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Journal of Orofacial and Health Sciences

Journal homepage: https://www.johs.in/

INNOVATIVE PUBLICATION

Original Research Article

Assessment of periodontal status and dental caries and other associated risk factors in Type 2 diabetic and nondiabetic subjects of durg city

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ARTICLE INFO

Article history:
Received 17-04-2024
Accepted 04-07-2024
Available online 13-07-2024

Keywords:
Assessment
Dental Caries
Periodontal Status
Type 2 Diabetic and Nondiabetic subjects

ABSTRACT

Introduction : Oral health affects quality of life and can increase risk for systemic diseases. Dental caries and tooth loss has been reported in patients with Diabetes. There is a 'bi-directional' relationship between Type 2 Diabetes Mellitus and periodontal disease.

Materials and Methods: 600 subjects, age group of 25-50 years was selected from 4 zones by in Durg city. From each zone one ward's house was randomly selected. 150 subjects were examined from selected wards of each zone. Blood Glucose Test was done by using Glucometer. Periodontal status and dental caries status was recorded using CPI Index and W.H.O. Dentition Status and Treatment Needs. Statistical analyses were performed using SPSS 16.0. Descriptive statistics were calculated. Fisher's exact test, t-test, One way ANOVA, Mann Whitney U Test and Kruskal Wallis Test were applied.

Results: Mean number of CPI score (2.88 + 0.56) was higher in T2DM subjects as compared to Nondiabetic subjects (2.05 + 0.68). Mean number of Loss of Attachment Score (0.90 + 0.49) was greater in T2DM subjects than in Nondiabetic subjects (0.24 + 0.43). There was no statistically significant difference in Mean Decayed Teeth between T2DM subjects (1.41 + 1.67) and Nondiabetic subjects (1.26 + 1.84) ($p > 0.05$). DMFT was statistically significant when compared between the diabetic and non-diabetic subjects ($p < 0.05$).

Conclusion : Diabetic subjects were affected by a severe degree of periodontal disease in comparison to non-diabetic subjects. Dental Caries was not found to be significantly different between diabetics and non-diabetics.

1. Introduction

Oral health is an integral part of general health. Sir William Osler has correctly stated that "Oral health is the mirror of general health".[1] Oral health and General Health have a two-way street. Oral health affects quality of life and can increase risk for systemic diseases.[2] Oral symptoms are present in many systemic disorders. In order to provide the patient with a suitable diagnosis and therapy referral, it is imperative that these oral symptoms be identified accurately.[3–5]

India is a developing country and has the largest population in the world.[6] Because of changes in life styles and dietary habits, Prevalence of Dental Caries is increasing in India.[7] According to oral health survey of Ministry of Health -WHO 2007-08, prevalence of dental caries among 12-year- old's ranged between 23.0 % to 71.5 % and adults aged 35-45 years was between 48.1% to 86.4%. Similarly, periodontal diseases among adults & elderly were in the range of 15.32 % to 77.9 % & 19.9% to 96.1%.[8]

Poor oral hygiene is a risk factor for periodontal disease and dental caries. Dental plaque includes Steptococcus Mutans, Actinomyces and Veillonellae. Steptococcus Mutans is considered to be the main etiologic agents in

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https://doi.org/10.18231/j.johs.2024.014

dental caries. Dental plaque also consists of periodontal micro-organisms such as Actinomyces, Actinobaccilus, Veillonella, Bacteroides, Capnocytophaga, Spirocheata, All adults experience at some point during their lifetime some deterioration of their periodontal structures. As more people retain their teeth throughout their lifetime and as the proportion of older people increases, more teeth are at risk for periodontal disease. Destructive periodontal disease is becoming more commonplace worldwide.[9]

Globally, diabetes mellitus is becoming a more serious public health issue.[10] Diabetes Mellitus is a syndrome characterized by inadequate insulin secretion which leads to chronic hyperglycaemia and both acute and chronic complications.[11–13]

The two main types of diabetes mellitus are T1DM or insulin-dependent diabetes mellitus and T2DM or non-insulin-dependent diabetes mellitus.[14] Compared to T1DM, T2DM is far more common and frequently found by accident. Although T2DM more typically develops with increasing age, it is now being diagnosed more frequently in children and young adults.[15]

According to recent estimates, approximately 285 million people worldwide (6.6%) in 20–79 year age group, have diabetes and by 2030, 438 million people (7.8%) of the adult population, is expected to have diabetes. It is estimated that the total number of people with diabetes in India will rise to 87.0 million by 2030 making India the diabetes capital of the world.[16]

Diabetes Mellitus and Periodontal Diseases have a major impact on the health and well-being of millions of people worldwide.[17] The American Society of Diabetes defined periodontal disease as the sixth complication of diabetes in 1997.[1,18,19] Diabetes modifies the severity of periodontal disease and increases the likelihood of developing it. Prophylactic therapies and periodontal therapy are often more necessary for them.[18,20] Diabetes patients have been documented to have dental cavities and tooth loss. Patients with diabetes were shown to have a higher prevalence and a higher likelihood of acquiring oral mucosal lesions in comparison to healthy controls.[21]

Diabetes is believed to promote periodontitis through an exaggerated, inflammatory response to periodontal microflora.[22] There is a 'bi-directional' relationship between Type 2 Diabetes Mellitus and periodontal disease, with Type 2 Diabetes Mellitus being associated with increased prevalence and severity of periodontal disease, and periodontitis being associated with poorer glycaemic control.[23,24] Various research have observed that periodontal diseases are more prevalent and have increased severity among Diabetics than their counterparts.[1,25,26]

Although dental caries has been researched in patients with diabetes mellitus, no clear correlation has been found. Diabetes mellitus and dental cavities have a complicated interaction.[22] With age, the prevalence of both has

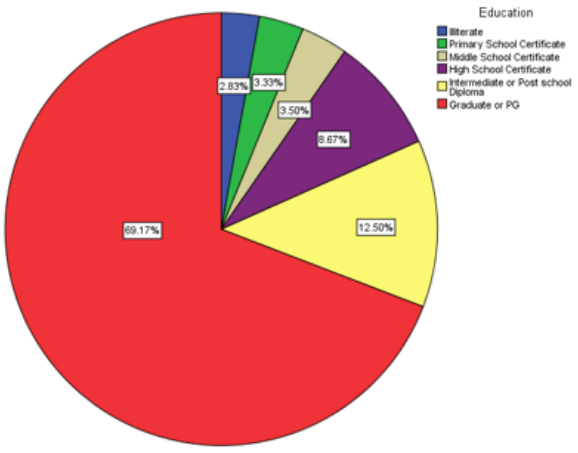

Figure 1: Distribution of study population according to education level

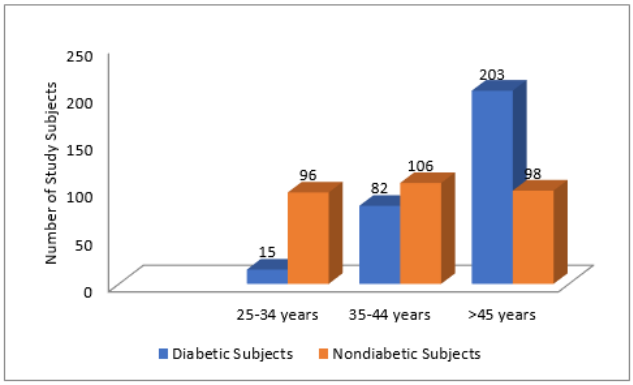

Figure 2: Age wise distribution of diabetic and nondiabetic subjects

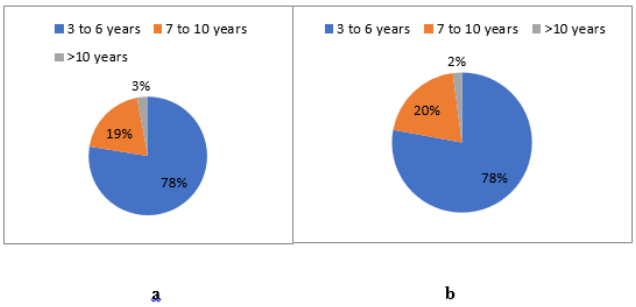

Figure 3: a: Distribution of diabetes mellitus in males according to duration of diabetes mellitus **b:** Distribution of diabetes mellitus in females according to duration of diabetes mellitus

Table 1: Distribution of CPI score among diabetic and nondiabetic subjects

CPI Score	Diabetic Subjects	Nondiabetic Subjects	Total	p-value
0	2(0.33)	4(0.67)	6(1)	
1	2(0.33)	51(8.5)	53(8.83)	
2	49(8.16)	172(28.67)	221(36.83)	<0.001 (HS)
3	224(37.33)	73(12.17)	297(49.50)	
4	23(3.83)	0(0)	23(3.83)	

CPI Score – Community Periodontal Index Score, Fisher's exact test, p-value < 0.001 at 95% Confidence Level, (HS) Highly Significant

Table 2: Distribution of CPI score among study population according to age

CPI Score	25-34 years	35-44 years	>=45 years	Total	p-value
0	2(0.33)	2(0.33)	2(0.33)	6(1)	
1	32(5.33)	12(2.00)	9(1.5)	53(8.83)	
2	66(11.00)	82(13.67)	73(12.17)	221(36.83)	0.003(S)
3	11(1.83)	81(13.5)	205(34.17)	297(49.50)	
4	0(0)	11(1.83)	12(2.00)	23(3.83)	

CPI Score – Community Periodontal Index Score, Fisher's exact test, p-value < 0.05 at 95% Confidence Level, (S) Significant

Table 3: Distribution of loss of attachment score among diabetic and nondiabetic subjects

Groups	Loss of Attachment score 0	Loss of Attachment score 1	Loss of Attachment score 2	p-value
Diabetic Subjects	53	224	23	
Nondiabetic Subjects	227	73	0	<0.001 (HS)
Total	280	297	23	

Fisher's exact test, p-value < 0.001 at 95%Confidence Level, (HS) Highly Significant

Table 4: Distribution of loss of attachment score among study population according to age

Age	Loss of Attachment score 0	Loss of Attachment score 1	Loss of Attachment score 2	p-value
25-34 years	100	11	0	
35-44 years	96	81	11	<0.001 (HS)
>=45 years	84	205	12	
Total	280	297	23	

Fisher's exact test, p-value < 0.001 at 95% Confidence Level, (HS) Highly Significant

Table 5: Mean number of CPI score among diabetic and nondiabetic subjects

Groups	N	Mean + SD	p-value
Diabetic Subjects	300	2.88 + 0.56	<0.001 (HS)
Nondiabetic Subjects	300	2.05 + 0.68	

CPI Score – community periodontal index score,t-test, p-value < 0.001 at 95% confidence level, (HS) highly significant

Table 6: Mean number of loss of attachment scores among diabetic and nondiabetic subjects

Groups	N	Mean + SD	p-value
Diabetic Subjects	300	0.90 + 0.49	<0.001 (HS)
Nondiabetic Subjects	300	0.24 + 0.43	

t-test, p-value < 0.001 at 95% Confidence Level, (HS) Highly Significant

Table 7: Mean decayed teeth (DT) among diabetic and nondiabetic subjects

Groups	Mean + SD	Minimum, Maximum	p-value
Diabetic Subjects	1.41 + 1.67	0, 9	0.057 (NS)
Nondiabetic Subjects	1.26 + 1.84	0, 11	

Mann whitney test, p-value > 0.05 at 95% Confidence Level, (NS) Not Significant

Table 8: Mean decayed teeth (DT) among study population according to age and sex

Age	Mean + SD	Minimum, Maximum	p-value
25-34 years	1.05 + 1.82	0, 7	
35-44 years	1.35 + 1.83	0, 11	0.004 (S)
>=45 years	1.43 + 1.69	0, 9	
Sex	Mean + SD	Minimum, Maximum	p-value
Male	1.20 + 1.65	0, 9	0.002 (S)
Female	1.67 + 1.98	0, 11	

For Age Kruskal-Wallis test, p-value < 0.05 at 95% Confidence Level, (S) Significant, For Sex Mann whitney test, p-value < 0.05 at 95% Confidence Level, (S) Significant

Table 9: Mean decayed missing filled teeth (DMFT) among diabetic and nondiabetic subjects

Groups	Mean + SD	Minimum, Maximum	p-value
Diabetic Subjects	3.69 + 4.62	0, 28	0.002 (S)
Nondiabetic Subjects	3.36 + 5.91	0, 31	

Mann whitney test, p-value < 0.05 at 95% Confidence Level, (S) Significant

Table 10: Mean decayed missing filled teeth (DMFT) among study population according to age and sex

Age	Mean + SD	Minimum, Maximum	p-value
25-34 years	1.52 + 3.60	0, 24	
35-44 years	2.95 + 4.94	0, 31	<0.001 (HS)
>=45 years	4.62 + 5.77	0, 28	
Sex	Mean + SD	Minimum, Maximum	p-value
Male	3.36 + 5.26	0, 28	0.006 (S)
Female	3.95 + 5.41	0, 31	

For Age Kruskal-Wallis test, p-value < 0.001at 95% Confidence Level, (HS) Highly Significant, For Sex Mann whitney test,p-value < 0.05 at 95% Confidence Level, (S) Significant

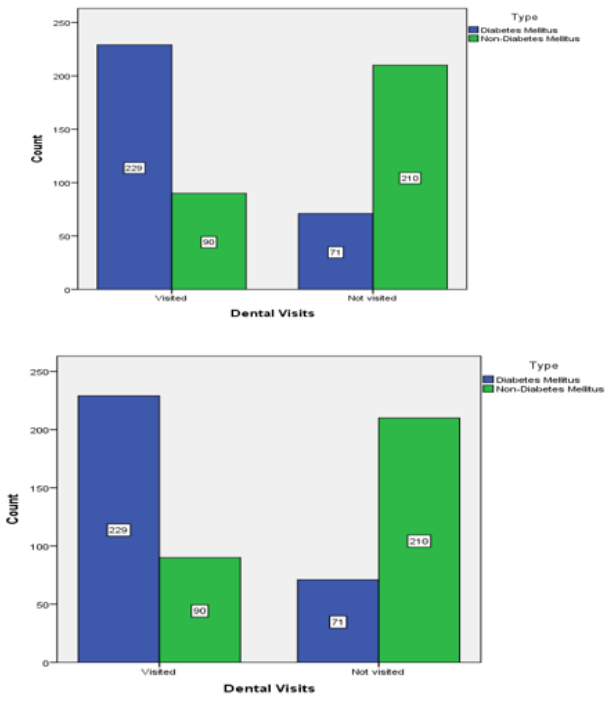

Figure 4: Distribution of diabetes mellitus and nondiabetes mellitus subjects according to visit

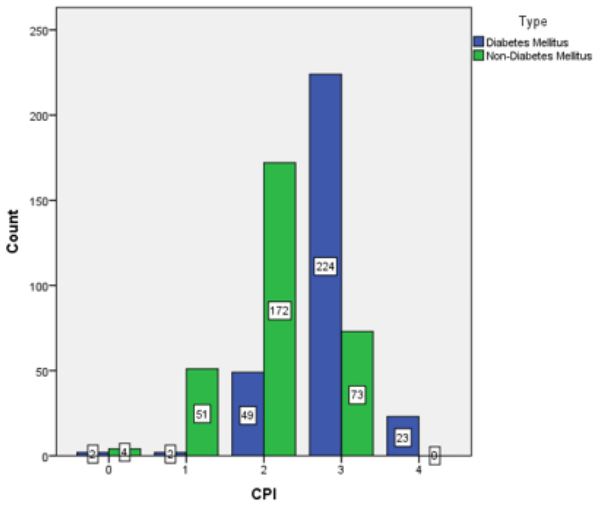

Figure 5: Distribution of CPI scores among diabetic and nondiabetic subjects

increased. Depending on the tooth and location (coronal or root surface), Type 2 DM may have a different effect on the development of caries.[25] Regarding the connection between dental caries and diabetes, the literature does not consistently show a trend.[22] Less research has been

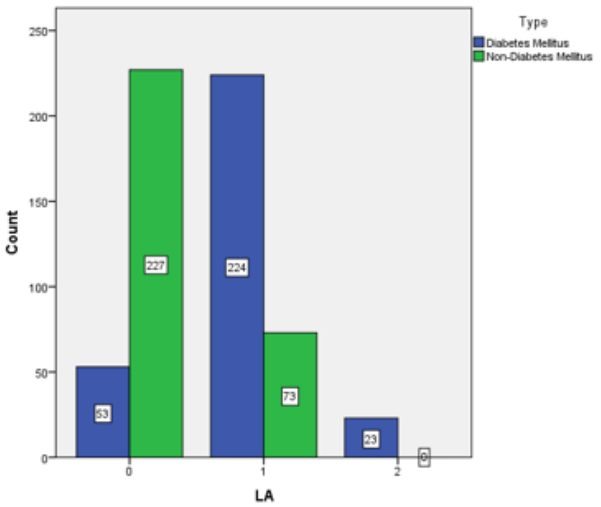

Figure 6: Distribution of LOA scores among diabetic and nondiabetic subjects

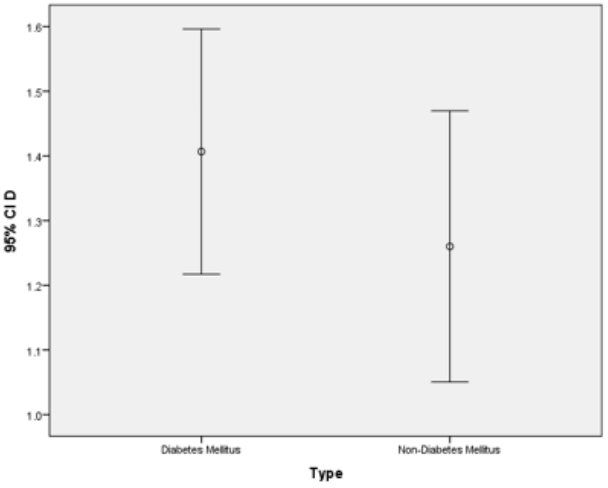

Figure 7: Mean decayed teeth among diabetic and nondiabetic subjects

done on the connection between diabetes and dental caries, especially in adults.[27]

There aren't many research on the topic available elsewhere in the nation, but none have been done in this region of Chhattisgarh State. Hence, an attempt was made in the present study to assess prevalence of dental caries, periodontal status, and other associated risk factors in subjects with and without T2DM subjects in Durg city.

2. Materials and Methods

2.1. Study design

A Descriptive Cross-Sectional Study was conducted on assessment of dental caries, periodontal status with T2DM

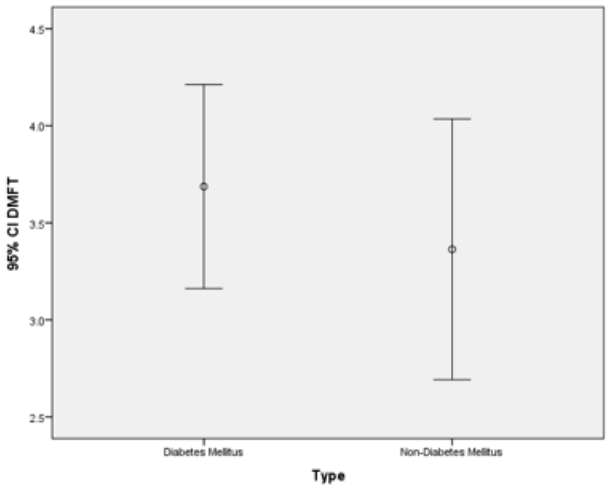

Figure 8: Mean decayed missing filled teeth among diabetic and non diabetic subjects

and Non Diabetes Mellitus of Durg city on (March 2022 to May 2022). Ten subjects were tested on average each day.

2.2. Sample size

According to the census of India 2011, Durg had a population of 2,68,679.[28] Sample size estimation for the present study was based on data from a previously published study by Kanjirath P.P. et al.[29]

The study conducted by Kanjirath P.P. et al. revealed that 84% of people had periodontal disorders.

$$n = Z_{\alpha}^{2}\, p\, q / L^{2}$$

n = 293 (For every group)

2.3. Methodology

The street map was obtained from the Corporation office in Durg City. A total of 600 subjects (300 diabetics and 300 nondiabetics) belonging to the age group of 25-50 years were selected from all zones by Multi-stage sampling technique. From each zone one ward was randomly selected. 150 subjects were included from selected ward of each zone. In each zone 600 households were visited to get 75 known diabetic subjects. A glucometer blood test was performed on non-diabetic individuals. Similarly, subjects were selected from all four zones to reach a sample size of 600 subjects. Data was collected by conducting door-to-door surveys in the selected wards.

Inclusion Criterion

1. Subjects with a confirmed diagnosis of Diabetes Mellitus (TYPE II for 3 years)
2. The age group is between 25 – 50 years
3. Minimum of 3 teeth should be present in each sextant
4. Non-diabetic subjects with no history of diabetes or other systemic diseases. Non-diabetic subjects had blood glucose levels fasting at less than 126 mg./dl when checked on a glucometer. The non-diabetic subjects underwent a random blood sugar test using Glucometer to confirm their non diabetic status.

Exclusion Criteria

1. Subject who had all teeth missing
2. Subject to the history of systemic diseases like hypertension, epilepsy etc.
3. Pregnant women and Lactating Mothers
4. Subject to any hormonal therapy
5. Subject to those who have undergone antimicrobial, vitamin, Dilantin sodium and other medications
6. Subjects who fail to give consent

2.4. Assessments

All research participants provided written informed consent, and this study uses proforma. Ethical clearance was taken from the Institutional Ethical Committee Rungta Dental College, Bhilai. CPI Probe and CPI index (Community Periodontal Index) were used to examine periodontal status. The World Health Organization's Dentition Status and Treatment Needs (1997) was utilized to evaluate the state of dental caries.

This is the standard index used to assess periodontal disease status as recommended by World Health Organization. Three indicators of periodontal status are used for this assessment: gingival bleeding, calculus and periodontal pockets. The mouth is divided into sextants defined by tooth numbers: 18-14, 13-23, 24-28, 38-34, 33-43, 44-48.

2.5. Statistical analysis

Statistical analysis were performed using SPSS version 16, USA. Significance level was fixed at 0.05 ($p < 0.05$). We computed descriptive statistics.

The mean CPI score, mean DT, mean MT, and mean DMFT of subjects with and without diabetes were determined.

To compare the CPI score between patients with diabetes and those without, as well as the Loss of Attachment score between subjects with and without diabetes, Fisher's exact test was employed.

The mean number of CPI scores and the mean number of loss of attachment scores between patients with and without diabetes were compared using the t-test.

One way ANOVA was used for comparison of mean number of CPI score and mean number of loss of attachment score according to age.

The mean decayed teeth (DT), mean missing teeth (MT), and mean decayed filled teeth (DMFT) of patients with and without diabetes were compared using the Mann-Whitney test.

Kruskal-Wallis Test was used for comparison of Mean Decayed Teeth (DT), Mean Missing Teeth (MT) and Mean Decayed Missing Filled Teeth (DMFT) according to age.

3. Results

A total of 600 subjects in the age range of 25 to 50 years were examined, out of which 431 (71.83%) were males and 169 (28.17%) were females.

Table 1 and Figure 1 reveals that among 300 diabetic subjects, 224 diabetics had shallow pockets, 49 diabetics had calculus on their teeth surface, 23 had deep pockets, 2 had bleeding when gentle probing was done around free gingiva and 2 diabetic subjects had healthy periodontal tissue. While in nondiabetic subjects 172 had calculus on their teeth surface, 73 had shallow pockets, 51 had bleeding when gentle probing was done around free gingiva, 4 nondiabetic subjects had healthy periodontal tissue and no participants had deep pockets. The difference in CPI scores between diabetic and non diabetic subjects was statistically highly significant ($P < 0.001$). Subjects with the highest CPI score of 3 were seen among age groups of 45 years and above, indicating that this age group had a greater percentage of periodontal pockets. When subjects were categorized based on the CPI scores, the comparison across 3 groups were statistically significant ($p= 0.003$) (Table 2)

Majority of the subjects (n = 297, 49.5%) presented with periodontal attachment loss of 4-5mm. 23 (3.83 %) subjects had attachment loss of 6-8mm, an attachment loss of 9-11mm was not observed in any subjects. Differences in distribution of loss of attachment scores among diabetics and nondiabetics were statistically highly significant ($p < 0.001$). (Table 3, Figure 2) Among subjects presented with an attachment loss of score 2, 12 were from 45 years & above age group and 12 from 35-44 years of age. The comparison across the 3 groups was highly statistically significant ($p < 0.001$). (Table 4)

The estimation of CPI and LOA mean scores between type II diabetics and non-diabetics are shown in Table 5 and Table 6. The highest mean scores for CPI (2.72 + 0.62) and LOA (0.76 + 0.51) among type II diabetics were observed in 45 years and above group, whereas the lowest CPI (1.77 + 0.64) and LOA (0.10 + 0.30) scores were among the age group of 25-34 years. Similar results of mean scores for CPI and LOA scores were observed among diabetics and non-diabetics (Table 5 and Table 6). It was observed that CPI and LOA means were higher for the type II diabetics group. The difference in mean scores between diabetics and non-

diabetics was highly statistically significant (p<0.001).

To check Dental Care status WHO oral health assessment form (1997) was used and DMFT scores were derived as per WHO guidelines for analysis of data. Only the DT component did not varied significant (p=0.057). The untreated caries (mean DT) was lowest (1.26 + 1.84) in non-diabetics when compared to diabetics (1.41 + 1.67). (Table 7, Figure 3) The mean number of decayed teeth was the lowest in 25-34 years group (1.05 + 1.82) and highest in 45 years and above group (1.43 + 1.69). (Table 8)

The mean DMFT among diabetic subjects was 3.69 + 4.62, whereas it was 3.36 + 5.91 in non-diabetic subjects and there was statistically significant difference in Mean DMFT (p<0.002) between the diabetic and non-diabetic subjects. (Table 9, Figure 4) The mean DMFT was the lowest in the 25-34 year age group (1.52 + 3.60), and highest in 45 years and above age group (4.62 + 5.77). Significant variability was seen in dental caries experience across the age groups in the study subjects (<0.001). (Table 10)

4. Discussion

4.1. Periodontal status

Gingivitis and Periodontitis is a multifactorial disease that has been associated with multiple risk factors. In the present study, more periodontal diseases were found in T2DM subjects as comparison to Nondiabetic subjects. This may be a result of poorer oral hygiene care. Bleeding was more in non-diabetics as a comparison to diabetics. Hintao J et al. demonstrated the same thing in their study.[25] Findings were in contrast to a study conducted by Bridges et al. in which diabetics were higher in all the parameters of CPI.[30] Mean CPI score was higher in diabetics as compared to nondiabetics, which is similar to as obtained by an epidemiological study,[26] which is in accordance with Das M et al study.[1]

In the present study majority (53.33%) of the patients presented with some degree of loss of attachment. 4-5 mm loss of attachment was seen in 34.17% of the study population, mostly in the 45-50 years age group. T2DM is associated with rapid periodontal breakdown due to impaired leukocyte function, altered collagen metabolism and micro vascular changes. Around 2.0% of the subjects had loss of attachment of 6-8 mm mostly in the age group of 45-50 years, which needs further studies to explain this relationship.

The distribution of the Loss of Attachment score in this study showed a significant difference between the diabetic and non-diabetic patients. This study confirms the findings of Lalla E et al. that T2DM sufferers experienced more alveolar bone loss than non-diabetic subjects.[31] (Table 3) More periodontal pockets were recorded in T2DM subjects as a comparison to nondiabetic subjects which is supported by Das M et al. study finding.[1,32]

Severity of periodontal disease was high among T2DM subjects compared with Nondiabetic subjects as more loss of attachment and pockets were found among diabetics when compared with non-diabetics. This finding is consistent with the most of the previous studies done by Hintao J et al.[25] Tsai C et al.[33] Ryan ME et al.[34] and Perrson RE et al.[35].

Several studies found higher prevalence and severity of periodontal disease among diabetic patients than among healthy controls. Studies show that poorly controlled T2DM increases the risk of progressive bone loss and attachment loss over time.[36] The duration of having T2DM is an important factor to evaluate the risk of T2DM on the development of periodontal diseases.[34] Studies have shown that diabetic patients with periodontal infection have a greater risk of worsening glycemic control over time compared to T2DM subjects without periodontal diseases.[36] Thus, there is a reciprocal association between periodontal diseases and type 2 diabetes. Diabetes management must include the prevention and treatment of periodontal infections.[37]

4.2. Dental caries status

Dental Caries is affected by the consumption of dietary sugars, salivary flow, exposure to fluoride and preventive behaviors.

Studies show either higher[25,28,38,39] similar[40] or lower caries[41] prevalence among diabetics than among the controls. The relationship between T2DM and dental caries is complex. Both have increased prevalence with age. The impact of T2DM on caries development may differ between teeth and sites (coronal or root surface).[25]

There was no significant difference in the Mean decayed teeth (DT) between T2DM subjects and nondiabetic subjects (p value > 0.05) which is similar to the findings reported by Lalla E et al., Albrecht M et al. and Al-Attas S.[31,38,42] Bacic M et al. and Bharateesh JV et al., in separate studies have observed that diabetics have a somewhat lower number of decayed teeth than non-diabetics.[40,41] In his study of caries among T2DM patients of southern Thailand, Hintao J et al reported that there was no difference in coronal caries among T2DM and controls.[25] Our finding are not in agreement with the findings of Ilguy M et al. study.[39] Mean Decayed Teeth was significantly higher in the group of T2DM subjects compared to Nondiabetic subjects in Kanjirath PP et al study.[29] In our study, it was found that Mean decayed Teeth (DT) were highest in the oldest age group subjects (45 years and above) in the group of T2DM. These findings support research done by Hintao J et al.[25]

Although the mean number of missing teeth did not give a direct insight into the periodontal status, it was an important factor in estimating oral health. Mean Missing Teeth (MT) was higher in T2DM subjects in comparison to Nondiabetics subjects. Bagic IC et al found that T2DM

subjects had fewer remaining teeth as comparison to nondiabetics,[43] our result are in agreement with the findings reported by Hintao J et al. and Bacic M et al.[25,40] Kim HK et al. found significant differences in Mean Missing Teeth (MT) in T2DM subjects as compared to non-diabetics.[38,44] Contradictory result was obtained by Lalla E et al. in their study.[31] Oral complications most frequently associated with T2DM subjects include tooth loss, gingivitis, periodontitis and pathologic changes of oral soft tissues.[30,45]

Mean Decayed Missing and Filled teeth among Type 2 DM subjects were 3.69 + 4.62. In the present study, a significant increase in the mean DMFT was seen with an increase in the age of the subjects. Our study demonstrated that 45-50 years age group of study subjects had fewer remaining teeth. Mean Decayed Missing Filled Teeth was more on T2DM subjects as a comparison to non-diabetics. Kanjirath P.P. et al[29] and Albrecht M et al[38] and supported the same finding in their study, which was also consistent with the results of Bacic M et al.[40]

The goal of this study was to evaluate and compare the periodontal health and caries of people without diabetes and those with diabetes. It was found that diabetic subjects manifest a relatively higher degree of periodontal disease when compared to non-diabetics. Meanwhile, there was no difference in caries status of both diabetics and non-diabetics. It is desirable to conduct studies further to explore and clarify the association between diabetes and caries status.

This study has few limitations of its own concerned with present study, being a household survey can at best provide a glimpse of the situation but in order to have comprehensive information on disease dynamics, one should conduct carefully planned longitudinal studies and clinical trials.

5. Conclusion

Periodontal disease in diabetics is more severe, characterized by deep and shallow pockets, while in non-diabetics, it's more common as bleeding and calculus. The loss of attachment is more prevalent in diabetics. The study found no significant difference in coronary and root caries between diabetics and non-diabetics, but it was more prevalent in older individuals. The findings align with global studies, but some are inconsistent, suggesting a need for stronger research on diabetes' role in dental caries and periodontal diseases.

Dental professionals must have comprehensive knowledge of patients' diabetes status, especially diabetic patients with periodontitis. Diabetes treatment teams should also focus on dental care, especially for adult patients. Collaboration between dental surgeons and medical professionals is essential, and cooperation and consultation between all team members is highly recommended.

6. Ethics Approval

Ethical Approval was taken from Rungta Dental College, Bhilai

7. Consent to Participate

Informed Consent was taken from participants.

8. Source of Funding

The authors did not receive support from any organization for the submitted work. There was no funding to assist with the preparation of this manuscript.

9. Conflict of Interest

None.

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Cite this article: Chandrakar M. Assessment of periodontal status and dental caries and other associated risk factors in Type 2 diabetic and nondiabetic subjects of durg city. *J Orofac Health Sci* 2024;11(2):54-62.