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Prevalence of Gingivitis and Periodontitis among Diabetic and Hypertensive Patients Visiting a University Dental Hospital - A Retrospective Analysis

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ABSTRACT

Background:

The most common risk factors of periodontal disease are diabetes and hypertension which plays a significant role in modulating the pathogenesis of periodontitis.

Aim:

The aim of the study is to find the prevalence of gingivitis and periodontitis among diabetic and hypertensive patients visiting a university dental hospital.

Materials and Methods:

This retrospective study was carried out by analysing the case records of patients who visited Saveetha Dental College during a period between June 2019 to March 2020. The data included patients who had a history of diabetes and hypertension. Demographic details such as Age, Sex, Marital Status, Occupation, Address, Medical Status were recorded. Periodontal parameters such as bleeding on probing, probing pocket depth, loss of attachment were recorded to assess the periodontal status of the study population. The data was tabulated and entered in excel and the data was analysed using Statistical Package for Social Sciences (SPSS) software, chi square test was done and a p value of 0.05 was set to be statistically significant. Non parametric chi square test was done for statistical analysis and the variables compared were age, gender, gingivitis, periodontitis among diabetic and hypertensive patients.

Results:

The total number of patients in the study were 2858 patients. Prevalence of gingivitis in diabetic patients was 52.85% , hypertensive patients was 27.85% and both diabetes and hypertension was 19.3%. The prevalence of periodontitis in diabetics was 53.84%, hypertensives was 24.37% and in patients with both diabetes and hypertension was 21.72%. There was higher male predilection among the diabetic and hypertensive patients. The mean age age group of gingivitis and periodontitis in diabetic and hypertensive patients was 53.38±10.97 years.

Conclusion:

Within the limitations of the study, we found male predilection among both diabetic and hypertensive patients. Gingivitis and Periodontitis was more common in the age group of 46-60 years. Among diabetic patients, 41.26% had gingivitis and 58.74% had periodontitis. There was a higher prevalence of periodontitis (55.07%) than gingivitis (44.93%) in the hypertensive group.

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Similarly, among the patients who had both diabetes and hypertension , there was a higher prevalence of periodontitis (61.15%) than gingivitis (38.85%).

Keywords: Gingivitis; Periodontitis; Periodontal diseases; Diabetes; Hypertension

INTRODUCTION

Periodontal disease is a chronic inflammatory disease which has deteriorating effects on esthetic and functional aspects of the dentition [1,2]. The disease initially begins as gingivitis due to microbial plaque accumulation around the teeth [3]. Gingivitis if left untreated may lead to periodontitis resulting in the formation of periodontal pockets,clinical attachment loss and mobility leading to tooth loss [4]. Various other risk factors like tobacco use, immunodeficiency like acquired immunodeficiency syndrome, neutrophil disorders, osteoporosis, dietary factors, genetic factors play a crucial role in the disease pathogenesis [5]. The most common systemic risk factors of periodontal diseases are diabetes and hypertension.

Previously our team had conducted various studies on treatment modalities for periodontal diseases and periodontal procedures [1,6–12]. There were many studies done over the past 5 years correlating various disease and factors related to periodontal disease, [13,14] radiological, in vitro studies, case studies [15–17] reviews [18,19]. The idea for this research stemmed from the current interest in our community and its cultural habits.

Diabetes mellitus and Hypertension are among the most common multifactorial disorders , chronic non-communicable diseases affecting both developing countries and also the developed countries. It occurs at a higher prevalence in the older age group and result from both genetic and environmental etiological factors [20]. Diabetes mellitus is a chronic disease increasing in explosive patterns in India [21]. India has been called "the diabetes capital of the world" because of its high diabetes rates; ~41 million Indians have diabetes, accounting for one-fifth of all diabetes cases worldwide [22].

Diabetes mellitus is defined as a metabolic disorder which causes hyperglycemia due to defect in both the insulin action and insulin secretion or sometimes either one [23]. The elevated blood sugar levels adversely affects oral health, manifesting itself in several oral diseases and conditions [24]. Diabetes causes poor healing, xerostomia with subsequent increased accumulation of plaque and food debris, higher susceptibility to infections, and pronounced hyperplasia of gingiva all contributing to the increased incidence of periodontal disease in diabetics [25,26]. Periodontitis has been referred to as the sixth complication of diabetes [27]. Both diabetes and periodontal diseases are thought to share a common pathogenesis that involves an enhanced inflammatory response to the periodontal microflora that can be observed at the local and systemic level [28,29].

Similarly, HT is considered to be one of the most common causes of morbidity and mortality affecting about one billion people worldwide [30,31]. Both hypertension and periodontitis have several common risk factors like increased age, smoking, stress and socioeconomic factors [32].

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There are pathophysiological mechanisms and links involved between both periodontal diseases and hypertension [33]. The possible pathways which link both hypertension and periodontitis could be inflammation, infections in oral cavity, oxidative stress and endothelial dysfunction [34].

Epidemiological studies on periodontal diseases vary considerably in prevalence between countries and between geographic regions within the countries [35–38]. Our team has rich experience in research and we have collaborated with numerous authors over various topics in the past decade [39][16,17,40–60]. Assessment of the prevalence of these diseases in our population can add valuable information to the oral health planners for proposing strategies and also can aid in bringing awareness to the public. Thus the aim of this retrospective study was to assess the prevalence of gingivitis and periodontitis among diabetic and Hypertensive patients visiting Saveetha dental college and Hospitals.

MATERIALS AND METHODS

This present study was conducted as a retrospective cross sectional study with consecutive non probability sampling among the outpatients of private dental institute , Chennai, Tamil Nadu. The study design was reviewed and approved by the institutional ethical committee. The study setting was a University setting. This study was done by examining 86000 records of patients who underwent treatment at the dental hospital during the time period of June 2019 to March 2020.

Patients who had a medical history of diabetes, hypertension and both were included in the study. Patients who had other systemic complications along with diabetes and hypertension were excluded from the study. Case sheets with incomplete data were also excluded. From the 86000 records, a total of 2858 patients visiting the hospital were included in the study. Demographic details such as Age, Sex, Marital Status, Occupation, Address, Medical Status were recorded. Periodontal parameters such as bleeding on probing, probing pocket depth, loss of attachment were recorded to assess the periodontal status of the study population. The age group of the patients were categorised as 18 to 25 years, 26 to 45 years, 46 to 60 years and above 60 years.

Data Analytics

Data was entered and tabulated into a spreadsheet using Excel version 16.37 (Microsoft Corp, Redmond, Wash) and was analysed using Statistical Package for Social Sciences (SPSS) software, version 1.0.0.1347 64 bit (IBM corp., NY, USA). The frequency and percentages of all the study variables were represented in the form of graphs and tables. The data was represented by the means of bar graphs. Non parametric chi square test was used and results were correlated and associated. In this present study, the significance level was predetermined at the probability value of 5% or less. $p<0.05$ was considered to be as the level of statistical significance.

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RESULTS

The study evaluated the prevalence of gingivitis and periodontitis among diabetic and hypertensive patients visiting SIMATS. The total number of patients in the study were 2858 patients. The age range of the patients was 21 to 84 years. The mean age of the study population was 53.38±10.97 years.Around 57% (1391) of the total study population were males and 42% (1025) of them were females, $p<0.05$ (Figure 1). Among the total study population about 1192 patients (41.71%) had gingivitis and 1666 patients (58.29%) had periodontitis, $p<0.05$ (Table 1). Prevalence of gingivitis was more (53.69%) in males and than females (46.3%), $p<0.05$ (Table 1) . Gingivitis was most commonly seen in the age group of 46 to 60 years(48.15%) and least (0.75%) among the age group of 18 to 25 years, $p<0.05$ (Figure 2). Prevalence of periodontitis in males were higher (59.43%) than females of 40.52%, $p<0.05$ (Table 1). Patients in the age group of 46 to 60 years old were more prone to periodontitis(52.10%) than the lesser age groups, $p<0.05$ (Figure 3).

There were 1527 (53.43%) of diabetic patients, 739 (25.86%) were hypertensive and the remaining 592 (20.71%) patients were having both diabetes and hypertension, $p<0.05$ (Figure 4). There was a higher prevalence of male patients with diabetes among the gingivitis patients when compared to the others, $p<0.05$ (Figure 5). There was a higher number of male patients with diabetes among the periodontitis patients when compared to the others, $p<0.05$ (Figure 6) Patients of age 46 to 60 years with diabetes were higher in the gingivitis group when compared to the others, $p<0.05$ (Figure 7). There is a higher number of patients of age 46 to 60 years with diabetes among the periodontitis patients when compared to the others, $p<0.05$ (Figure 8)

Among the hypertensive patients, 22.29% of 26 to 45 years, 50% of 46 to 60 years, 27.71% of the age above 60 years had gingivitis, $p<0.05$ (Figure 9). The age distribution of periodontitis patients with hypertension was 0.25% of 18 to 25 years, 20.64% of 26 to 45 years, 51.35% of 46 to 60 years, 27.77% of the age above 60 years, $p<0.05$ (Figure 10). The age distribution of diabetic and hypertensive patients with gingivitis was 16.96% of 26 to 45 years, 49.13% of 46 to 60 years, 33.91% of the age above 60 years, $p<0.05$ (Figure 11). The age distribution of diabetic and hypertensive patients with periodontitis was 13.54% of 26 to 45 years, 51.38% of 46 to 60 years, 35.08% of the age above 60 years, $p<0.05$ (Figure 12).

The statistical software SPSS was used for the descriptive and inferential analysis. A chi square test was done to check the association and a p value of < 0.05 was considered statistically significant.

DISCUSSION

The mean age of the study population was 53.38±10.97 years which was similar to the study done by Sekino S et al, 2020 [4]. Prevalence of gingivitis was more at the 46 to 60 years age group. This was in contrast to the study done by Mathur 2002 B et al 2002 where the prevalence of periodontal diseases (89.6%) was in 35 to 45 years and 79.9% in 65.74 years [61]. Prevalence of periodontitis was more in the age group of 46 to 60 years which was contradicting the study done by Mathur B et al., 2010 [61]. Periodontitis had a male predilection, which is

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similar to the findings given by Eke at al., 2012 [62]. This could be due to poor oral hygiene and also to habits such as smoking.

Periodontitis is a host mediated inflammatory disease which is triggered by pathogenic microorganisms and is characterized by elevated levels of various cytokines and inflammatory mediators [6,18]. The inflammatory mediators and tissue breakdown products are usually detected at gingival tissues, gingival cervicular fluid, serum and saliva [9] Periodontitis and diabetes have a bi-directional relationship, which can influence the clinical outcomes of each other [63,64]. Hyperglycemia has shown to cause depression in polymorphonuclear leukocyte chemotaxis and apoptosis which leads to retention of the leukocytes in the periodontal tissue and causes more tissue destruction [65,66]. The exposure of collagen fibres to increased glucose levels causes nonenzymatic glycation and oxidation which changes the physical properties and reduces the collagen solubility and increases the connective tissue degradation [67]. Adipokines contribute to the susceptibility of diabetes and periodontitis, the leptin properties can be important in the upregulation of periodontal inflammation in people with diabetes [68]. Since diabetes is a confirmed major risk factor for periodontitis, the glycemic level control is of key importance [69–71].Our institution is passionate about high quality evidence based research and has excelled in various fields ([55,56,72–80]. Periodontal therapies could result in reduction of blood glucose levels thus benefiting the diabetic patients [67,81].

The chronic inflammatory process of periodontitis and the host response causes a hypothetical association between periodontitis and cardiovascular disease [82,83]. Many studies have documented that hypertensive patients had higher prevalence of periodontitis [84–87]. The inflammatory response with periodontitis causes adverse effects on the regulation and control of the blood pressure , indicating that inflammation can be a potential link between hypertension and periodontitis [34]. The periodontal pathogens can destruct and invade gingival tissues by proteolysis and introduces endothelial cell activation which is also involved in the pathogenesis of hypertension [88]. When periodontitis worsens, periodontal inflammation increases the reactive oxygen species into the systemic circulation [89,90]. This oxidative stress which is induced is implicated in hypertension also [34]. Studies suggest that the endothelial dysfunction is reversible after periodontal therapy in hypertensive patients [91,92].

From our present observations the prevalence of diabetes was more among the study population than hypertension. Diabetes is alarmingly gaining the status of a possible epidemic in India having more than 62 million diabetic patients who are currently diagnosed with the disease [93] . In our study, males had a higher prevalence of diabetes when compared to females. Male prevalence of systemic disease was also reported in the study by Danan G et al, 2011[94]. On the contrary, a study by Kapil et al 2018 stated female prevalence of diabetes and hypertension[95]. But recently it has become more apparent that middle aged male have a more significant chance of having diabetes than females in several other populations [96]. The prevalence of gingivitis

and periodontitis was more in the age group of 46 to 60 years,which was consistent with the study done by Bacic in 1998.[97] This could be attributed with to the age changes in the periodontium, along with the untoward effects of diabetes on the collagen metabolism.

The prevalence of gingivitis and periodontitis in hypertension is more in the age group of 46 to 60 years. One major reason for this trend is the patterns of Blood pressure changes and increasing hypertension prevalence with age [98]. Prevalence of gingivitis and periodontitis among patients having both diabetic and hypertension is high among 46 to 60 years.This could be related to the current lifestyle modifications and other environmental risk factors.

The findings from the present study population can have a huge impact on raising awareness on prevalence of gingivitis and periodontitis among diabetic and hypertensive patients. However the current study had a geographic limitation of analysing only the South Indian population. For future scope of the research with larger sample size and inclusion of different ethnicity will provide better results . Further longitudinal and interventional studies can provide deeper knowledge to oral health planners for proposing strategies to help in development of dental health care management.

CONCLUSION

Within the limitations of the study, we found male predilection among both diabetic and hypertensive patients. Gingivitis and Periodontitis was more common in the age group of 46-60 years. Among diabetic patients, 41.26% had gingivitis and 58.74% had periodontitis. There was a higher prevalence of periodontitis (55.07%) than gingivitis (44.93%) in the hypertensive group. Similarly, among the patients who had both diabetes and hypertension , there was a higher prevalence of periodontitis (61.15%) than gingivitis (38.85%).

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CONFLICT OF INTEREST : None declared

AUTHORS CONTRIBUTION

Author 1 (Swetha Ilangovan) carried out the retrospective study by acquisition of the data and performing the necessary statistical analysis and interpretation of the data and drafted the manuscript. Author 2 (Dr. Priya Lochana Gajendran) helped with the conception and the design of the topic and participated in the study design, statistical analysis and supervised the drafting of the article and revised the manuscript critically for important intellectual content. Author 3 (Dr. Geo Mani) participated in the study design and coordinated in the preparation and development of the manuscript. All the authors had made a substantial contribution to the final manuscript and gave the approval for the version to be submitted.

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Received 16 February 2021; Accepted 08 March 2021.

REFERENCES

1. Ramesh A, Ravi S, Kaarthikeyan G. Comprehensive rehabilitation using dental implants in generalized aggressive periodontitis. J Indian Soc Periodontol. 2017 Mar;21(2):160–3.
2. Loe H. Periodontal Disease: The sixth complication of diabetes mellitus [Internet]. Vol. 16, Diabetes Care. 1993. p. 329–34. Available from: http://dx.doi.org/10.2337/diacare.16.1.329
3. Page RC. Gingivitis. J Clin Periodontol. 1986 May;13(5):345–59.
4. Sekino S, Takahashi R, Numabe Y, Okamoto H. Current status of periodontal disease in adults in Takahagi, Japan: a cross-sectional study. BMC Oral Health. 2020 Feb 19;20(1):60.
5. Genco RJ, Borgnakke WS. Risk factors for periodontal disease. Periodontol 2000. 2013 Jun;62(1):59–94.
6. Khalid W, Varghese SS, Sankari M, Jayakumar ND. Comparison of Serum Levels of Endothelin-1 in Chronic Periodontitis Patients Before and After Treatment. J Clin Diagn Res. 2017 Apr;11(4):ZC78–81.
7. Panda S, Jayakumar ND, Sankari M, Varghese SS, Kumar DS. Platelet rich fibrin and xenograft in treatment of intrabony defect. Contemp Clin Dent. 2014 Oct;5(4):550–4.
8. Thamaraiselvan M, Elavarasu S, Thangakumaran S, Gadagi JS, Arthie T. Comparative clinical evaluation of coronally advanced flap with or without platelet rich fibrin membrane in the treatment of isolated gingival recession. J Indian Soc Periodontol. 2015 Jan;19(1):66–71.
9. Varghese SS, Thomas H, Jayakumar ND, Sankari M, Lakshmanan R. Estimation of salivary tumor necrosis factor-alpha in chronic and aggressive periodontitis patients. Contemp Clin Dent. 2015 Sep;6(Suppl 1):S152–6.
10. Ramesh A, Varghese SS, Doraiswamy JN, Malaiappan S. Herbs as an antioxidant arsenal for periodontal diseases. J Intercult Ethnopharmacol. 2016 Jan;5(1):92–6.
11. Ravi S, Malaiappan S, Varghese S, Jayakumar ND, Prakasam G. Additive Effect of Plasma Rich in Growth Factors With Guided Tissue Regeneration in Treatment of Intrabony Defects in Patients With Chronic Periodontitis: A Split-Mouth Randomized Controlled Clinical Trial. J Periodontol. 2017;88(9):839–45.
12. Ramamurthy J, Mg V. COMPARISON OF EFFECT OF HIORA MOUTHWASH VERSUS CHLORHEXIDINE MOUTHWASH IN GINGIVITIS PATIENTS: A CLINICAL TRIAL. Asian J Pharm Clin Res. 2018;11(7):84–8.
13. Priyanka S, Kaarthikeyan G, Nadathur JD, Mohanraj A, Kavarthapu A. Detection of cytomegalovirus, Epstein-Barr virus, and Torque Teno virus in subgingival and atheromatous plaques of cardiac patients with chronic periodontitis. J Indian Soc Periodontol. 2017 Nov;21(6):456–60.
14. Ramesh A, Varghese SS, Jayakumar ND, Malaiappan S. Chronic obstructive pulmonary disease and periodontitis--unwinding their linking mechanisms. J Oral Biosci. 2016;58(1):23–6.
15. Avinash K, Malaippan S, Dooraiswamy JN. Methods of Isolation and Characterization of Stem Cells from Different Regions of Oral Cavity Using Markers: A Systematic Review. Int J Stem Cells. 2017 May 30;10(1):12–20.
16. Kavarthapu A, Thamaraiselvan M. Assessing the variation in course and position of

inferior alveolar nerve among south Indian population: A cone beam computed tomographic study. Indian J Dent Res. 2018 Jul;29(4):405–9.

17. Ramesh A, Vellayappan R, Ravi S, Gurumoorthy K. Esthetic lip repositioning: A cosmetic approach for correction of gummy smile - A case series. J Indian Soc Periodontol. 2019 May;23(3):290–4.

18. Khalid W, Vargheese SS, Lakshmanan R, Sankari M, Jayakumar ND. Role of endothelin-1 in periodontal diseases: A structured review. Indian J Dent Res. 2016 May;27(3):323–33.

19. Mootha A, Malaiappan S, Jayakumar ND, Varghese SS, Toby Thomas J. The Effect of Periodontitis on Expression of Interleukin-21: A Systematic Review. Int J Inflam [Internet]. 2016 Feb 22 [cited 2020 Jun 6];2016. Available from: https://www.hindawi.com/journals/iji/2016/3507503/abs/

20. King RA. The Genetic Basis of Common Diseases. Oxford University Press; 1992. 978 p.

21. Pradhan R, Dinesh Kumar B, Mitra A. Some Salient Points in Type 2 Diabetes Prevalence in Rural Bengal [Internet]. Vol. 3, Studies on Ethno-Medicine. 2009. p. 127–31. Available from: http://dx.doi.org/10.1080/09735070.2009.11886349

22. Joshi SR, Parikh RM. India; the diabetes capital of the world: Now heading towards hypertension. Journal-Association of Physicians of India. 2007;55(Y):323.

23. Expert Committee on the Diagnosis and Classification of Diabetes Mellitus. Report of the expert committee on the diagnosis and classification of diabetes mellitus. Diabetes Care. 2003 Jan;26 Suppl 1:S5–20.

24. Borgnakke WS. IDF Diabetes Atlas: Diabetes and oral health – A two-way relationship of clinical importance [Internet]. Vol. 157, Diabetes Research and Clinical Practice. 2019. p. 107839. Available from: http://dx.doi.org/10.1016/j.diabres.2019.107839

25. Falk H, Hugoson A, Thorstensson H. Number of teeth, prevalence of caries and periapical lesions in insulin-dependent diabetics. Scand J Dent Res. 1989 Jun;97(3):198–206.

26. Gandara BK, Morton TH. Non-Periodontal Oral Manifestations of Diabetes: A Framework for Medical Care Providers [Internet]. Vol. 24, Diabetes Spectrum. 2011. p. 199–205. Available from: http://dx.doi.org/10.2337/diaspect.24.4.199

27. Ebersole JL, Holt SC, Hansard R, Novak MJ. Microbiologic and immunologic characteristics of periodontal disease in Hispanic americans with type 2 diabetes. J Periodontol. 2008 Apr;79(4):637–46.

28. Southerland JH, Taylor GW, Offenbacher S. Diabetes and periodontal infection: making the connection. Clin Diabetes. 2005;23:171+.

29. Lalla E, Kaplan S, Chang S-MJ, Roth GA, Celenti R, Hinckley K, et al. Periodontal infection profiles in type 1 diabetes. J Clin Periodontol. 2006 Dec;33(12):855–62.

30. Shah A, Afzal M. Prevalence of diabetes and hypertension and association with various risk factors among different Muslim populations of Manipur, India. J Diabetes Metab Disord. 2013 Dec 19;12(1):52.

31. Chobanian AV, Bakris GL, Black HR, Cushman WC, Green LA, Izzo JL Jr, et al. The Seventh Report of the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure: the JNC 7 report. JAMA. 2003 May 21;289(19):2560–72.
32. Grassos C, Gourlis D, Papaspyropoulos A, Spyropoulos A, Kranidis A, Almagout P, et al. ASSOCIATION OF SEVERITY OF HYPERTENSION AND PERIODONTITIS: PP.20.296. J Hypertens. 2010 Jun;28:e335.
33. Macedo Paizan ML, Vilela-Martin JF. Is there an association between periodontitis and hypertension? Curr Cardiol Rev. 2014 Nov;10(4):355–61.
34. Leong X-F, Ng C-Y, Badiah B, Das S. Association between hypertension and periodontitis: possible mechanisms. ScientificWorldJournal. 2014 Jan 8;2014:768237.
35. Shaju JP, Zade RM, Das M. Prevalence of periodontitis in the Indian population: A literature review. J Indian Soc Periodontol. 2011 Jan;15(1):29–34.
36. Edman K, Öhrn K, Nordström B, Holmlund A, Hellberg D. Trends over 30 years in the prevalence and severity of alveolar bone loss and the influence of smoking and socio-economic factors--based on epidemiological surveys in Sweden 1983-2013. Int J Dent Hyg. 2015 Nov;13(4):283–91.
37. Holtfreter B, Schützhold S, Kocher T. Is Periodontitis Prevalence Declining? A Review of the Current Literature. Current Oral Health Reports. 2014 Dec 1;1(4):251–61.
38. Al Qahtani NA, Joseph B, Deepthi A, Vijayakumari BK. Prevalence of chronic periodontitis and its risk determinants among female patients in the Aseer Region of KSA. J Taibah Univ Med Sci. 2017 Jun;12(3):241–8.
39. Subramanyam D, Gurunathan D, Gaayathri R, Vishnu Priya V. Comparative evaluation of salivary malondialdehyde levels as a marker of lipid peroxidation in early childhood caries. Eur J Dent. 2018 Jan;12(1):67–70.
40. Panchal V, Jeevanandan G, Subramanian E. Comparison of instrumentation time and obturation quality between hand K-file, H-files, and rotary Kedo-S in root canal treatment of primary teeth: A randomized controlled trial. J Indian Soc Pedod Prev Dent. 2019 Jan;37(1):75–9.
41. Rajeshkumar S, Kumar SV, Ramaiah A, Agarwal H, Lakshmi T, Roopan SM. Biosynthesis of zinc oxide nanoparticles usingMangifera indica leaves and evaluation of their antioxidant and cytotoxic properties in lung cancer (A549) cells. Enzyme Microb Technol. 2018 Oct;117:91–5.
42. Abhinav RP, Selvarasu K, Maheswari GU, Taltia AA. The Patterns and Etiology of Maxillofacial Trauma in South India. Ann Maxillofac Surg. 2019 Jan;9(1):114–7.
43. Marimuthu M, Andiappan M, Wahab A, Muthusekhar MR, Balakrishnan A, Shanmugam S. Canonical Wnt pathway gene expression and their clinical correlation in oral squamous cell carcinoma. Indian J Dent Res. 2018 May;29(3):291–7.
44. Sweta VR, Abhinav RP, Ramesh A. Role of virtual reality in pain perception of patients following the administration of local anesthesia. Ann Maxillofac Surg. 2019 Jan;9(1):110–3.
45. Felicita AS. Orthodontic extrusion of Ellis Class VIII fracture of maxillary lateral incisor

- The sling shot method. Saudi Dent J. 2018 Jul;30(3):265–9.
46. Rao TD, Kumar MPS. Analgesic efficacy of paracetamol vs ketorolac after dental extractions. J Adv Pharm Technol Res. 2018;11(8):3375.
47. Fluoride, fluoridated toothpaste efficacy and its safety in children - review. Int J Pharm Res [Internet]. 2018 Oct 1;10(04). Available from: http://www.ijpronline.com/ViewArticleDetail.aspx?ID=7041
48. 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 May;29(4):276–90.
49. Paramasivam A, Vijayashree Priyadharsini J, Raghunandhakumar S. N6-adenosine methylation (m6A): a promising new molecular target in hypertension and cardiovascular diseases. Hypertens Res. 2020 Feb;43(2):153–4.
50. Mehta M, Deeksha, Tewari D, Gupta G, Awasthi R, Singh H, et al. Oligonucleotide therapy: An emerging focus area for drug delivery in chronic inflammatory respiratory diseases. Chem Biol Interact. 2019 Aug 1;308:206–15.
51. Padavala S, Sukumaran G. Molar Incisor Hypomineralization and Its Prevalence. Contemp Clin Dent. 2018 Sep;9(Suppl 2):S246–50.
52. Pandian KS, Krishnan S, Kumar SA. Angular photogrammetric analysis of the soft-tissue facial profile of Indian adults. Indian J Dent Res. 2018 Mar;29(2):137–43.
53. Nair M, Jeevanandan G, R V, Emg S. Comparative evaluation of post-operative pain after pulpectomy with k-files, kedo-s files and mtwo files in deciduous molars -a randomized clinical trial. Braz Dent Sci. 2018 Oct 24;21(4):411.
54. Ke Y, Al Aboody MS, Alturaiki W, Alsagaby SA, Alfaiz FA, Veeraraghavan VP, et al. Photosynthesized gold nanoparticles from Catharanthus roseus induces caspase-mediated apoptosis in cervical cancer cells (HeLa). Artif Cells Nanomed Biotechnol. 2019 Dec;47(1):1938–46.
55. 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 Apr;48(4):299–306.
56. Vijayashree Priyadharsini J, Smiline Girija AS, Paramasivam A. In silico analysis of virulence genes in an emerging dental pathogen A. baumannii and related species. Arch Oral Biol. 2018 Oct;94:93–8.
57. Krishnan RP, Ramani P, Sherlin HJ, Sukumaran G, Ramasubramanian A, Jayaraj G, et al. Surgical Specimen Handover from Operation Theater to Laboratory: A Survey. Ann Maxillofac Surg. 2018 Jul;8(2):234–8.
58. Ezhilarasan D. Oxidative stress is bane in chronic liver diseases: Clinical and experimental perspective. Arab J Gastroenterol. 2018 Jun;19(2):56–64.
59. Palati S, Ramani P, Shrelin HJ, Sukumaran G, Ramasubramanian A, Don KR, et al. Knowledge, Attitude and practice survey on the perspective of oral lesions and dental health in

geriatric patients residing in old age homes. Indian J Dent Res. 2020 Jan;31(1):22–5.
60. 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 Dec;47(1):3297–305.
61. Bali RK, Mathur VB, Talwar PP, Chanana HB. National oral health survey and fluoride mapping 2002-2003, India. 2004; Available from: https://www.scienceopen.com/document?vid=15faaccb-cbe2-43d8-b8f6-48da7a311b5d
62. Eke PI, Dye BA, Wei L, Thornton-Evans GO, Genco RJ. Prevalence of Periodontitis in Adults in the United States: 2009 and 2010 [Internet]. Vol. 91, Journal of Dental Research. 2012. p. 914–20. Available from: http://dx.doi.org/10.1177/0022034512457373
63. Taylor GW. Bidirectional interrelationships between diabetes and periodontal diseases: an epidemiologic perspective. Ann Periodontol. 2001 Dec;6(1):99–112.
64. Chee B, Park B, Bartold PM. Periodontitis and type II diabetes: a two-way relationship. Int J Evid Based Healthc. 2013 Dec;11(4):317–29.
65. Manouchehr-Pour M, Spagnuolo PJ, Rodman HM, Bissada NF. Impaired neutrophil chemotaxis in diabetic patients with severe periodontitis. J Dent Res. 1981 Mar;60(3):729–30.
66. Graves DT, Liu R, Alikhani M, Al-Mashat H, Trackman PC. Diabetes-enhanced inflammation and apoptosis--impact on periodontal pathology. J Dent Res. 2006 Jan;85(1):15–21.
67. Sharma M, Jindal R, Siddiqui MA, Wangnoo SK. Diabetes and Periodontitis: A medical perspective. Journal of the International Clinical Dental Research Organization. 2016 Jan 1;8(1):3.
68. Preshaw PM, Foster N, Taylor JJ. Cross-susceptibility between periodontal disease and type 2 diabetes mellitus: an immunobiological perspective. Periodontol 2000. 2007;45:138–57.
69. Khader YS, Dauod AS, El-Qaderi SS, Alkafajei A, Batayha WQ. Periodontal status of diabetics compared with nondiabetics: a meta-analysis. J Diabetes Complications. 2006 Jan;20(1):59–68.
70. Chávarry NGM, Vettore MV, Sansone C, Sheiham A. The relationship between diabetes mellitus and destructive periodontal disease: a meta-analysis. Oral Health Prev Dent. 2009;7(2):107–27.
71. Salvi GE, Carollo-Bittel B, Lang NP. Effects of diabetes mellitus on periodontal and peri-implant conditions: update on associations and risks. J Clin Periodontol. 2008 Sep;35(8 Suppl):398–409.
72. Vijayashree Priyadharsini J. In silico validation of the non-antibiotic drugs acetaminophen and ibuprofen as antibacterial agents against red complex pathogens. J Periodontol. 2019 Dec;90(12):1441–8.
73. 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 [Internet]. 2018; Available from: https://europepmc.org/article/med/29624863
74. 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 Oct;89(10):1241–8.

75. 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 Sep;23(9):3543–50.

76. 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 Feb;48(2):115–21.

77. 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;1–6.

78. Samuel SR. Can 5-year-olds sensibly self-report the impact of developmental enamel defects on their quality of life? Int J Paediatr Dent. 2021 Mar;31(2):285–6.

79. R H, Hannah R, Ramani P, Ramanathan A, R JM, Gheena S, et al. CYP2 C9 polymorphism among patients with oral squamous cell carcinoma and its role in altering the metabolism of benzo[a]pyrene [Internet]. Vol. 130, Oral Surgery, Oral Medicine, Oral Pathology and Oral Radiology. 2020. p. 306–12. Available from: http://dx.doi.org/10.1016/j.oooo.2020.06.021

80. Chandrasekar R, Chandrasekhar S, Sundari KKS, Ravi P. Development and validation of a formula for objective assessment of cervical vertebral bone age. Prog Orthod. 2020 Oct 12;21(1):38.

81. Preshaw PM, Alba AL, Herrera D, Jepsen S, Konstantinidis A, Makrilakis K, et al. Periodontitis and diabetes: a two-way relationship. Diabetologia. 2012 Jan;55(1):21–31.

82. Humphrey LL, Fu R, Buckley DI, Freeman M, Helfand M. Periodontal disease and coronary heart disease incidence: a systematic review and meta-analysis. J Gen Intern Med. 2008 Dec;23(12):2079–86.

83. Zamirian M, Others. Relationship between periodontal disease and acute myocardial infarction. icrj [Internet]. 2008; Available from: https://www.researchgate.net/profile/Razieh_Javanmardi2/publication/45796489_Relationship_Between_Periodontal_Disease_and_Acute_Myocardial_Infarction/links/546610370cf25b85d17f5546.pdf

84. Wakai K, Kawamura T, Umemura O, Hara Y, Machida J, Anno T, et al. Associations of medical status and physical fitness with periodontal disease. J Clin Periodontol. 1999 Oct;26(10):664–72.

85. Gołębiewska M, Taraszkiewicz-Sulik K, Kuklińska A, Musiał WJ. Periodontal condition in patients with cardiovascular diseases. Adv Med Sci. 2006;51 Suppl 1:69–72.

86. Holmlund A, Holm G, Lind L. Severity of Periodontal Disease and Number of Remaining Teeth Are Related to the Prevalence of Myocardial Infarction and Hypertension in a Study Based on 4,254 Subjects [Internet]. Vol. 77, Journal of Periodontology. 2006. p. 1173–8. Available from: http://dx.doi.org/10.1902/jop.2006.050233

87. Engström S, Gahnberg L, Högberg H, Svärdsudd K. Association between high blood pressure and deep periodontal pockets: a nested case-referent study. Ups J Med Sci. 2007;112(1):95–103.
88. Assinger A, Buchberger E, Laky M, Esfandeyari A, Brostjan C, Volf I. Periodontopathogens induce soluble P-selectin release by endothelial cells and platelets. Thromb Res. 2011 Jan;127(1):e20–6.
89. Sobaniec H, Sobaniec-Lotowska ME. Morphological examinations of hard tissues of paradontium and evaluation of selected processes of lipid peroxidation in blood serum of rats in the course of experimental periodontitis. Med Sci Monit. 2000;6(5):875–81.
90. Tomofuji T, Ekuni D, Yamanaka R, Kusano H, Azuma T, Sanbe T, et al. Chronic administration of lipopolysaccharide and proteases induces periodontal inflammation and hepatic steatosis in rats. J Periodontol. 2007 Oct;78(10):1999–2006.
91. Vidal F, Cordovil I, Figueredo CMS, Fischer RG. Non-surgical periodontal treatment reduces cardiovascular risk in refractory hypertensive patients: a pilot study. J Clin Periodontol. 2013 Jul;40(7):681–7.
92. Elter JR, Hinderliter AL, Offenbacher S, Beck JD, Caughey M, Brodala N, et al. The effects of periodontal therapy on vascular endothelial function: a pilot trial. Am Heart J. 2006 Jan;151(1):47.
93. Kumar A, Goel MK, Jain RB, Khanna P, Chaudhary V. India towards diabetes control: Key issues. Australas Med J. 2013 Oct 31;6(10):524–31.
94. Danaei G, Finucane MM, Lu Y, Singh GM, Cowan MJ, Paciorek CJ, et al. National, regional, and global trends in fasting plasma glucose and diabetes prevalence since 1980: systematic analysis of health examination surveys and epidemiological studies with 370 country-years and 2\textperiodcentered 7 million participants. Lancet. 2011;378(9785):31–40.
95. Kapil U, Khandelwal R, Ramakrishnan L, Khenduja P, Gupta A, Pandey RM, et al. Prevalence of hypertension, diabetes, and associated risk factors among geriatric population living in a high-altitude region of rural Uttarakhand, India. J Family Med Prim Care. 2018 Nov;7(6):1527–36.
96. Herman WH, Taylor GW, Jacobson JJ, Burke R, Brown MB. Screening for prediabetes and type 2 diabetes in dental offices. J Public Health Dent. 2015 Feb 6;75(3):175–82.
97. Bacić M, Plancak D, Granić M. CPITN assessment of periodontal disease in diabetic patients. J Periodontol. 1988 Dec;59(12):816–22.
98. Kearney PM, Whelton M, Reynolds K, Muntner P, Whelton PK, He J. Global burden of hypertension: analysis of worldwide data. Lancet. 2005;365(9455):217–23.

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TABLES:

Table 1: Table representing the Gender Distribution among Gingivitis and Periodontitis patients.

Gender	Gingivitis	Periodontitis
Male	640 (53.69%)	990 (59.43%)
Female	552 (46.31%)	675 (40.52%)
Transgender	-	1 (0.06%)
Total	1192	1666

FIGURES LEGENDS

Figure 1: Pie chart showing the gender distribution among all the patients in the study

Figure 2: Bar graph showing the distribution of different age groups among all the gingivitis patients

Figure 3: Bar graph showing the distribution of different age groups among all the periodontitis patients

Figure 4: Pie chart showing the systemic status of the patients in the study population.

Figure 5: Bar graph showing the male and female prevalence of the gingivitis patients with the medical status

Figure 6: Bar graph showing the male and female prevalence of the periodontitis patients with the medical status

Figure 7: Bar graph showing the distribution of different age groups among the diabetic patients with gingivitis

Figure 8: Bar graph showing the distribution of different age groups among the diabetic patients with periodontitis

Figure 9: Bar graph showing the distribution of different age groups among the hypertensive patients with gingivitis.

Figure 10: Bar graph showing the distribution of different age groups among the hypertensive patients with periodontitis

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Figure 11: Bar graph showing the distribution of different age groups among the patients with both diabetes and hypertension with gingivitis

Figure 12: Bar graph showing the distribution of different age groups among the patients with both diabetes and hypertension with periodontitis

FIGURES

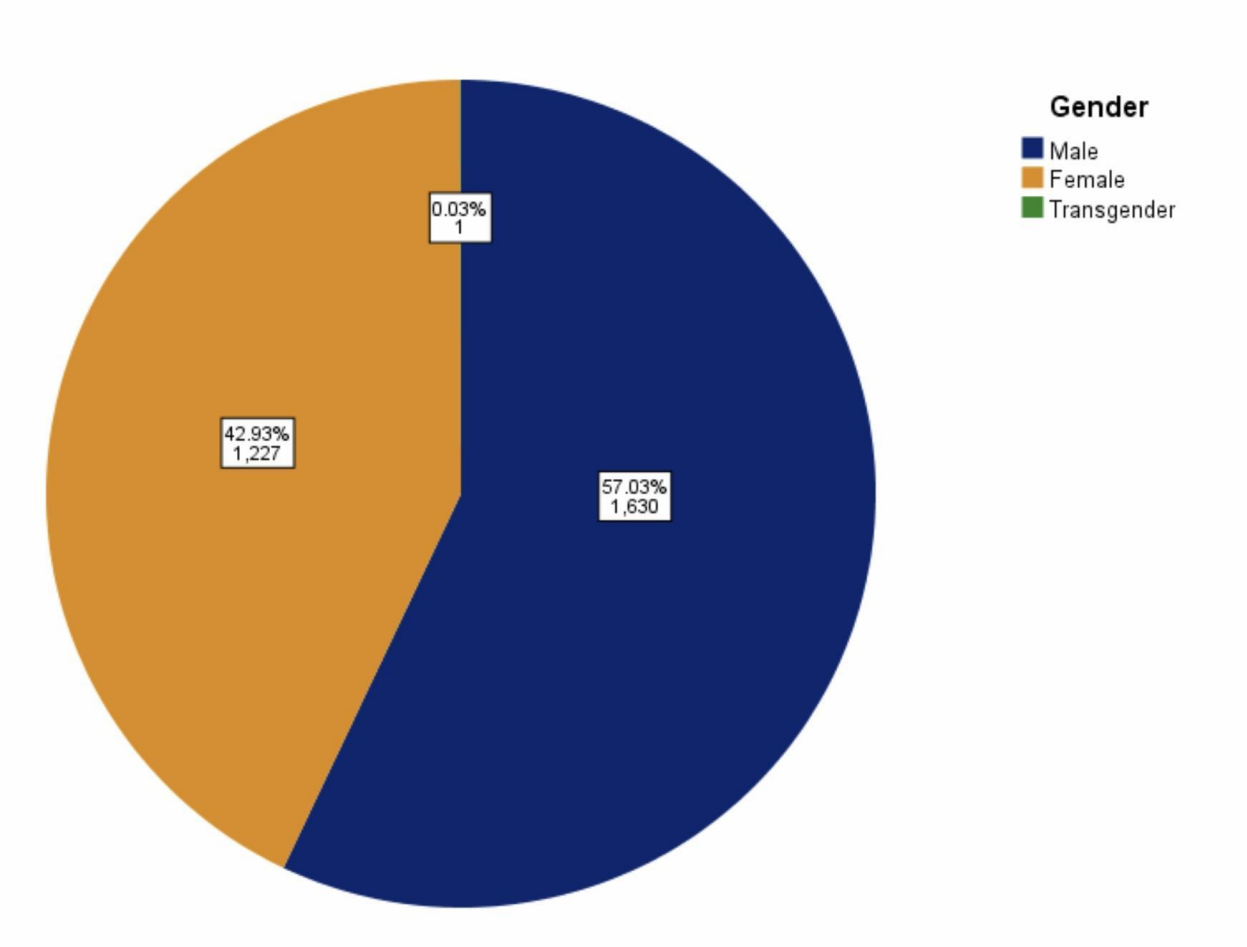

Figure 1: This pie chart shows the distribution of study subjects based on gender. Dark blue colour represents the male patients, yellow represents the female patients and dark green represents the trangender patients. Among the study participants males formed the majority

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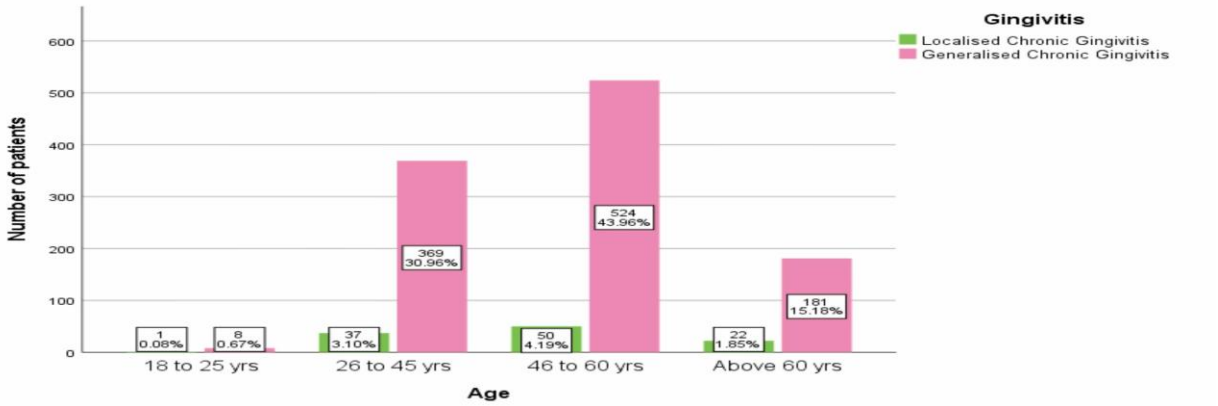

Figure 2: This bar graph represents the association between the age distribution and gingivitis among the patients, where the x axis denotes the age distribution and the y axis denotes the number of patients with gingivitis. The green colour denotes the localized chronic gingivitis patients and pink colour represents generalized chronic gingivitis. Chi square test was done and the association between age groups and the type of gingivitis, was found to be statistically significant with p value of 0.001 (p value <0.05). There were a higher number of patients in the 46 to 60 years age group among the gingivitis patients when compared to the others.

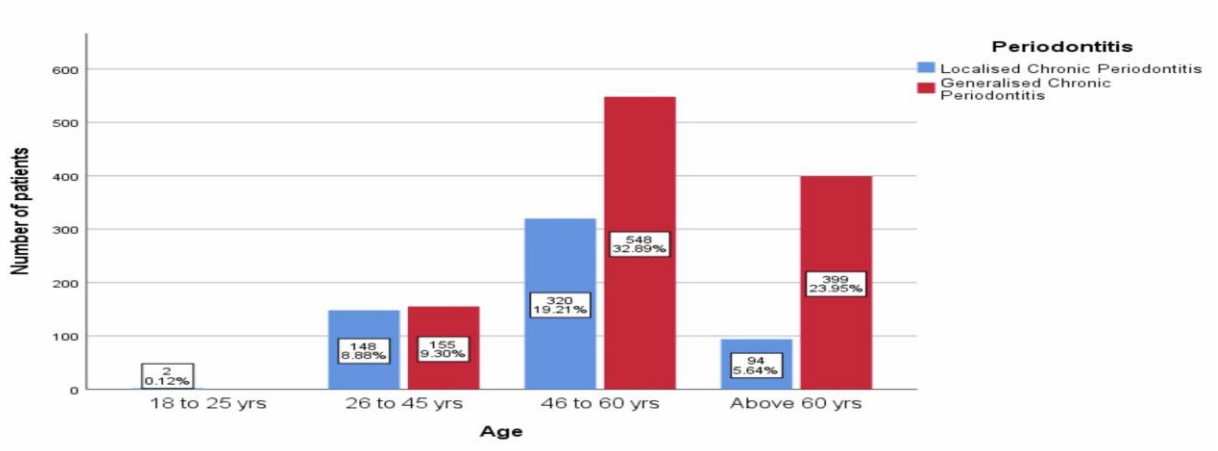

Figure 3: This bar graph represents the association between the age distribution and periodontitis among the patients, where the x axis denotes the age distribution and the y axis denotes the number of patients with periodontitis. The blue colour denotes the localized chronic periodontitis patients and red colour represents generalized chronic periodontitis. Chi square test was done and the association between age groups and periodontitis was found to be statistically significant with a p value of 0.001 (p value <0.05). Patients in the age group of 46 to 60 years predominantly had periodontitis when compared to the other age groups.

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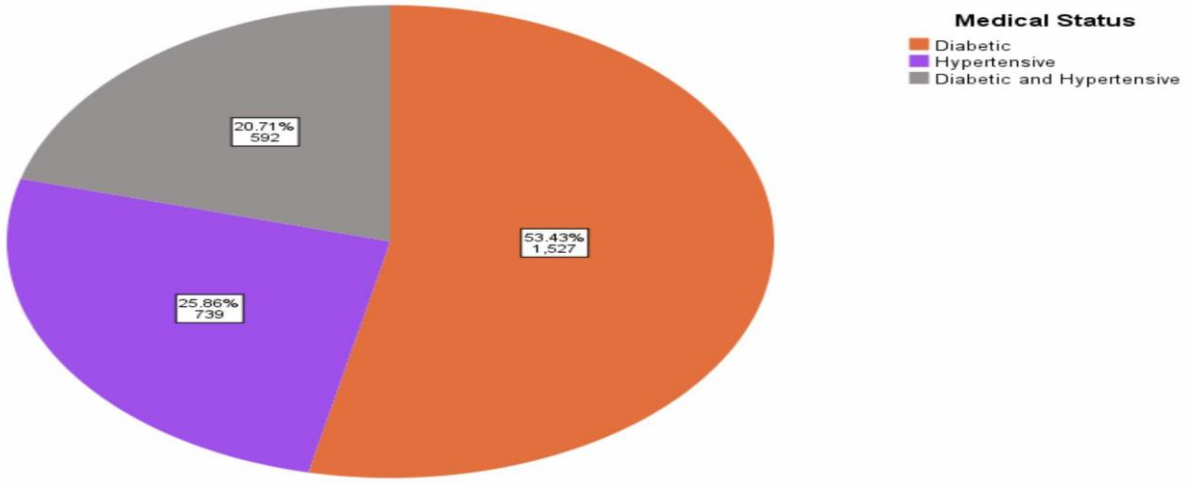

Figure 4: This pie chart represents the medical status count among all the patients. The orange colour represents diabetic patients, purple colour represents hypertensive patients and grey colour represents patients with both diabetes and hypertension. There were 1527 diabetic patients, 739 hypertensive patients and 592 patients who had both diabetes and hypertension . There were higher number diabetic patients in the study population than hypertensive patients.

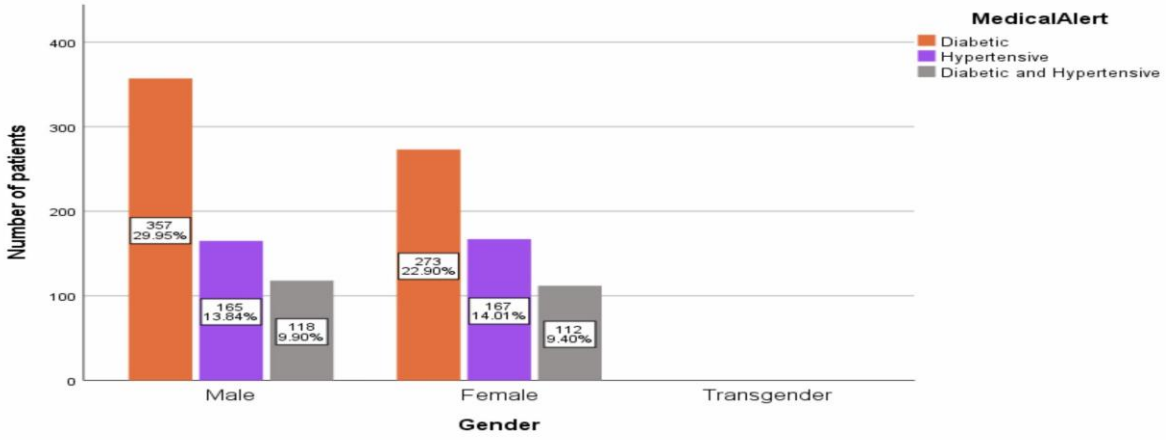

Figure 5: This bar graph represents the relationship between the gender distribution and the systemic status of the gingivitis patients , where the x axis denotes the medical status and the y axis denotes the gender distribution across the scale of number of patients with gingivitis. The orange colour represents diabetic patients, purple colour represents hypertensive patients and grey colour represents patients with both diabetes and hypertension. Chi square test was done and the association between gender and systemic status of gingivitis patients was found to be statistically significant and with p value of 0.001 (p value <0.05). There was a majority of male patients with diabetes among the gingivitis patients when compared to females.

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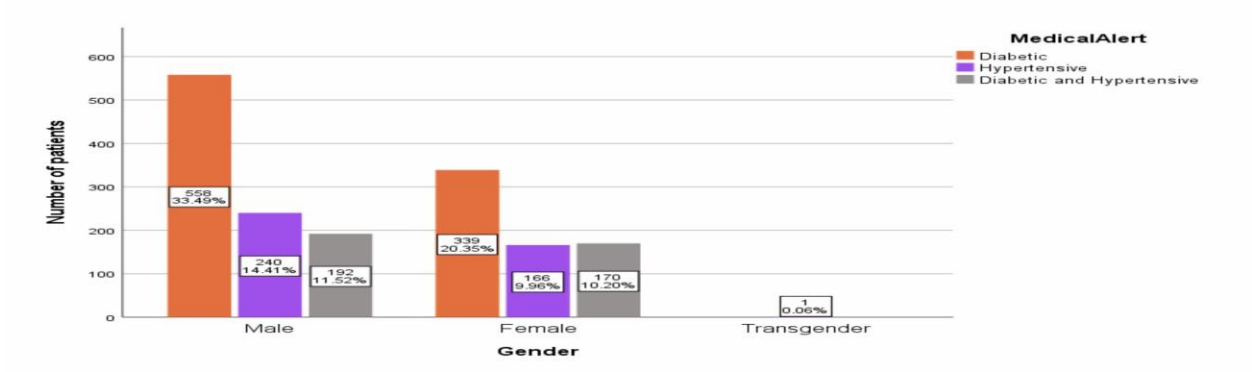

Figure 6: This bar graph represents the relationship between the gender distribution and the systemic status of the periodontitis patients , where the x axis denotes the systemic status and the y axis denotes the number of patients with periodontitis. The orange colour represents diabetic patients, purple colour represents hypertensive patients and grey colour represents patients with both diabetes and hypertension. Chi square test was done and the association between gender and medical status of periodontitis patients was found to be statistically significant and with p value of 0.016 (p value <0.05). There was a majority of male patients with diabetes among the periodontitis patients when compared to the other groups.

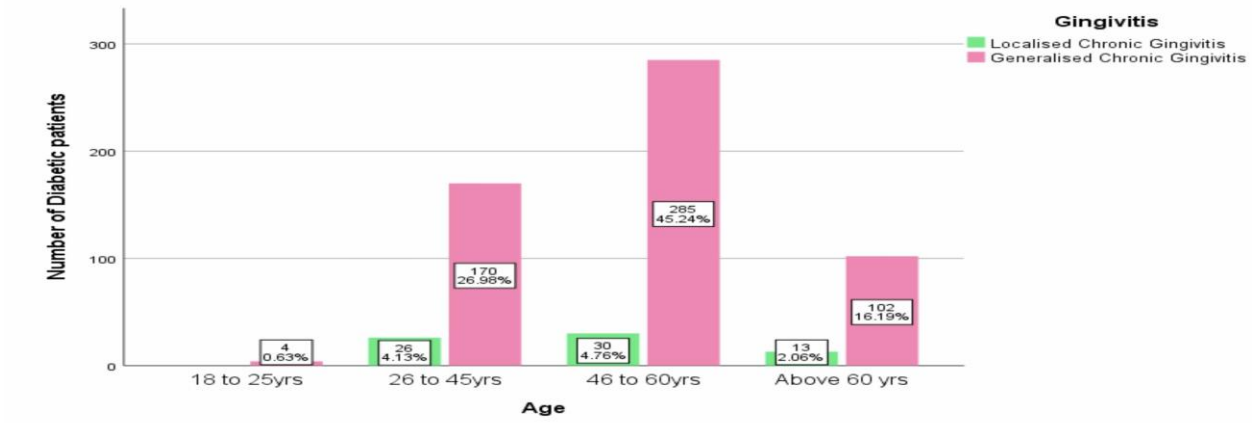

Figure 7: This bar graph represents the association between the age distribution and gingivitis among the diabetic patients, where the x axis denotes the age distribution and y axis denotes the number of patients with gingivitis. The green colour represents the localized chronic gingivitis patients and pink colour represents generalized chronic gingivitis. Chi square test was done and the association between age groups and gingivitis among diabetic patients was found to be statistically significant and with p value of 0.001 (p value <0.05). There were more patients of age 46 to 60 years with gingivitis among the diabetic patients when compared to the others.

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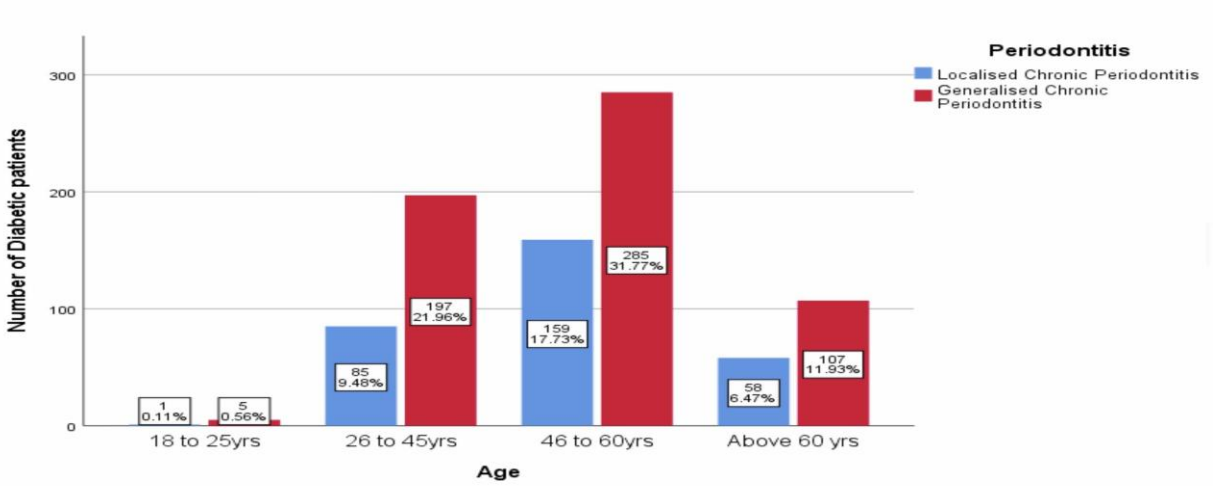

Figure 8: This bar graph represents the association between the age distribution and periodontitis among the diabetic patients, where the x axis denotes the age distribution and y axis denotes the number of periodontitis patients. The blue colour represents the localized chronic periodontitis patients and red colour represents generalized chronic periodontitis. Chi square test was done and the association between age groups and periodontitis among diabetic patients was found to be statistically significant and with p value of 0.001 (p value <0.05). There were more patients of age 46 to 60 years with periodontitis among the diabetic patients when compared to the others.

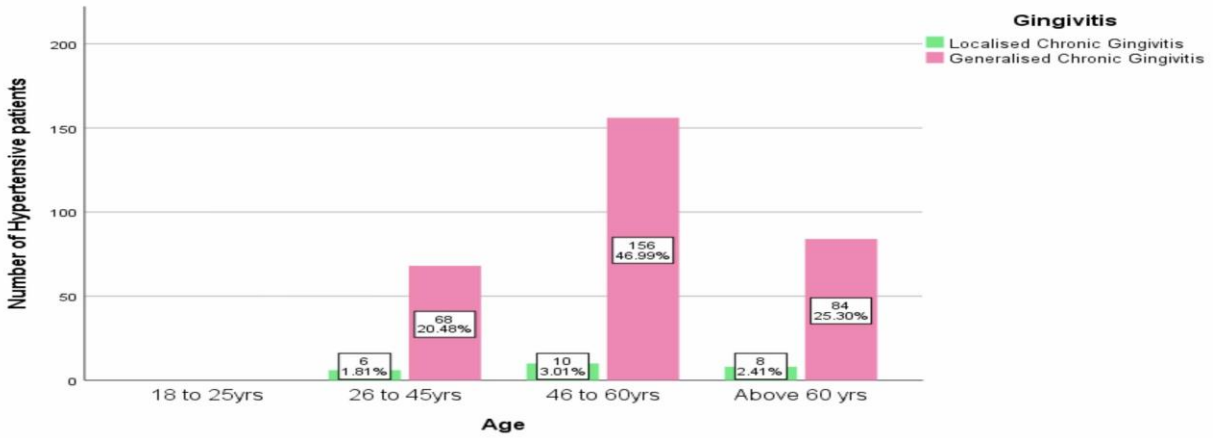

Figure 9: This bar graph represents the association between the age distribution and gingivitis among the hypertensive patients, where the x axis denotes the age distribution and y axis denotes the number of gingivitis patients.The green colour represents the localized chronic gingivitis patients and pink colour represents generalized chronic gingivitis. Chi square test was done and the association between age groups and gingivitis among hypertensive patients was found to be statistically significant, with p value of 0.001 (p value <0.05). There were more patients of age 46 to 60 years had gingivitis among the hypertensive patients when compared to the others.

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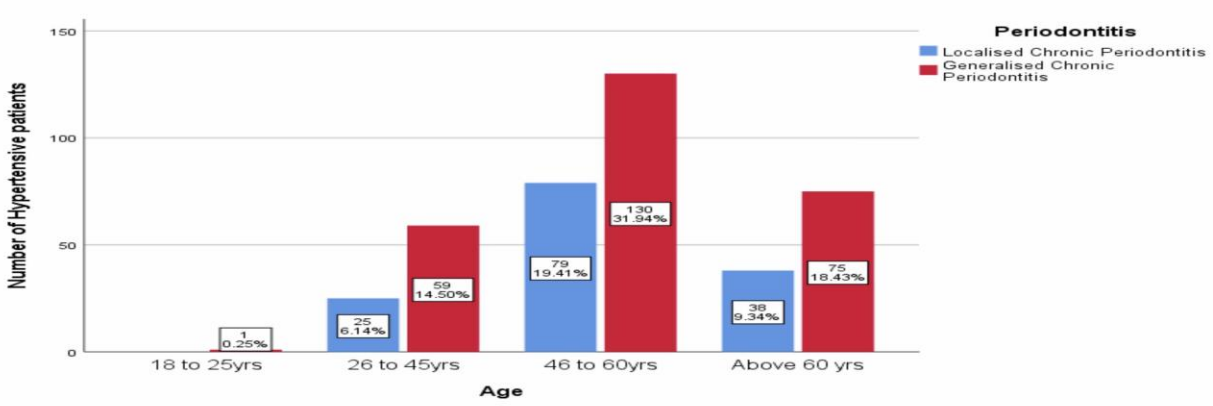

Figure 10: This bar graph represents the association between the age distribution and periodontitis among patients with hypertension, where the x axis denotes the age distribution and y axis denotes the number of periodontitis patients.The blue colour represents the localized chronic periodontitis patients and red colour represents generalized chronic periodontitis. Chi square test was done and the association between age groups and periodontitis among hypertensive patients was found to be statistically significant and with p value of 0.001 (p value <0.05). Patients in the age group of 46 to 60 years had more periodontitis among hypertensive patients when compared with the other age groups.

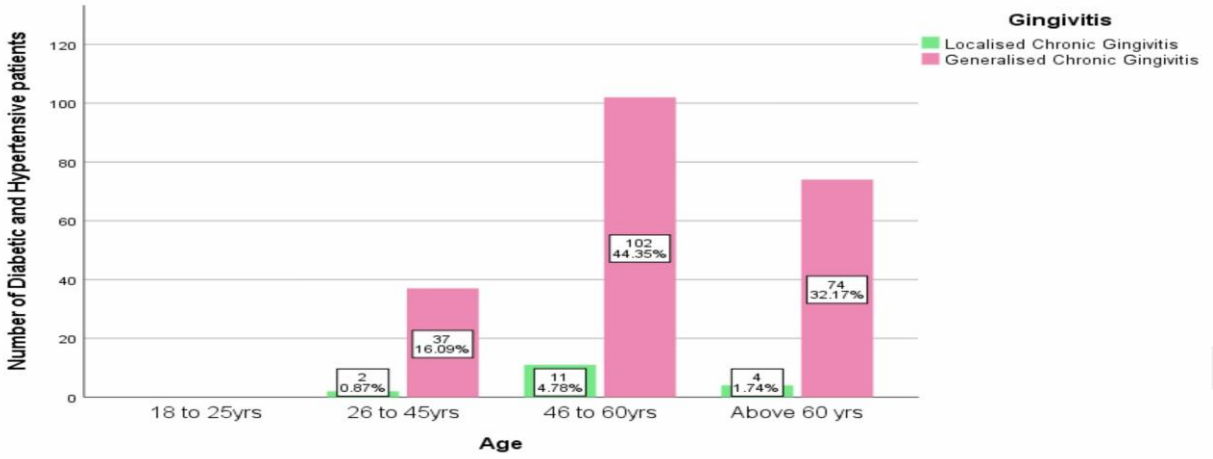

Figure 11: This bar graph represents the association between the age distribution and gingivitis among patients with both diabetes and hypertension, where the x axis denotes the age distribution and y axis denotes the number of gingivitis patients.The green colour represents the localized chronic gingivitis patients and pink colour represents generalized chronic gingivitis. Chi square test was done and the association between age groups and gingivitis among diabetic and hypertensive patients was found to be statistically significant and with p value of 0.001 (p value <0.05). Majority of patients who had gingivitis among patients with both diabetes and hypertension belonged to the age group of 46 to 60 years.

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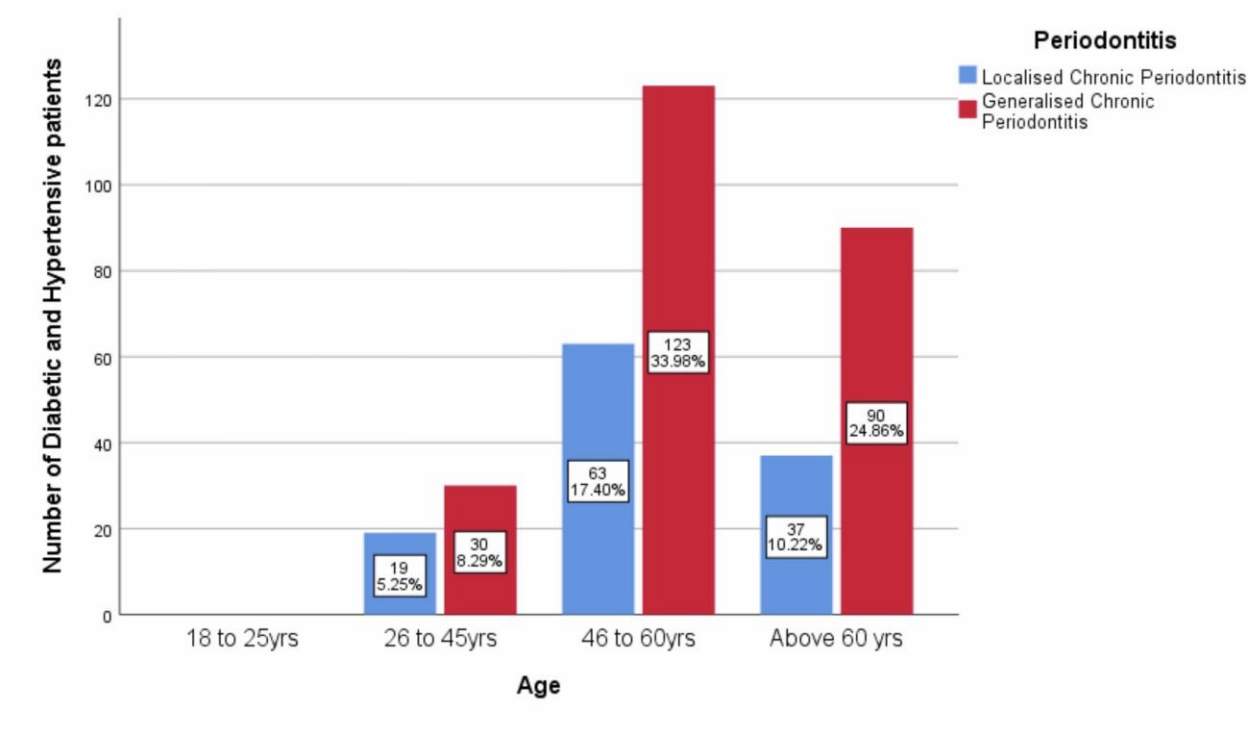

Figure 12: This bar graph represents the association between the age distribution and periodontitis among patients with both diabetes and hypertension, where the x axis denotes the age distribution and y axis denotes the number of periodontitis patients.The blue colour represents the localized chronic periodontitis patients and red colour represents generalized chronic periodontitis. Chi square test was done and the association between age groups and periodontitis among diabetic and hypertensive patients was found to be statistically significant and with p value of 0.001 (p value <0.05). Majority of patients who had periodontitis among patients with both diabetes and hypertension belonged to the age group of 46 to 60 years.