0.001	4.22	4.81	0	20
2.00	879	4.11	2.669		3.93	4.29	0	15
3.00	690	3.43	2.551		3.24	3.62	0	18
4.00	65	2.88	2.260		2.32	3.44	0	10
Total	1995	3.91	2.680		3.79	4.03	0	20

P<0.05 is considered significant, Category 1 denotes patients from 10 years to 25 years of age group, Category 2 denotes patients from 26 years to 45 years of age group, Category 3 denotes patients from 45 years to 65 years of age group, Category 4 denotes patients above 65 years.

Early detection of incipient caries is one of the important steps in modern dentistry to create awareness among the community. In epidemiological studies, DMFT is the most commonly used index for the caries assessment, which does not cover the total spectrum of caries progression. [41] There are several advantages of this index-simplicity, ease to use in clinical practice, ease to master the criteria, ease to comparing results worldwide and over a longer period of time. [42] There are few limitations to the index that include, it does not record the initial white spot lesion, there is no differentiation in assessing the level of lesions like the ones that can be restored in the ones that require more complicated treatment. It does not give details about the depth of penetration, caries state, and type of restoration required or done. It only provides a number that corresponds to the teeth or surface which is decayed or missed or restored. Moreover the need for health care and treatment of the carious teeth and further evaluation of the date remains unknown. [43,44]

Comparison of different age groups with mean Decay (D) value was done. One way ANOVA test to assess the association between age groups and mean value showed statistically significant relation with p value=0.001. Graph 1 explains the mean decay value and itsassociation with different age categories. The mean decay value for category 1 is 4.52, for category 2 is 4.11 for category 3 is 3.43 and category 4 is 2.88. This shows that the mean decay value was higher in 10-25 years of age group. Similar study conducted by Wilda et al. stated that the prevalence of dental caries in female adults is 6.81 and male adults are 6.58. [45] A study conducted by Yabao et al. in school children, stated the prevalence of dental caries in permanent teeth was 68.2%. [46] They explain that the sugar consumption of the children was twice as recommended by WHO. Further analysis on the dietary intake of the patients and its association with dental caries should be assessed.
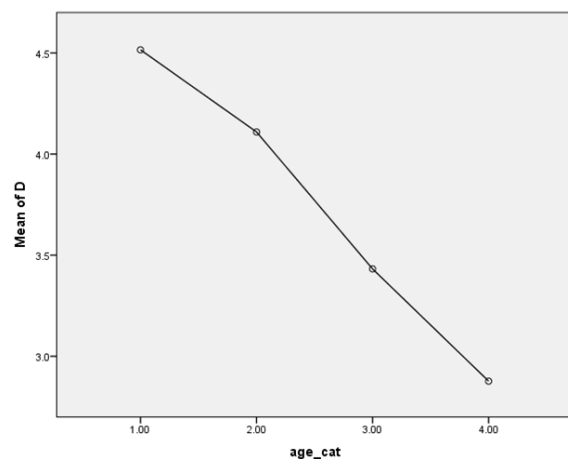
Graph 1: Scatter plot shows the association between age groups and mean Decay values. X axis represents the age category (Category 1 denotes patients from 10 years to 25 years of age group, Category 2 denotes patients from 26 years to 45 years of age group, Category 3 denotes patients from 45 years to 65 years of age group, Category 4 denotes patients above 65 years.) and Y axis represents the mean decay value.

**: One way ANOVA test, *: p value=0.000 (<0.005). Statistically significant association between age groups and mean decay value. Thus, the mean decay value was higher in younger individuals that is from 10 to 25 years (Mean decay value=4.52).
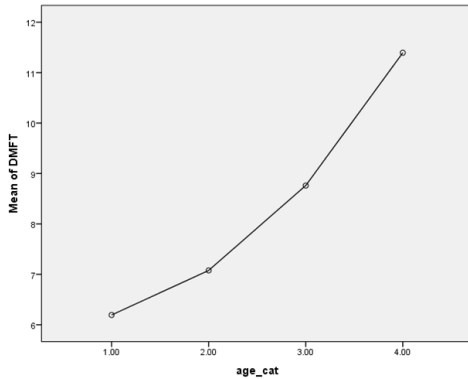
Graph 2: Scatter plot shows the association between age groups and mean DMFT values. X axis represents the age category (Category 1 denotes patients from 10 years to 25 years of age group, Category 2 denotes patients from 26 years to 45 years of age group, Category 3 denotes patients from 45 years to 65 years of age group, Category 4 denotes patients above 65 years.) and Y axis represents the mean DMFT value. **: One way ANOVA test, *: p value=0.000 (<0.005). Statistically significant association between age groups and mean DMFT value. Thus, the mean DMFT value was higher in older individuals that are above 65 years (Mean DMFT value=11.39).

Graph 2 shows the mean difference in DMFT between age groups. The mean DMFT value for category 1 is 6.19, category 2 is 7.08, category 3 is 8.76 and category 4 is 11.39. Study conducted by Ditmyer et al. states the decay was more prevalent in younger individuals and the DMFT values were higher in older individuals which is similar to a study. [47] This is because the elderly population might have more difficulties in getting access to dental care service compared to other age groups. There could be several factors beyond economic status that contribute to the development of caries that include geographical proximity of the dental clinic or health care service center, difficulty in travelling such as mobility, need for assistance, fatigue, medical conditions etc. All these factors could hinder the elderly population to attain dental care services and thus lead to a higher risk of developing caries. Oral health education and health promotion oriented to elderly population should be involved as one of the public health priorities in the future. [48]

Similar studies have been done to assess the prevalence in the Chennai population. Our institution is passionate about high quality evidence based research and has excelled in various fields. [49-55] We hope this study adds to this rich legacy.

A study conducted by Poorani et al., the prevalence of dental caries was higher in older age groups (77.7%), which is similar to our study. They also state that the prevalence was higher in females (49.1%) than in males (41.8%). [56] Few studies have been done in school going students in Chennai which include Ponnudurai et al. study on prevalence of dental caries among school children in Chennai based on ICDAS-II, found that the prevalence rate was 68.8%. [57] Gamal et al. study on prevalence of dental caries and gingivitis in school going population states the prevalence of dental caries was 34.72%. [58] Sunayana et al. study on prevalence of dental caries in 12 years and 15 years age, found the prevalence rate was 46.9% for 12 years of age and 48.5% for 15 years of age. [59] Unlike these studies, the present study includes individuals with all age groups, and the prevalence was assessed for each age category.

The limitations of the study include small sample size that cannot be generalized to a larger population and manual errors during data collection. Further studies can be done over a larger population and multicentric. Prevalence can be analysed between gender groups.

Conclusion

From the present study, we can conclude that the mean decay value is higher in younger individuals (below 20 years), whereas mean DMFT value was higher in older individuals. Early diagnosis of dental caries can help in better treatment and prognosis and help reduce the polarization of dental caries burden in Chennai city.

Acknowledgement

Conflict of Interest

None

References

1. Tafere Y, Chanie S, Dessie T, Gedamu H. Assessment of prevalence of dental caries and the associated factors among patients attending dental clinic in Debre Tabor general hospital: A hospital-based cross-sectional study. BMC Oral Health. 2018 4;18(1):119.

2. Mehta A. Trends in dental caries in Indian children for the past 25 years. Indian J Dent Res. 2018;29(3):323–8.

3. Abbass MMS, Mahmoud SA, El Moshy S, Rady D, AbuBakr N, Radwan IA, et al. The prevalence of dental caries among Egyptian children and adolescences and its association with age, socioeconomic status, dietary habits and other risk factors. A cross-sectional study. F1000Res. 2019;3(8):8.

4. Ortiz AS, Tomazoni F, Knorst JK, Ardenghi TM. Influence of socioeconomic inequalities on levels of dental caries in adolescents: A cohort study. Int J Paediatr Dent. 2020;42–9.

5. Mota-Veloso I, Soares MEC, Alencar BM, Marques LS, Ramos-Jorge ML, Ramos-Jorge J. Impact of untreated dental caries and its clinical consequences on the oral health-related quality of life of schoolchildren aged 8–10 years. Quality of Life Research. 2016;25:193–199.

6. Damyanov ND, Witter DJ, Bronkhorst EM, Creugers NHJ. Dental status and associated factors in a dentate adult population in bulgaria: a cross-sectional survey. Int J Dent. 2012;13:578401.

7. Assaf AV, de Castro MM, Zanin L, Tengan C, Pereira AC. Effect of different diagnostic thresholds on dental caries calibration - a 12 month evaluation. CDOEAP. 2006;34(3):213-219.

8. World Health Organization. Oral Health Surveys: Basic Methods. WHO;1977:68.

9. Shankar S, Kruthika M, Shaikh H, Naveen N, Vinay S. Comparison of def index with Nyvad's new caries diagnostic criteria among three to six years old children in a school at Bangalore city. Indian J Dent Res. 2012;23:135-9

10. Pitts NB. Are we ready to move from operative to non-operative/ preventive treatment of dental caries in clinical practice? Caries Res J. 2004;38(3):294–304.

11. Harini G, Leelavathi L. Nicotine replacement therapy for smoking cessation-An overview. Indian J Public Health. 2019;10:3588.

12. Kannan SSD, Kumar VS, Rathinavelu PK, Indiran MA. Awareness and attitude towards mass disaster and its management among house surgeons in a dental college and hospital in Chennai, India. Disaster Med Public Health. 2017;173:121-129.

13. Prabakar J, John J, Srisakthi D. Prevalence of dental caries and treatment needs among school going children of Chandigarh. Indian J Dent Res. 2016;27(5):547–52.

14. 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.

15. Kumar RP, Pradeep Kumar R, Vijayalakshmi B. Assessment of fluoride concentration in ground water in Madurai District, Tamil Nadu, India. Res J Pharm Technol. 2017;10(1):309-310.

16. Kumar RP, Pradeep Kumar R, Preethi R. Assessment of water quality and pollution of porur, Chembarambakkam and Puzhal Lake. Res J Pharm Technol. 2017;10(10):2157.

17. 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;80:51–60.

18. 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.

19. Khatri S, Madan K, Srinivasan S, 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.

20. Pavithra RP, Pavithra PR, Jayashri P. Influence of naturally occurring phytochemicals on oral health. Res J Pharm Technol. 2019;12(8):3979-3983.

21. Neralla M, Jayabalan J, George R, Rajan J, P SKM, Haque AE, et al. Role of nutrition in rehabilitation of patients following surgery for oral squamous cell carcinoma. Int J Pharm Sci Res. 2019;10:3197–203.

22. 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.

23. Pratha AA, AshwathaPratha A, 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.

24. Prabakar J, John J, Arumugham IM, Kumar RP, Sakthi DS. Comparative evaluation of the viscosity and length of resin tags of conventional and hydrophilic pit and fissure sealants on permanent molars: An in vitro study. Contemp Clin Dent. 2018;9(3):388–94.

25. Mohapatra S, PradeepKR,Meignana AI, Sri Sakthi D, 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;10:375.

26. 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):276–90.

27. 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(9):3275–80.

28. 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.

29. 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;27(11):1206.

30. 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).

31. 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. Therm Sci. 2020;24(1B):575–81.

32. Murugan MA, Jayaseelan V, Jayabalakrishnan D, Maridurai T, Kumar SS, 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):1847–56.

33. Vadivel JK, Govindarajan M, Somasundaram E, Muthukrishnan A. Mast cell expression in oral lichen planus: A systematic review. J Investig Clin Dent. 2019;10(4):e12457.

34. Chen F, Tang Y, Sun Y, Veeraraghavan VP, Mohan SK, Cui C. 6-shogaol, an active constiuents 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.

35. Manickam A, Devarasan E, Manogaran G, Priyan MK, Varatharajan R, Hsu CH, et al. Score level based latent fingerprint enhancement and matching using SIFT feature. Multimed Tools Appl. 2019;78(3):3065–85.

36. Wu F, Zhu J, Li G, Wang J, Veeraraghavan VP, Krishna Mohan S, et al. Biologically synthesized green gold nanoparticles from induce growth-inhibitory effect on melanoma cells (B16). Artif Cells Nanomed Biotechnol. 2019;47(1):3297–305.

37. 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):646–52.

38. 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):82–9.e6.

39. 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 Int. 2020;27(8):8166–75.

40. Paramasivam A, VijayashreePJ, Raghunandhakumar S. N6-adenosine methylation (m6A): A promising new molecular target in hypertension and cardiovascular diseases. Hypertens Res. 2020;43(2):153–4.

41. Frencken JE, de Souza AL, van der Sanden WJM, Bronkhorst EM, Leal SC. The Caries Assessment and Treatment (CAST) instrument. Community Dent Oral Epidemiol. 2013;41(1):e71–7.

42. Souza AL de, de Souza AL, Leal SC, Bronkhorst EM, Frencken JE. Assessing caries status according to the CAST instrument and WHO criterion in epidemiological studies. BMC Oral Health. 2014;14:119.

43. Peter S. Essentials of preventive community dentistry. Arya (Medi) Publishing House. 2008:828.

44. Ekstrand KR, Gimenez T, Ferreira FR, Mendes FM, Braga MM. The International Caries Detection and Assessment System–ICDAS: A systematic review. Caries Res. 2018;52:406–19.

45. Seibert W, Farmer-Dixon C, Bolden TE, Stewart JH. Assessing dental caries prevalence in African-American youth and adults. J Tenn Dent Assoc. 2004;84(2):24–7.

46. Yabao RN, Duante CA, Velandria FV, Lucas M, Kassu A, Nakamori M, et al. Prevalence of dental caries and sugar consumption among 6–12-y-old school children in La Trinidad, Benguet, Philippines. Eur J ClinNutr. 2005;59(12):1429–38.

47. Ditmyer M, Dounis G, Mobley C, Schwarz E. Inequalities of caries experience in Nevada youth expressed by DMFT index vs. Significant Caries Index (SiC) over time. BMC Oral Health. 2011;11.

48. Liu L, Zhang Y, Wu W, Cheng M, Li Y, Cheng R. Prevalence and correlates of dental caries in an elderly population in northeast China. PLoS One. 2013;8(11):e78723.

49. 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):1441–8.

50. Ezhilarasan D, Apoorva VS, Ashok Vardhan N. Syzygium cumini extract induced reactive oxygen species-mediated apoptosis in human oral squamous carcinoma cells. J Oral Pathol Med. 2019;48(2):115–21.

51. Ramesh A, Varghese S, Jayakumar ND, Malaiappan S. Comparative estimation of sulfiredoxin levels between chronic periodontitis and healthy patients-A case-control study. J Periodontol. 2018;89(10):1241–8.

52. 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. Clin Oral Investig. 2020;24;3275–3280.

53. Sridharan G, Ramani P, Patankar S, Vijayaraghavan R. Evaluation of salivary metabolomics in oral leukoplakia and oral squamous cell carcinoma. J Oral Pathol Med. 2019;48(4):299–306.

54. 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.

55. 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):3543–50.

56. Poorani ES, Chandana CS. Prevalence of dental caries among Chennai population. Res J Pharm Biol Chem Sci. 2015;7(10):895.

57. Arangannal P, Mahadev SK, Jayaprakash J. Prevalence of dental caries among school children in Chennai, based on ICDAS II. J Clin Diagn Res. 2016;10(4):ZC09–12.

58. Nasser G, Rupkumar, Junaid M. Prevalence of dental caries and gingivitis among corporation school-going children in Chennai city–A population-based cross-sectional study. SRM J Res Dent Sci. 2019;10(1):7-11.

59. Sunayana G, John J, Saravanan S, Arumugham MI. Prevalence of dental caries among 12 and 15 year old school children in Chennai city. J Indian Assoc. Public Health Dent. 2009;7(13):54.