



**THE PREVALENCE OF DENTAL CARIES IN TYPE II DIABETIC PATIENTS AND NON-DIABETIC PATIENTS – REVIEW**

**Mageshwari M<sup>1</sup>, Manjula G<sup>2</sup>, Mayma Nathasha M<sup>3</sup>, Khadijah Mohideen<sup>4\*</sup>,  
Thayumanavan B<sup>5</sup> and Saranya R<sup>6</sup>**

<sup>1,2,3</sup>CRRI, Sathyabama Dental College and Hospital, Chennai, Tamil Nadu, India

<sup>4,5,6</sup>Department of Oral Pathology and Microbiology, Sathyabama Dental College and Hospital, Chennai, Tamil Nadu, India

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**ABSTRACT**

Diabetes mellitus is a common metabolic disorder. Diabetic patients have many predisposing factors which lead to increased incidence of caries. Increase in caries among diabetic patients is due to repeated intake of food and consumption of even less amount of carbohydrate may lead to caries when combined with increase in glucose in the blood and decreased salivary secretions. Several studies have found the relation between oral and salivary findings revealing that concentration of glucose in saliva is increased in diabetic patients. The association between diabetes and dental caries is less clear, hence this drove us in searching for comprehensive understanding.

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**INTRODUCTION**

Diabetes mellitus is not excluded from having an oral manifestation, since many systemic diseases represent with various oral symptoms (Grossi SG, 2001). Diabetes mellitus is a type of metabolic disorder where there is deficit of insulin secretion or insulin working potential or both (American diabetes association –Diagnosis and Classification, 2006). There is a complex relationship between the diabetes mellitus and dental caries (Vasquez MS and Contreras SS, 2005). There are lot of contributing factors for a greater incidence of dental caries in diabetic patients but other factors such as lower sugar intake in a controlled diabetic patient, could result in a lower incidence rate of dental caries. Dental caries is diagnosed easily at its later stages, but it is quite difficult to assess when it is progressing, which often requires a radiographic examination and is hard to diagnose in its beginning stages. Hence this signifies that dental caries usually initiates as a dormant state and dental caries can take 6-8 months to be easily diagnosed under the influence of severe aggravating factors (Taylor GW and Borgnakke WS, 2008). Diabetic patients who are under good control can exhibit a lower dental caries index when compared to non-diabetic patients, because of lower sugar consumption, but diabetic patients without control exhibits high caries index, when compared to normal

healthy adults because of cariogenic food consumption (Bacic M *et al.*, 1989). Decay is the common public health issue that is prevalent throughout the world. As developing countries started the use of more processed foods, the dental caries is also becoming a major oral health concern among the people living in developing countries (Liljemark WF and Bloomquist, 1996).

**DISCUSSION**

Saliva is the ultra-filtrate of blood which is the best indicator to determine a disease at its earlier stage which eventually leads to successful treatment. Among all blood components, glucose is transferable across the epithelium of the salivary gland. Of all the factors in saliva, glucose has close association to the oral atmosphere in diabetic patients (Shreya Gupta *et al.*, 2017). The regulator of blood glucose level, the insulin secreted by the pancreatic beta cells, is necessary for metabolism of carbohydrates, fats and proteins. Glycogenesis is a process that converts glucose to glycogen and stores it in the liver and muscle cells, which is necessary for regulation of blood glucose when there is surplus of glucose in blood. It also suppresses the discharge of stored glucose from glycogen in the liver that is called as glycogenolysis and this process decelerates the catabolism of fats into fatty acids, triglycerides and ketones. It can switch over the process of gluconeogenesis in kidney and liver from non carbohydrate sources by fat and protein breakdown for production of glucose to storage of fat and proteins (Lamb W, 2007).

\*Corresponding author: **Khadijah Mohideen**

Department of Oral Pathology and Microbiology,  
Sathyabama Dental College and Hospital, Chennai, Tamil  
Nadu, India

Diabetes mellitus is related to abnormal breakdown of carbohydrate, fat and proteins. Type I diabetes, insulin dependent type is mainly affecting the children and young adults which are caused by insulin deficiency (National Diabetes Statistics., US, 2017). The destruction of insulin secreting beta cells of the pancreas leads to deficiency of insulin in type I diabetes mellitus (Clinical Practise Recommendation, 2005, Redondo MJ *et al.*, 2001, Lambert AP *et al.*, 2004, and Devendra D *et al.*, 2004). The nature of type I diabetes mellitus may be associated with environmental, autoimmune and genetic (National Diabetes Statistics., US, 2017). The altered immune function by the exposure to one or more environmental “triggers”, begins the destruction of beta cells of pancreas (Redondo MJ *et al.*, 2001, Lambert AP *et al.*, 2004, and Devendra D *et al.*, 2004). The triggers which play important role in the altered immune response may include viruses like enterovirus, coxsackie, congenital rubella (Lammi N *et al.*, 2005 and Robles DT *et al.*, 2001) ecological toxins such as nitrosamines (Helgason T and Jonasson MR, 1981) and edible products like cereals, gluten, early contact to bovine milk’s protein (Akerblom HK *et al.*, 2002, Virtanen SM *et al.*, 2000, Vaarala O *et al.*, 1999, Thorsdottir I and Ramel A *et al.*, 2003 and Norris JM *et al.*, 2003).

Among all the diagnosed cases of diabetes predominantly 90-95% are type II diabetes which is developed by insulin resistance and defects in the secretion. The factors associated with the diabetes mellitus are older age group, increased BMI, diabetes history in the family, diabetes during the period of pregnancy, abnormal glucose metabolism, sedentary lifestyle, race and ethnicity. This does not commonly occur in children and adolescent. But the prevalence of type II diabetes in children differs in some races such as African-American, Hispanic/ Latino Americans, American Indians, some Asian-American, native Hawaiians and Pacific Islanders populations (National Diabetes Statistics., US, 2007). The primary risk factors for type II diabetes are living style and excessive consumption of food but at the same time genetic may also be a factor among these. Type II diabetes mellitus has 2.4 times higher threat in emergence of the disease with individuals having familial background (Pierce M *et al.*, 1995).

The dental caries which is the prevalent global disease, poses a major public health dispute. Dental caries is an irreversible microbial disease of the calcified tissues of the teeth, characterized by demineralization of the in-organic part and destruction of the organic substances of the tooth, which often leads to cavitation (Shafer’s Textbook of Oral Pathology 8<sup>th</sup> edition, 2017).

Dental caries is a complex disease and primarily caused by ingestion of sugar, which is a necessary source of daily intake of energy but their extreme consumption has severe consequences. Sugars are components of the larger family of sweeteners-which are either available naturally or a part of food substances and drinks. Sugar utilization modifies the healthy bacteria present in the oral cavity to the ones that change sugars into acids resulting in loss of minerals from the enamel. Repeated consumption of sugar during the day increases the rate of acid attack and the possibility of developing dental caries. To limit the rising epidemic of the dental caries, WHO suggests the daily intake of free sugars to be 10 % or less of total energy, which is equivalent to 50 grams or 10 teaspoons of sugars per day (Marshall T, 2015, Moynihan P and Kelly S, 2013, Sheiham A and James W,

2014, Watt R and Rouxel P, 2012 , WHO Guideline: sugars intake for adults and children. Geneva 2015).

The dental caries has common effect on people of all age groups during their life span (Selwitzrh *et al.*, 2007).The endogenic bacteria principally includes *Streptococcus mutans*, *Streptococcus sobrinus*, *Lactobacilli* species in the plaque biofilm produces organic acids derived from fermented carbohydrates of diet. This results in decrease in the critical pH in the oral cavity, which eventually lead to loss of mineral from the tooth structures (Featherstone JD *et al.*, 2003, and Caufield PW *et al.*, 2000).The resultant failure of buffering action of saliva leads to the acidic oral environment which inhibits the reabsorption of minerals from saliva and ultimately resulting in cavity formation (Selwitz *et al.*, 2007). Saliva is crucial for maintaining the balance in oral cavity and the salivary effects and its components on the oral microbes that controls the progress of caries. The important components of saliva like calcium, inorganic phosphorus, alkaline phosphatase levels, immunoglobulins and salivary protein, the flow rate, viscosity, buffering capacity, pH, etc. plays a vital role in commencing and development of dental caries (Clarkson BH, 1999). Initially dental caries begins as white spot lesions in the enamel which appear as small areas of subsurface demineralization. It initiates as demineralization in the root surfaces, and then the region becomes softened and facilitates bacterial penetration which occurs in the preliminary stages of caries development.

Risk factor for caries in diabetic patients include insufficient salivary flow and composition, increased bacterial population, less exposure to fluoride, recession of gingiva, immunological factors and genetic factors (Featherstone JD *et al.*, 2003, Krol DM, 2003, Anderson M, 2002, Hassell TM *et al.*, 1995, and Thomson WM., 2004). Gingival recession due to poor oral hygiene and loss of attachment due to periodontal diseases exposes the root surface to the oral environment resulting in root caries in the diabetic patient. The behavioral and style of living modalities for caries in diabetic patients are inclusive of improper maintenance of oral cavity, poor food habits, repeated intake of food and oral medications (Featherstone JD *et al.*, 2003, Krol DM, 2003 and Touger – Decker R and Van Loveren C, 2003).

There is increased incidence of dental caries in middle-income countries even with the fact that it is escapable through simple and economical measures and also untreated dental caries is the well-known of the 291 conditions included in the 2010 Global Burden of Disease Study. As sugar intake is increasing with the population and health care systems are unable to offer suitable prevention or approach to dental care towards the middle income countries. The sequelae of untreated dental caries, mostly for children, are reduced nutrition, less attendance in school and at work, cut downs overall efficiency and significant impacts on quality of life and socialism (Fisher-Owens S *et al.*, 2007, Ismail *et al.*, 2013, Pitts N *et al.*, 2011, Schwendicke F *et al.*, 2014, and Zero D *et al.*, 2011).

Increased popularity of diabetes mellitus along with its other complications, has become an main public health issue worldwide. The association between diabetes mellitus and periodontal disease has been formerly recognized but the association between diabetes and dental caries is more complex (Maricelle Abayon. Thesis. , 2009. Diabetes and Dental Caries Prevalence: Is There an Association?

Department of Community and Preventive Medicine, School of Medicine and Dentistry, University of Rochester, Rochester, New York). Some studies did not discover any relationship between the two diseases, while other studies have noticed that diabetic patients with poor glycemic index showed undesirable outcomes concerning the tooth decay index.

Millions of people worldwide are affected by diabetes mellitus, which is said to be a chronic metabolic disorder. According to World Health Organization, a disease is considered to be a public health importance only when its prevalence is more than 1% (Puranik MA and Hiremath SS, 2006). According to Wild S *et al.* the global prevalence of diabetes estimates for the year 2000 was estimated as 2.8% and its projection for the year 2030 may approximately rise up to 4.4% (Wild S *et al.*, 2004). Ira B Lamster *et al.* suggests that diabetes has a major effect on the oral cavity and its structures and impairs the quality of life in diabetic patients (Ira BL, 2012). The common oral manifestations of these patients will include xerostomia, dental caries, gingivitis and periodontal disease, burning mouth and candidal infections (Hawraa KA, 2012). The association between diabetes mellitus and dental caries in adults are of less concern, even though both are related with consumptions of carbohydrates (Reddy CVK and Maurya M, 2008, and Singh A *et al.*, 2014), deficiency of insulin in these patients promotes the decreased salivary secretion and high glucose level in saliva directly leads to increased incidence of caries in diabetic patients (Moin M and Malik A, 2015 ). Smyth *et al.* in 2006 study reported that the diabetic population was 171 million initially in the year 2000 and it is expected to reach up to 3,666 million in the year 2030 (Smyth S *et al.*, 2006). Almost 3 million deaths per year are due to diabetes, which is equivalent to 5.2% of all deaths which was reported by Roglic *et al.* (Aziz HK, 2012, and Vaziri PB *et al.*, 2009). The children, teenagers and young adults are not commonly affected by type II diabetes mellitus, but adults who are aged more than 30 years are most commonly affected by the type II diabetes mellitus. The reason for getting type II diabetes mellitus in that age group is being that increased level of blood glucose and obesity are listed to be the first reasons among them (Alemzadeh R and Wyatt DT, 2004). Lin B P *et al.* reported that with increased age of the patient, type II diabetes mellitus prevalence also increases. With increase in age the cemental caries tends to rise and on the other hand the enamel caries prevalence decreases with increase in age. Older diabetic patients are more prone to root surface caries (Lin BP *et al.*, 1999). Shu-Fen Chuang *et al.* conducted a study in the year 2004 by comparing the oral and dental manifestation in diabetic and non diabetic uremic patients who are receiving the hemodialysis treatment. In this study, the diabetic uremic patients who are taking regular maintained hemodialysis treatment exhibits more risk of developing dental caries and xerostomia due to their lower salivary pH. Hence, poor diabetic control, diet habit and xerostomia may affect the oral health between diabetic and non diabetic individuals (Shu-Fen Chuang *et al.*, 2004). VP Hariharavel *et al.* in the year 2015 reported that the diabetic patients tend to have a higher incidence of dental caries when compared to non diabetic individuals. This is being a controversy on the fact that the diabetic patients who are under a controlled diet of restricting all the types of refined carbohydrates such as sucrose and includes more protein content in their diet tends to have a lower cariogenic food when compared to non diabetic individual who tends to eat all

types of food without any restriction (VP Hariharavel *et al.*, 2015). Lin B P *et al.* conducted a comparative study in 1999 with 42 older adults, who are having type II diabetes mellitus with a control group. This study showed a statistically significant difference in the DMFS among the two groups. But after converting to percentage there was no significant difference between diabetic and non diabetic. Because of the sample size of this study the comparison between well controlled diabetic, poorly controlled diabetic and non diabetic showed no association between poor glycemic control and increased prevalence of dental caries (Lin BP *et al.*, 1999). Bakhshandeh S conducted a study in 2005 among 299 adults in Iran about the relations between characteristic related to diabetes and oral health. The investigators found that men with Type I diabetes have 40% higher threat of having poor oral health (decayed, missing, filled teeth score >15) as compared to those with Type II diabetes. With poorly controlled diabetes there was increased DMFT scores for males. Type I diabetic woman appeared to be 1.3 times more possible to have poor dental health when compared to women with Type 2 diabetes, but all these were not showing any statistical significance (Bakhshandeh S *et al.*, 2008). Collin HL *et al.* conducted a study in the year 1998, which consists of HbA1c analysis of 20 number of type II diabetes mellitus patients who are recently diagnosed with the disease and they are non – insulin dependent diabetes mellitus. The study has control subjects of 40 non diabetic adults and found that there was no association with the metabolic control of the disease and the dental caries. In the same way the dental caries occurrence don't significantly differ among patients with non insulin dependent diabetes mellitus and patients who are not affected by the diabetic disease. They also found that there was no change in microbes which tend to cause dental caries, among the two groups. The study even showed that prevalence of heart disease and hypertension was also not associated with caries, among the two groups. But this study is done with small sample size, the study showed limited statistical power to detect the significance (Collin HL *et al.*, 1998). According to Hintao J *et al.* in the year 2007 did a multiple logistic regression model using a data, the data comprises of 105 type II diabetes mellitus and 103 non diabetic patients. They are constructed to have an effect of non insulin dependent diabetic mellitus and caries on both the coronal and radicular parts of teeth and correlate the factors related to dental caries and diabetes mellitus. The factors such as smoking status was adjusted, patients with removable dentures, lactobacilli count, salivary buffer capacity, age, number of missing teeth and presence of one carious lesion. Finally, there was significant relation between type II diabetes and root caries prevalence (Hintao J *et al.*, 2007).

Hence from the above discussion we conclude that there is significance in prevalence of dental caries among diabetic patients since both are related to consumption of carbohydrate. There are several other factors in diabetic patient which leads to dental caries include poor metabolic control, reduced salivary flow and poor oral hygiene. Some of the above study comprises a smaller sample group which showed no difference in both the groups but there was no statistical significance in the studies, but the study done with a large population group showed some significance regarding the increase in prevalence of dental caries in type II diabetes mellitus patients.

## CONCLUSION

Thus, we conclude by saying that there must be more complex relationship between the type II diabetes mellitus and dental caries, even though very well controlled diabetic patients tends to show a lower dental caries index when compared to non diabetic controls. This is because of restriction of cariogenic food substances by the diabetic patients who are under good controlled diet. But on the other hand there are patients who are not under good diabetic control showed a poor oral hygiene where there is lot of chance of getting root surface caries. This is because of the exposure of root surface of tooth to oral environment in diabetic patients due to increased periodontal conditions and an aggravating factor such as xerostomia also leads to root caries formation. Hence, it is clear that there is a need in awareness among the patients who are having the chronic systemic diseases such as the diabetes mellitus are in the high risk of developing dental caries. Since diabetes mellitus affects age groups since 30, some of them tend to loss their teeth and smile in early 35, because of poor oral maintenance and the prognosis for their disease becomes worsen, thereby their confidence to face the social world without teeth is a total doom to them. There are lots of advanced treatment modalities available for the restoration of the dental caries affected teeth endodontically but root caries lead to a poor prognosis and prosthetic replacement of the lost tooth is challenging due to the poor periodontal condition of the remaining abutment teeth. So, rehabilitating the patient with the original natural smile is a tough job since, patient's expectation for good and natural results within a low economy do not favor the outcome many times. So, prevention is better than cure, than hesitating for duration, cost and course of treatment.

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