International Journal of Advances in Medicine
Golamari UMR et al. Int J Adv Med. 2019 Aug;6(4):1220-1225
http://www.ijmedicine.com

pISSN 2349-3925 | eISSN 2349-3933

DOI: http://dx.doi.org/10.18203/2349-3933.ijam20193274

Original Research Article

Correlation between salivary glucose and blood glucose levels in diabetic and non-diabetic individuals

Uma Maheswara R. Golamari[1], Meenakshi Sundari Subramaniyan Natarajan[2]*, Annam Lakshmanan[2], Rajeswari K. Balakrishnan[3]

[1]Department of Medicine, Shri Satya Sai Medical College and Research Institute, Nellikuppam, Kanchipuram, Tamilnadu, India
[2]Department of Medicine, SRM Medical College Hospital and Research Centre, SRM IST, Kattankulathur, Kanchipuram, Tamilnadu, India
[3]Department of Medicine, Meenakshi Medical College Hospital and Research Institute, Enathur, Kanchipuram District, Tamilnadu, India

Received: 25 May 2019
Revised: 10 June 2019
Accepted: 03 July 2019

***Correspondence:**
Dr. Meenakshi Sundari Subramaniyan Natarajan,
E-mail: dr.meenakshisundari@gmail.com

ABSTRACT

Background: The aim of this study was to determine as well as to compare the salivary glucose levels in the diabetic and non-diabetic population and correlate the values with their fasting blood glucose and HbA1c (glycated Haemoglobin) levels. Many researchers have proposed the possibility of using salivary glucose estimation for screening and monitoring of effect in general population and in resource poor settings. But studies on this subject in Indian population are limited.
Methods: The current study was an analytical cross sectional study of a group of 100 diabetic patients and 100 healthy controls, conducted in the Department of General Medicine, SRM medical college hospital. The mean difference in the salivary glucose between diabetic and non-diabetic population was compared using unpaired t-test.
Results: There was a strong positive association between FBS (fasting blood sugar) and salivary glucose in the overall population. There was a strong positive correlation between FBS and Salivary glucose in FBS <200. There was a moderate positive association between FBS and salivary glucose in people with FBS value between 200 to 300 mg/dl. There was a weak positive association between FBS and salivary glucose in people with FBS value >300 mg/dl, which was statistically not significant. There was a strong positive correlation between HbA1c and salivary glucose in the overall population.
Conclusions: There appears to be a strong positive association between fasting blood sugar and salivary glucose value in both study groups. But the correlation seems to be relatively weak in fasting blood sugar range above 300 mg/dl. Considering this positive association, further studies are needed to explore the possibility of utilizing salivary glucose for monitoring glycemic control.

Keywords: HbA1c glycated haemoglobin, Fasting blood sugar, Salivary glucose

INTRODUCTION

Diabetes has been spreading its roots to an alarming level in all age groups with an augmentative nature. It is a disease with an iceberg phenomenon where most patients visit a clinician only when complications arise. It is estimated to be affecting 300 million people by the year 2025 and 366 million by 2030.[1] Trials like "The Diabetes

Control and Complication Trial (DCCT)" done in type 1 diabetes and United Kingdom Prospective Diabetes Study (UKPDS)" done in type 2 diabetes showed that improved glycemic control reduced the risk of developing micro vascular complications and slows down the disease progression.[2,3]

Regular monitoring of blood glucose is a prerequisite of tight glycemic control which will influence the treatment outcome of the disease. The contemporary method of screening for blood glucose is an invasive procedure. It is proven to be a distressing one due to the repeatability of the procedure during follow up visits. The prevalence of needle anxiety is 22% among patients of all ages and 27% among children.[4] about 20.5% of patients avoided medical treatment involving needles because of needle anxiety.[5] The needle anxiety in turn adversely affects the compliance which may lead to poor glycemic control and development of complications in these patients. An alternative, simple, efficient, cost effective method would be testing glucose levels in saliva. There is promising evidence elaborating the usefulness of saliva due to its diverse biochemical parameters.[6] The serum glucose diffuses to saliva after the advanced glycated end products in diabetic patients compromise the microvasculature and basal membrane of the salivary gland.[7] This had made researchers validate the salivary parameters to a spectrum of systemic illness.

Hence an appraisal of salivary glucose concentration in type 2 diabetic cases was made along with its quantitative association with blood glucose levels to scrutinize a noninvasive model for glucose assessment. Our study aims to estimate and compare the salivary glucose levels in the diabetic and non-diabetic population as well as to estimate the correlation between fasting blood glucose and salivary glucose levels among the diabetic and non-diabetic population.

METHODS

The current study was an analytical cross-sectional study. The study was conducted in the Department of General Medicine, SRM Medical College Hospital and Research Centre.

The study period is twelve months from September 2017 to August 2018. A total of 200 subjects were included in the study, out of which 100 were diabetic patients (Study group 1) and another 100 were healthy controls (Study group 2). Ethical Clearance was obtained from the ethical committee of SRM medical college hospital and Research Centre for the study, written and informed consent was sought from the patients and their attenders. Patients with oral lesions, salivary gland disorders and tobacco chewers were excluded.

Intravenous blood was collected using 25G needle from the median cubital vein. The clotted blood was centrifuged at 3000 rpm for 10 minutes and then serum was separated. After thoroughly rinsing their mouth with water, the subjects were asked to expectorate 2ml of unstimulated whole saliva into a sterile container gradually over a period of 5-10 minutes.

After transferring the saliva into a disposable test tube, it was centrifuged at 2000 rpm for 2-3 minutes. Reagent was added to the separated supernatant and incubated at 37 degree for 5 minutes. Chi-square test was used to test statistical significance. P value <0.05 was considered statistically significant. For statistical analysis IBM SPSS version 22 was used.

RESULTS

Of the 200 study subjects, the mean age of the study population was 55.24 with the range of 27 to 85 years. The proportion of male and female subjects in our study were 105 (52.50%) and 95 (47.50%) respectively. The mean FBS of the study population was 159.98 with values ranging from 64 to 480 mg/dL. In Figure 1, there was statistically significant (r Value: 0.894, P-value <0.001) strong positive correlation seen between FBS and salivary glucose in overall population.

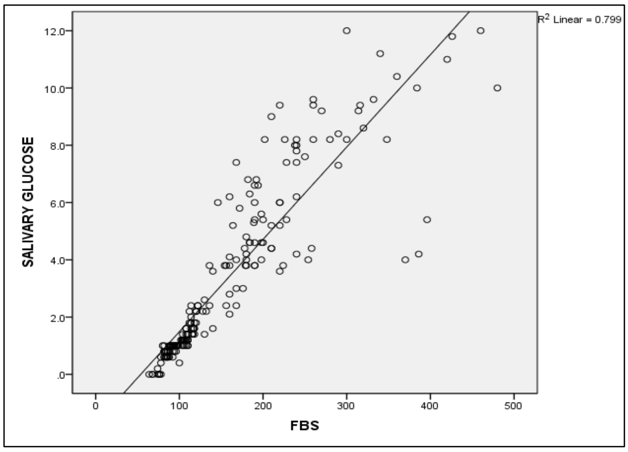

Figure 1: Correlation between FBS and salivary glucose in overall study population (N=200).

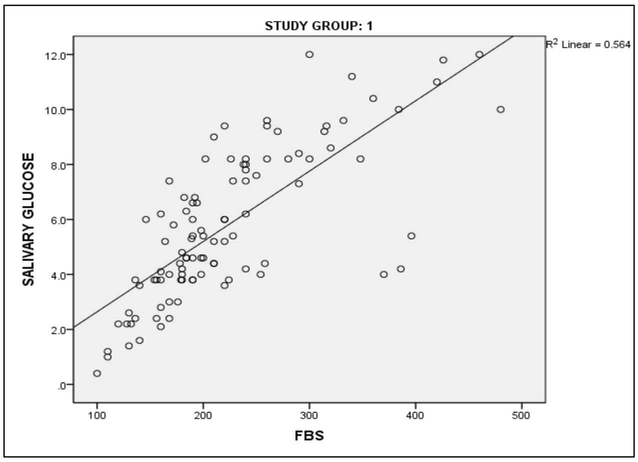

Figure 2: Correlation between FBS and salivary glucose in case group (Study group 2).

In Figure 2, there was statistically significant (r-value 0.751 and P-value < 0.001) strong positive correlation seen between FBS and salivary glucose in case group. The Mean of FBS was 222.78±80.01 in case group and mean of FBS was 97.17±1 in control group. The mean HbA1c of the study population was 7.71 with the minimum value 4.6 % and maximum 16.10%.

The Mean of HbA1C was 9.64±2.09 in case group and mean of HbA1c was 5.78±0.43 in control group. The mean salivary glucose in overall population was 3.42 mg/dl with value ranging from 0 and 12.0. The Mean of salivary glucose was 5.78±2.73 mg/dl in Diabetics and mean of salivary glucose was 1.06±0.53mg/dl in Non-Diabetics.

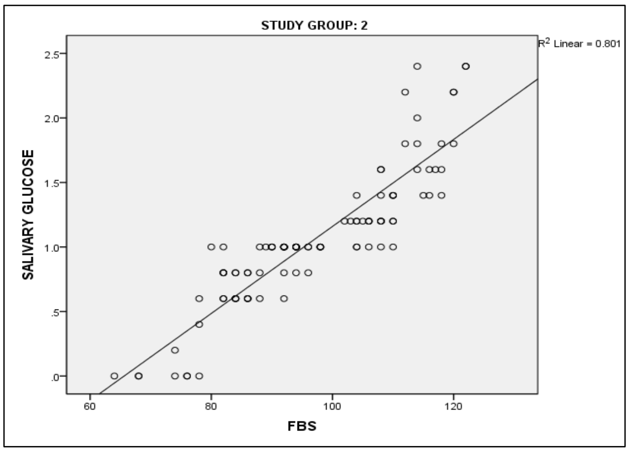

Figure 3: Correlation between FBS and salivary glucose in control group (Study group 2).

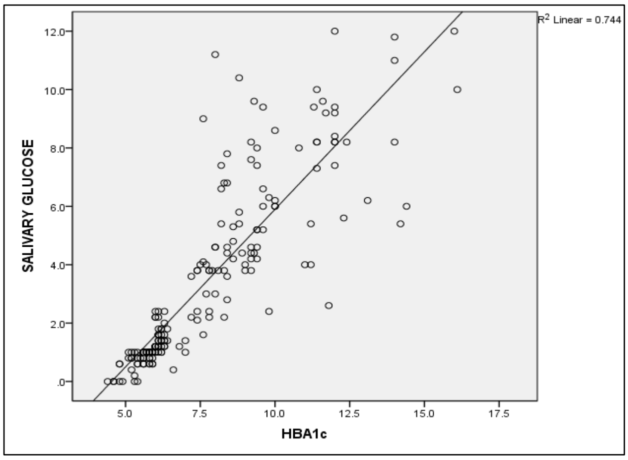

Figure 4: Correlation between salivary glucose and HbA1c among the overall population.

In figure 3, there was statistically significant (r-value: 0.895 and P-value:< 0.001) strong positive correlation seen between FBS and salivary glucose in control group.

In Figure 4, there was strong positive correlation between HbA1c and salivary glucose in study group which was statistically significant (r-value 0.862 and P-value <0.001). There was strong positive correlation between HbA1c and salivary glucose in cases group which was statistically significant (r-value 0.646 and P-value <0.001).

There was strong positive correlation between HbA1c and salivary glucose in control group which was statistically significant (r-value 0.743 and P-value <0.001).

Subgroup analysis

In figure 5, there was strong positive correlation between FBS and salivary glucose in FBS less than 200, which was statistically significant (r-value 0.913 and P-value <0.001).

In Figure 6, there was moderate positive correlation between FBS and salivary glucose in people with FBS value between 200 to 300 mg/dl, which was statistically significant (r-value=0.513 and P value 0.002).

In figure 7, there was weak positive correlation between FBS and Salivary glucose in people with FBS value above 300 mg/dl, which was statistically not significant (r-value 0. 205 and P value 0.463).

In figure 8, there was strong positive correlation between HbA1c and salivary glucose in people with FBS less than 200 mg/dl, which was statistically significant (r-value 0.853 and P value <0.001).

In Figure 9, there was weak positive correlation between HbA1c and salivary glucose in people with FBS value 200 to 300 mg/dl, which was statistically significant (r-value 0. 464 and P value 0.005).

In figure 10, there was weak positive correlation between FBS and Salivary glucose in people with FBS value above 300 mg/dl, which was statistically not significant (r-value 0. 234 and P value 0.402).

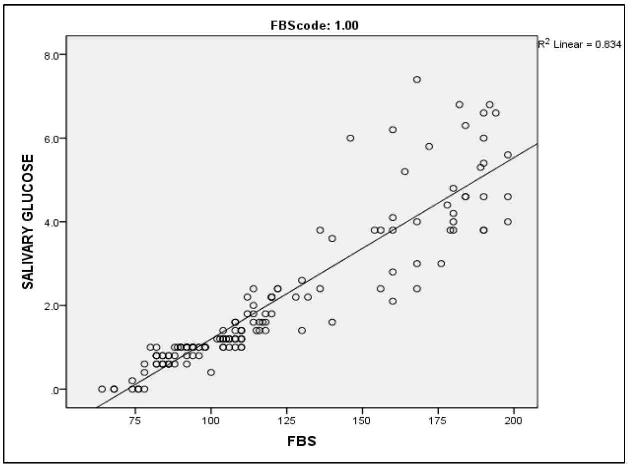

Figure 5: Correlation between salivary glucose and FBS among people with FBS <200 (FBS Code 1.00).

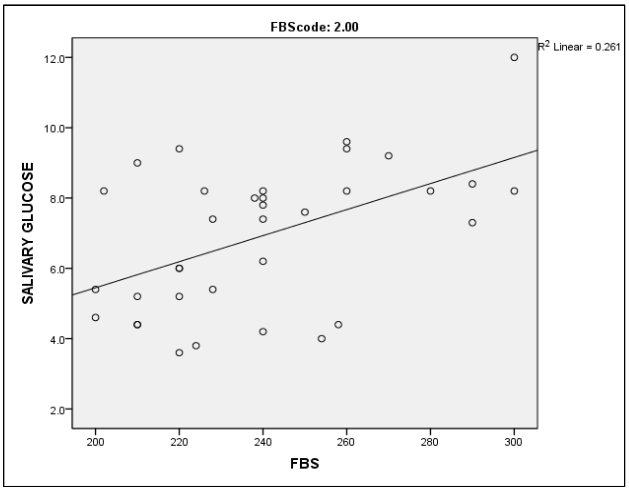

Figure 6: Correlation between salivary glucose and FBS among people with FBS 200 – 300 (FBS code: 2.00).

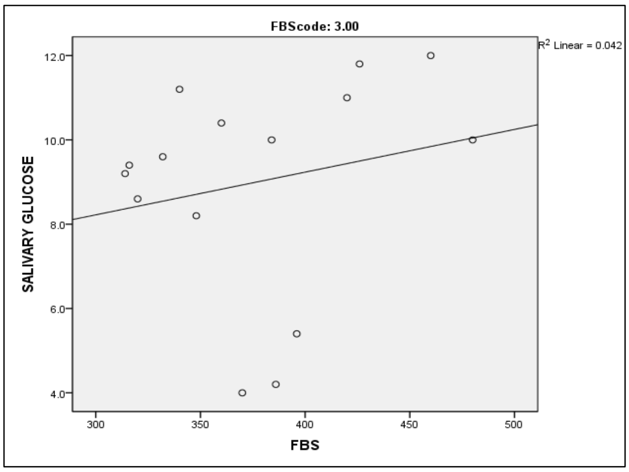

Figure 7: Correlation between salivary glucose and FBS among people with FBS above 300 (FBS Code: 3.00).

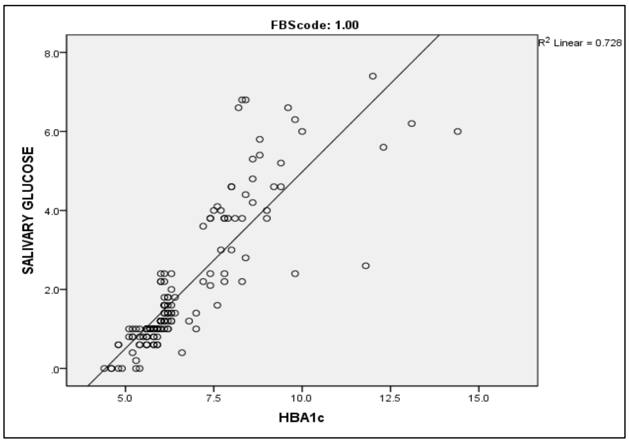

Figure 8: Correlation between salivary glucose and HbA1c among people with FBS less than 200 (FBS Code 1.00).

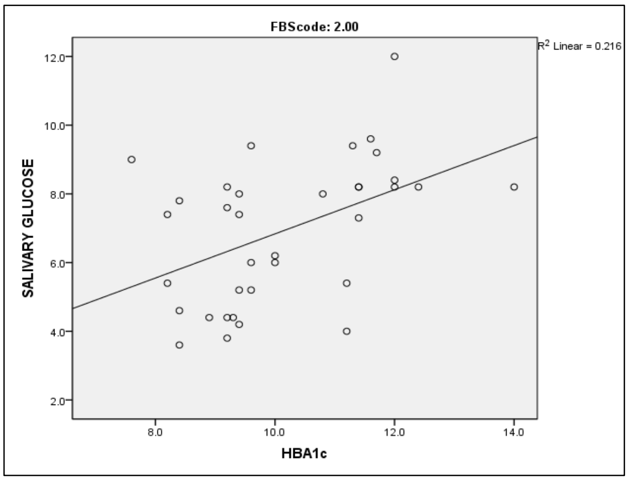

Figure 9: Correlation between salivary glucose and HbA1c among people with FBS 200 to 300 (FBS code: 2.00).

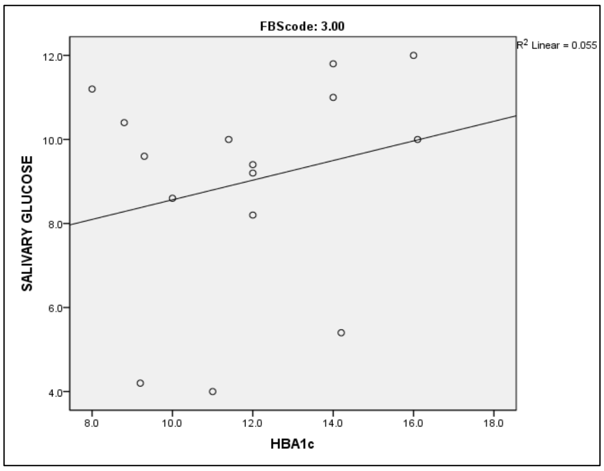

Figure 10: Correlation between salivary glucose and HbA1c among people with FBS above 300 (FBS Code: 3.00).

DISCUSSION

The technique of using saliva as a diagnostic fluid has increased in the meantime especially in the field of clinical endocrinology as most of the unconjugated steroids, hormones and antibodies can be easily and precisely measured in saliva. Glucose being a small molecule has the ability to easily diffuse through the semi permeable membranes and thus is detected in the saliva. The presence of increased glucose content in diabetes is due to the alteration in the basement membrane of the salivary gland which leads to the leakage of glucose in saliva.

Our study estimated and compared the salivary glucose levels in the diabetic and non-diabetic population and also estimated the correlation between fasting and salivary glucose levels among the diabetic and non-diabetic population. In Figure 2, it was observed that there was a strong positive correlation between FBS and Salivary glucose in cases group (r value 0.751 and P value <0.001) and also a significant correlation between FBS and Salivary glucose in FBS less than 200 (Figure 5), whereas a moderate correlation between FBS and salivary glucose was observed in people with FBS value between 200 to 300 mg/dl (Figure 6), and a weak correlation between FBS and Salivary glucose in people with FBS value above 300 mg/dl (Figure 7), which was statistically not significant (r value 0. 205 and P value 0. 463). In Figure 4, on comparing HbA1c and salivary glucose in the overall population there was strong positive correlation between HbA1c and salivary glucose in cases group as well as control group (r value: 0.743 and P value <0.001).

Similar results were demonstrated by T. Sashikumar R et al. They estimated the levels of glucose in the saliva of type 2 diabetic patients and compared them with healthy controls. As per the study findings, the glucose values in saliva were significantly higher in cases as compared to controls as well as a significant positive correlation was observed between salivary glucose levels and plasma glucose. Patel BJ et al, have concluded the use of salivary glucose level as a diagnostic tool in Diabetes. Similar to our study, there was a statistically significant correlation between salivary and plasma glucose levels in patients with diabetes. Studies by forbat et al, showed discrepancy with our study as it showed no significant correlation between salivary and plasma glucose level, this discrepancy was due to the inappropriate sampling techniques used for determining blood glucose.[8-10]

Mascarenhas P et al, assimilated studies on glycemia and its detection and correlation between various laboratory parameters like blood glucose, HbA1c, and salivary glucose and have performed a meta-analysis. The results were conclusive of the evidence that the salivary glucose concentration has a favorable association with HbA1c (r= 0.37) in addition to glycemia (r= 0.49) and they claimed that salivary glucose testing could have wider acceptance among diabetics and non-diabetics as well. In contrary to the proposed results, Gupta A et al, in their study on 250 diabetic patients evaluated the role of salivary glucose in diagnosing the disease condition. The results proved to be negative, with r=0.073, P=0.24 and hence they stated that salivary glucose is ineffective in predicting the presence of disease condition. This could be mainly due to oral retention of alimentary carbohydrates, consumption of glucose by bacteria and patients with poor gingival status.[11,12]

Eventually, with the upcoming prevalence of diabetes, salivary glucose analysis can be used as a diagnostic, cost-effective and reliable noninvasive procedure to estimate as well as to monitor the glucose levels in diabetic patients of all socio economic status and thereby increase the patient's compliance by being a patient friendly procedure. Our study has been one of the few studies in India focusing on the alternative methods in diagnosing diabetes and since India has become the capital of diabetes, it is of a great concern to detect diabetes in the early stage by using noninvasive methods over invasive methods.

CONCLUSION

The use of salivary glucose for estimation and monitoring of glucose proves to be an effective procedure in diabetic patients with fasting blood glucose ranging between 200-300 mg/dl. But the correlation seems to be relatively weak in fasting blood sugar range above 300 mg/dl. Considering this positive association, further studies are needed to explore the possibility of utilizing salivary glucose for monitoring glycemic control.

ACKNOWLEDGEMENTS

Authors would like to thank Dean and management of SRM Medical Hospital and Research Center for allowing us to successfully conduct and complete this study.

Funding: No funding sources
Conflict of interest: None declared
Ethical approval: The study was approved by the Institutional Ethics Committee

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Cite this article as: Golamari UMR, Natarajan MSS, Lakshmanan A, Balakrishnan RK. Correlation between salivary glucose and blood glucose levels in diabetic and non-diabetic individuals. Int J Adv Med 2019;6:1220-5.