Assessment of periodontal health among patients with diabetes mellitus: a retrospective study

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Abstract: Periodontitis, dental caries and oral cancer are among the most common dental diseases affecting people globally. Periodontitis has been identified as the sixth complication of diabetes, in which diabetic patients are more susceptible to develop periodontal disease thrice as often as non-diabetic patients. The risk of periodontitis increases in people with poorly controlled diabetes. The aim of this study was to assess the periodontal health among patients with diabetes mellitus. This retrospective study was conducted from June 2019-March 2020 among patients with diabetes mellitus. A total of 200 patients with diabetes were enrolled. Data regarding the periodontal status of the patients were collected from their records and analysis was carried out using IBM Statistical Package for Social Science (SPSS version 23). Descriptive statistics (frequency distribution and percentage) and inferential statistics (chi-square test) were done. In the present study, out of 200 diabetic patients, 116 patients had gingivitis and 84 patients had periodontitis. Prevalence of both gingivitis and periodontitis was higher among patients within the age group of 45-54 years. Also, prevalence of both gingivitis and periodontitis was higher in males than females. Association between age and periodontal status was found to be statistically significant with the p value of 0.04. The present study showed the prevalence of gingivitis and periodontitis among diabetic patients was 58% and 42% respectively.

Keywords: Diabetes; Periodontal Disease; Periodontitis; Prevalence; Risk Factors innovative technique

INTRODUCTION

Periodontitis is a bacterially induced inflammatory disease involving supporting tissue and teeth structures. It is caused by a specific microorganism, leading to the destruction of periodontal ligament and alveolar bone. Periodontal disease begins as inflammation in the gingival tissues and may cause periodontitis where it progressively disrupts the connective tissue attachment and alveolar bone (Lalla *et al.*, 2008);(Thamaraiselvan *et al.*, 2015). However, the etiological factors of periodontitis are multifactorial. Earliest experimental and histopathologic studies proved that trauma from occlusion can cause pathologic disturbance in the periodontium. The occlusal forces transmitted to the periodontium clearly cause physiologic and pathologic changes to the periodontal structures (Sanadi *et al.*, 2016).

Periodontitis has been associated with a number of other systemic diseases namely, respiratory disease, chronic kidney disease, chronic pulmonary obstructive disease and diabetes mellitus (Ramesh, Sheeja S. Varghese, *et al.*, 2016). Diabetes is one of the most prevalent diseases in the nation and the sixth complication of diabetes is periodontitis. According to the World Health Organization (WHO), more than 10% of the civilizations are expected with diabetes by 2030 (Wild *et al.*, 2004). Historically, periodontitis and diabetes mellitus are the inflammatory diseases that have the capacity to influence clinical outcomes of each other (Ramesh, Sheeja Saji Varghese, *et al.*, 2016). Evidence showed that periodontal diseases are common in diabetes groups and the prevalence increases when glycemic index is uncontrolled (Chee, Park and Bartold, 2013);(Varghese *et al.*, 2015). A survey from National Health and Nutrition Examination lll has confirmed a significant prevalence of periodontal disease in patients of diabetes (17.3%) than non-diabetics (9%) . In addition to this, the prevalence of

diabetes found in periodontitis patients was almost double than that observed in patients without periodontitis (Thorstensson and Hugoson, 1993);(Avinash, Malaippan and Dooraiswamy, 2017);(Khalid *et al.*, 2016).

In the previous history, there have been many speculations regarding the higher prevalence of periodontal problems in diabetic patients and *vice versa* (Chee, Park and Bartold, 2013);(Ravi *et al.*, 2017). The comorbidities associated with the systemic inflammation are possibly having an impression on diabetes control and its complications (Priyanka *et al.*, 2017);(Ramamurthy J And, 2008). The pathogenic bacterial products are able to systemic effects and local cytotoxic effects at the periodontium. These responses are initiated by the secretion of host-derived mediators of inflammation and tissue breakdown, which lead to breakdown of collagen fibers of the periodontal ligament (Mootha *et al.*, 2016). Ultimately, the periodontal pocket occurs and it deepens as further tissue destruction and bone resorption progresses. Condition of hyperglycemia will increase both proliferation of bacteria and cytokines released in the oral cavity (Panda *et al.*, 2014). Also, elevated exposure of collagen fibers to aldose sugars result in reduced collagen solubility. Hence, more accelerated degradation of connective tissues happens (Khalid *et al.*, 2017).

Historically, there is an established bidirectional relationship between diabetes and periodontitis. The hyperglycemic condition of diabetes has always been profound in causing periodontal problems. Inflammation-mediated oxidative-stress pathways and advanced glycation end products (AGEs)-receptor for AGEs (RAGE) interactions may explain the interconnection of periodontitis to diabetes (Kavarthapu and Thamaraiselvan, 2018). Periodontitis may cause systemic inflammation by means of periodontal organisms and virulence factors enter into the circulation through oral cavity (Ramesh, Ravi and Kaarthikeyan, 2017). Since the periodontal tissue is highly vascular, it may serve as a gateway for systemic circulation of bacterial products of any inflammation. The local inflammatory mediators and infectious products may stimulate insulin resistance by the alteration of adipocyte function and insulin receptor substrate-1(Sharma *et al.*, 2016);(Ramesh *et al.*, 2019).

The treatment considerations of periodontitis are more emphasized in diabetic patients for several reasons. The protein metabolic changes in diabetes mellitus may be reflected in uncontrolled periodontal infections. Also, compromised food intake due to periodontitis and lack of functional dentition results in impaired diet. These conditions are particularly at risk for patients with pregnancy, uncontrolled diabetes, long standing diabetes and poor dental hygiene (Newman *et al.*, 2018).

There is rarity in the literature of similar study within Indian population considering limited investigations and evidence regarding the relationship of diabetes mellitus and periodontal disease.

Our department is passionate about research we have published numerous high quality articles in this domain over the past years (Abraham *et al.*, 2005; Devaki, Sathivel and BalajiRaghavendran, 2009; Neelakantan *et al.*, 2010, 2015; Arja *et al.*, 2013; Ramshankar *et al.*, 2014; Sumathi *et al.*, 2014; Surapaneni and Jainu, 2014; Surapaneni, Priya and Mallika, 2014; Ramamoorthi, Nivedhitha and Divyanand, 2015; Manivannan *et al.*, 2017; Ezhilarasan, 2018; Ezhilarasan, Sokal and Najimi, 2018; J *et al.*, 2018; Ravindiran and Praveenkumar, 2018; Malli Sureshbabu *et al.*, 2019; Mehta *et al.*, 2019; Krishnaswamy *et al.*, 2020; Samuel, Acharya and Rao, 2020; Sathish and Karthick, 2020)

Thus, this study was undertaken to assess the periodontal health among patients with diabetes mellitus.

MATERIALS AND METHODS

This retrospective cross-sectional study was conducted in Saveetha dental college and hospital, Saveetha university, Chennai, to assess the periodontal status among patients with diabetes mellitus reporting from June 2019 to March 2020. The approval for this university setting study was obtained from the institutional review board and it was covered by the ethical approval number ; SDC/SIHEC/2020/DIASDATA/0619-0320. Patient's informed consent was obtained prior to the clinical examinations of the patients.

After assessment in the university patient data registry, around 86000 patient records between June 2019 to March 2020 were reviewed and analysed. Case records of 200 patients who were diagnosed with diabetes mellitus, aged above 30 years with more than 6 remaining teeth and eligible for the study were included in the study. All missing data, patients with other systemic diseases and completely edentulous patients were excluded in this study. Cross verification of data for errors was done with the help of an external examiner. Data regarding the periodontal status of the patients in the terms of probing depth, clinical attachment loss, mobility, bleeding on probing and furcation involvement were collected from their records. The William Periodontal Probe was used to assess the probing depth in all the quadrants, excluding third molars. Periodontitis is diagnosed when a patient has 5mm or more than 5mm probing depth seen in more than two teeth or more than 30% of teeth surfaces.

All the obtained data were tabulated in Microsoft Office Excel (2013). The collected data was validated and analysed with Statistical Package for Social Sciences for Windows, version 23.0 (SPSS Inc., Chicago, IL, USA) and results were obtained. Descriptive statistics (frequency distribution and percentage) were conducted to report the distribution of age groups, gender and periodontal status of the patients. Inferential statistics (chi-square test) were done to find the correlation in the variable factors. P value < 0.05 was considered statistically significant.

RESULTS AND DISCUSSION

Diabetes is considered as "a systemic promoting factor creating suitable conditions for local agents producing gingivitis and periodontitis"(Nand *et al.*, 2018). Henceforth, this study was conducted to assess the periodontal health among patients with diabetes mellitus.

In the present study, out of 200 diabetic patients, 116 (58%) patients had gingivitis and 84 (42%) patients had periodontitis. (Figure 1)

The study population was divided based on their age as follows: 30-44 years, 45-54 years, 55-64 years, 65-74 years and 75-84 years. Among 30-44 years, 18 (9.00%) had gingivitis and 39 (19.50%) had periodontitis. Among 45-54 years, 47 (23.50%) had gingivitis and 26 (13.00%) had periodontitis. Among 55-64 years, 24 (12%) had gingivitis, while 23 (11.50%) had periodontitis. Among 65-74 years, 6 (3.0%) had gingivitis, 14 (7.0%) had periodontitis. Among 75-84 years, 3 (1.5%) had periodontitis. Prevalence of both gingivitis and periodontitis was higher among patients within the age group of 45-54 years. Association between age and periodontal status was assessed using Chi-square test and was found to be statistically significant with the p value of 0.04. (Figure 2)

Among 200 diabetic patients, 113 were males and 87 were females. Among 113 males, 67 (33.5%) had gingivitis, while 46 (23.0%) had periodontitis. Among 87 females, 49 (24.5%) had gingivitis, while 38 (19%) had periodontitis. Prevalence of both gingivitis and periodontitis was higher in males than females. Association between gender and periodontal status was assessed using Chi-square test and was found to be statistically not significant with the p value of 0.673. (Figure 3)

In the present study, out of 200 diabetic patients, 116 (58%) patients had gingivitis and 84 (42%) patients had periodontitis. This is in corroborating with a study in Vellore that showed a prevalence of 45.9% of chronic periodontitis in individuals with diabetes(Nand *et al.*, 2018). Similarly, a case-control study in Bangalore found periodontitis in diabetic individuals was 2.1 times higher than those without systemic diseases(Apoorva, Sridhar and Suchetha, 2013). A population of Mauritians also revealed the similar finding, in which all the patients that suffered diabetes had been diagnosed with chronic periodontitis(Eke *et al.*, 2012). A prevalence of 47% was shown in the study done in the United States. Studies in Pakistan and Bangladesh both reported a similar prevalence of periodontitis within the range of 34.5% to 42%(Susin *et al.*, 2004);(Bokhari *et al.*, 2015);(Horn *et al.*, 2007).

The prevalence of chronic periodontitis among healthy individuals was extremely low in this study as compared to 86.6% from the National Oral Health Survey from 2002-2003. In addition, studies in Tamil Nadu and Nagpur reported prevalence of 37.8% and 34.7%, respectively(Apoorva, Sridhar and Suchetha, 2013). The lower incidence rate of periodontitis in this current study may be explained with the limited duration of study and Chennai may be well covered with facilities from private and public health-care systems and hence, reducing prevalence of periodontitis.

In the present study, prevalence of both gingivitis and periodontitis was higher in males than females. In Quebec, the population-based data over a period of 1986 to 2003 had revealed an increased prevalence rate of type 2 diabetes mellitus and more marked in males (6% to 8.4 %) than females (6.4% to 7.1%), suggesting increased cases of periodontitis among diabetic patients(Horn *et al.*, 2007). In contrast to this study, Nand et al had reported a higher proportion of females in the group with periodontitis when compared in groups of diabetic and non-diabetic(Nand *et al.*, 2018). A study by Mittal et al demonstrated 26% subjects were diabetic females and 23% subjects were diabetic males(Mittal M, 2010). The differences in all findings may be attributable to the rate of incidence and mortality in each country. Nonetheless, the results obtained from this study showed no significant difference in the prevalence of periodontitis among gender distribution with and without diabetes, corroborating with study by Nand et al.

In this present study, prevalence of periodontitis was higher among patients within the age group of 45-54 years. Also, association between age and periodontal status was found to be statistically significant. In line with the study, a study had portrayed the majority of the diabetics were in the group of 45-54 years and had higher association with chronic periodontitis. In a study, diabetic patients had the highest frequency of more than 5mm attachment loss and the mean of deep pockets was more marked in diabetics than non-diabetic patients(Kesavan *et al.*, 2015). Shaju et al reported a prevalence of 89.6% periodontal problem in the age group 35-44 years. She also stated the prevalence of periodontitis increased with age however; a low incidence rate in older age can be explained due to increased teeth loss in elderly(Shaju, Zade and Das, 2011).

The limitations of this study include its small sample size distribution, geographic limitation and associated confounding factors such as smoking habits were not considered. There is a need to adopt more preventive dental health care among those with diabetes mellitus for the reduction of prevalence and complications of periodontal disease. This includes proper diagnosis with advanced technology for better management approach and its outcome. This study will help to promote awareness on the effect of systemic diseases on periodontium.

CONCLUSION

Within the limitations of this study, it can be concluded that the prevalence of gingivitis and periodontitis among diabetic patients was 58% and 42% respectively. Also, the prevalence of diabetes was more common among the

age group of 45-54 years and the association between age and periodontal disease was found to be statistically significant.

AUTHORS CONTRIBUTIONS

Nor Masitah Mohamed Shukri analysed, interpreted, tabulated data and wrote the manuscript. Arvina Rajasekar performed the validation, data design and critically revised the manuscript. Arthi Balasubramaniam revised the manuscript. All the three authors have equally contributed to the final manuscript.

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REFERENCES

1. Abraham, S. *et al.* (2005) 'Evaluation of the inhibitory effect of triphala on PMN-type matrix metalloproteinase (MMP-9)', *Journal of periodontology*, 76(4), pp. 497–502.
2. Apoorva, S. M., Sridhar, N. and Suchetha, A. (2013) 'Prevalence and severity of periodontal disease in type 2 diabetes mellitus (non-insulin-dependent diabetes mellitus) patients in Bangalore city: An epidemiological study', *Journal of Indian Society of Periodontology*, 17(1), pp. 25–29.
3. Arja, C. *et al.* (2013) 'Oxidative stress and antioxidant enzyme activity in South Indian male smokers with chronic obstructive pulmonary disease', *Respirology* , 18(7), pp. 1069–1075.
4. Avinash, K., Malaippan, S. and Dooraiswamy, J. N. (2017) 'Methods of Isolation and Characterization of Stem Cells from Different Regions of Oral Cavity Using Markers: A Systematic Review', *International journal of stem cells*, 10(1), pp. 12–20.
5. Bokhari, S. A. H. *et al.* (2015) 'Periodontal disease status and associated risk factors in patients attending a Dental Teaching Hospital in Rawalpindi, Pakistan', *Journal of Indian Society of Periodontology*, 19(6), pp. 678–682.
6. Chee, B., Park, B. and Bartold, P. M. (2013) 'Periodontitis and type II diabetes: a two-way relationship', *International journal of evidence-based healthcare*, 11(4), pp. 317–329.
7. Devaki, T., Sathivel, A. and BalajiRaghavendran, H. R. (2009) 'Stabilization of mitochondrial and microsomal function by polysaccharide of Ulva lactuca on D-Galactosamine induced hepatitis in rats', *Chemico-biological interactions*, 177(2), pp. 83–88.
8. Eke, P. I. *et al.* (2012) 'Prevalence of periodontitis in adults in the United States: 2009 and 2010', *Journal of dental research*, 91(10), pp. 914–920.
9. Ezhilarasan, D. (2018) 'Oxidative stress is bane in chronic liver diseases: Clinical and experimental perspective', *Arab journal of gastroenterology: the official publication of the Pan-Arab Association of Gastroenterology*, 19(2), pp. 56–64.
10. Ezhilarasan, D., Sokal, E. and Najimi, M. (2018) 'Hepatic fibrosis: It is time to go with hepatic stellate cell-specific therapeutic targets', *Hepatobiliary & pancreatic diseases international: HBPD INT*, 17(3), pp. 192–197.
11. Horn, O. K. *et al.* (2007) 'Incidence and Prevalence of Type 2 Diabetes in the First Nation Community of Kahnawá:ke, Quebec, Canada, 1986–2003', *Canadian Journal of Public Health*, pp. 438–443. doi: 10.1007/bf03405434.
12. J, P. C. *et al.* (2018) 'Prevalence and measurement of anterior loop of the mandibular canal using CBCT: A cross sectional study', *Clinical implant dentistry and related research*, 20(4), pp. 531–534.
13. Kavarthapu, A. and Thamaraiselvan, M. (2018) 'Assessing the variation in course and position of inferior alveolar nerve among south Indian population: A cone beam computed tomographic study', *Indian journal of dental research: official publication of Indian Society for Dental Research*, 29(4), pp. 405–409.
14. Kesavan, R. *et al.* (2015) 'Periodontal status among type II diabetic and nondiabetic individuals in Chennai, India: A comparative study', *Journal of Indian Association of Public Health Dentistry*, p. 393. doi: 10.4103/2319-5932.171167.
15. Khalid, W. *et al.* (2016) 'Role of endothelin-1 in periodontal diseases: A structured review', *Indian journal of dental research: official publication of Indian Society for Dental Research*, 27(3), pp. 323–333.
16. Khalid, W. *et al.* (2017) 'Comparison of Serum Levels of Endothelin-1 in Chronic Periodontitis Patients Before and After Treatment', *Journal of clinical and diagnostic research: JCDR*, 11(4), pp. ZC78–ZC81.
17. Krishnaswamy, H. *et al.* (2020) 'Investigation of air conditioning temperature variation by modifying the structure of passenger car using computational fluid dynamics', *Thermal Science*, 24(1 Part B), pp. 495–498.
18. Lalla, E. *et al.* (2008) 'Oral disease burden in northern Manhattan patients with diabetes mellitus', *American journal of public health*, 98(9 Suppl), pp. S91–4.
19. Malli Sureshbabu, N. *et al.* (2019) 'Concentrated Growth Factors as an Ingenious Biomaterial in Regeneration of Bony Defects after Periapical Surgery: A Report of Two Cases', *Case reports in dentistry*, 2019, p. 7046203.
20. Manivannan, I. *et al.* (2017) 'Tribological and surface behavior of silicon carbide reinforced aluminum matrix

nanocomposite', *Surfaces and Interfaces*, 8, pp. 127–136.

21. Mehta, M. *et al.* (2019) 'Oligonucleotide therapy: An emerging focus area for drug delivery in chronic inflammatory respiratory diseases', *Chemico-biological interactions*, 308, pp. 206–215.

22. Mittal M, T. H. (2010) 'Prevalence of periodontal diseases in diabetic and non-diabetic patients: A clinical study', *Internet J Epidemiol*, 10(1), pp. 1–5.

23. Mootha, A. *et al.* (2016) 'The Effect of Periodontitis on Expression of Interleukin-21: A Systematic Review', *International journal of inflammation*, 2016, p. 3507503.

24. Nand, K. *et al.* (2018) 'Chronic periodontitis among diabetics and nondiabetics aged 35–65 years, in a rural block in Vellore, Tamil Nadu: A cross-sectional study', *Journal of Indian Society of Periodontology*, p. 0. doi: 10.4103/jisp.jisp_217_17.

25. Neelakantan, P. *et al.* (2010) 'Root and Canal Morphology of Mandibular Second Molars in an Indian Population', *Journal of endodontics*, 36(8), pp. 1319–1322.

26. Neelakantan, P. *et al.* (2015) 'Photoactivation of curcumin and sodium hypochlorite to enhance antibiofilm efficacy in root canal dentin', *Photodiagnosis and photodynamic therapy*, 12(1), pp. 108–114.

27. Newman, M. G. *et al.* (2018) *Newman and Carranza's Clinical Periodontology E-Book*. Elsevier Health Sciences.

28. Panda, S. *et al.* (2014) 'Platelet rich fibrin and xenograft in treatment of intrabony defect', *Contemporary clinical dentistry*, 5(4), pp. 550–554.

29. Priyanka, S. *et al.* (2017) 'Detection of cytomegalovirus, Epstein-Barr virus, and Torque Teno virus in subgingival and atheromatous plaques of cardiac patients with chronic periodontitis', *Journal of Indian Society of Periodontology*, 21(6), pp. 456–460.

30. Ramamoorthi, S., Nivedhitha, M. S. and Divyanand, M. J. (2015) 'Comparative evaluation of postoperative pain after using endodontic needle and EndoActivator during root canal irrigation: A randomised controlled trial', *Australian endodontic journal: the journal of the Australian Society of Endodontology Inc*, 41(2), pp. 78–87.

31. Ramamurthy J And (2008) 'Comparison of effect of Hiora mouthwash versus Chlorhexidine mouthwash in gingivitis patients:A clinical trial', *Asian Journal of Pharmaceutical and Clinical Research*, 11(7), pp. 84–88.

32. Ramesh, A., Varghese, S. S., *et al.* (2016) 'Chronic obstructive pulmonary disease and periodontitis – unwinding their linking mechanisms', *Journal of Oral Biosciences*, pp. 23–26. doi: 10.1016/j.job.2015.09.001.

33. Ramesh, A., Varghese, S. S., *et al.* (2016) 'Herbs as an antioxidant arsenal for periodontal diseases', *Journal of intercultural ethnopharmacology*, 5(1), pp. 92–96.

34. Ramesh, A. *et al.* (2019) 'Esthetic lip repositioning: A cosmetic approach for correction of gummy smile - A case series', *Journal of Indian Society of Periodontology*, 23(3), pp. 290–294.

35. Ramesh, A., Ravi, S. and Kaarthikeyan, G. (2017) 'Comprehensive rehabilitation using dental implants in generalized aggressive periodontitis', *Journal of Indian Society of Periodontology*, 21(2), pp. 160–163.

36. Ramshankar, V. *et al.* (2014) 'Risk stratification of early stage oral tongue cancers based on HPV status and p16 immunoexpression', *Asian Pacific journal of cancer prevention: APJCP*, 15(19), pp. 8351–8359.

37. Ravindiran, M. and Praveenkumar, C. (2018) 'Status review and the future prospects of CZTS based solar cell – A novel approach on the device structure and material modeling for CZTS based photovoltaic device', *Renewable and Sustainable Energy Reviews*, 94, pp. 317–329.

38. Ravi, S. *et al.* (2017) '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', *Journal of Periodontology*, pp. 839–845. doi: 10.1902/jop.2017.160824.

39. Samuel, S. R., Acharya, S. and Rao, J. C. (2020) 'School Interventions-based Prevention of Early-Childhood Caries among 3-5-year-old children from very low socioeconomic status: Two-year randomized trial', *Journal of public health dentistry*, 80(1), pp. 51–60.

40. Sanadi, D. R. M. *et al.* (2016) 'Role of trauma from occlusion in periodontal disease- A controversy', *IOSR Journal of Dental and Medical Sciences*, pp. 118–122. doi: 10.9790/0853-150904118122.

41. Sathish, T. and Karthick, S. (2020) 'Wear behaviour analysis on aluminium alloy 7050 with reinforced SiC through taguchi approach', *Journal of Materials Research and Technology*, 9(3), pp. 3481–3487.

42. Shaju, J. P., Zade, R. M. and Das, M. (2011) 'Prevalence of periodontitis in the Indian population: A literature review', *Journal of Indian Society of Periodontology*, 15(1), pp. 29–34.

43. Sharma, M. *et al.* (2016) 'Diabetes and Periodontitis: A medical perspective', *Journal of the International Clinical Dental Research Organization*, p. 3. doi: 10.4103/2231-0754.176244.

44. Sumathi, C. *et al.* (2014) 'Production of prodigiosin using tannery fleshing and evaluating its pharmacological effects', *TheScientificWorldJournal*, 2014, p. 290327.

45. Surapaneni, K. M. and Jainu, M. (2014) 'Comparative effect of pioglitazone, quercetin and hydroxy citric acid on the status of lipid peroxidation and antioxidants in experimental non-alcoholic steatohepatitis',

Journal of physiology and pharmacology: an official journal of the Polish Physiological Society, 65(1), pp. 67–74.

46. Surapaneni, K. M., Priya, V. V. and Mallika, J. (2014) 'Pioglitazone, quercetin and hydroxy citric acid effect on cytochrome P450 2E1 (CYP2E1) enzyme levels in experimentally induced non alcoholic steatohepatitis (NASH)', *European review for medical and pharmacological sciences*, 18(18), pp. 2736–2741.

47. Susin, C. *et al.* (2004) 'Periodontal Attachment Loss in an Urban Population of Brazilian Adults: Effect of Demographic, Behavioral, and Environmental Risk Indicators', *Journal of Periodontology*, pp. 1033–1041. doi: 10.1902/jop.2004.75.7.1033.

48. Thamaraiselvan, M. *et al.* (2015) 'Comparative clinical evaluation of coronally advanced flap with or without platelet rich fibrin membrane in the treatment of isolated gingival recession', *Journal of Indian Society of Periodontology*, 19(1), pp. 66–71.

49. Thorstensson, H. and Hugoson, A. (1993) 'Periodontal disease experience in adult long-duration insulin-dependent diabetics', *Journal of clinical periodontology*, 20(5), pp. 352–358.

50. Varghese, S. S. *et al.* (2015) 'Estimation of salivary tumor necrosis factor-alpha in chronic and aggressive periodontitis patients', *Contemporary clinical dentistry*, 6(Suppl 1), pp. S152–6.

51. Wild, S. *et al.* (2004) 'Global Prevalence of Diabetes: Estimates for the year 2000 and projections for 2030', *Diabetes Care*, pp. 1047–1053. doi: 10.2337/diacare.27.5.1047.
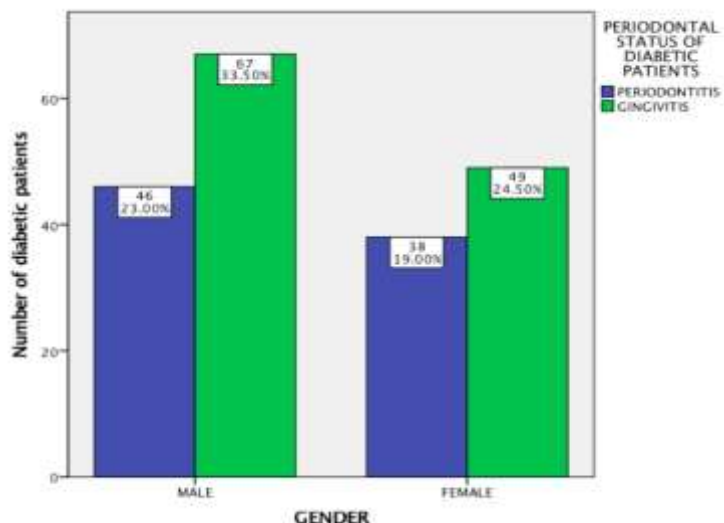
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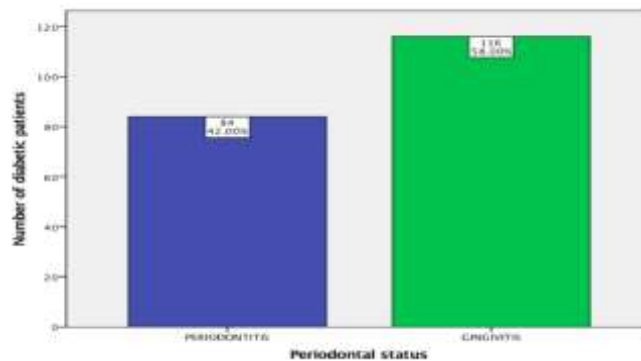
Fig.1: Bar graph depicting the distribution of periodontal status among diabetic patients. X axis represents the periodontal status and Y axis represents the number of diabetic patients. Majority of the diabetic patients had gingivitis (green) followed by the patients with periodontitis (blue)
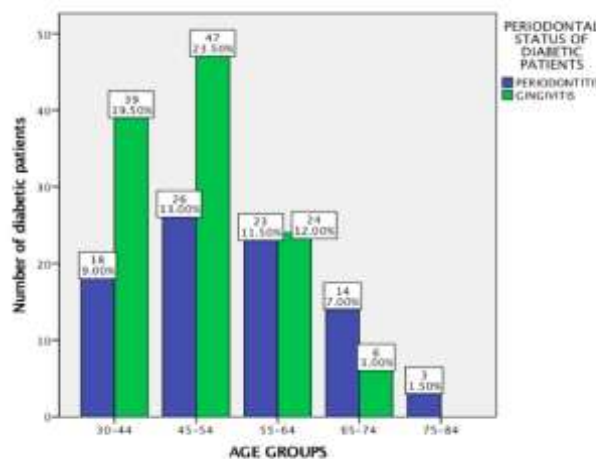
Fig.2: Bar graph depicting the association between age groups and periodontal status of diabetic patients. X axis represents age groups and Y axis represents the number of diabetic patients. Prevalence of both gingivitis (green) and periodontitis (blue) was higher among patients within the age group of 45-54 years. Association between age and periodontal status was statistically significant. Chi-square test; p-0.04(<0.05)

Fig.3: Bar graph depicting the association between gender and periodontal status of diabetic patients. X axis represents gender and Y axis represents the number of diabetic patients. Prevalence of both gingivitis (green) and periodontitis (blue) was higher in males than females. Association between gender and periodontal status was statistically not significant. Chi-square test; p-0.673(.0.05)