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**A RANDOM ASSESSMENT OF DIABETIC CONTROL OF PATIENTS  
VISITING DENTAL HOSPITAL**

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**ABSTRACT**

Diabetes mellitus is defined as a metabolic disorder which causes an increase in blood sugar for a prolonged time period. Early diagnosis of diabetes and prediabetes is essential and recommended for a healthy and better life. Screening is more essential in developing countries like India to reduce late diagnosis. Assessment of blood glucose levels is required prior to procedures to avert complications which can occur. The unnecessary complication can be due to poor diabetes control. Occasionally, there can also be a delay in dental treatment. Poor diabetic control causes major challenges. An assessment of the diabetic control will help identify the burden of dental fraternity, identify patients, improve disease control and avert complications both oral and systemic. The study of this nature will have an enormous public health impact. The study is to raise awareness of diabetes and its prevalence among the population. In this study we assess the diabetic control of patients visiting dental college. The aim of the study is to raise awareness of

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diabetes and its prevalence among the population. This was a retrospective study done under a hospital setting. All the patients' records were collected from June 2019 to March 2020 and were reviewed. The data included patients who had undergone blood glucose tests. The data was tabulated and entered in excel and the data was analysed using SPSS package software.  $p < 0.05$  was considered to be the level of statistical significance, in the study. The assessment for diabetic control of patients visiting a dental hospital was done. There is a significant higher incidence of male patients who reported with diabetes mellitus than female patients. Among the known diabetic about 11.25% of patients are not under any medication. A significant number of patients tested with abnormal results. Screening for diabetes is essential to avoid late diagnosis. Most common age group with unknown diabetes is 40 to 60 years old.

**Keywords: Diabetes; Hyperglycemia; Diabetic Control; Random blood sugar; RBG**

### 1. INTRODUCTION

Diabetes is a metabolic disorder which causes high blood sugar for a prolonged time period [1]. Diabetes affects all age groups and it is one of the main causes which affects mortality and morbidity all over the world [2]. It is characterised by hyperglycemia which results due to defect in both the insulin action and insulin secretion or sometimes either one [3]. Diabetes has complications which can be microvascular and macrovascular [4]. There are several pathogenic processes involved in diabetes. They can be due to the result of autoimmune destruction of the pancreatic beta cell with consequent insulin deficiency to abnormalities that result in resistance to insulin action. The basis of abnormalities in carbohydrate, fat and protein metabolism in diabetes is deficient action of insulin on

target tissues [5]. Insulin secretion impairment and its defects in insulin action frequently coexist in the patient and it is often unclear which is the primary cause for hyperglycemia or if both the abnormalities together cause it. And it is known that nature tries to eliminate anything which is not used or not normal [6].

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 [7]. 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 [8]. Its prevalence in India is higher than the combination of nearly all Western European nations [9]. The prevalence of diabetes is

anticipated to double all over the world, from 171 million in 2000 to 366 million in 2030 with a maximum increase in India [10]. It is predicted that by 2030 diabetes mellitus may affect and burden upto 79.4 million individuals in India, China (42.3 million) and the United States (30.3 million) will also see significant increase in individuals affected by the disease [9]. India currently faces an unforeseeable future in relation to the potential burden that diabetes may impose upon the country. Many influences affect the frequency of the disease throughout the country, and the identification of those factors is important to facilitate changes when facing the health challenges caused by it [11]. The number of patients with diabetes mellitus cases in India are rising at a startling rate. The risk factors peculiar for developing diabetes among Indians include high familial aggregation, insulin resistance, central obesity, and lifestyle changes attributed to urbanisation [12].

Long-term consequences of hyperglycemia are very diverse and affect partially most of the tissues and organs of the organism [13]. The long-term effects of DM include: Retinopathy, Nephropathy,, Cardiovascular disorders and Autonomic and Peripheral Neuropathy [14, 15]. Impairment of growth and susceptibility is certain infection may

also accompany chronic hyperglycemia. Acute and life threatening consequences of uncontrolled diabetes are hyperglycemia with ketoacidosis or the non ketotic hyperosmolar syndrome [16]. Long term complication Retinopathy is with potential loss of vision, nephropathy with risk of foot ulcer and amputations and charcot joints and autonomic neuropathy causing gastrointestinal, genitourinary and cardiovascular symptoms and sexual dysfunction [17, 18]. Patients with diabetes mellitus can also have secondary infections [19]. The triggers for these processes should be studied further [20]. Metabolic diseases like diabetes mellitus follow a sequential pattern and hence are easier to treat than dysplastic conditions [21, 22].

Due to Diabetes mellitus rising to an frightening epidemic level, early diagnosis of diabetes and prediabetes is essential and is recommended [15]. Screening for diabetes and prediabetes in a dental office will provide a crucial benefit to patients and creates interprofessional relationships and collaboration to bring a change and build a care model in which various health care professionals work together to care for a panel of patients with disease [23, 24]. Dental professionals can recognise and find undetected potential dysglycemia and refer

for medical checkup and physician advice. Such interprofessional and patient centered care can contribute to improved health, wellbeing, and quality of life in patients with diabetes [25]. Ely cohort study identified that screening could bring forward the diagnosis of T2DM on the average by 3.3 years. Early identification of at-risk individuals can delay or prevent the onset of T2DM with minimal microvascular complications [26–28]. The microvascular complication can be due to lipid accumulation and can lead to atherosclerosis [29]. Screening for diabetes especially in underdeveloped countries is essential to reduce late diagnosis [30].

The study of this nature will have an enormous public health impact. An assessment of the diabetic control will help identify the burden of dental fraternity, helps us to identify patients with the disease, to improve the disease control and avert complications- both oral and systemic. The main aim of the study is to assess the diabetic control of patients visiting dental college. This would help to know the diabetic control among patients and also help raise awareness of diabetes and its prevalence among the population.

## **2. MATERIALS AND METHODS**

### **2.1 Study Setting**

The study was conducted as a retrospective cross sectional study in a dental hospital setting among the patients visiting Saveetha Dental College, Chennai, Tamil Nadu and was ethically approved by the Institutional Review Board. The study was done in the time period of June 2019 to March 2020. The study sample included both male and female genders with a wide age range but were predominantly South Indian of varied populations due to the geographic limitations.

### **2.2 Data Collection**

This study was done by examining 86000 records of patients who underwent treatment at Saveetha Dental College during the time period of June 2019 to March 2020. All the records of patients who undergo Random Blood Glucose assessment in the in-house laboratory before dental procedures were collected. The inclusion criteria for this study was patients who had undergone RBS assessment prior to the procedures and whose case sheets records were filled. The exclusion criteria for this study was patients who didn't undergo RBS assessment and patients whose case sheets were blank. The data collected from the patients were demographic data (Age, Gender, Marital Status, Occupation, Address). The diagnosis criteria for diabetes was based on blood glucose and symptoms

[31]. In this study the normal range of blood glucose results were 80 to 150 mg/dl. Above 150mg/dl it was considered to be diabetic with high or impaired glucose level and below 80 mg/dl was considered to be hypoglycemic. The age group of the patients were categorised as 1 to 20 years, 20 to 40 years old, 40 to 60 years old and Above 60 years. The final study sample was a total of 3949 patients who had undergone RBS assessment. Any gross incomplete data which had the possibility of bias and could affect the studies was not included. The data was photographically registered for dentolegal documentation, communication and to improve the learning process [32]. All the data collected was cross verified by another examiner.

### 2.3 Data Analysis

Data was entered into a spreadsheet using Excel version 16.37 (Microsoft Corp, Redmond, Wash). The data which was collected was analysed using Statistical Package for Social sciences (SPSS) software, version 1.0.0.1347 64 bit (IBM corp., NY, USA). The data was assessed by being subjected to descriptive analysis with the help of frequencies, percentages, means and the data was also analysed by running descriptive statistics in the form of crosstabs.

The type of analysis done was correlation and association. Univariate analysis was done between individual factors. A nonparametric test - Chi square test of Independence was performed using the same SPSS software to find the statistical significance of the current study. 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.

### 3. RESULTS AND DISCUSSION

The total number of patients in the current study was 3949 patients. All the patients had visited the dental clinic of Saveetha Dental College and Hospital. The patients had undergone Random Blood Glucose Test. Among this study sample 2374 were Male patients (60.12%) and 1574 Female patients (39.86%) and 1 transgender patient (0.03%). The age distribution among the patients was 1 to 20 yrs (7.9%) - 311 out of 3949 patients; 20 to 40 yrs (20.8%) - 822 out of 3949; 40 - 60 yrs (48.6%) - 1918 out of 3949; Above 60 yrs (22.7% ) - 898 out of 3949 patients,  $p < 0.05$  [Table 1]. 40 to 60 years old have significantly higher random blood glucose values when compared to others,  $p < 0.05$  [Table 2].

The RBS results 12.4% were normal while 86.4% were diabetic with impaired blood

glucose results & 1.2% hypoglycemic,  $p < 0.05$  [Figure 1]. Diabetic status of patients was either known to them (26.8%) or was unknown (73.2%) [Figure 2].

Among males, 6.89% had normal blood glucose values, 52.62% had impaired/higher blood glucose values, 0.61% had Hypoglycemic results. In females, 5.55% had normal results, 33.7% had high/impaired blood glucose results, 0.61% had hypoglycemic results, 0.03% transgender had impaired blood glucose results, the diabetic control between males and females was found to be statistically significant  $p < 0.05$  [Figure 3].

Among the known diabetics, 2.33% were of age 20 to 40 years, 16.43% were 40 to 60 years, 8.03% were above the age of 60 years. The age distribution of unknown diabetics were as follows: 7.88% were 1 to 20 years, 18.49% were 20 to 40 years, 32.13% were 40 to 60 %, 19.71% were above 60 years of age,  $p < 0.05$  [Figure 4]. Among the known diabetics patients who were under medication were 23.78% and no medication was 3.01%,  $p < 0.05$  [Figure 5]. Among the Known Diabetic patients under medication- 30.72% had normal results, 55.01% had high or impaired blood glucose results, 3.02% had hypoglycemic results; patients who were not under any medication - 3.50% had normal

results, 7.18% had high glucose results, 0.57 had hypoglycemic results,  $p < 0.05$  [Figure 6]. Patients with known diabetic status, who had normal results- 0.38% were 20 to 40 years, 3.31% were 40 to 60 years, 1.89% were above 60 years of age; patients with diabetic results having high or impaired blood glucose levels - 8.32% were 20 to 40 years, 57.94% were 40 to 60 years, 28.07% were above 60 years of age, patients with hypoglycemia, 0.09% 40 to 60 years of age,  $p < 0.05$  [Figure 7]. Patients with Unknown diabetic history, who had normal results, 2.70% were 1 to 20 years, 4.74% were 20 to 40 years, 5.12% were 40 to 60 years, 2.39% were above 60 years of age; patients with high blood glucose results - 7.61% were 1 to 20 years of age, 19.96% were 20 to 40 years, 38.26% were 40 to 60 years, 17.61% were above the age of 60 years; patients with hypoglycemic results, 0.45% were 1 to 20 years, 0.55% were 20 to 40 years, 0.52% were 40 to 60 years, 0.10% were above 60 years of age,  $p < 0.05$  [Figure 8].

Among the known diabetic, patients with normal results- 3.21% male, 2.61% female; patients with diabetic results (high or impaired blood glucose levels) - 56.33% male, 38% females, patients with hypoglycemic results- 0.09% females,  $p < 0.05$  [Figure 9]. Among the unknown

diabetic history patients, Patients who had normal results- 8.23% male. 6.78% female; patients who had diabetic results due to high or impaired blood glucose levels - 51.26% male, 32.13% female, 0.03% transgender; patients who had hypoglycemic results- 0.83% males and 0.80% females,  $p < 0.05$  [Figure 10].

The statistical software SPSS was used for the descriptive and inferential analysis. Using a non parametric test - chi square test we found the statistical significance of the study. The P value was found to be  $P < 0.05$  which was considered to be the level of statistical significance. Hence the study was statistically significant.

Diabetes mellitus is a disease which occurs due to high blood sugar level. This can be due to insufficient insulin production or insulin inactivity or it can be both the abnormality together [3, 33]. Hyperglycemia which can be even slightly raised blood sugar levels but it adversely affects oral health, manifesting itself in several oral diseases and conditions [25]. The most common oral health problems associated with diabetes are: Periodontal diseases- gingivitis, periodontitis, saliva and salivary gland dysfunction, dental caries, fungal infections like candidiasis, burning sensation and loss of taste perception, oral mucosal diseases like

recurrent aphthous stomatitis and lichen planus, traumatic ulcers and irritation fibroma [34–36].

Recently there has been a certain rise at an alarming level for both oral cancer and diabetes mellitus in Asia in the past decade [37, 38]. In this study we noted that there was male preponderance, which was also seen in the study done in Scotland [39]. It could be due to insulin resistance, men are more insulin resistant even without diabetes [40, 41]. The abnormality seems to be more common in males with a male to female ratio of 2.5:1.0 [42]. Recently it has become more apparent that middle aged male have a more significant chance of having diabetes than females in several other populations [43]. The pattern of age distribution in the prevalence of diabetes mellitus showed that the peak incidence was however observed in the age group of 40 to 60 years but people of all groups are affected ( $p < 0.05$ ). The reason is insulin resistance and impaired pancreatic function due to age leads to Diabetes. Undiagnosed diabetic were 61.08% which was higher than the study done by Borrell *et al* [44]. The reason could be unawareness among patients [45]. Some patients were diagnosed late [46] due to lack of information. The overall frequency of diabetes mellitus in the general public is low

but high in the patients who are aged more than 25 years and it further increases in those aged more than 40 years [47]. To avoid any complications, in these patients a well-balanced diet along with proper oral hygiene is essential [48].

The state wise percentage among India, Chennai had 13.5% Diabetes prevalence. The range of Diabetes value was 55mg/dl to 558 mg/dl wider when compared to Barasch *et al* [49], varied populations with normal and uncontrolled. The upper limit of uncontrolled diabetic value is due to lack of periodic awareness and assessment. The mean RBS value - 152.22mg/dl similar to Harase *et al* 2015 [50]. Among the known diabetic about 55.01% of them under medication had impaired glucose levels. The reason for this could be due to poor adherence to the prescribed medication can also be a factor for impaired glycemic control [51]. The lack of periodic testing causes the patients to continue with the same initial medication prescribed during the assessment which can lead to hyperglycemia and complications. The glycemic control can be achieved only when there is a proper use of the anti-diabetic regimen medications regularly with good adherence to the treatment prescribed [52]. Among the known diabetic about 11.2% of them don't take their medication. This can be

due to critical beliefs [53], low education & low income [54], treatment complexity. About 61.08% of the patients are unknown diabetics with impaired and higher blood glucose levels. This may be due to the lack of awareness and education about diabetes, its symptoms and its screening procedures. A study done by Deepa *et al* reported that 75.5% of the population in Chennai were aware of the condition [55]. Early detection and prompt diagnosis leads to a better prognosis of the disease and for better health and successful treatment [56].

This study will have a huge impact on the public by raising awareness by knowing the prevalence of diabetic control among all the age groups and different genders. This study helps in giving valuable information to oral health planners for proposing strategies to help in development of dental health management. It will assist the clinician to be ready and to be prepared for diagnosing diabetic patients and knowing how to treat them.

The study was limited by a few factors. There were geographic limitations to the study which had more South Indian population and this study was a cross sectional and uncentered study. The sample size and duration of the study can be expanded for better results. Also for precise

diagnosis HbA1c test can be used for future studies. For further scope of the study larger sample size and inclusion of different ethnicity will give better results.

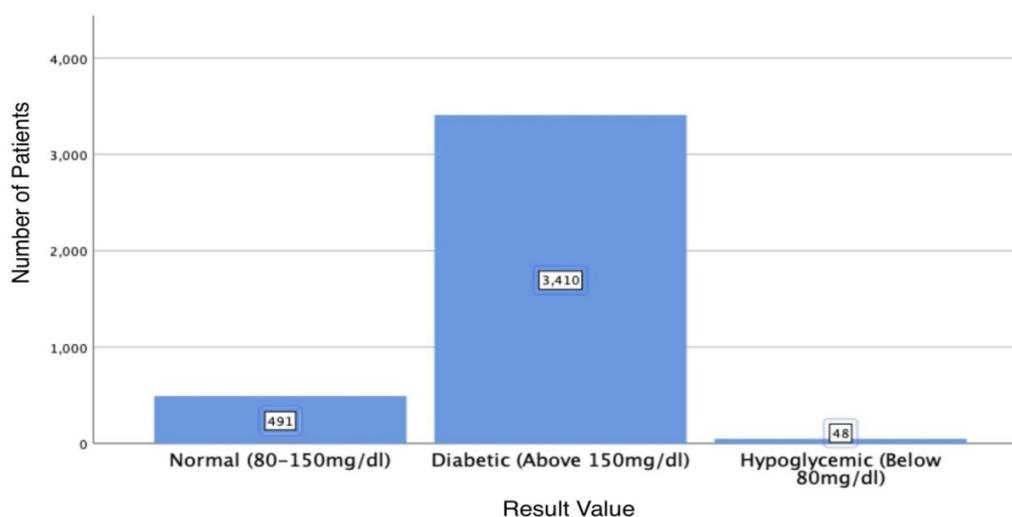
Longitudinal and periodic studies can be done to evaluate the diabetic control of the patients.

**Table 1:** Table depicting the distribution of different age groups in random blood sugar tested patients. There were a higher number of patients in the age group 40 to 60 years (48.6%)

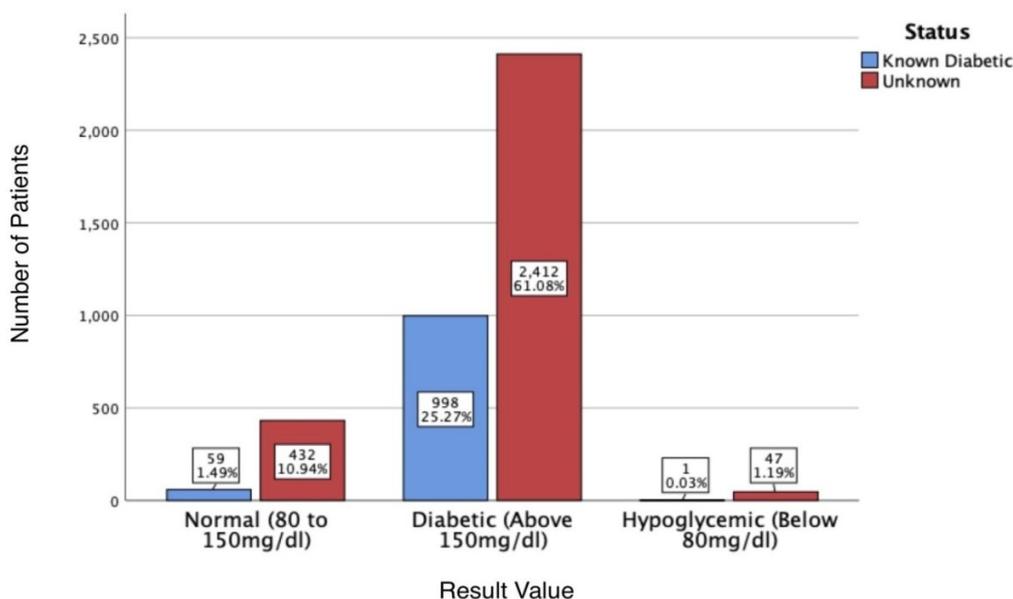
AGE	FREQUENCY	PERCENTAGE
1 to 20 years	311	7.9%
20 to 40 years	822	20.8%
40 to 60 years	1918	48.6%
Above 60 years	898	22.7%

**Table 2:** Table depicting the distribution of different age groups in random blood sugar tested patients with their RBS test results. There is a significant higher incidence in the age group of 40 to 60 years among the random blood sugar tested diabetes mellitus patients than the other age groups (Chi square test,  $p \leq 0.05$ )

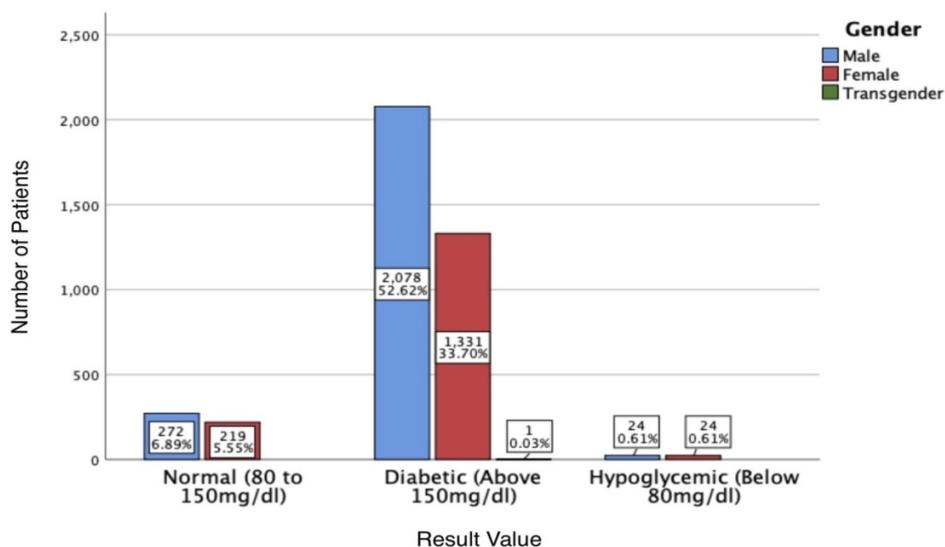
AGE	NORMAL (80-150mg/dl)	DIABETIC (>150mg/dl)	HYPOGLYCEMIC (<80mg/dl)
1 to 20 years	78	220	13
20 to 40 years	141	665	16
40 to 60 years	183	1719	16
Above 60 years	89	806	3
TOTAL	491	3410	48



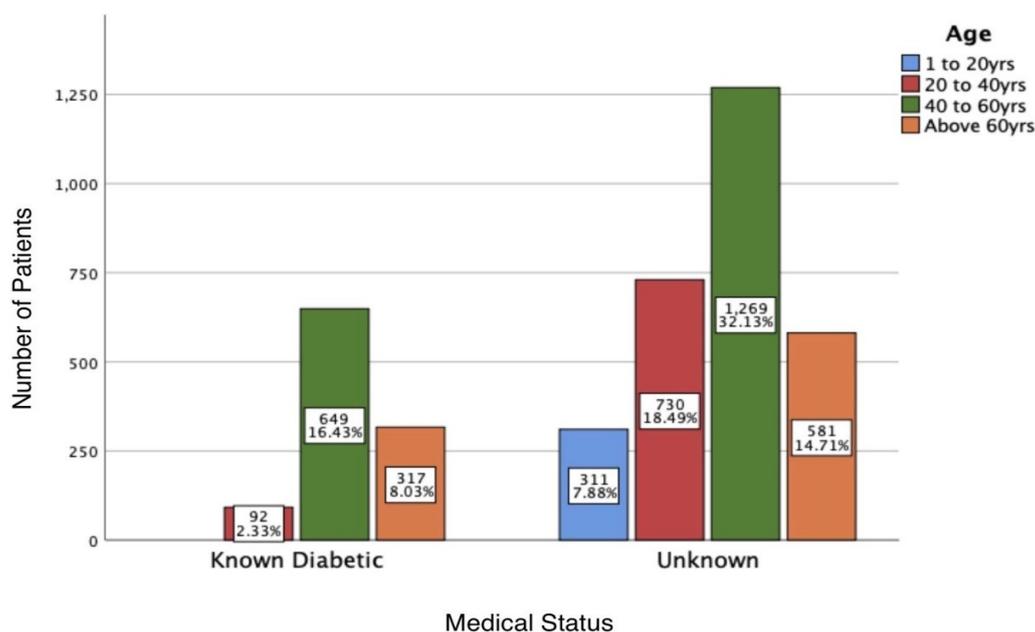
**Figure 1:** Bar graph showing the distribution of random blood sugar results in tested patients across the scale of blood glucose level in the x axis and number of patients in the y axis. There were 491 patients who had normal blood glucose results, 3410 patients had high or impaired blood glucose results and 48 patients had hypoglycemia



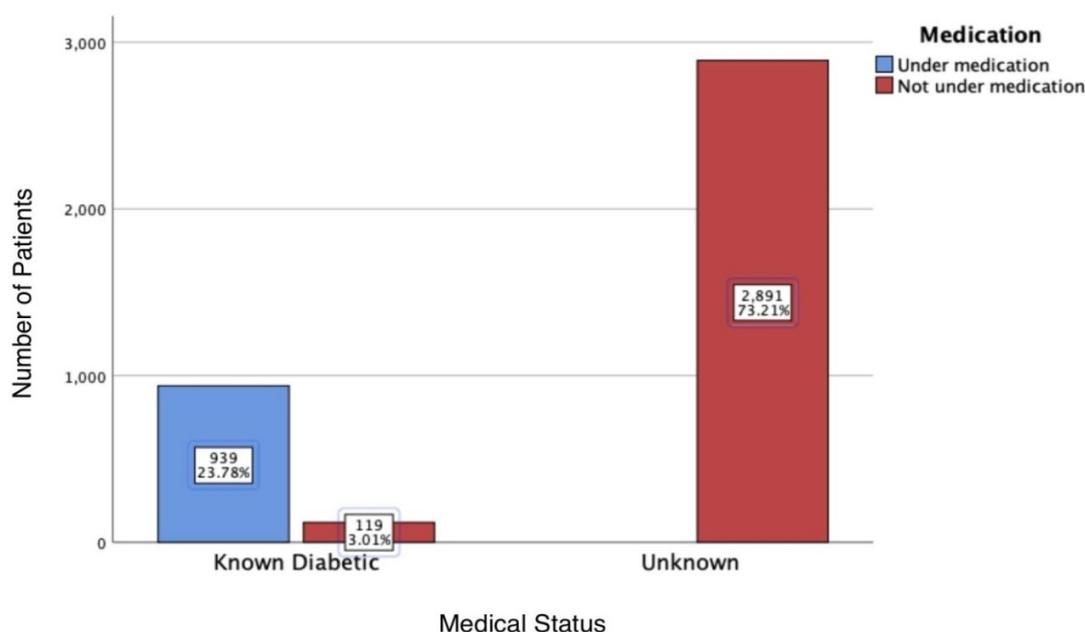
**Figure 2:** Bar graph showing the distribution of random blood sugar results and the diabetic status in tested individuals across the scale of random blood sugar results in the x axis and number of patients in the y axis. The known diabetic patients were represented by blue colour and unknown diabetic patients were represented by red colour. There were more number of unknown diabetic patients who had high blood glucose results (61.08%) among the random blood sugar tested patients. Chi square test was done and p value was found to be 0.00 (p value <0.05, Statistically Significant)



**Figure 3:** Bar graph showing the gender distribution in random blood sugar tested patients across the scale of random blood sugar results in x axis and number of patients in the y axis. Male patients were represented by blue, female patients were represented by red and transgender patients were represented by green. There were more male patients who reported with diabetes mellitus with high or impaired blood glucose results (52.62%) than the female patients. Chi square test was done and p value was found to be 0.00 (p value <0.05, Statistically Significant)



**Figure 4:** Bar graph showing the distribution of different age groups and diabetic status in random blood sugar tested patients across the scale of diabetic status in the x axis and number of patients in the y axis. Patients aged 1 to 20 years were represented by blue colour, 20 to 40 year patients were represented by red colour, 40 to 60 year patients were represented by green colour and patients who were above 60 years were represented by orange colour. There were more patients in the age group of 40 to 60 years (32.13%) among the random blood sugar tested diabetes mellitus patients than the other age groups. Chi square test was done and p value was found to be 0.00 (p value <0.05, Statistically Significant)



**Figure 5:** Bar graph showing the distribution of diabetic status and medication status in the random blood sugar tested patients across the scale of diabetic status in the x axis and number of patients in the y axis. Patients who were under medications for diabetes were represented by blue colour and patients who were not under any medication for diabetes were represented by red colour. There were more patients who were under medication in known diabetic patients (23.78%) among the random blood sugar tested patients. Chi square test was done and p value was found to be 0.00 (p value <0.05, Statistically Significant)

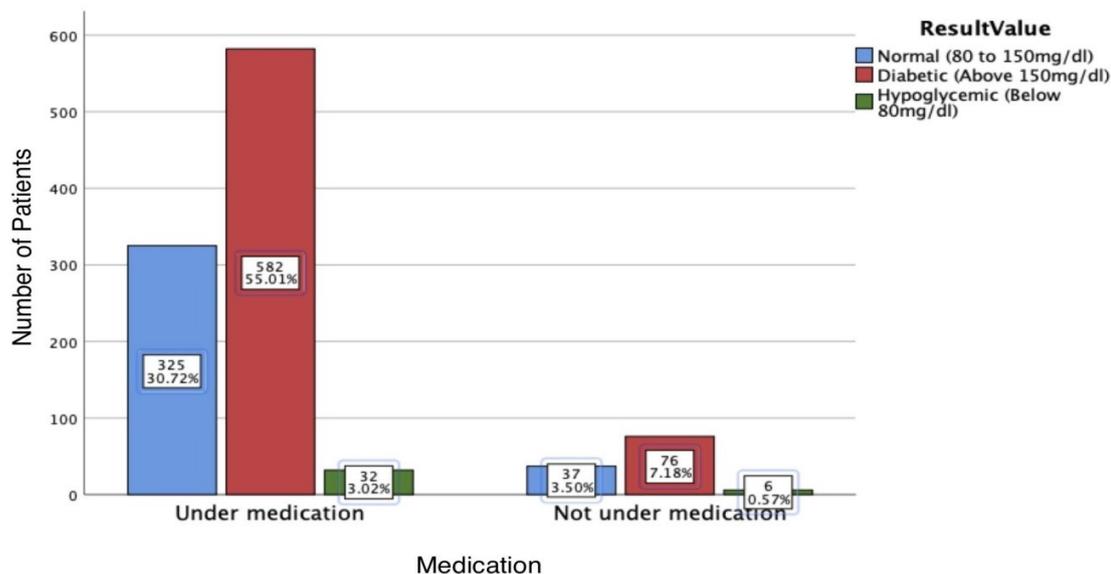


Figure 6: Bar graph showing the distribution of random blood sugar results and the medication status among the tested patients across the scale of medication status in the x axis and number of patients in the y axis. Patients with normal blood glucose results value of 80 to 150 mg/dl were represented by blue colour, patients with high or impaired blood glucose values were represented by red colour and patients who had blood glucose values less than the normal were represented by green colour. There were a higher number of diabetic patients who were not under medication (55.01%) among the random blood sugar tested diabetes mellitus patients. Chi square test was done and p value was found to be 0.00 (p value <0.05, Statistically Significant)

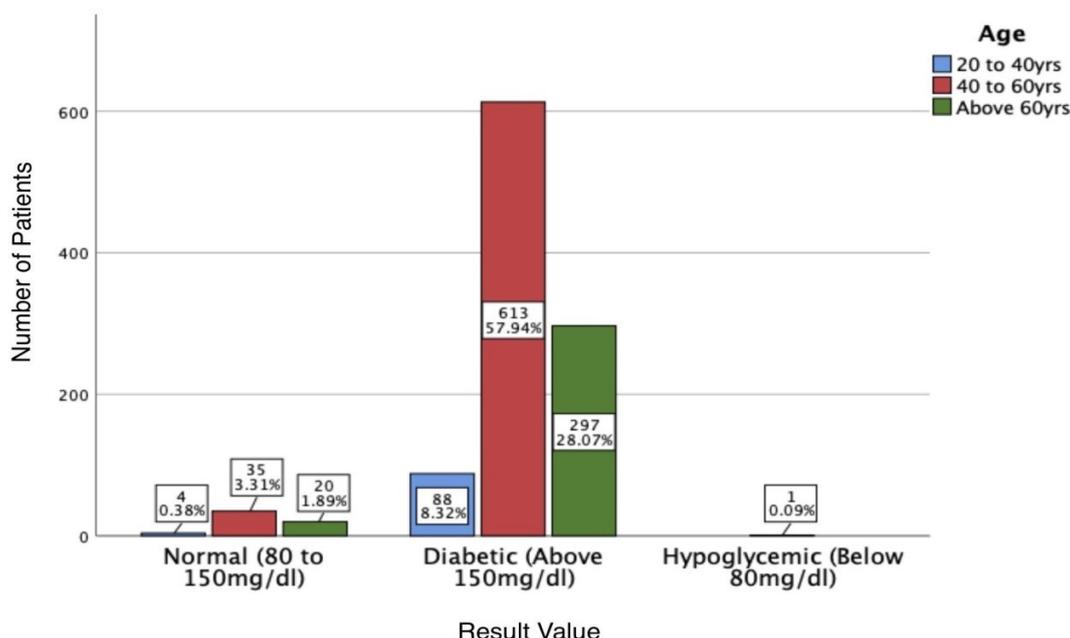
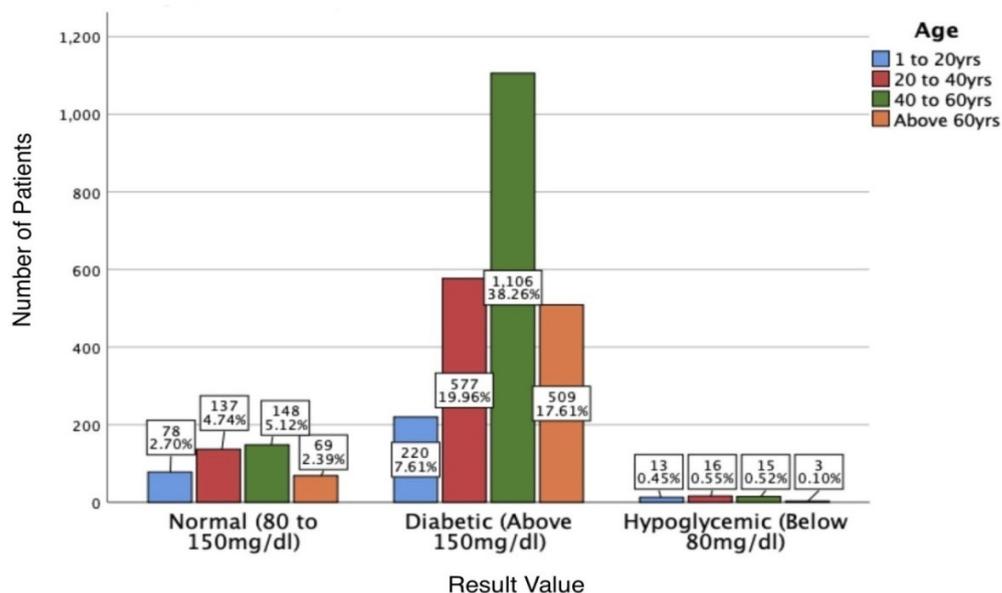
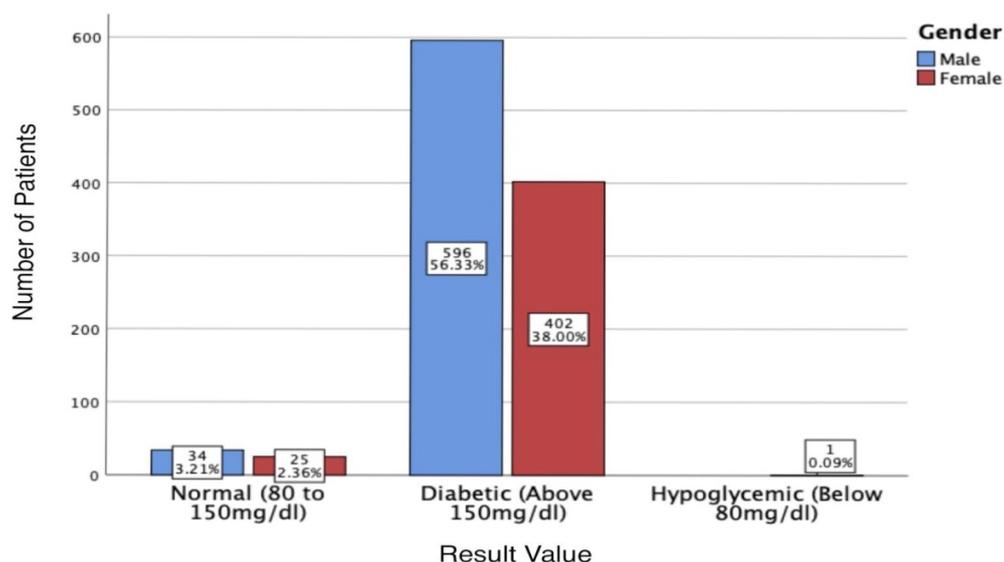


Figure 7: Bar graph showing the distribution of different age groups in known diabetic random blood sugar tested patients with the random blood glucose results across the scale of random blood sugar results in the x axis and number of patients in the y axis. Patients aged 20 to 40 years were represented by blue colour, 40 to 60 years patients were represented by red colour, and patients who were above 60 years were represented by green colour. There were more patients in the age group of 40 to 60 years among the known diabetic patients who had diabetic results (57.94%) in the random blood sugar testing when compared to the others. Chi square test was done and p value was found to be 0.00 (p value <0.05, Statistically Significant)



**Figure 8:** Bar graph showing the distribution of different age groups in No/Unknown diabetic status patients across the scale of random blood sugar test results in the x axis and number of patients in the y axis. Patients aged 1 to 20 years were represented by blue colour, 20 to 40 year patients were represented by red colour, 40 to 60 year patients were represented by green colour and patients who were above 60 years were represented by orange colour. There were more patients with diabetes mellitus in the age group of 40 to 60 years (38.26%) among the random blood sugar tested diabetes mellitus patients than the other age groups. Chi square test was done and p value was found to be 0.00 (p value <0.05, Statistically Significant).



**Figure 9:** Bar graph showing the gender distribution in known diabetic random blood sugar tested patients with the random blood glucose results across the scale of random blood sugar results in the x axis and number of patients in the y axis. Male patients were represented by blue colour and female patients were represented by red colour. There were more number of male patients among the known diabetic patients who had diabetic results (56.33%) in the random blood sugar testing when compared to the others. Chi square test was done and p value was found to be 0.00 (p value <0.05, Statistically Significant)

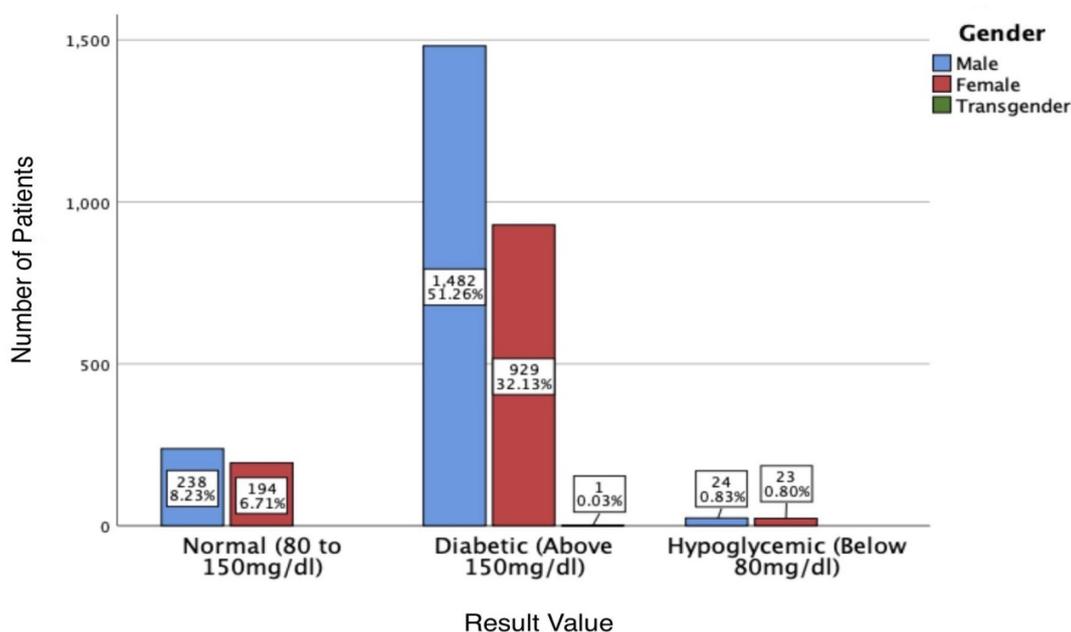


Figure 10: Bar graph showing the gender distribution in No/Unknown diabetic random blood sugar tested patients with the random blood glucose results across the scale of random blood sugar results in the x axis and number of patients in the y axis. Male patients were represented by blue female patients were represented by red and transgender patients were represented by green. There were more number of male patients among the unknown diabetic patients who had diabetic results (51.26%) in the random blood sugar testing when compared to the others. Chi square test was done and p value was found to be 0.00 (p value <0.05, Statistically Significant)

#### 4. CONCLUSION

Within the limitations of the study, a significant number of patients tested with abnormal results. Most common age group with unknown diabetes is 40 to 60 years old. Routine blood glucose testing in dental hospitals for the populations at risk or diagnosed with diabetes will be beneficial to the community and dental practices can provide a setting for pre-diabetes and diabetes screening and monitoring. Screening for diabetes is essential to avoid late diagnosis which can cause further problems.

#### 5. Acknowledgement

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#### 6. Conflict of Interest

Authors declare that we do not have any conflict of interest.

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