Original Article

A study on salivary ph changes in diabetes mellitus of varied origin and control levels

Balla Sriramulu[1], Devineni Bala Sundar[2], Mohd Rasheeduddin Imran[3*]

{[1]Associate Professor, Department of Physiology}, {[2]Tutor, Department of Biochemistry}, Rajiv Gandhi Institute of Medical Sciences, Srikakulam, Andhra Pradesh, INDIA.
[3]Assistant Professor, Department of Physiology, Bhaskar Medical College, Telangana, INDIA.
Email: dr.imran1980@gmail.com

Abstract

Aim and Objective: to perform a comparative study of salivary ph among newly diagnosed, well controlled and poorly controlled diabetes mellitus patients. **Materials and Methods:** the study was conducted in research lab of department of physiology on total 150 individuals in three groups of 50 male subjects each of 45 to 55 years of age, weighing 50 to 70 kgs. pH and buffer capacity measurement pH of saliva samples was determined using a pH meter (Hana Italy). To estimate Glycosylated Hb levels 5 ml of whole blood was collected and HbA1c kits were used (i- CHROMATM HbA1c, Republic of Korea). All the values were recorded and comparison tables were derived after statistical analysis by paired t test using SPSS 23 version and the results were analyzed. **Results:** The pH values and the HbA1c levels recorded were compared among the three study groups. In the present study the mean HbA1c values of uncontrolled diabetics were significantly higher than other two groups. Student paired t-test showed a significant difference in pH values between the three groups, with significantly lower pH values in the uncontrolled diabetic group (P<0.001)
Keywords: Salivary pH, Glycosylated Hb.

[*]**Address for Correspondence:**
Dr Mohd Rasheeduddin Imran, H.No: 18-8-241/10, Moinbagh, Riyasathnagar, Hyderabad-500059, Telangana, INDIA.
Email: dr.imran1980@gmail.com
Received Date: 20/06/2016 Revised Date: 11/07/2016 Accepted Date: 18/08/2016

Access this article online	
Quick Response Code:	Website: www.medpulse.in
	DOI: 22 August 2016

INTRODUCTION

The prevalence of diabetes is rapidly rising all over the globe at an alarming rate[8,16] and has reached epidemic proportions in many countries[2]. Over the past 30 yr, the status of diabetes has changed from being considered as a mild disorder of the elderly to one of the major causes of morbidity and mortality affecting the youth and middle aged people. It is important to note that the rise in prevalence is seen in all six inhabited continents of the globe[17]. Nowhere is the diabetes epidemic more pronounced than in India as the World Health Organization (WHO) reports show that 32 million people had diabetes in the year 2002[17]. The International Diabetes Federation (IDF) estimates the total number of diabetic subjects to be around 40.9 million in India and this is further set to rise to 69.9 million by the year 2025[15]. Nearly 80% of the affected people live in middle- and low-income countries. Type 2 diabetes mellitus, which constitutes more than 95% of all the diabetic populations, has an insidious onset with a long, latent, asymptomatic phase[2]. The chronic hyperglycemia of diabetes is associated with long-term damage, dysfunction, and failure of different organs, especially of eyes, kidneys, nerves, heart and blood vessels[14]. It is still not clear whether caries risk can be higher in diabetic pediatric patients due to affected salivary factors as compared to controls[1,4,5,12,13]. Long standing hyperglycaemia besides damaging various systems of body may also impair salivary gland functions, which leads to a reduction in the salivary flow and changes in saliva's composition. Saliva plays a crucial role in protection of the oral cavity (Edgar *et al*., 2004). Thus, flushing (clearance and exposure) of the soft and hard tissues and biological effects of saliva constituents, such as Ph regulatory components, inorganic components participating in the de- and remineralisation of tooth

How to site this article: Balla Sriramulu, Devineni Bala Sundar, Mohd Rasheeduddin Imran. A study on salivary ph changes in diabetes mellitus of varied origin and control levels. *MedPulse – International Medical Journal.* August 2016; 3(8): 793-797. http://www.medpulse.in (accessed 24 August 2016).

tissues, and proteins, peptides, lipids and carbohydrates affecting microbial growth and colonization, are of importance. Saliva flow and oral muscle activities are the key determinants for flushing. Lack of proper amount of saliva may lead to discomfort for the individual, such as a burning sensation, dysphagia, speech impairment, taste disturbances and increase risk for dental caries (Bergdahl, 2000; Närhi, 1994)[6]. The buffering capacity of saliva is one of the most important functions of saliva; therefore, saliva keeps the pH of the oral cavity in the normal range, resulting in remineralization of teeth. This capacity is mainly attributed to the concentration of its bicarbonate content,[3,7] which in turn depends on the amount of salivary flow[18]. Therefore, a factor decreasing salivary flow rate can decrease its buffering capacity, resulting in increased susceptibility to caries risk[9]. The ability to use saliva as a diagnostic tool is of great value as the sample can be collected non-invasively, does not require a professional personal. Moreover the saliva can be collected at the point of its origin and manufacture and so is unaffected by collection or storage in the body. Establishing a range of normal values for a variety of extrinsic and intrinsic salivary components will enable investigators and clinicians in a variety of disciplines to use saliva as a diagnostic tool. The epidemic of obesity and diabetes requires new methods to identify individuals at risk for developing clinical diabetes. This is necessary because there are scientific issues with the current diagnostic criteria, and because the standard assessments of diabetes risk, diagnosis and complications require expensive and/or invasive testing that contributes to the existing disparities in diabetes prevention, prediction, and monitoring experienced by disadvantaged populations.

AIM OF THE STUDY

To perform a comparative study of salivary ph among newly diagnosed, well controlled and poorly controlled diabetes mellitus patients.

MATERIALS AND METHODS

This was a prospective study was done in the research laboratory of Department of Physiology., Rajiv Gandhi Institute of Medical Sciences, Srikakulam between 2015 till 2016. This study was conducted on total 150 individuals in three groups of 50 male subjects each of 45 to 55 years of age, weighing 50 to 70 kgs.

GROUP I : newly diagnosed Diabetes Mellitus patients: diagnosed as diabetics since last two months.

Group II: well controlled Diabetes Mellitus patients: diagnosed as diabetics for the last 10 years and the blood sugar levels and HbA1c are under well controlled levels.

Group III: Poorly controlled Diabetes Mellitus patients: diagnosed as diabetics for the last 10 years and the blood sugar levels and HbA1c are under poor controlled levels.

MATERIALS:

Ethical clearance: The study had commenced after obtaining approval from Scientific Committee of the study institute and from the Institutional Review Board at the study institute.

After obtaining informed written consent, detail history and physical examination was done in all subjects.

Inclusion Criteria

1. The subjects were chosen in age groups of 45 – 55 years of age.
2. Only male subjects are taken as cases and controls.
3. The subjects were on average Indian diet.
4. The subjects were diagnosed type II diabetes mellitus,
5. The subjects were not on any other medications except oral hypoglycemic (Metformine tablet, Glibenclamide tablet),

Exclusion Criteria

1. Subjects having any other systemic diseases were excluded,
2. Alcoholics and tobacco chewers were excluded,
3. Subjects who were on any other medication except oral hypoglycemic,
4. Subjects who were on diet restriction.

METHODS

The subjects are instructed to stay 6 hours fasting in order to prevent the effect of confounding factors on the pH of salivary samples and then The unstimulated salivary sample was collected, between 9 - 11 a.m. The subjects were instructed not to spit forcibly to avoid blood contamination. Resting saliva was collected for five minutes. Once the saliva was collected, the graduated sampling tube was placed in an ice carrier box and transferred to department research laboratory, for biochemical analysis.

ANALYSIS OF SALIVARY pH: pH and buffer capacity measurement pH of saliva samples was determined using a pH meter (Hana Italy).

ESTIMATION OF HbA1c: 5 ml. of whole blood is collected and HbA1c kits were used (i- CHROMATM HbA1c, Republic of Korea). Diabetes may be defined as having an HbA1c >6.5%, >6.5% to 8 = controlled diabetes, >8.0% = uncontrolled diabetic.

All the diabetic patient which included in the study were under medication (Metformine tablet, Glibenclamide tablet)

Statistical Analysis

The data was analyzed using the SPSS statistical software version 23. All value of biochemical parameters were

expressed as mean ± SD. Intergroup comparisons of salivary pH and HbA1c in the uncontrolled diabetic group, controlled diabetic group and newly diagnosed diabetic group subject group were determined by using **t-test**. Levels of significance between group for all the parameters of the study with the gender were determined by employing Student's 't' test.

RESULTS

The parameter considered in this study is the salivary pH in relation to the Glycosylated Hemoglobin (HbA1c) of the diabetic individuals of varied duration and control levels. The following tables describe the mean levels of HbA1c and the salivary pH and the comparison tables are drawn between the groups.

Table 1: Comparison table of **mean levels** of HbA1c and Salivary pH in all the three groups

Sr No.	Groups	Mean HbA1c ± S.D	Mean Salivary pH ± S.D
1	Newly diagnosed diabetics	6.36 ±0.20616	7.1672 ± 0.1937
2	Controlled diabetic	6.996 ±0.26058	7.0324 ± 0.1578
3	Uncontrolled diabetic	14.644 ± 18.84	6.8584 ± 0.15737

Table 2: Comparison table of mean levels of HbA1c and significance between Group I and Group II

Sr. No.	Groups	Mean HbA1c ± S.D	t-value	p-value
1	Newly diagnosed diabetics	6.36 ± 0.20616	-8.939	<0.001
2	Controlled diabetic	6.996 ±0.26058		

Highly significant (p≤0.001), Significant (p≤0.05)

Table 3: Comparison table of mean levels of HbA1c and significance between Group I and Group III

Sr. No.	Groups	Mean HbA1c ± S.D	t-value	p-value
1	Newly diagnosed diabetics	6.36 ± 0.20616	-2.195	<0.05
2	Uncontrolled diabetic	14.644 ± 18.84		

Highly significant (p≤0.001), Significant (p≤0.05)

Table 4: Comparison table of mean levels of HbA1c and significance between Group II and Group III

Sr. No.	Groups	Mean HbA1c ± S.D	t-value	p-value
1	Controlled diabetic	6.996 ±0.26058	-2.03	= 0.05
2	Uncontrolled diabetic	14.644 ± 18.84		

Highly significant (p≤0.001), Significant (p≤0.05)

Table 5: Comparison table of mean levels of Salivary pH and significance between Group I and Group II

Sr. No.	Groups	Mean Salivary pH ±S.D	t-value	p-value
1	Newly diagnosed diabetics	7.1672 ± 0.1937	2.964	<0.05
2	Controlled diabetic	7.0324 ± 0.1578		

Highly significant (p≤0.001), Significant (p≤0.05)

Table 6: Comparison table of mean levels of Salivary pH and significance between Group I and Group III

Sr. No.	Groups	Mean Salivary pH ± S.D	t-value	p-value
1	Newly diagnosed diabetics	7.1672 ± 0.1937	5.598	<0.001
2	Uncontrolled diabetic	6.8584 ± 0.15737		

Highly significant (p≤0.001), Significant (p≤0.05)

Table 7: Comparison table of mean levels of Salivary pH and significance between Group II and Group III

Sr. No.	Groups	Mean Salivary pH ± S.D	t-value	p-value
1	Controlled diabetic	7.0324 ± 0.1578	3.533	<0.05
2	Uncontrolled diabetic	6.8584 ± 0.15737		

Highly significant (p≤0.001), Significant (p≤0.05)

DISCUSSION

Considering important and numerous roles of saliva in the oral cavity, the present study was undertaken to compare salivary pH, which is one of the most important parameters of this oral fluid, in patients with diabetic subjects of different onset and control levels in the research laboratory of department of Physiology at Rajiv Gandhi Institute of Medical Sciences (RIMS), Srikakulam. The results showed lower salivary pH values in diabetic patients compared to healthy subjects. In the present study, the subjects were selected from one population and the age and gender were matched in the two study groups in order to eliminate the effect of confounding factors on pH values. In order to eliminate the effect of other confounding factors on the pH of salivary samples, all the subjects in the case and control groups were asked to refrain from eating and drinking for

two hours before collection of salivary samples. Some authors have reported that a decrease in salivary flow in diabetic patients results from an increase or decrease in the salivary flow. (B1) Since there is a decrease in salivary flow in diabetic patients a decrease in the salivary pH values might be attributed to this fact. (B2) Studies have shown that enamel demineralization begins with a decrease in salivary pH values to below 5.5. Therefore, a decrease in salivary pH will be associated with an increase in caries rate. Wolff and Klienberg showed that a decrease in salivary flow and also a decrease in wettability of mucosa are associated with a decrease in salivary pH. Therefore, a decrease in salivary pH results in a decrease in salivary flow, leading to xerostomia and complications such as periodontal diseases, caries, candidiasis, angular cheilitis and enlargement of salivary glands. In patients with uncontrolled diabetes, cheilosis, a tendency for xerostomia and crack formation, burning sensation, hyposalivation and changes in the microflora of the oral cavity with widespread presence of Candida albicans, hemolytic streptococci and staphylococci have been reported [(10)]. However, these changes are not specific. Other findings include a change in the eruption pattern of teeth, increased tenderness of teeth to percussion, an increase in the incidence of enamel hypoplasia and an increase in caries rate. Probably, the most important changes in uncontrolled diabetes are decreases in the body's defense mechanisms and an increase in susceptibility to infections, which results in destructive periodontal diseases. Fenoll-Palomares *et al* evaluated salivary flow, its pH and its buffering capacity in healthy volunteers and their relationship with age, gender, obesity, smoking and use of alcohol. The results showed that salivary flow depends on age and gender and is directly proportional to bicarbonate concentration. In a study by Moreira salivary parameters of flow rate, pH and calcium concentration were evaluated in a group of children with type I diabetes mellitus. The results showed that except for an increase in calcium concentrations all the other salivary parameters with a role in caries process were seen in patients with diabetes, including a decrease in salivary flow and pH values. It was concluded that a decrease in salivary pH is certainly due to a decrease in unstimalated salivary flow. In addition, it was emphasized that a decrease in salivary pH values in patients with diabetes indicates a decrease in the buffering capacity of saliva and an increase in caries rate. The results of the present study, too, showed a decrease in salivary pH results in controlled or uncontrolled diabetic patients compared to newly diagnosed diabetic subjects. Busato *et al* evaluated the effect of clinical status and salivary condition on xerostomia and oral hygiene in patients with type I diabetes mellitus. Salivary conditions were evaluated with the use of stimulated salivary flow, pH values, buffering capacity, and concentrations of proteins, amylase, urea, calcium and glucose. The results did not show a significant effect of salivary conditions on xerostomia. In a study by Al-AHas *et al* Candida colonization and its species diversity was evaluated in diabetic patients. It was reported that diabetic patients not only had higher carrier state percentages but also they had more Candida species resistant to Azol group medications. Oral candidiasis in diabetic patients was related to blood glucose level control, the type of diabetes and salivary pH. The results showed lower salivary pH values in diabetic patients compared to healthy subjects. Moor *et al* evaluated xerostomia and salivary flow rate in patients with type I diabetes mellitus and concluded that in patients with more severe neuropathies, more severe signs of xerostomia, along with greater decreases in salivary flow rates, are seen. Due to the importance of saliva in maintaining oral hygiene, treatment of oral diseases in such patients requires more comprehensive control of salivary function. Lin *et al* evaluated salivary function deficiencies in patients with type II diabetes mellitus and concluded that such deficiencies result in xerostomia in diabetic patients, although further studies were recommended. Chawez *et al* evaluated the effect of diabetes and control of blood glucose level on the function of salivary glands and reported that in diabetic patients with poor control of blood glucose levels; there was greater salivary gland dysfunction. Dodds *et al* evaluated salivary changes in patients with type II diabetes mellitus and hypertension and reported that the patterns of salivary flow decrease and protein concentration increase were similar in both groups but more prominent in diabetic patients. In addition, diabetic patients were more susceptible to xerostomia and oral cavity infections compared to non-diabetic patients[11].

SUMMARY AND CONCLUSION

The present study has shown that the salivary pH is affected in diabetic individuals of longer duration irrespective of control state. The pH is more affected in poorly controlled diabetics than controlled diabetic. The decreased pH reduces the buffering action of the saliva and renders the oral cavity prone to many dental diseases. Dental caries that gets infected can lead to spread of infection to other organs including brain. The recent advances shoe that estimation of biochemical parameters in the saliva can also be used as biomarkers for different diseases. The study has a scope to make the patients of poorly controlled diabetes mellitus can be explained about the effects of reduced pH that effects the oral cavity and also signifies the importance of controlling the sugar

levels under recommended levels and maintain proper oral hygiene.

REFERENCES

1. A.R. Moreira et al., Flow rate, pH and calcium concentration of saliva of children and adolescents with type 1 diabetes mellitus, Braz J Med Biol Res, August 2009, Volume 42(8) 707-711. (13)
2. Ambady Ramachandran ET AL., Type 2 Diabetes in India: Challenges and Possible Solutions, CHAPTER 40, Type 2 Diabetes in India: Challenges and Possible Solutions. (DM2).
3. Bardow A, Moe D, Nyvad B, and Nauntofte B. The buffer capacity and buffer systems of human whole saliva measured without loss of CO2. Arch Oral Biol 2000; 45: 1-12. (A13)
4. Dawes C. What is the critical pH and why does a tooth dissolve in acid? J Can Dent Assoc 2003; 69: 722-724. (A11)
5. Edblad E, Lundin SA, Sjodin B, Aman J. Caries and salivary status in young adults with type 1 diabetes. Swed Dent J 2001; 25: 53-60. (A8)
6. Författare: Martin Ågren, Handledare: Ingegerd Johansson Professor, 30-year (1983-2013) trends in saliva flow rate and saliva buffer capacity. Analyses from 10-year repeated, cross-sectional population samples in the Jönköping area, Örebro universitet Institutionen för hälsovetenskap och medicin Enheten klinisk medicin Kurs: Medicin, avancerad nivå. Examensarbete Datum: 2015-06-07. (14)
7. Hosein islami, Comparative Evaluation of Salivary pH Levels in Type II Diabetic Patients and Healthy Subjects, VISI J Akademik, 4 (2015), 144-148. (12)
8. Huizinga MM, Rothman RL. Addressing the diabetespandemic: A comprehensive approach. Indian J Med Res2006;124 : 481-4 (A1)
9. Heintze U. Secretion rate, buffer effect and number of lactobacilli and Streptococcus mutans of whole saliva of cigarette smokers and nonsmokers. Scand J Dent Res 1984; 92: 294-301. (A15)
10. Joshi SR, Das AK, Vijay VJ, et al. Challenges in diabetes care in India: sheer numbers, lack of awareness and inadequate control. J Assoc Physicians India. 2008;56:443-50. (A6)
11. JH eurman et al., Saliva in non-insulin-dependent diabetic patients and control subjects: The role of the autonomic nervous system. Oral Surg Oral Med Oral Pathol Oral Radiol Endod. 1998 Jul;86(1):69-76. (21)
12. Mata AD, Marques D, Rocha S, Francisco H, Santos C, Mesquita MF, et al. Effects of diabetes mellitus on salivary secretion and its composition in the human. Mol Cell Biochem 2004; 261: 137-142. (A9)
13. Reuterving CO, Reuterving G, Hagg E, Ericson T. Salivary flow rate and salivary glucose concentration in patients with diabetes mellitus influence of severity of diabetes. Diab Metab 1987; 13: 457-462. (A10)
14. Sicree R, Shaw JE, Zimmet PZ. The global burden of diabetes. In: Gan D (Editor), Diabetes atlas. 2nd edn. Brussels: International Diabetes Federation; 2003. p 15-71. (A12)
15. Sicree R, Shaw J, Zimmet P. Diabetes and impaired glucosetolerance. In: Gan D, editor. Diabetes Atlas. InternationalDiabetes Federation. 3rd ed. Belgium: InternationalDiabetes Federation; 2006 p. 15-103. (A3)
16. V. Mohan et al, Epidemiology of type 2 diabetes: Indian scenario. Diabetes Indian J Med Res 125, March 2007, pp 217-230. (DM1)
17. Wild S, Roglic G, Green A, Sicree R, King H.Global prevalence of diabetes: Estimates for the year 2000and projections for 2030. Diabetes Care 2004; 27 : 1047-53. (A2)
18. Wikner S, and Soder PO. Factors associated with salivary buffering capacity in young adults in Stockholm, Sweden. Scand J Dent Res 1994; 102: 50-3. (A14)

Source of Support: None Declared
Conflict of Interest: None Declared