PREVALENCE OF DIABETES MELLITUS AMONG PATIENTS VISITING DIFFERENT OUTPATIENT DEPARTMENTS (OPDs) OF A PRIVATE DENTAL COLLEGE HOSPITAL, CHENNAI, INDIA - A RETROSPECTIVE STUDY

Type of Manuscript: Original research

Running title: Prevalence of diabetes mellitus among patients visiting different outpatient departments (OPDs) of a private dental college hospital

Authors

Vaishnavi Devi. B
Saveetha Dental College and Hospitals, Saveetha Institute of Medical and Technical Sciences, Saveetha University Chennai, India
Email Id: 151701024.sdc@saveetha.com
Contact no: +91 7299254666

Pratibha Ramani (Corresponding Author)
Head of Department Department of Oral Pathology, Saveetha Dental College and Hospitals,
Saveetha Institute of Medical and Technical Sciences, Saveetha University
Chennai, India
Email Id: pratibaramani@saveetha.com
Contact no: +91 9841414603

Delphine Priscilla Antony.S
Senior Lecturer Department of Conservative Dentistry and Endodontics, Saveetha Dental College and Hospitals, Saveetha Institute of Medical and Technical Sciences, Saveetha University
Chennai, India
Email Id: delphine.sdc@saveetha.com
Contact no: +91 9790856274

ABSTRACT

Diabetes mellitus is a group of physiological dysfunctions characterised by increased blood glucose level resulting directly from insulin resistance or impaired insulin secretion leading to micro and macrovascular complications. The oral complications of diabetes mellitus includes increased incidence of dental caries, dry mouth, burning mouth syndrome and periodontitis. Assessment of blood glucose levels is essential prior to any specialised procedure to avert any
further oral and systemic complications. Screening of diabetes mellitus condition has become a necessity in developing countries and study of this nature will have enormous public health impact. The aim of this study is to assess the prevalence of diabetes mellitus in patients visiting different outpatient departments of private dental college hospital, Chennai. All the cases referred from the month of June 2019 to March 2020 for random blood sugar tests were chosen for the study. Data was collected from the dental hospital record system. Result data was tabulated in excel and imported to SPSS for correlation and association. \( P<0.05 \) was considered to be the level of statistical significance in this study. Within the limits of the present study, diabetes mellitus prevalence in random blood sugar tested patients is 33.3% with a higher male incidence and more prevalent among the age group of 41 to 60 years. Knowledge about the prevalence of diabetes mellitus in the patients visiting dental hospital will be helpful to the clinician to prevent any further complications before any specialised procedure.

Key words
Diabetes mellitus; hyperglycemia; insulin resistance; oral complications; random blood sugar

1. INTRODUCTION
Diabetes mellitus is a chronic metabolic disease characterized by hyperglycemia due to defects in insulin secretion, insulin action, or both\(^1\). Defects in insulin secretion and in insulin action frequently coexists in the same patient. It affects all age groups and it is the main cause of mortality and morbidity all over the world due to its microvascular and macrovascular complications. Various pathologic processes are involved in the development of diabetes mellitus condition. These processes range from autoimmune destruction of the pancreatic \(\beta\)-cells with consequent insulin deficiency to abnormalities that result in resistance to insulin action\(^2,3\). Diabetes mellitus can be classified into two main types: (i). Type 1 diabetes, also called insulin dependent diabetes mellitus, is caused by impairment of insulin secretion by beta cells of the pancreas. (ii). Type 2 diabetes, also called non-insulin dependent diabetes mellitus, is caused by decreased sensitivity of target tissues to insulin\(^4\). Type 1 diabetes represents about 10% of diabetes mellitus cases all around the world\(^5\). Although it affects all age groups, the majority of individuals are diagnosed either at the age of 4 to 5 years or in their early adulthood\(^6\). Type 2 diabetes is the predominant form of diabetes and accounts for about 90% of all cases of diabetes mellitus\(^7\). According to the World Health Organization (WHO) held in 2003, India has reported with 32 million diabetic individuals, currently has the highest incidence of diabetes worldwide\(^3\). It’s rising highly in epidemic levels in recent days making India the diabetic capital of the world. The numbers are increasing at an alarming rate\(^8\). The major risk factors distinct in developing diabetes mellitus among Indians include high familial aggregation, obesity, genetics and lifestyle changes due to urbanization\(^9\). Advancements in technology and communication systems have greatly affected and shaped modern society leading to a sedentary lifestyle\(^10\). India currently faces an uncertain future in relation to the potential burden that diabetes mellitus may impose on the country.

The common symptoms of hyperglycemia include frequent urination, excessive thirst, extreme hunger, sometimes weight loss and blurred vision\(^11\). Impairment of growth and susceptibility to certain infections may also accompany chronic hyperglycemia\(^12\). It is a universally known fact that nature tries to eliminate anything that is not normal\(^13\). Acute, life-threatening consequences of uncontrolled diabetes are hyperglycemia with ketoacidosis or the nonketotic hyperosmolar
Possible complications of chronic diabetes mellitus includes retinopathy with potential loss of vision; nephropathy resulting in renal failure; peripheral neuropathy with risk of foot ulcers, amputations, and autonomic neuropathy causing gastrointestinal, genitourinary, and cardiovascular symptoms and sexual dysfunction. Dental implications of diabetes mellitus is well known. Various soft tissue abnormalities are reported to be associated with diabetes mellitus in the oral cavity. Periodontal diseases (periodontitis and gingivitis), salivary gland dysfunction leading to a reduction in salivary flow, changes in saliva composition and taste dysfunction are the common oral complications of diabetes mellitus. Whole saliva represents a complex balance among local and systemic sources. This allows for the application of saliva in the diagnosis not only for salivary gland disorders but also for oral diseases and systemic conditions. Due to the increased physiological stress and impaired immunity there is a high incidence of oral fungal and bacterial infections reported in patients with diabetes mellitus. In addition, delayed wound healing, mucosal neurosensory disorders, dental caries and tooth loss are some of the common complications in patients with diabetes mellitus. Prolonged and chronic hyperglycemia leads to increased secretion of proinflammatory cytokines such as tumour necrosis factor-α and prostaglandin E. Altered immune function in these conditions causes impaired polymorphonuclear leukocyte function facilitating bacterial persistence and accumulation of advanced glycation end products in the tissue. Protracted wound healing of the oral mucosa in patients with diabetes mellitus may be attributed to factors like delayed vascularisation, minimised blood flow, decline in innate immunity, decreased growth factor production, and psychological stress. Metabolic disorders like diabetes mellitus follow a proper predictable sequential progression unlike the dysplastic conditions and hence the treatment is easier. Diabetes mellitus negatively affects all the age groups but more common in the fourth to fifth decade of life. The overall prevalence of diabetes mellitus in the general population is low but significantly high in adults aged more than 25 years and further increased in those aged more than 40 years. For some reasons, the condition seems to be more common in males with a male to female ratio of 2.5:1.0. Hence, screening and diagnosing it at an early stage especially for middle aged men is an important requisite.

An assessment of prevalence of diabetes mellitus among patients visiting dental college will help us to identify the burden of dental fraternity and also to improve disease control. It helps us in disease identification followed by management to avert further systemic and oral complications. Patients with diabetes mellitus have high chances of implant failure, chronic periodontitis leading to delay in extraction procedure. This study will help in raising awareness of the condition and in achieving precise diagnosis followed by treatment. Certain recommendations to the dental clinicians can be given for some specialised or high risk procedures based on the inference of this study. The aim of this study is to assess the prevalence of diabetes mellitus in patients visiting different Outpatient departments (OPDs) of a private dental college hospital, Chennai.

2. MATERIALS AND METHODS
2.1 Study setting
The present study was conducted as a retrospective cross sectional study on the prevalence of diabetes mellitus in the patients visiting the dental hospital. A randomised sample of healthy patients who had been tested for random blood sugar values were chosen for the study. The study took place in a private college hospital setting within the university. The retrospective data
obtained from the institution was being ethically approved (ethical approval number: SDC/SIHEC/2020/DIASDATA/0619-0320) and the number of people involved in the study includes 3 members - Guide, researcher, reviewing expert.

2.2 Sampling
A total of 86000 patient case records were reviewed and analysed for the study. All the cases referred for random blood sugar tests to check for diabetes mellitus from the month of June 2019 to March 2020 were included for the study. The records of all patient data were reviewed from initial to last and were arranged in chronological order. Sample size n = 3982 patients. Normal range of random blood glucose level is 80 to 150 mg/dl. Cut off value for diabetes mellitus is 150 mg/dl and above. All the blood sugar report data were properly reviewed and cross verified by another examiner. Sampling bias was minimised by simple random sampling. Internal validity is applicable to the study.

2.3 Data analysis
The collected data includes both normal and diabetes mellitus patients undergoing blood glucose tests. Gross incomplete data was excluded as it affects the study. Excel tabulation of all the verified data and importing to the Statistical Package for Social Sciences (SPSS) software, version 1.0.0.1327 64 bit edition (IBM corp., NY, USA) for the statistical tests was done. The data was assessed by being subjected to descriptive analysis with the help of frequencies, percentage and analysed by running descriptive statistics in the form of crosstabs. Independent variables in the study include ethnicity, age, frequency and gender and the dependent variables include diabetes mellitus, blood sugar levels. Non parametric test - Chi square statistical test was done and the results were correlated and associated.

3. RESULTS AND DISCUSSION
The study evaluated the prevalence of diabetes mellitus among the patients visiting private dental college. A total number of 3982 patients' blood glucose reports were included in this study. The statistical software SPSS was used for the descriptive and inferential analysis. Results on categorical measurement were presented in percentage (%). Level of significance was predetermined at the probability value of $P \leq 0.05$ and any value $\leq 0.05$ was considered to be statistically significant.

The age prevalence in random blood sugar tested patients infer that 8.3% in the age group of 1 to 20 years and 20.7% in the age group of 21 to 40 years have tested random blood sugar. In the age group of 41 to 60 years, 48.2% and 22.2% above the age group of 60 years have tested for random blood sugar (Figure 1). The blood glucose report shows that below the age of 20 years all the patients are normal and in the age group of 21 to 40 years 22% of patients have borderline diabetes mellitus condition and in the age group of 41 to 60 years 41% of patients have been significantly reported with diabetes mellitus. Above the age group of 60 years 35.7% are diabetic with the remaining patients being predominantly normal. It shows that 41 to 60 years show more prevalence of diabetes mellitus (Figure 2). P value is $p=0.001$ and hence it is statistically significant.

Gender prevalence in the Random blood sugar tested patient shows that the 60% male patients, 39% female patients and 1 transgender patient has reported (Figure 3). There is an male prevalence in the random blood sugar levels. Among 3982 patients, 38% male patients have been reported with diabetes mellitus condition and 62% male patients have reported normal. 68% of female patients have reported normal and 32% of female patients have reported with diabetes mellitus (Figure 4). P value is $p=0.001$ and hence it is statistically significant.
Normal range of random blood glucose level is 80 to 150 mg/dl. Cut off value for diabetes mellitus is 150 mg/dl and above. Diabetes mellitus prevalence among the random blood sugar tested patients shows that 33.5% are diabetic and the remaining 66.5% are normal (Figure 5). P value is $p=0.001$ and hence it is statistically significant. Clinic prevalence of random blood sugar tested patients shows that 61% patients have been reported from the graduate (UG) clinic and 38.9% patients from postgraduate (PG) clinics (Figure 6). 51% of patients reported from the graduate clinics are known to be diabetic and the remaining 49% patients are normal. Also, 47% of patients reported from the postgraduate clinics are diabetic and the rest 53% patients being normal (Figure 7). P value is $p=0.001$ and hence it is statistically significant. This data shows there is a high incidence of diabetes mellitus among the patients reported from the graduate clinics. The probability value is $p=0.001$ for the study hence the study was statistically significant (Table 1).

![Bar graph showing the distribution of different age groups in the random blood sugar tested patients. X axis represents the age group and y axis represents the number of patients across the scale of patient count in the y axis and age group in the x axis. There is a significant higher incidence of patients in the age group of 41 to 60 years testing for random blood glucose values. Chi square statistical test was done and the p value was found to be 0.001 (p value ≤ 0.05, statistically significant).](image-url)
Figure 2. Bar graph showing the distribution of different age groups in random blood sugar tested patients. X axis represents the age prevalence in random blood sugar tested patients and the y axis represents the number of patients. The blue colour represents the 1 to 20 years age group, red colour represents the 20 to 40 years, green colour represents the 40 to 60 years, and orange colour represents above 60 years age group. There is a significant higher incidence of diabetes mellitus in the age group of 41 to 60 years than the other age groups. Chi square statistical test was done and the p value was found to be 0.001 (p value ≤0.05, statistically significant).
Figure 3. Pie chart showing the gender distribution in random blood sugar tested patients. The blue colour represents the male patients and red colour represents the female patients. There is a significantly higher incidence of male patients reporting for the random blood sugar test. Chi square statistical test was done and the p value was found to be 0.001 (p value ≤0.05, statistically significant).
Figure 4. Bar graph showing the gender distribution in random blood sugar tested patients. X axis represents the gender prevalence in random blood sugar tested patients and y axis represents the number of patients. The blue colour represents the male patients and red colour represents the female patients. There is a significantly higher incidence of male patients reported with diabetes mellitus than the female patients. Chi square statistical test was done and the p value was found to be 0.001 (p value ≤ 0.05, statistically significant).
Figure 5. Bar graph showing the prevalence of diabetes mellitus condition in random blood sugar tested patients. X axis represents the random blood sugar test reports and the y axis represents the number of patients. There is a significant incidence of diabetes mellitus among the patients reporting for the random blood sugar tests. Chi square statistical test was done and the p value was found to be 0.001 (p value $\leq 0.05$, statistically significant).
Figure 6. Bar graph showing the clinic prevalence in random blood sugar tested patients. X axis represents the clinic name and y axis represents the number of patients. There is a significant higher incidence of patients reporting from the graduate clinic for the random blood sugar tested patients than the postgraduate clinic. Chi square statistical test was done and the p value was found to be 0.001 (p value ≤ 0.05, statistically significant).
Figure 7. Bar graph showing the clinic prevalence in random blood sugar tested patients. X axis represents the clinic prevalence in random blood sugar tested patients and y axis represents the number of patients. The blue colour represents the graduate clinic and red colour represents the postgraduate clinic. There is a significantly higher incidence of patients reporting from the graduate clinic with diabetes mellitus than the postgraduate clinic. Chi square statistical test was done and the p value was found to be 0.001 (p value ≤ 0.05, statistically significant).

Test Statistics

<table>
<thead>
<tr>
<th></th>
<th>Age</th>
<th>Gender</th>
<th>ClinicName</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chi-Square</td>
<td>1343.905(^a)</td>
<td>159.560(^b)</td>
<td>136.036(^c)</td>
</tr>
<tr>
<td>df</td>
<td>3</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Asymp. Sig.</td>
<td>.000</td>
<td>.000</td>
<td>.000</td>
</tr>
</tbody>
</table>

\(^a\) 0 cells (0.0\%) have expected frequencies less than 5.

The minimum expected cell frequency is 995.5.
b. 0 cells (0.0%) have expected frequencies less than 5. The minimum expected cell frequency is 1990.5.

c. 0 cells (0.0%) have expected frequencies less than 5. The minimum expected cell frequency is 1991.0.

Table 1. Table showing the non parametric Chi square test analysis of the study. The test results showed the probability value to be $\leq 0.05$. Hence, the study is statistically significant.

Diabetes mellitus is a polygenic disorder and maybe a cluster of metabolic disorders within which there are high glucose levels over a protracted amount. It is associated with disturbances in the carbohydrates, lipid, and protein metabolism. Diabetes is gaining the status of a potential epidemic in India with more than the 65 million diabetes mellitus individuals currently diagnosed with the disease. Its prevalence is higher than in nearly all Western European nations. The trends in epidemiology of oral cancer and systemic conditions like diabetes mellitus in Asia in the past decade (2000-2012) shows an alarming increase in number. Long term consequences of hyperglycemia are very heterogeneous and affect all the tissues and organs of the body partially. Ischemia, increased reactive oxygen species (ROS) production and inflammation are some of the several damaging processes initiated by these implications. The relationship between diabetes mellitus and oral diseases has received considerable attention in the past few decades. Oral complications can be expected in diabetes mellitus patients since the oral cavity is highly vascularized and innervated. Pathogenic mechanisms of diabetic complications include insulin resistance, dyslipidemia, hypertension, immune dysfunction. Also, patients with diabetes mellitus are highly prone to secondary infections. The triggers for these processes should be studied further. For better diagnosis and understanding the origin of various cellular changes using markers of immune response like human leukocyte antigen-DR (HLA-DR) and those expressed on monocytes and macrophages like CD 68 and leukocyte common antigen (LCA), immunohistochemistry can be preferred. The occurrence of histopathological changes in the oral mucosa identified using cytological markers should be helpful in finding disease progression in these systemic conditions.

There is evidence that low oxidant levels produced by diabetes mellitus leads to periodontitis than in non diabetic patients. Saliva acts as a buffer against the acidic byproducts from the bacterial fermentation of carbohydrates, a change in mere quantity (hyposalivation) could influence its protective act against dental caries. Some studies say that the reason for hyposalivation in diabetes mellitus patients is mainly due to diabetic neuropathy. Similarly, the periodontal pocket will get deeper carrying the dental plaque as the disease worsens, until it reaches the alveolar bone that will eventually be destroyed with the periodontal attachment. It leads to destruction of periodontal tissues, loss of alveolar bone and finally tooth loss. Tooth loss due to periodontitis is very common in these patients. Diabetes mellitus patients are highly immunocompromised and hence infections like human cytomegalovirus (CMV) have tropism for salivary gland ductal epithelium and establish a persistent and lifelong infection. The pattern of age distribution in the prevalence of diabetes mellitus showed that people of all groups are affected but the peak incidence was however observed in the age group of 41 to 60 years (fig 1,2) (p <0.05). This finding is in concordance with a number of previous studies in...
India and other parts of the world. According to a study among the American population, the mean age group of the diabetes mellitus patients is $52.8 \pm 12.7$ years.\cite{43} With the increasing age there is an impaired pancreatic function leading to decreased insulin action. Reduced functional status of the body leads to substantial lipid accumulation which leads to atherosclerosis giving rise to microvascular complications.\cite{44,45}

More recently, it has become apparent that middle-aged men are at significantly higher risk of diabetes than women in several different populations.\cite{46} One possible explanation for this observation is that men, on average, may have to gain less weight due to obesity with increased insulin resistance to develop type 2 diabetes mellitus than women, in part because men without diabetes are generally more insulin resistant than women.\cite{43,47,48} In our study, the gender distribution reveals male preponderance in the blood glucose tested patients(fig 3,4)(p <0.05). This finding is in accordance with a study held in Scotland, prevalence of diabetes is increasingly more in male population.\cite{49} There is an impaired pancreatic function and increased insulin resistance with increase in age in the male population.

In our study, the prevalence of diabetes mellitus in the patients visiting the dental hospital is 33%(fig 5)(p<0.05). Urban population screened for diabetes mellitus in Chennai showed that prevalence of diabetes mellitus was 42% in the adult population which is slightly higher than the values obtained in our study.\cite{50} This finding of our study is in concordance with a study conducted by Yang, which shows that 34.4% of diabetes mellitus patients have been reported.\cite{51}

It is important to know the prevalence of diabetes mellitus, as these patients have decreased wound healing ability and are more prone to infections. Early detection and prompt diagnosis can lead to better prognosis and help in the implementation of successful clinical treatment.\cite{52}

In our study, we have found that more number of patients have been reported from the graduate clinics (fig 6)(p <0.05) and the prevalence of diabetes mellitus condition is also more in the patients reported from the graduate clinics(fig 7). Postgraduate clinics have limited patient count and thereby there is a reduced number of patients referred for the blood glucose level tests. This finding is the first data to analyse this parameter based on the best of knowledge obtained from the available data.

This study will have a huge impact in public health and will be helpful in creating awareness by knowing the prevalence among different gender and age groups. The findings of this study will assist the clinician to be prepared for any treatment in the diabetic patients by knowing its prevalence. There is a geographic limitation to the study as it predominantly covers the South Indian population and it is also an unicentered study. This can be modified by performing longitudinal and periodic studies to evaluate the prevalence of diabetes mellitus. In the future, a larger population with different ethnicity can be included to provide better results and for precise diagnosis HbA1C tests can be preferred in the future studies. This study gives valuable information to oral health planners in proposing strategies for the development of oral health management.

**4. CONCLUSION**

Within the limits of the present study, a significant number of patients have been reported with diabetes mellitus. The most common age group reported with diabetes mellitus condition is 41 to 60 years with a higher incidence of male patients, primarily reported from the graduate clinics. Routine glucose testing with regular screening and pre monitoring of diabetes mellitus condition is an essential factor during dental checkup and beneficial to the community as it plays a major role in wound healing and other problems.
5. ACKNOWLEDGEMENT
The authors would like to acknowledge the help and support rendered by the Department of Special care Dentistry and Information Technology department of SIMATS for their constant assistance with the research.

6. CONFLICT OF INTEREST
Authors declare no potential conflict of interest.

7. REFERENCES


