https://doi.org/10.46389/rjd-2021-1053
www.rjdnmd.org

Rom J Diabetes Nutr Metab Dis
2021; volume 28, issue 4, pages 363–368

Original Research

Study to evaluate the oral health and salivary pH in type II diabetes individuals among south Indian population in Chengalpet district – A case control study

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Received: 9 June 2021 / Accepted: 22 July 2021

Abstract

Background and aims: Diabetes mellitus is a systemic disease associated with periodontal diseases. Research conducted over more than a decade proves a bidirectional relationship between diabetes and periodontal disease. This study compares the periodontal status, dental caries and salivary pH in diabetics with non-diabetics. **Materials and methods:** About 100 subjects participated in the study. 50 subjects each were included in group I (control group), group II (test group). Periodontal status (assessed by Russel's index), salivary pH, dental caries of all patients were evaluated. Statistical analysis was done using a student t-test. **Results:** The mean periodontal status in group I was 0.32, whereas 3.78 in group II. There was a statistically significant increase in Russel's index in group II. The mean salivary pH in group I was 7.42, in group II it was 6.44 indicating a statistically significant decrease in salivary pH in the diabetic group. The mean DMFT index in group I was 1.68 whereas in group II it was 7.06. This shows a statistically significant increase in DMFT score in the test group. **Conclusion:** Diabetic patients seem to have poor periodontal status, reduced salivary pH, increased dental caries than controls. This strengthens the hypothesis that hyperglycemia worsens oral health of diabetic individuals.

Keywords: periodontal disease, salivary pH, diabetes mellitus, dental caries, hyperglycemia.

Background

Type II diabetes mellitus (Non-Insulin Dependent Diabetes Mellitus – NIDDM) is a heterogeneous group of metabolic disorders characterized by variable degrees of insulin resistance, impaired insulin secretion and increased glucose production. It usually occurs with increasing age and obese individuals. India leads the world today with the largest number of diabetics. Diabetes mellitus is a systemic disease commonly associated with periodontal diseases. The relationship between these two diseases is not totally clear. There is evidence to suggest a two-way relationship between diabetes and periodontal disease. Periodontitis increases the risk of poor glycemic control leading to the development of complications in people with diabetes thereby aggravating the disease [1]. Several investigators have reported a higher incidence and severity of periodontal disease in type II diabetic patients (NIDDM) when compared with non-diabetic controls. On the other hand, in diabetics with poor glycemic levels, diabetes can reduce the body's ability to respond efficiently to the bacterial challenge leading to extensive periodontal destruction [2].

Diabetes is associated with impaired wound healing, exaggerated monocyte response to dental plaque antigens, and impaired neutrophil chemotactic responses, all of which can lead to increased local tissue destruction [3, 4]. As the relationship between diabetes and periodontal disease is bidirectional, it remains a much sought-after topic in literature and research. Dental practitioners have the responsibility for early identification, assessment, and management of oral manifestations of patients with or at risk of developing diabetes [5].

Aim

The aim of the present study is to evaluate and compare the periodontal status, dental caries, and salivary pH in diabetics with non-diabetics.

Materials and methods

Ethical approval of the study proposal

The study was approved by the Institutional Ethical committee. The study was done at Karpaga Vinayaga Institute of Dental Sciences, chinnakolambakkam, Chengalpet. All study participants were given a detailed verbal and written description of the study and signed an informed consent form before the commencement of the study.

Study design and patients

This is a case-control study. The study population includes those diabetic individuals and healthy controls who attended the outpatient department of Karpaga Vinayaga Institute of dental sciences for dental treatment.

Inclusion criteria

A total of 100 subjects were examined. The subjects were divided into two groups. Group I comprised of 50 non-diabetic subjects (24 females, 26 males) with no known history of diabetes mellitus or any other systemic illness with fasting plasma glucose levels less than 120 mg /dl. Group II consists of 50 types II diabetic subjects (22 females, 28 males) with a known history of diabetes mellitus with fasting plasma glucose levels greater than 170 mg/dl.

Exclusion criteria

- history of systemic disease
- those having taken any antibiotic therapy
- smokers
- pregnant or lactating females,
- those on antiviral or immunosuppressive drugs
- salivary gland disorders
- alcoholics
- xerostomia

Laboratory, anthropometric and clinical data collection

The procedures followed were in accordance with Helsinki declaration of 1975, as revised in 2000. Fasting blood glucose was collected for the measurement of plasma glucose levels in both groups. The parameters selected for the study were clinical parameters including Russel's Periodontal index, DMFT index, biochemical parameters including salivary pH of the individual. Those individuals between the age range 25–60 with type II diabetes mellitus were included. Plasma glucose levels were estimated by using a fully automated biochemical analyzer (TULIP). Following the collection of blood samples, unstimulated salivary samples were collected with the help of capillary tubes. The pH of the saliva was immediately measured with the help of a pH meter. Following this, the DMFT index and Russel's periodontal index of each subject were done to assess caries and periodontal status of the subject respectively. Statistical analysis: sample size calculation was done with the help of a statistician. SPSS software version was made use for statistical analysis. Paired t-test was used to compare the variables between controls and cases. p Value<0.05 was considered to be significant.

https://doi.org/10.46389/rjd-2021-1053

Results

The study comprises a total of 100 subjects with 50 subjects each in control and diabetic groups. Student t-test was used to calculate the mean and standard deviation (SD) of the data.

The mean Russel's index value in the control group was 0.32 with an SD of 0.37 whereas in the diabetic group it was 3.78 with a standard deviation (SD) of 1.33. In comparison, there was a statistically significant increase in the mean Russel's score in diabetics with p-value <0.00001 (Table 1, Figure 1).

The mean salivary pH in the control group was 7.42 with an SD of 0.26 whereas in the diabetic group the mean was 6.44 with a standard deviation of 0.22. In comparison of the mean values, there was a statistically significant decrease in salivary pH value of the diabetic group than the control group with a p-value <0.00001 (Table 2, Figure 2).

The mean DMFT score in the control group was 1.68 with an SD of 1.41 whereas in the diabetic group the mean was 7.06 with an SD of 7.17. On comparing the mean DMFT score there was a statistically significant increase in DMFT score in diabetics than in the control group with a p-value <0.00001. Dental caries were found to be minimum in non-diabetics and maximum in diabetics (Table 3, Figure 3).

Discussion

The relationship between diabetes and oral health is very complex and is mysterious. In the recent past, numerous epidemiologic studies have been done to understand the association between diabetes and periodontal disease. The earliest studies were done in the 1970s to study the association between type II diabetes mellitus (NIDDM) and periodontal disease in females following which many studies were conducted. Diabetes mellitus is a metabolic disorder with systemic and oral manifestations as well. Oral manifestations include xerostomia, increased incidence of and intensity of caries, detriment in periodontal status including deep pockets, attachment loss and tooth mobility. Periodontal disease is considered to be the sixth complication of diabetes mellitus [6]. Periodontitis, an infectious oral disease affecting supporting structures of teeth is caused by interaction between pathogenic bacteria and the immune system of the host [7].

Table 1: Comparison of mean Russel's score and SD between diabetics and controls.

Group	Russel's Score		
	Mean	SD	p-Value*
Controls	0.32	0.37	<0.00001
Diabetics	3.78	1.33	

*Unpaired t-test

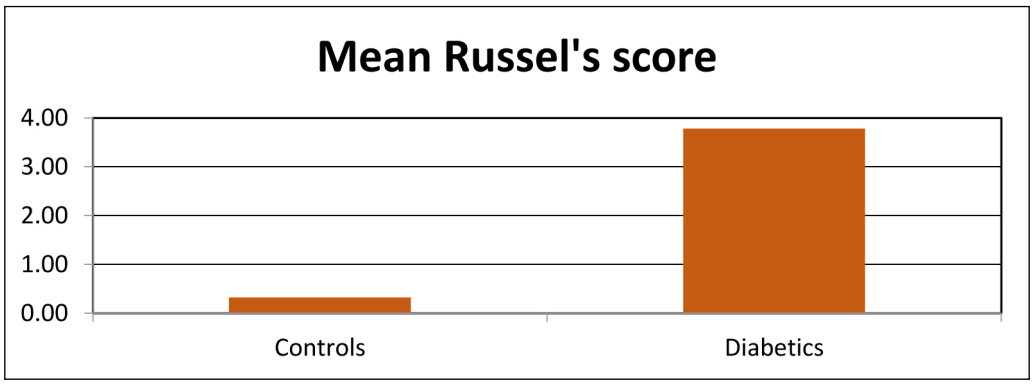

Figure 1: Comparison of mean Russel's score between diabetics and controls.

Table 2: Comparison of mean salivary pH and SD between diabetics and control.

Group	Salivary pH		
	Mean	SD	p-Value*
Controls	7.42	0.26	<0.00001
Diabetics	6.44	0.22	

*Unpaired t-test

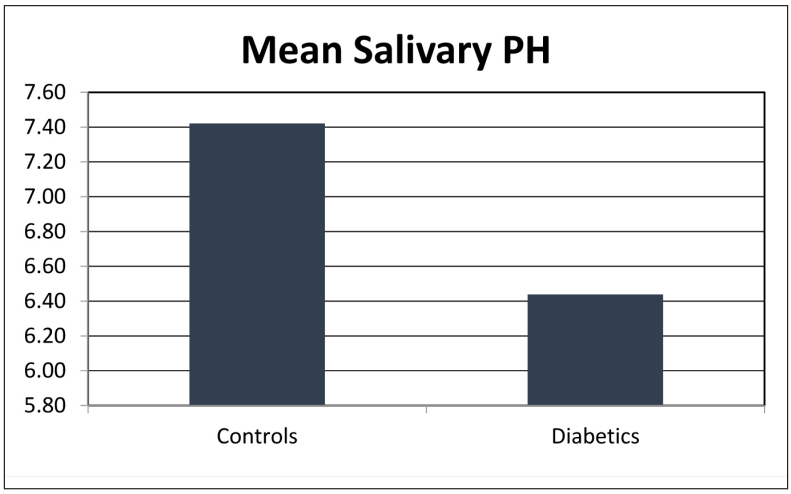

Figure 2: Comparison of mean salivary pH between diabetics and control.

Table 3: Comparison of mean DMFT score and SD between diabetics and controls.

Group	DMFT score		
	Mean	SD	p-Value*
Controls	1.68	1.41	<0.00001
Diabetics	7.06	7.17	

*Unpaired t-test

In our present study, the periodontal status of the diabetic individuals was assessed with Russel's periodontal index. There was a statistically significant increase in mean Russel's score in diabetics when compared to controls with a p value <0.00001. In diabetes mellitus, there is an alteration in the function of immune cells including neutrophils, monocytes, and macrophages. There is impairment in adherence of neutrophils, chemotaxis, and phagocytosis which in turn inhibits bacterial killing resulting in increased periodontal destruction [8, 9]. As the the periodontal pocket is a site of persistent bacterial attack, an intact wound healing response is important to maintain periodontal health. Increased glucose levels in gingival crevicular fluid (GCF) may directly hamper the wound healing capacity of fibroblasts in periodontium by preventing attachment and migration of these cells which are important for wound healing and normal tissue turnover [10].

In hyperglycemia, non-enzymatic glycosylation of proteins and other macromolecules take place resulting in formation of what are called are advanced glycation end products (AGEs). AGEs have a receptor called 'receptor for AGE' RAGE. AGE-RAGE interaction takes place resulting in activation of AGE. RAGE is found on

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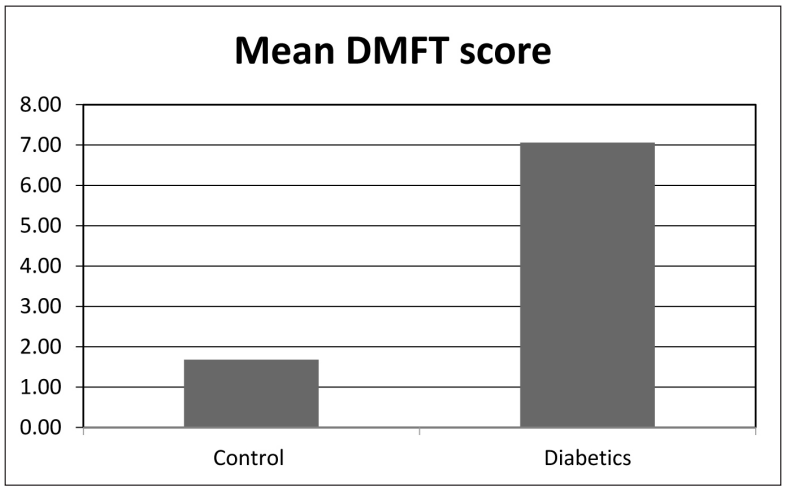

Figure 3: Comparison of mean DMFT score between diabetics and controls.

the surface of smooth muscle cells, endothelial cells, neurons, and macrophages/monocytes [11]. This receptor is found in the periodontium. There is a 50% increase in mRNA for RAGE found in the gingival tissues of type II diabetes subjects compared to non-diabetic controls [12, 13]. The AGE-RAGE interaction on monocytes will increase cellular oxidant stress, thereby activating the transcription factor Nuclear Factor Kappa β (NF-Kβ). This will alter the phenotype of monocyte/macrophage resulting in increased production of pro-inflammatory cytokines such as interleukins IL-1β, TNF-α, prostaglandins [14]. These pro-inflammatory cytokines will contribute to the pathogenesis of the periodontal disease. Changes in collagen synthesis, maturation and homeostatic turnover commonly occur in diabetes. As collagen is the major structural protein in the periodontium, these changes may contribute to the pathogenesis of periodontal disease and alterations in wound healing. There is reduced production of collagen and glycosaminoglycans by human gingival fibroblasts in high a glucose environment [15]. In addition to decreased collagen synthesis, the newly formed collagen is susceptible to degradation by MMPs such as collagenase which is elevated in diabetic tissues including periodontium. This [16, 17] might be the reason why people with type II diabetes have more widespread or severe periodontal disease than individuals without diabetes [18, 19].

Hyperglycemia in diabetes is associated with decreased salivary secretion and high salivary glucose levels owing to a disturbance in glucose metabolism [20, 21]. Moreover, dry mouth is a significant complaint in diabetes which would explain the increased incidence of dental caries in diabetics when compared to non-diabetics. The oral cavity is being constantly exposed to saliva, the important function of which is mechanical cleansing and oral clearance. Diabetes may cause changes in salivary glands which may contribute to the reduced flow rate of saliva and alteration in salivary composition. Studies have shown an increased prevalence of dental caries in diabetics [22]. In the present study, as salivary pH is influenced by diet, unstimulated saliva samples were collected. Blood glucose influences the salivary factors such as buffering capacity, flow rate, glucose content and acidogenic bacterial level. Increased concentration of glucose in saliva and GCF may contribute to lowering the pH of saliva, resulting in acidogenic bacteria and plaque formation. The plaque formation, besides increasing caries susceptibility, may also cause a periodontal breakdown. In the present study, diabetics when compared with non-diabetics showed decreased salivary pH and increased DMFT score. Increased prevalence of acidic environment owing to decreased salivation/xerostomia in diabetic patients may lead to reduced salivary pH levels as well enhanced plaque formation. This may have a role in developing oral complications in these patients. The DMFT index shows a statistically significant increase in diabetics as compared to normal subjects with a p-value<0.00001, which could be secondary to reduced pH of saliva thereby increasing the risk of caries susceptibility in diabetics.

Conclusion

Diabetes mellitus, a challenging metabolic disorder, is one of the most common non-communicable diseases around the world. It is one of the leading causes of death. As warned by WHO, India might be the "Diabetic capital of the world". The findings of the present study prove that diabetic subjects seem to have poor periodontal status, reduced salivary pH, and increased dental caries when compared to non-diabetic subjects further strengthening the relationship between both diseases. This study insists on the need for diabetic individuals to maintain good oral health for better glycemic control.

AcknowledgementI

would like to thank the management of Karpaga Vinayaga Institute of Dental Sciences for giving me an opportunity to conduct this study.

Funding

Self.

Conflict of interest

Nil.

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 https://doi.org/10.46389/rjd-2021-1053