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Original Research

## Saliva: A tool in assessing glucose levels in Diabetes Mellitus

B N V S Satish<sup>1</sup>, P Srikala<sup>2</sup>, B Maharudrappa<sup>3</sup>, Sharanabasappa M Awanti<sup>4</sup>, Prashant Kumar<sup>5</sup>, Deepa Hugar<sup>6</sup>

### Contributors:

<sup>1</sup>Professor, Department of Oral Pathology & Microbiology, HKES's S Nijalingappa Institute of Dental Sciences & Research, Gulbarga, Karnataka, India; <sup>2</sup>Post Graduate Student, Department of Oral Pathology & Microbiology, HKES's S Nijalingappa Institute of Dental Sciences & Research, Gulbarga, Karnataka, India; <sup>3</sup>Professor & Head, Department of Oral Pathology & Microbiology, HKES's S Nijalingappa Institute of Dental Sciences & Research, Gulbarga, Karnataka, India; <sup>4</sup>Professor & Head, Department of Biochemistry, MR Medical College, Gulbarga, Karnataka, India; <sup>5</sup>Reader, Department of Oral Pathology & Microbiology, HKES's S Nijalingappa Institute of Dental Sciences & Research, Gulbarga, Karnataka, India; <sup>6</sup>Lecturer, Department of Oral Pathology & Microbiology, HKES's S Nijalingappa Institute of Dental Sciences & Research, Gulbarga, Karnataka, India.

### Correspondence:

Dr. B N V S Satish. Department of Oral Pathology & Microbiology, HKES's S Nijalingappa Institute of Dental Sciences & Research, Gulbarga, Karnataka, India. Phone: +91 - 9480226407. Email: bnvs26@gmail.com

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### Abstract:

**Background:** Diabetes mellitus is a metabolic disorder affecting people worldwide, which require constant monitoring of their glucose levels. Commonly employed procedures include collection of blood or urine samples causing discomfort to the patients. Hence the need for an alternative non invasive technique is required to monitor glucose levels. Saliva present in the oral cavity not only maintains the health of the oral cavity but plays a important role in diagnosis of cancers of the oral cavity, periodontal diseases, HIV, heart diseases etc. The aim of the present study was undertaken to correlate the glucose levels in saliva and blood of diabetic and healthy non diabetic individuals and to determine the efficacy of saliva as a diagnostic tool.

**Materials & Methods:** A total of 30 individuals of which 20 patients were diabetic patients and on medication and 10 patients were healthy non diabetic individuals were included in the study. Blood and saliva were collected under resting conditions and were subjected to glucose estimation.

**Results:** Salivary and blood glucose concentrations were determined in non diabetic healthy individuals (n=10) and Type II Diabetes mellitus patients (n=20). Glycosylated haemoglobin A1c was also determined in both Type II diabetic patients and Control group and a significant correlation ( $r=0.73$ ) and ( $r=0.46$ ) was found between HbA1c and serum glucose concentrations in diabetic and control group respectively. A significant correlation ( $r=0.54$ ) and ( $r=0.45$ ) was found between

fasting blood glucose and fasting salivary glucose for diabetic group and control group respectively. A positive correlation ( $r=0.39$ ) and ( $r=0.38$ ) was found between fasting salivary glucose and HbA1c for diabetic and control group respectively.

**Conclusion:** These findings suggest that the saliva can be used in the assessment of the blood glucose concentration in diabetes mellitus patients.

**Key Words:** Diabetes mellitus, glucose, saliva

### Introduction

Diabetes mellitus is a disorder of carbohydrate metabolism characterized by hyperglycemia and glycosuria, reflecting a distortion in the equilibrium between utilization of glucose by the tissues and liberation of glucose by the liver. Asian Indians seem to be at a greater risk of developing this disorder. Currently we have 40.9 million people suffering from diabetes and the predicted estimate by the year 2025 is around 70 million. The crude prevalence rate of diabetes in urban areas is about 9% and in rural areas, has increased to around 3% of the total population.<sup>1</sup>

Diagnostic tests based on fluids generally use blood and urine, less frequently the esoteric fluids such as saliva, sweat and tears. These days interest has been increasing in non invasive diagnostic testing. All steroids of diagnostic significance in routine clinical endocrinology can now be measured readily in saliva. Antibodies, unconjugated steroids, hormones and certain drugs of diagnostic significance can now be easily and accurately measured in saliva.<sup>2</sup> In the present study saliva has been used to measure the glucose concentration in blood, thereby making self measurement of glucose a non invasive procedure.

The present study is aimed at determining the correlation between salivary and blood glucose concentrations in non diabetic healthy individuals & patients with Type II diabetes mellitus.

### Materials and Methods

#### Collection of Samples

All the subjects were the ones who visited the Oral Medicine department of HKE Society's S. Nijalingappa Institute of Dental Sciences & Research, Gulbarga

(Karnataka). The samples were obtained from individuals who volunteered to participate in this study.

30 patients (Diabetes mellitus Type II=20, non diabetic control=10) in the age group of 25-45 years were considered. Blood and salivary samples were collected from these individuals during resting condition. The unstimulated saliva was collected from both diabetic and control group by the method of spitting the saliva, while the subject was fasting. All the subjects were asked to wash their mouth thoroughly before collection of salivary samples.

The subject were asked to swallow the saliva present in the mouth and then to remain still without moving the tongue or swallowing the saliva for one minute. The subjects were asked to spit the saliva into clean sterile containers once in every 60 seconds for a total of five minutes.

Fasting blood samples were also collected from both the diabetic and control group by venipuncture technique.

Fasting Serum and salivary glucose levels were determined by the use of autoanalyser, (cobas c III, Germany) and

independent Student's t-test. A P value <0.05 was accepted as significant.

### Results

In our study the control group showed fasting serum glucose levels ranging from 60-100mg/dL, with a mean of 90.5 mg/dL and SD of 11.19. The fasting salivary glucose levels ranged from 3.7-5.9 mg/dL, with a mean of 4.32 mg/dL and SD of 0.62 and the glycosylated haemoglobin ranged from 4.2 – 5.4% with a mean of 4.74 and SD of 0.42. (Table 1)

In the diabetic group, the fasting serum glucose ranged from 105-373 mg/dL, with a mean of 205.2 mg/dL and SD of 78.26. The fasting salivary glucose ranged from 6.0-25.1mg/dL, with a mean of 12.11 mg/dL and SD of 6.38 and glycosylated haemoglobin ranged from 4.7 – 9.5% with a mean of 6.97 and SD of 1.61. (Table 2)

The comparison of glucose with control group and diabetic group showed a significant differences in fasting blood glucose, fasting salivary glucose and fasting HbA1c ( $t$  value >2.048 for  $p=0.05$ ). (Table 3)

**Table 1: Mean and standard deviation for control group.**

	Fasting blood glucose	Fasting salivary glucose	HbA1C
Mean	90.5	4.32	4.74
SD	11.19	0.62	0.42

**Table 2: Mean and standard deviation of diabetic group.**

	Fasting blood glucose	Fasting salivary glucose	HbA1C
Mean	205.2	12.11	6.97
SD	78.26	6.38	1.61

**Table 3: Comparison of glucose with student's t test between control group and diabetic group t values (>2.048 for p=0.05) shows significant difference in fasting blood glucose, fasting salivary glucose and fasting HbA1c between control group and diabetic group.**

Fasting blood glucose	Fasting salivary glucose	HbA1C
4.45	3.72	4.17

semiautoanalyser, (Erba chem7, Germany) respectively. Glycosylated haemoglobin (HbA1c) was also determined in all the subjects by using autoanalyser, (cobas c III, Germany).

### Statistical Analysis

Mean and standard deviation (SD) of fasting serum glucose, fasting salivary glucose and fasting HbA1cs were calculated for the diabetic and control group. These were then compared using Pearson's correlation coefficient and

Correlation coefficient values shows that there is significant positive correlation between fasting blood glucose and fasting salivary glucose, fasting blood glucose and HbA1c, fasting salivary glucose and HbA1c for  $P<0.05$ . (Table 4)

### Discussion

Diabetes mellitus a disorder of carbohydrate metabolism poses a challenge to health professionals. The key aspect being management and normalization of blood glucose

**Table 4: Correlation between fasting blood glucose, fasting salivary glucose and HbA1c for control group and diabetic group.**

<b>Correlation coefficient between</b>	<b>Control group</b>	<b>Diabetic group</b>
Fasting blood glucose and fasting salivary glucose	0.45	0.54
Fasting blood glucose and HbA1c	0.46	0.73
Fasting salivary glucose and HbA1c	0.38	0.39

levels so as to reduce the associated complications. In individuals with a history of diabetes, oral health problems are usually related to metabolic control of the disease and poorly controlled glucose levels tend to have an adverse effect on salivary glands. Usually there is an imbalance between oxidant and anti oxidant status. The oxidative stress in diabetes includes oxygen derived free radicals generation due to non enzymatic glycosylation, auto oxidizing of glycogen products with changes in tissue content.<sup>3</sup>

The technique usually involved in estimation of the glucose levels is by venipuncture technique, which is traumatic, especially in children leading to anxiety and trauma.<sup>4</sup> Hence the need for an alternative technique arises.

These days interest has been increasing in the use of saliva as a diagnostic fluid because all steroids of diagnostic significance, antibodies, hormones, certain drugs etc can easily and accurately be measured. Another advantage of saliva is that it is an organic fluid and can be collected easily and can be easily preserved.<sup>5</sup>

Glucose is a small molecule that can readily diffuse through the semipermeable membrane and hence can be detected in saliva especially when the blood sugar levels are elevated. Other explanations given for the presence of glucose in saliva are diabetic membranopathy i.e alteration in the basement membrane of the salivary glands which leads to leakage of glucose in saliva. According to Harrison and Bowen any alteration in the basement membrane of blood vessels may cause increased transport of glucose into saliva.<sup>5,6</sup>

Several studies have been conducted on biochemical changes in saliva of diabetic patients with debatable results. The salivary glucose concentrations seem to correlate with the serum glucose concentrations in the patients of Type II diabetes mellitus.<sup>7,8</sup> A significant glucose concentration in saliva from insulin dependent diabetes mellitus (Type I) was also reported<sup>5</sup>.

In our study a significant correlation was found between glycosylated haemoglobin and serum glucose concentrations in both diabetic group and control group which suggests that diabetic group had an average elevated blood glucose concentration over an extended time period and the control group had normal blood glucose concentration over an extended time period suggesting that the control group are non diabetic (Table 1 & 2).

A significant correlation found between fasting blood glucose and fasting salivary glucose, fasting salivary glucose and glycosylated haemoglobin for both diabetic and healthy control group supports the use of saliva as a diagnostic fluid in Type II diabetes and also would prove valuable especially in children of Type I insulin dependent diabetes mellitus (Table 3).

However further studies on larger populations and in different geographic areas are required to establish salivary glucose estimation as a diagnostic tool in assessing glucose levels in diabetes mellitus.

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