

Correlation between Xerostomia, Hyposalivation, and Oral Microbial Load with Glycemic Control in Type 2 Diabetic Patients

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ABSTRACT

Aims and objectives: The present study is an attempt to investigate prevalence of xerostomia and hyposalivation in type 2 diabetes mellitus using a modified Schirmer test (MST) and finding any association between xerostomia, hyposalivation, and oral microflora, namely, *Streptococcus mutans*, *Lactobacillus* spp., and *Candida* spp. with the glycemic control of individual.

Background: Diabetes mellitus is a chronic metabolic disorder characterized by hyperglycemia and resulting in either lack or relative insufficiency of insulin. In addition to systemic alterations, oral manifestations of diabetes mellitus have been reported, such as xerostomia and hyposalivation, alteration in taste, caries, gingivitis, and periodontal disease.

Materials and methods: Thirty individuals with known history of diabetes mellitus type 2 were chosen as cases and 30 age- and sex-matched healthy controls were taken as control group. For assessment of hyposalivation, unstimulated salivary flow rate was measured using a MST with a commercially available Schirmer test strip having a millimeter scale (0–35 mm).

Results: In our study, we found that the difference in the wettability of Schirmer strip among diabetics and healthy controls was more significant at the end of the 1st minute due to decreased salivary flow in diabetics.

Conclusion: An early assessment of salivary flow and xerostomia in type 2 diabetic patients and its treatment, along with routine oral hygiene and maintenance, may alter the clinical outcomes of diabetes.

Keywords: Diabetes mellitus, Hyposalivation, Xerostomia.

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INTRODUCTION

Diabetes mellitus is a chronic metabolic disorder characterized by hyperglycemia and resulting in either lack or relative insufficiency of insulin. It is caused by the low insulin production of the pancreas or the lack of response of the peripheral tissues to the hormone. The insulin regulates the carbohydrate metabolism and its absence causes a reduction of blood glucose entering cells, consequently increasing its blood level, characterizing the hyperglycemia state.¹

In addition to systemic alterations, oral manifestations of diabetes mellitus have been reported, such as xerostomia and hyposalivation, alteration in taste, caries, gingivitis, periodontal disease, fungal infections, oral lichen planus, tooth loss, odontogenic abscesses, soft tissue lesions, coated tongue, fissured tongue, and geographic tongue.

Xerostomia is used to denote subjective complaint of mouth dryness, whereas hyposalivation is an objective reduction in salivary secretion. Although most patients with xerostomia have hyposalivation others may not. On the contrary, patients who had documented hyposalivation may not complain of xerostomia. Changes in oral microbiota have also been associated with hyposalivation. An increase in the number of some oral microbial flora has been observed in patients with hyposalivation, and may be associated with an increased incidence of dental caries, periodontitis, and candidiasis.^{2,3}

Both xerostomia and hyposalivation have been associated with diabetes mellitus.^{4,5} Although xerostomia and salivary flow have been studied in patients with type 2 diabetes mellitus, the methods used to measure salivary flow, such as gravimetric and volumetric measurements, are impractical in clinical practice.^{6,7} Therefore, the present study is an attempt to investigate prevalence of xerostomia and hyposalivation in type 2 diabetes mellitus using a modified Schirmer test and finding any association between xerostomia, hyposalivation, and oral microflora, namely *Streptococcus mutans*, *Lactobacillus* spp., and *Candida* spp. with the glycemic control of individual.

MATERIALS AND METHODS

Subjects for study were individuals with known history of diabetes mellitus type 2 from general population.

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30 individuals with known history of diabetes mellitus type 2 were chosen as cases and 30 age- and sex-matched healthy controls were taken as control group. The exclusion criteria considered were:

- History of medication known to affect salivary secretion in past 6 months
- History of undergoing or have undergone radiotherapy or chemotherapy treatment
- History of known salivary gland disorders
- History of condition affecting immunocompromised status (other than diabetes mellitus)
- History of mental disorders or under psychiatric medication
- Individuals with type 1 diabetes mellitus
- Individuals with known history of smoking
- Xerostomia was assessed by series of questions (modified as given by Fox et al)
 - Does your mouth feel dry at night or on awakening?
 - Does your mouth feel dry at other times of the day?
 - Do you keep a glass of water by your bed?
 - Do you sip liquids to aid in swallowing dry foods?
 - Does your mouth feel dry when eating a meal?
 - Do you have difficulties swallowing any foods?
 - Do you chew gum daily to relieve oral dryness?
 - Do you use hard candies or mints daily to relieve oral dryness?
 - Does the amount of saliva in your mouth seem to be too little?
 - Do you feel that your tongue sticks to the palate when you wake up in the morning?

For assessment of hyposalivation, unstimulated salivary flow rate was measured using a modified Schirmer test (MST) with a commercially available Schirmer test strip having a millimeter scale (0–35 mm). All tests were performed from 8 to 12 am according to Fontana et al. After 3 to 5 minutes of rest, patients were asked to swallow the saliva in the mouth prior to test and not

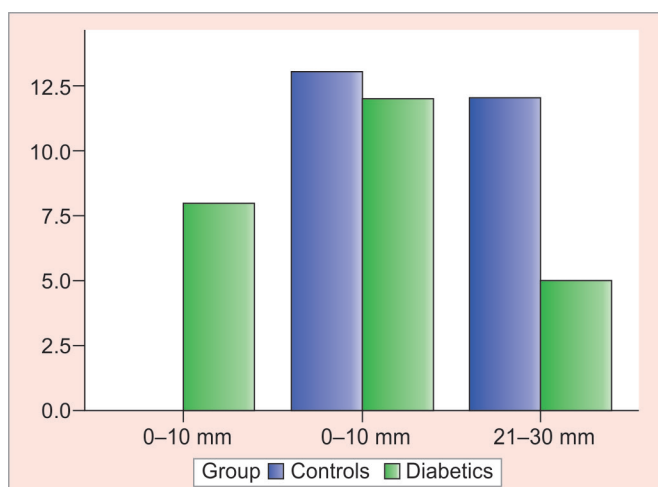
to swallow anymore during the test. The patients were asked to rest the tongue on the hard palate so that the test strip would not touch the tongue during the test. The rounded end of the strip was positioned at the floor of mouth; wettability of strip was noticed at 1 to 3 minutes. Hyposalivation was considered when the strip became wet < 25 mm at 3 minutes.

For oral microbial load assessment, 5 ml of patient’s saliva was collected in collection tubes for microbiological assessment using conventional colony count method. Different culture medium was used Mitis salivarius bacitracin agar medium for *S. mutans*, Rogosa SL agar for *Lactobacillus*, and sabouraud dextrose agar for *Candida* spp.

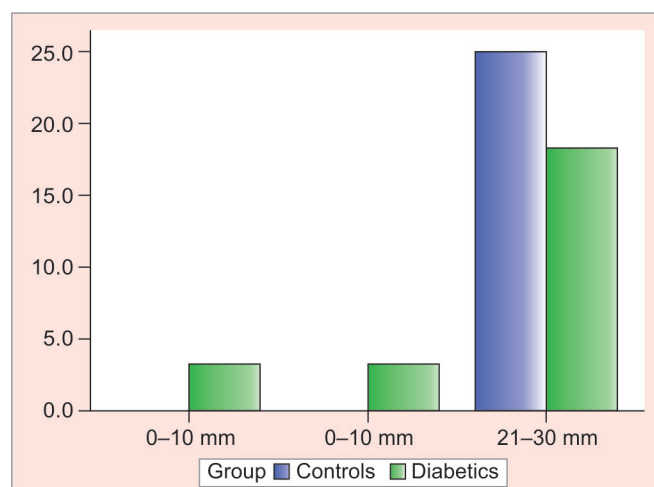
RESULTS

In our study, we found that the difference in the wettability of Schirmer strip among diabetics and healthy controls was more significant at the end of 1st minute due to decrease salivary flow in diabetics (Graph 1). Since the millimeter grading available on Schirmer strip was till 35 mm, the exact difference between wettability of Schirmer strip could not be calculated at the end of the 3rd minute (Graph 2) because most of the healthy individuals showed complete wettability of strip at the end of 2nd minute only while diabetics because of decrease salivary flow showed increasing wetting of strip at successive readings (Graph 3). This difference was calculated using chi-square test and we found significant difference in the wettability among diabetics and healthy group with a p-value of 0.03 at end of 1st minute, 0.022 at end of 2nd minute.

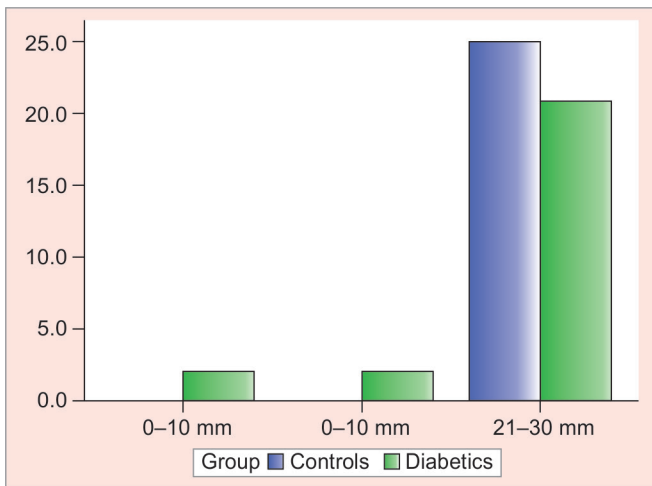
Regarding xerostomia scores using questionnaire method, we found no significant difference in the subjective feeling of oral dryness among diabetics and healthy group (Graph 4).



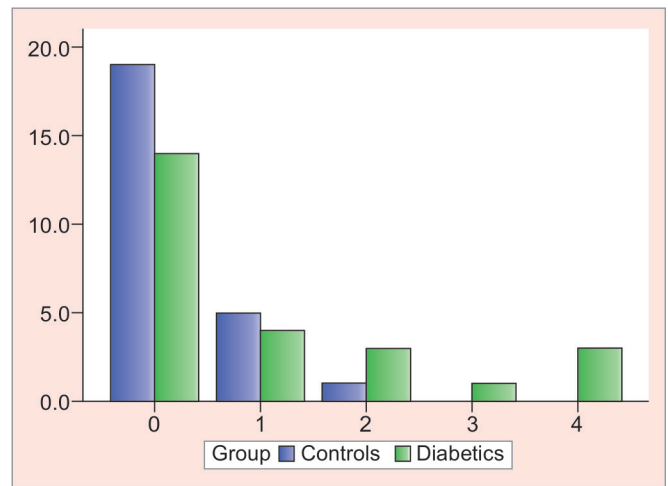
Graph 1: Schirmer's strip wettability at 1 minute



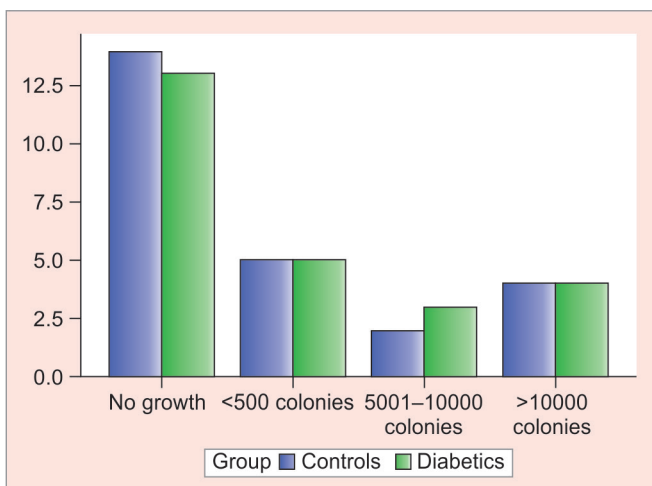
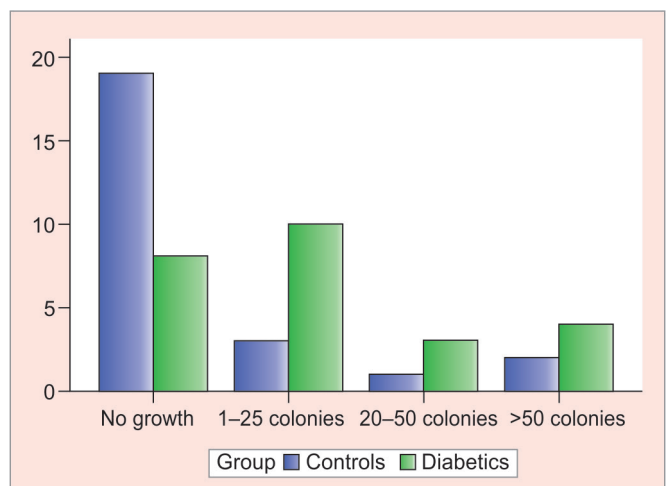
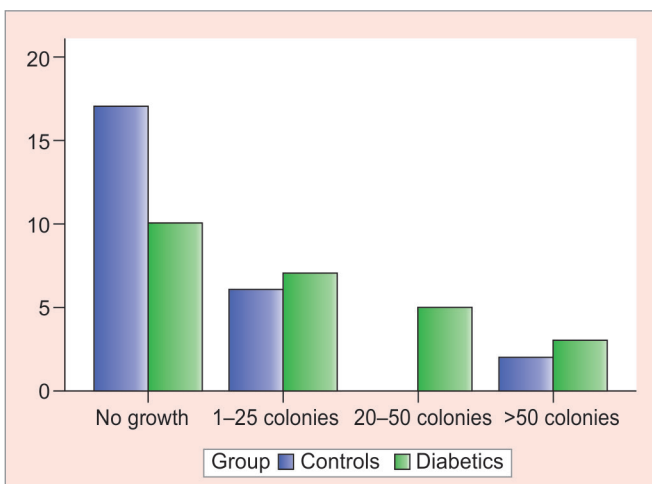
Graph 2: Schirmer's strip wettability at 3 minutes



Graph 3: Schirmer's strip wettability at 2 minutes



Graph 4: Xerostomia scores

Graph 5: *Streptococcus mutans* coloniesGraph 6: *Lactobacillus* spp.Graph 7: *Candida* spp.

The saliva was collected for microbial assessment. We found significant increase in *Candida* colony count and *Lactobacillus* spp. in diabetic group. It was also found that the individuals who showed less wettability of Schirmer strip and had hyposalivation showed more number of

microbial colonies as compared with individuals who had normal salivary flow (Graphs 5 to 7).

DISCUSSION

Regarding the difference in salivary flow rate as measured with Schirmer test strip, we observed that diabetic individuals had significant decrease salivary flow rate as compared with nondiabetic individuals. We also compared relation of salivary flow rate with glycosylated hemoglobin status. The degree of hyposalivation was inversely related to hemoglobin A1c (HbA1c) level. Individuals with poor glycemic control had significantly lower salivary flow rate. Our study results are similar to Radhika et al (2014),⁸ who found statistically significant difference in salivary flow rates of unstimulated and stimulated saliva between the diabetics and nondiabetics. Salivary flow rate was least in uncontrolled diabetics, followed by controlled diabetics and then nondiabetics. Bernardi et al (2007)⁹ also found the flow rate was lower in the type 2 diabetic patients, regardless of whether they were well or poorly metabolically controlled, compared with healthy individuals ($p < 0.05$).

In our study, we found no significant difference between subjective feeling of dryness in diabetic and nondiabetic individuals. Diabetics who had complaint of xerostomia had poor glycemic control and positive correlation with HbA1c levels. The most common complaint observed was that patient realized the need to sip liquids in swallowing dry foods and most of the patients reported dryness during night time and on awakening. Carolina et al (2010)¹⁰ also observed similar results with no statistical significant difference in xerostomia between diabetic and nondiabetic individuals. Sreebny et al (2010)¹¹ observed that of the 40 diabetic subjects, 43% (n=17) stated that their mouth usually felt dry.

Regarding the difference in microbial load between diabetic and nondiabetic individuals, we found significant difference in colony count of *Lactobacillus* spp. and *Candida* spp. between diabetic and nondiabetic individuals. As many as 66% of diabetic individuals had *Lactobacillus* colony count >50 as compared with 33% of nondiabetic individuals (p=0.015), and 60% of diabetics had *Candida* count >50 as compared with 40% of nondiabetic individuals (p=0.066). Also the relation of microbial load with glycosylated hemoglobin status revealed positive correlation between the colony count of *Lactobacillus* spp. and *Candida* spp. observed with HbA1c levels. These findings were in correlation to study by Siribang et al (2009),¹² who observed *S. mutans*, *Lactobacillus* spp., and *Candida* spp. were present in 96.6, 90.4, and 74.8% among diabetics. In patients who had hyposalivation, the mean scores for *S. mutans*, *Lactobacillus* spp., and *Candida* spp. were significantly higher than those of patients who did not have hyposalivation. Hill et al (1999)¹³ studied prevalence of candidiasis and its association with diabetes control and found glycosylated Hb above 12% was strongly associated with oral yeast infection.

CONCLUSION

Our study results suggest that individuals with diabetes may have impaired salivary flow in comparison with nondiabetic subjects, but they may not have concomitant xerostomic complaints. Decreased salivary flow rate in diabetic individuals favors the growth of microorganisms,

which can lead to dental caries and other infections of the oral cavity.

Recent studies emphasized that the early assessment of salivary flow and xerostomia in type 2 diabetic patients and its treatment, along with routine oral hygiene and maintenance, may alter the clinical outcomes of diabetes.

REFERENCES

1. Willis AM, Coulter WA, Fulton CR, Hayes JR, Bell PM, Lamey P-J. Oral candidal carriage and infection in insulin-treated diabetic patients. *Diabet Med* 1999;16:675-679.
2. Fontana M, Zunt S, Eckert GJ, Zero D. A screening test for unstimulated salivary flow measurement. *Oper Dent* 2005 Jan-Feb;30(1):3-8.
3. Chen A, Wai Y, Lee L, Lake S, Woo SB. Using the modified Schirmer test to measure mouth dryness: a preliminary study. *J Am Dent Assoc* 2005 Feb;136(2):164-170.
4. Sandberg GE, Sundberg HE, Fjellstrom CA, Wikblad KF. Type 2 diabetes and oral health: a comparison between diabetes and non diabetic subjects. *Diabetes Research and Clinical Practice - Xerostomia in diabetes mellitus*. *Diabetes Res Clin Prac* 2000 Oct;50(1):27-34.
5. Hill LV, Tan MH, Pereira LH, Embil JA. Association of oral candidiasis with diabetes care. *J Clin Pathol* 1989 May;42(5):502-505.
6. Fisher BM, Lamey PJ, Samaranyake LP, MacFarlane TW, Frier BM. Carriage of *Candida* species in the oral cavity in diabetic patients: relationship to glycaemic control. *J Oral Pathol* 1987 May;16(5):282-284.
7. Fox PC, Busch KA, Baum BJ. Subjective reports of xerostomia and objective measures of salivary gland performance. *J Am Dent Assoc* 1987 Oct;115:581-584.
8. Radhika T, Kannan R. Diabetes mellitus and oral health 2012;4(1):137-142.
9. Bernardi MJ, Reis A, Loguercio AD, Kehrig R, Leite MF, Nicolau J. Study of the buffering capacity, pH and salivary flow rate in type 2 well-controlled and poorly controlled diabetic patients. *Oral Health Prev Dent* 2007;5(1):73-78.
10. Carolina A, Vasconcelos U, Soares MSM, Almeida PC, Soares TC. Comparative study of the concentration of salivary and blood glucose in type 2 diabetic patients. *J Oral Sci* 2010;52(2):293-298.
11. Sreebny LM, Valdin A. Xerostomia. Part I: Relationship to other oral symptoms and salivary gland hypofunction. *Oral Surg Oral Med Oral Pathol* 1988;66:451-458.
12. Khovidhunkit SP, Thaweboon S, Chomkhakhai U. Xerostomia, hyposalivation and oral microbiota in type 2 diabetic patients: a preliminary study. *J Med Assoc Thai* 2009;92(9):1220-1228.
13. Hill LVH, Tan MH, Pereira LH, Embil JA. Association of oral candidiasis with diabetic control. *J Clin Pathol* 1989;42:502-505.