



Oral Health Status among Type 2 Diabetes Mellitus patients in Rajasthan Population – A Case Control Study.

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(Received: 11 June 2024

Revised: 16 July 2024

Accepted: 10 August 2024)

KEYWORDS

Diabetes Mellitus, HbA1c, Standard Deviation, Periodontal Index

ABSTRACT:

Background: Diabetes Mellitus is a common endocrine metabolic disorder characterized by chronically increased levels of blood glucose with altered protein, carbohydrate, and lipid metabolisms.

Aims: To assess the oral health status among type 2 diabetes mellitus patients in Rajasthan population.

Objective: To evaluate and compare the oral health among uncontrolled type 2 DM patients and non-diabetic patients, controlled type 2 DM patients and non-diabetic control patients, uncontrolled and controlled type 2 DM patients.

Methodology: 300 patients were selected for the study sample. A brief case history was taken followed by DMFT and periodontal index. Study sample were further divided into 3 equal groups of 100 each on the basis of HbA1c values. Periodontal index and DMFT were recorded. Data collected and recorded were analyzed statistically.

Result: In this study, males outnumbered females with a 1.38: 1 ratio. Females were less diabetic with 47.62% with HbA1c <5.7 as compared to 68 (39.08%) males. The mean DMFT score of cases with HbA1c <5.7 was 3.67 ±1.46, of 5.7-6.4 was 3.87 ±1.42 and that of >6.4 was 3.56 ±1.40. Mean Periodontal Index of cases with HbA1c <5.7 was 2.08 ±1.38, of 5.7-6.4 was 2.03 ±1.49 and that of



>6.4 was 2.17 ± 1.23 .

Conclusion: In this study, no statistical difference was found for the same parameters between Group A (uncontrolled >6.5), Group B (controlled 5.7- 6.4) and Group C (non diabetic <5.7) diabetics. As we have seen there is no caries prevalence among diabetics which might be due to diet and other lifestyle modifications.

INTRODUCTION

Type 2 Diabetes Mellitus (DM) is a chronic metabolic disorder characterized by hyperglycemia.¹ Wild et al predicted the prevalence of diabetes to double globally by 366 million in 2030, with a maximum increase to be seen in India and about 79.4 million individuals to be affected by the disease.² A study done in 2012 showed a higher prevalence of Type 2 DM (17.7%) in the rural population of North Karnataka with a lower prevalence of about (5.2%) in the rural population of Coastal Karnataka.³ Type 2 DM previously termed non-insulin-dependent diabetes mellitus was revised by the American Diabetes Association and the criteria to establish the diagnosis of diabetes was given as a 75-g oral glucose tolerance test with a 2-h value of 200 mg/dL or more, a random plasma glucose of 200 mg/dL or more, with typical symptoms of diabetes or a fasting plasma glucose of 126 mg/dL or more on more than one occasion.⁴ Type 2 DM is characterized by insulin resistance (the cells in the body do not react to insulin) or defective secretion by the beta cells of the pancreas. The function of insulin is to mobilize the uptake of glucose by fat cells, and muscle cells and for the transport of glucose to the liver.⁵

AIMS AND OBJECTIVES

• **Aims-** To assess the oral health status among type 2 Diabetes Mellitus patients in Rajasthan population.

• **Objectives** – 1. To evaluate and compare the oral health among uncontrolled type 2 diabetes mellitus patients and non-diabetic patients.

2. To evaluate and compare the oral health among controlled type 2 diabetes patients and non-diabetic patients.

3. To compare the oral health among uncontrolled and controlled type 2 diabetes mellitus patients.

METHODOLOGY

The present case control study titled “Oral health status among type 2 diabetes mellitus patients in Rajasthan population – a case-control study” was carried out in the Department of Oral Medicine and Radiology at Darshan Dental College and Hospital, Udaipur. The study was conducted on 300 outpatients who visited the Department of Oral Medicine and Radiology. Informed consent was obtained from the study subjects. The patients were divided into 3 groups of 100 patients each according to HbA1c lab reports.

MATERIALS USED FOR THE STUDY-

- Gloves
- Betadine oral rinse
- Cotton rolls
- Syringes
- Test tubes



Photograph no. 1 Shows Materials used for the study



EQUIPMENTS –

- QUO- LAB (HbA1c analyzing unit)



Photograph no. 2 Shows Equipment used for the study

ARMAMENTARIUM –

- Dental chair with illumination
- Kidney tray
- Mouth mirror
- Straight probe
- William’s probe
- Naber’s probe
- Tweezers



Photograph no. 3 Shows Armamentarium used for the study

METHODOLOGY

The study was conducted among 300 patients reporting to the Department of Oral Medicine and Radiology who were satisfying the inclusion and exclusion criteria.

INCLUSION CRITERIA^{6,11}:

- The patient diagnosed with type 2 diabetes mellitus after the evaluation of the HbA1c test.

EXCLUSION CRITERIA^{5,8}:

- The patients with any other systemic diseases, recent history, or currently on medications other than type 2 diabetes mellitus.
- Patients with tobacco, betel nuts, consumption habits.
- Pregnant patients.

The patients reporting to the Department of Oral Medicine and Radiology were subjected to a brief case history questionnaire. Informed consent form was taken from the subjects.

A. INVESTIGATIONS FOR HbA1c TEST^{4,5} -

All the subjects were evaluated for HbA1c values and divided into 3 groups of 100 patient each as follows:

- Group A: (uncontrolled type 2 diabetes mellitus patients) – patients diagnosed with type 2 diabetes mellitus having HbA1c values $\geq 6.5\%$.
- Group B: (controlled type 2 diabetes mellitus) – patients diagnosed with type 2 diabetes mellitus having HbA1c values $\leq 5.7-6.4\%$.
- Group C: (non-diabetic patients)- patients with Hb1Ac $\leq 5.7\%$.

(Reference range of HbA1c according to the American Association of Diabetology) ⁴

Normal value < 5.7%

Prediabetes 5.7% to 6.4%

Diabetes 6.5% or higher



Photograph no.4 Shows Investigations for HbA1c test

Materials and Methods

All patients were subjected to clinical examination following COVID-19 protocols.

B. EXAMINATION OF SALIVARY GLANDS^{13,14}

All the patients were subjected to a complete examination of parotid and submandibular salivary glands for any tenderness, enlargements, swelling, stones, and abscesses.



Photograph no. 5 Shows Examination of Salivary glands

C. EXAMINATION OF ORAL SOFT TISSUES⁸

All the patients were subjected to detailed intra-oral examination for the size, location, color, margins, surface texture, and consistency, if present.

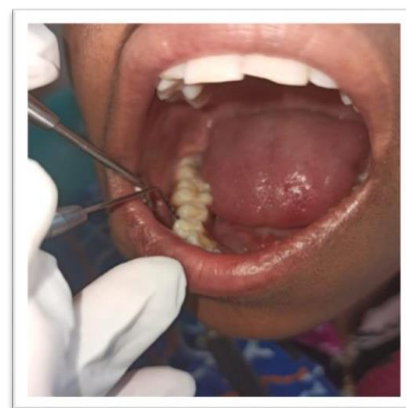


Photograph no. 6 Shows Examination of Oral soft tissues

D. EXAMINATION OF PERIODONTAL TISSUES⁹

1.All the patients were evaluated for bleeding on probing, gingival recession, mobility of the tooth, periodontal pocket, and furcation involvement.

2.Russell's Periodontal Index was assessed. Four gingival units were scored sequentially: the labial and lingual marginal gingival (M units) and the mesial and distal papillary gingival (P units). Scores were added and divided by the number of surfaces giving the sulcus bleeding index.



Photograph no. 7 Shows Examination of Periodontal Tissues



E. EXAMINATION OF DENTAL CARIES⁶

1. All the patients were evaluated for DMFT. DMFT is the sum of the number of

Decayed, missing due to caries, and Filled Teeth in the permanent teeth. The mean

number of DMFT is the addition of individual DMFT values divided by the sum of

the population.

2. The scoring for DMFT was considered as follows:

0.0- 1.1 - Very low

1.2-2.6 - Low

2.7- 4.4 - moderate

4.5- 6.5 - High

6.6> - Very high

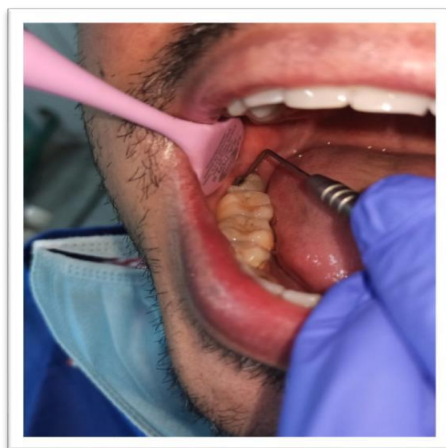
Root caries was examined separately as it is not covered under DMFT.

Dental caries was tested using a mouth mirror and a straight probe.

A white chalky appearance was indicative of early caries.

A brownish-black discoloration/loss of tooth structure were indicative of advanced

dental caries.

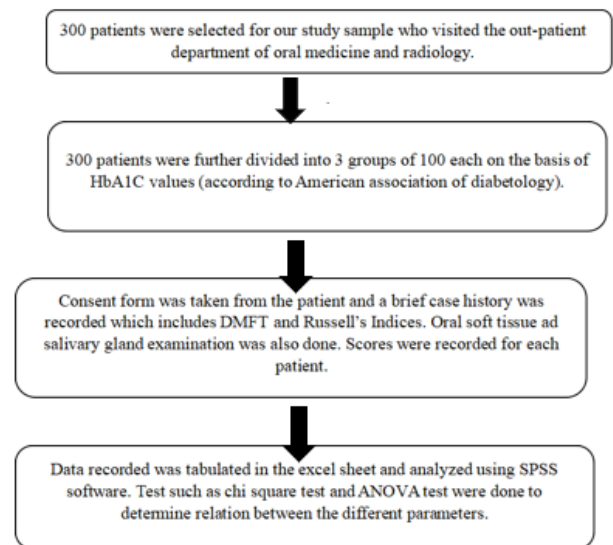


Photograph no. 8 Shows Examination of Dental Caries

STATISTICAL ANALYSIS

The data obtained was entered and tabulated in excel sheet and analyzed using SPSS software. Mean and standard deviation were used to analyze different clinical parameters between three groups: group 1, group 2 and group 3. Chi square test was used to compare observed results with expected results and ANOVA test was used to determine differences between research results from three or more unrelated samples. p - value as 0.5 was considered statistically significant.

SCHEMATIC DIAGRAM OF METHODOLOGY



RESULT

A total of 300 individuals were selected for type 2 diabetes and were divided into 3 equal groups of 100 individuals. After taking case history and based on their HbA1c test reports the patients were divided into three groups of 100 patients each.

Table no.1 Shows the Overall distribution of the study sample.

Reference range according to the American Association of Diabetology⁴,

Normal HbA1c values – less than 5.7%, Prediabetes - 5.7% to 6.4%, Diabetes-6.5% or higher. Group A: (uncontrolled type 2 diabetes mellitus patients) – patients diagnosed with type 2 diabetes mellitus having HbA1c values $\geq 6.5\%$. Group B: (controlled type 2 diabetes mellitus) – patients diagnosed with type 2



diabetes mellitus having HbA1c values $\leq 5.7-6.4\%$.
 Group C: (non-diabetic patients)- patients with Hb1Ac $\leq 5.7\%$.

HbA1c	No. of cases	%
<5.7	100	33.33%
5.7-6.4	100	33.33%
>6.4	100	33.33%
Total	300	100.00%

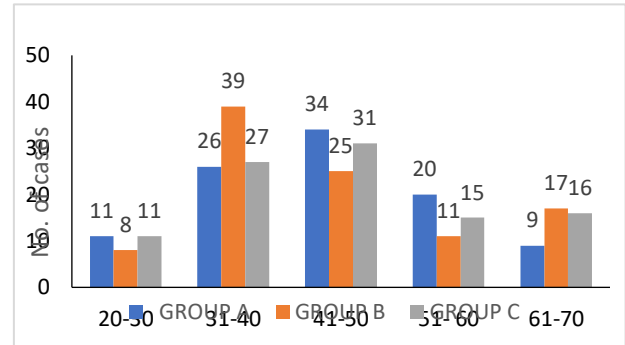
Table no. 1 shows that in our study 100 cases had (33.33%) >6.4 HbA1c followed by 100(33.33%) with HbA1c <5.7 and 100 (33.33%) HbA1c.

Table no. 2 and Graph no.1 Shows the distribution of study sample according to age-wise range.

Age ranges from 20 to 70 yrs. Maximum number of patients were in the age group of 31-50 years, followed by 41-50 years and 51-60.

AGE RANGE (YEARS)	GROUP A	GROUP B	GROUP C	TOTAL
20-30	11	8	11	30
31-40	26	39	27	92
41-50	34	25	31	90
51- 60	20	11	15	46
61-70	9	17	16	42

Table no. 2 shows the distribution of the study sample according to age. Age ranges from 20 to 70 yrs. Maximum number of patients were in the age group of 31-50 years, followed by 41-50 years and 51-60. Chi – 10.37; p =0.21



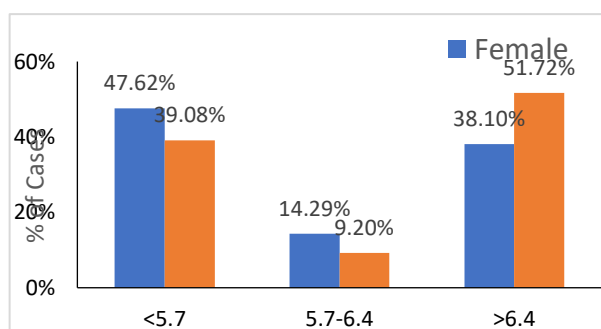
Graph no.1 Shows the distribution of study sample according to age-wise range. It shows that age ranges from 20 to 70 yrs. Maximum number of patients were in the age group of 31-50 years, followed by 51-60 years and 61-70 years.

Table no. 3 and Graph no.2 Shows Age-wise distribution and Gender-wise distribution of the study sample with relation to HbA1c.

All cases were of almost similar age groups (p=0.98, NS). The mean age of cases with HbA1c <5.7 was 46.36 ± 14.36 , of 5.7-6.4 was 47.68 ± 15.48 and that of >6.4 was 47.83 ± 13.56 . The male-to-female ratio in our study was 1.38:1. (M: F), showing an increased number of male patients compared to females. Males had a greater number of diabetics 90 (51.72%) as compared to females 48 (38.10%). Females were less diabetic with 47.62% with HbA1c <5.7 as compared to 68 (39.08%) males. However, the difference was statistically non-significant (p>0.05).

HbA1c	Mean Age	SD
<5.7	46.36	14.36
5.7-6.4	47.68	15.48
>6.4	47.83	13.56
Total	47.18	14.10

Table shows 3 that all cases were of almost similar age groups (p=0.98, NS). The mean age of cases with HbA1c <5.7 was 46.36 ± 14.36 , of 5.7-6.4 was 47.68 ± 15.48 and that of >6.4 was 47.83 ± 13.56 . p value = 0.98(NS).



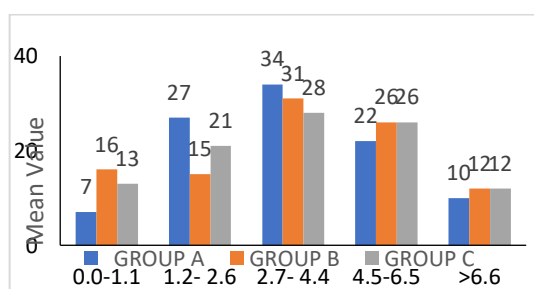
Graph no. 2 shows that in our study males outnumbered females with 1.38: 1 ratio. Males had a greater number of diabetics 90 (51.72%) as compared to females 48 (38.10%). Females were less diabetic with 47.62% with HbA1c <5.7 as compared to 68 (39.08%) males. However, the difference was statistically non-significant ($p>0.05$).

Table no. 4 and graph no.3 shows the comparison of DMFT score among the study population.

The mean DMFT score of cases with HbA1c <5.7 was 3.67 ± 1.46 , of 5.7-6.4 was 3.87 ± 1.42 and that of >6.4 was 3.56 ± 1.40 ; *p-value was 0.50 and was statistically significant

DMFT SCORE	GROUP A	GROUP B	GROUP C	TOTAL
0.0-1.1	7	16	13	36
1.2- 2.6	27	15	21	63
2.7- 4.4	34	31	28	93
4.5-6.5	22	26	26	74
>6.6	10	12	12	34

Table no. 4 Shows the comparison of DMFT score among the study population



Graph no. 3 shows the comparison of DMFT scores among the population. It is compared from the three groups (group A, group B, group C). DMFT score ranges from 0.0 - >6.6.

Table no. 5 Shows the distribution of the study sample according to the DMFT score with relation to HbA1c.

The mean DMFT Score with Relation to HbA1c were of almost similar DMFT scores in all groups ($p=0.5$, NS). The mean DMFT score of cases with HbA1c <5.7 was 3.67 ± 1.46 , of 5.7-6.4 was 3.87 ± 1.42 and that of >6.4 was 3.56 ± 1.4 .

HbA1c	Mean	SD
<5.7	3.67	1.46
5.7-6.4	3.87	1.42
>6.4	3.56	1.40
Total	3.65	1.43

Table no. 5 shows all cases were of almost similar DMFT scores in all groups ($p=0.5$, NS). The mean DMFT score of cases with HbA1c <5.7 was 3.67 ± 1.46 , of 5.7-6.4 was 3.87 ± 1.42 and that of >6.4 was 3.56 ± 1.4 . p value= 0.50(NS).

Table no. 6 and graph no.4 shows the comparison of periodontal indices among the study population.

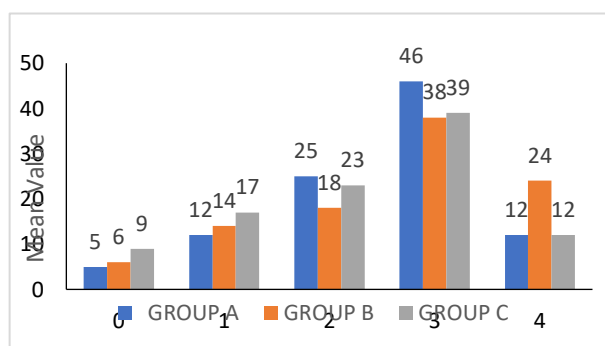
Periodontal indices range from 0-4. Maximum 123 patients had indices of 3 followed by 66 patients with indices 2. Group A show the maximum number having score 3.

Periodontal indices	GROUP PA	GROUP PB	GROUP PC	TOTAL
0	5	6	9	20
1	12	14	17	43
2	25	18	23	66
3	46	38	39	123
4	12	24	12	48

Table no. 6 Shows the comparison of Periodontal Index among study population. It shows a comparison of periodontal indices among the study population.



Periodontal indices range from 0-4. Maximum 123 patients had indices of 3 followed by 66 patients with indices 2. Chi – 9.84; p = 0.24(NS).



Graph no. 4 shows a comparison of periodontal indices among the study population. Periodontal indices range from 0-4. Maximum 123 patients had indices of 3 followed by 66 patients with indices 2.

Table no. 7 Shows the distribution of the study sample according to the Periodontal Index with relation to HbA1c.

Range was of almost similar Periodontal Index in all groups (p=0.79, NS). Mean Periodontal Index of cases with HbA1c <5.7 was 2.08 ±1.38, of 5.7-6.4 was 2.03 ±1.49 and that of >6.4 was 2.17 ±1.23. maximum mean was of group B.

HbA1c	MEAN	SD
<5.7	2.08	1.38
5.7-6.4	2.03	1.49
>6.4	2.17	1.23
Total	2.12	1.32

Table no. 8 Shows the comparison of DMFT score with age-wise ranges among study population.

Maximum patients were in the age group of 41-50 years with DMFT score 0.0-1.1, 1.2-2.6 and 2.7-4.4. Maximum patients with DMFT score 4.5-6.5 and >6.6 were in the age group of 31-40 years. Minimum number

of patients was 1 with DMFT score 1.2-2.6 in the 61-70 years age group.

AGE RANGE	0.0 – 1.1	1.2- 2.6	2.7- 4.4	4.5- 6.5	>6.6	TOTAL
20-30	5	9	13	11	4	43
31-40	6	16	25	26	12	85
41-50	12	21	27	17	7	84
51-60	7	16	15	10	8	56
61-70	6	1	13	10	3	33

Table no. 9 Shows the comparison of DMFT score with gender among study population.

In males’ maximum number of patients 42 had DMFT score 2.7-4.4 followed by 39 in 4.5-6.5. Similarly in females’ maximum number of patients 51 had DMFT score 2.7-4.4 followed by 36 and 35 in 1.2-2.6 and 4.5-6.5 DMFT scores respectively. Chi – 4.42; p=0.35 (NS).

DMFT SCORE	MALE	FEMALE	TOTAL
0.0-1.1	21	15	36
1.2- 2.6	27	36	63
2.7- 4.4	42	51	93
4.5- 6.5	39	35	74
>6.6	20	14	34

Table no. 10 Shows the comparison of the periodontal indices with age-wise ranges among the study population.

Out of 300, maximum 123 patients had indices 3 followed by 66 in indices 2, 48 in indices 4. This depicts that age range of 51-60 had more periodontal problems as compared to the other groups, whereas most people had the score 3. Chi – 14.37; p=0.57 (NS).



AGE RANGE	0	1	2	3	4	TOTAL
20-30	2	5	11	21	5	44
31-40	4	9	16	23	7	59
41-50	5	12	12	25	11	65
51-60	2	13	17	26	12	70
61-70	7	4	10	28	13	62
Total	20	43	66	123	48	300

Table no. 11 shows the comparison of the Periodontal Index with gender among the study population.

Maximum number of patients were found with PI 3 in both males and females. There were almost similar number of patients in both genders with PI 0 to 4. Chi – 0.77; p=0.94 (NS).

PI	MALE	FEMALE	TOTAL
0	12	8	20
1	22	21	43
2	34	32	66
3	61	62	123
4	24	24	48

Table no.11 shows maximum number of patients were found with PI 3 in both males and females. There were almost similar number of patients in both genders with PI 0 to 4. Chi= 0.77; p= 0.94(NS).

DISCUSSION

The present case control study was conducted at Darshan Dental College and Hospital at Udaipur, to evaluate the presence of dental caries, and periodontal disease in the Rajasthan population and to compare the uncontrolled diabetes group (group 1) with the controlled group (Group 2) and non-diabetic group (group 3) individuals with HbA1c levels between the

ranges of more than 6.4%, 5.7%-6.4% and less than 5.7% respectively. A total of 300 individuals were selected of type 2 diabetes and were divided into 3 equal groups of 100 individuals. After taking case history and based on their HbA1c test reports the patients were divided into three groups of 100 patients each (Table 1). (Reference range according to the American Association of Diabetology). Normal HbA1c values – less than 5.7%, Prediabetes -5.7% to 6.4%, Diabetes-6.5% or higher. Group A: (uncontrolled type 2 diabetes mellitus patients) – patients diagnosed with type 2 diabetes mellitus having HbA1c values $\geq 6.5\%$. Group B: (controlled type 2 diabetes mellitus) – patients diagnosed with type 2 diabetes mellitus having HbA1c values $\leq 5.7-6.4\%$. Group C: (non-diabetic patients)- patients with Hb1Ac $\leq 5.7\%$.

In our study, the DMFS (decayed-missing-filled surfaces) index score was used to assess caries because of its high sensitivity and its ability to determine the total caries experience of past and present by recording tooth surfaces involved instead of teeth. The mean DMFT score of cases with HbA1c < 5.7 was 3.67 ± 1.46 , of 5.7-6.4 was 3.87 ± 1.42 and that of > 6.4 was 3.56 ± 1.40 .; (Table 5) (Graph 3) ‘p-value was 0.50 and was statistically significant. The results of the present study are consistent with studies conducted by **JV Bharateesh et al** and **Yousuf Moosa et al (2011)**⁴⁷. It included a study population of 600, diabetic 300 and non-diabetic individuals. The study results showed the prevalence of dental caries to be higher in non-diabetics (32.3%) than in diabetics (13.6 %).

In our study, the male-to-female ratio in our study was 1.38:1. (M: F), showing an increased number of male patients compared to females. Males had a greater number of diabetics 90 (51.72%) as compared to females 48 (38.10%) (Table 3). Females were less diabetic with 47.62% with HbA1c < 5.7 as compared to 68 (39.08%) males. However, the difference was statistically non-significant ($p > 0.05$). This higher prevalence of Type 2 DM in males is consistent with the results of studies conducted by **Anjana RM et al**, **JV Bharateesh et al** and **Anna Nordstrom et al (2017)**⁴⁸. This increased prevalence of type 2 diabetes mellitus in males has been associated with altered factors such as physical characteristics, lifestyle factors, and different



estimates of body adiposity but the actual cause for this gender difference remains unclear.

In the present study, the mean age in Group 1 was 46 years, Group 2 was 47 years and Group 3 was 46 years. (Table 2) (Graph 1). A large community-based study in North India by **Jaya Prasad et al (2016)**⁴⁹ on prevalence and risk factors for diabetes found that the prevalence of DM was significantly higher among those aged between 45 and 69 years of age which is similar to the present study where the majority of the individuals were in the age group of 41-50 years. Another study done by **Mohd Mahmood et al (2018)**⁵⁰ in diabetic individuals showed the incidence of Type 2 DM to be higher among the age group of 41-60 years. The author attributed it to lifestyle modification after 40 years, an increase in stress rate, and various other physical changes in the body.

In the present study, the diabetic patients were further subdivided into Group 1, Group 2 and group 3 based on HbA1c values. The mean DMFS was evaluated (Table 5) (Graph 3) and the 'p-value was derived which was 0.50. The study conducted by **Rakesh Sutariya et al (2015)**⁵¹ who compared oral and dental manifestations in diabetic and non-diabetic individuals after HbA1c estimation along with DMFT (Decayed-Missing-Filling-Teeth) Index and CPI index in diabetic patients and concluded that no statistically significant results present between controlled and uncontrolled diabetic for several teeth, the prevalence of dental caries, endodontically treated teeth, periapical lesions, and restorations.

In the present study, Periodontal Index was done to determine the relationship between periodontal health and diabetes. Periodontal index of all the groups were compared with the HbA1c values. No significant prevalence was noted (Table 7) (Graph 4). In the study conducted by **Paunica et al (2023)**⁴⁵, diabetes mellitus has a detrimental effect on periodontal disease, increasing its prevalence, extent, and severity. In turn, periodontitis negatively affects glycemic control and the course of diabetes.

The hyper-glycaemia seen in diabetes besides damaging various systems in the body also impairs salivary gland function, which leads to a reduction in the salivary flow and changes in saliva's composition.¹⁰

As a consequence, various dental as well as mucosal alterations can occur which include the proliferation of various pathogenic microorganisms, taste alterations, burning mouth, dental caries, coated tongue, and halitosis^{62,63}. The subdivision of diabetics into three groups in our study was done depending on their HbA1c, which measures the average glucose concentration among diabetics and is ideal for monitoring the blood glucose control among our patients^{52,64}.

We conducted a case-control study due to time restraints and other practical difficulties; the study results would have been better if we had done a follow-up study. Qualitative salivary evaluation would have equipped us better to relate oral manifestations to salivary changes. Mucosal lesion assessment was done at a very basic level of clinical identification. Follow-up records and other investigative procedures would have helped us to study the mucosal changes more scientifically among the diabetic group⁵³. Hence, we suggest future studies among type 2 DM patients, to be follow-up studies. Qualitative estimation of salivary composition and detailed mucosal lesion assessment in diabetic patients with a larger sample size might give us more insight regarding oral manifestations in type 2 DM patients^{54,55}.

SUMMARY AND CONCLUSION

In our case control study, which was conducted among the population of Rajasthan showed that males outnumbered females, almost similar incidence of dental caries, no significant incidence of periodontal disease, as compared to non-diabetic individuals.

- No statistical difference was found for the same parameters between Group A (uncontrolled >6.5), Group B (controlled 5.7-6.4) and Group C (non diabetic <5.7) diabetics.
- Males had a greater number of diabetics 90 (51.72%) as compared to females 48 (38.10%).
- Maximum number of patients were in the age group of 31-50 years were suffering from type 2 DM.



- The mean DMFT Score with Relation to HbA1c were of almost similar DMFT scores in all groups.
- Periodontal index was similar for all the cases in relation to HbA1c.

The study concluded that there is no caries prevalence among diabetics which might be due to diet and other lifestyle modification. we can reduce the prevalence of periodontal diseases by education and awareness among these people regarding periodontal diseases. Regular oral hygiene and periodontal treatment can reduce the long-term destruction of supporting tissues. More long-term studies with larger sample size and follow up could be undertaken.

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