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RESEARCH ARTICLE
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CORRELATION BETWEEN HB1AC AND FASTING BLOOD GLUCOSE IN DIABETIC AND NON DIABETIC PERSON.

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ABSTRACT
In 2014, the IDF(International diabetic federation) estimated that 8.2% of adults aged 20–79 (387 million people) were living with diabetes; this compares with 382 million people in 2013, and the number of people with the disease was projected to rise beyond 592 million in 2035.T1DM is a result of absolute insulin deficiency whereas insulin resistance and relative insulin deficiency are the key elements of T2 High concentrations of glucose can increase the glycation of common proteins such as hemoglobin, forming Hemoglobin A1c (HbA1c). DM. The aim and objective is to study the relationship of fasting blood glucose and HbA1c and to establish a conversion equation between them. This study was conducted on the type 2 diabetic outpatient attending the out-patient diabetes clinic of Department of Medicine, PIMS Udaipur. A total 50 patients history of type 2 diabetes mellitus was recruited for the study after obtaining the informed consent.

INTRODUCTION
T1DM is a result of absolute insulin deficiency whereas insulin resistance and relative insulin deficiency are the key elements of T2DM. T2DM is often considered as chronic inflammatory disease and preceded or accompanied by the presence of metabolic syndrome. T2DM, which represents the majority of DM cases globally, is now among the most prevalent of all non-communicable diseases (). T2DM comprises of 80-90% of total diabetic population. Apart from hyperglycaemic condition, diabetes has become a pleiotropic phenomenon, which is associated with various short and long-term complications such as vision loss (retinopathy), neuropathy, foot ulcer, nephropathy, cardiomyopathy and central nervo High concentrations of glucose can increase the glycation of common proteins such as hemoglobin, forming Hemoglobin A1c (HbA1c). However, it is important to note that HbA1c is neither considered dysfunctional nor harmful.et al. Alberti, K. G. M. M. and Zimmet, P. (1999) Nevertheless, the concentration of HbA1c predicts diabetes complications because it reflects more harmful glycation sequelae of diabetes, such as retinopathy and nephropathy, which are understood to be due to harmful advanced glycation end productsts Castilho EM, Glass ML, Manço JC. The effects of 2,3-diphosphoglycerate, adenosine triphosphate, and glycosylated hemoglobin on the hemoglobin-oxygen affinity of diabetic patients. (Braz J Med Biol Res. 2003;36(6):731–7.) Glycatedhemoglobin (HbA1c) is routinely used marker for long term glycemic control. The formation of glycohemoglobin, especially the hemoglobin A1c (HbA1c) fraction, occurs when glucose becomes coupled with the amino acid valine in the β-chain of Hb; this

reaction is dependent on the plasma concentration of glucose (,). Since the early 1970s it has been known that diabetics display higher values of HbA1C because they have elevated blood glucose concentrations. Thus HbA1c has acquired a very important role in the treatment and diagnosis of diabetes mellitus. The relationship between HbA1c and blood glucose is documented in the literature denoting a straight relationship. 8-10 However, this relationship has not been confirmed by others.11 There is a controversy about the performance of HbA1c in case finding. Hemoglobin A1c is known to correlate with blood glucose levels over the lifetime of the red blood cell, which is approximately 120 days. Nathan DM, (Singer DE, Hurxthal K, Goodson JD. The clinical information value of the glycosylated hemoglobin assay. N Engl J Med. 1984;310(6):341–6.)(Tahara Y, Shima K. The response of GHb to stepwise plasma glucose change over time in diabetic patients. Diabetes Care. 1993;16(9):1313–4.)

MATERIAL AND METHOD

This study was designed to evaluate a study of correlation between Hb1AC and fasting blood glucose in diabetic and nondiabetic person among local Udaipur population. The present study includes 100 subjects of either sex among them

- 50 non-diabetic control
- 50 type 2 diabetic mellitus patient

Study design

Present study was conducted in the Department of Biochemistry ,PIMS, Udaipur. The subjects in our study groups were selected from outpatient visiting at Department of Medicine, PIMS Udaipur.

Subject selection

Based on the following inclusion and exclusion criteria of subjects for the study was made on the basis of detailed and proper clinical examination.

Inclusion Criteria

Diabetic patients

- Type 2 DM patients in age group of above 20 years ages and both genders.
- Out patient department patient in department of medicine, surgery, obs. gynae. Skin.

Exclusion Criteria

Patients having history of type 1 diabetes

- Hypertensive patients
- Chronic alcoholics and drug addicted.
- Pregnancy and gestational diabetes
- Adverse renal and liver disease.
- Acute and chronic inflammatory disease
- Patient with malignancy.
- Chronic renal failure, Nephrotic syndrome
- Familial hypercholesteremic syndromes.

Clinical History

A detailed clinical history of each patient was recorded in a self-constructed performa which include age, sex, address, occupation, socioeconomic status, personal history, medical history, present complain of present illness.

It was included age, sex, weight, history of the disease etc.

Biochemical Examination

Blood Collection: 5ml fasting blood sample was collected in plain vials for estimation of fasting blood glucose and HbA1c from healthy subjects and patients with the type 2 diabetic mellitus.
Following investigations were done in subjects of Experimental group and controls.

Serum sample: Five millimiters of blood was drawn from the peripheral veins under aseptic conditions. Collected blood sample was kept in test tubes at room temperature for 30-60 minutes to allow sedimentation for cellular fraction of blood. The sedimented blood sample was centrifuged at 3000 rpm for 10-15 minutes. Supernatant serum separated out with the help of micropipette. Then the sample was analysed by fully auto-analyser by modified IFCC method.

Glycaemic Parameters

Patient's glycaemic parameter data collected form outpatient records. The blood glucose and HbA1c measured with following schedule and methods. In brief, blood sample will be collected after an overnight fast and before the morning oral glycaemic control therapies.

1. **Glucose**

Blood glucose in the venous blood was determined by glucose oxidase-peroxidase method using the commercial supplied kit.

1. **Glycosylated haemoglobin(HbA1c)**

The concentration of both glycosylated haemoglobin and total hemoglobin were determined. The HbA1c/Total hemoglobin ratio is expressed as percentage HbA1c (%HbA1c).
HbA1c results were automatically recalculated to DCCT aligned units by the instrument using the NGSP/IFCC approved Master Equation. This calculation is programmed into the analyzer as part of the settings for this test. Three sets of results will be automatically printed out for each sample, THb, HbA1c and % HbA1c at 37°C. THb and HbA1c are used for determination of %HbA1c. %HbA1c must also be entered in the general tests and calculated tests of the test section menu (no settings required).

5. Result & Observation

Table 1.Demographics and clinical variables of the study population

Parameters	Cases (n=100)	Control (n=50)	Diabetic (n=50)	p-value
Age (Years)	49.49±0.95	48.14±1.33	50.84±1.32	p=0.1536
Weight (Kg)		64.72±11.41	67.12±12.95	p=0.327
Female (%) Male (%)	44% 54%	42% 58%	46% 54%	-
Height (CM)	161.54±8.51	162.56±8.62	160±8.37	p=0.135
BMI (Kg/m2)	26.41±4.02	24.29±2.44	26.01±4.30	p=0.015
Fasting Blood glucose (mg/dl)		105.62±8.61	258.68±83.37	p<0.001

HBA1c		5.27±0.33	11.58±3.39	p<0.001

Values are presented as Mean ± Standard deviation (SD). P<0.05 was considered statistically significant difference. Independent sample t-test was used to compare means of demographics, and clinical variables of subjects. BMI: Body Mass Index , HBA1C: Glycated haemoglobin, HB: Haemoglobin.

Subjects with desirable HBA1c levels (HBA1c≤ 6.0% of Hb) had a lower mean blood glucose (105.62±8.61) as compared with those of higher HBA1c levels (11.58±3.39% of Hb) which is highly statistically significant (p<0.001) (Fig. 4A and B).

Fig. 1. Shows the correlation between HbA1C and FBG. A positive correlation was found that predicted a significant correlation between HbA1C and FBG (P<0.001).

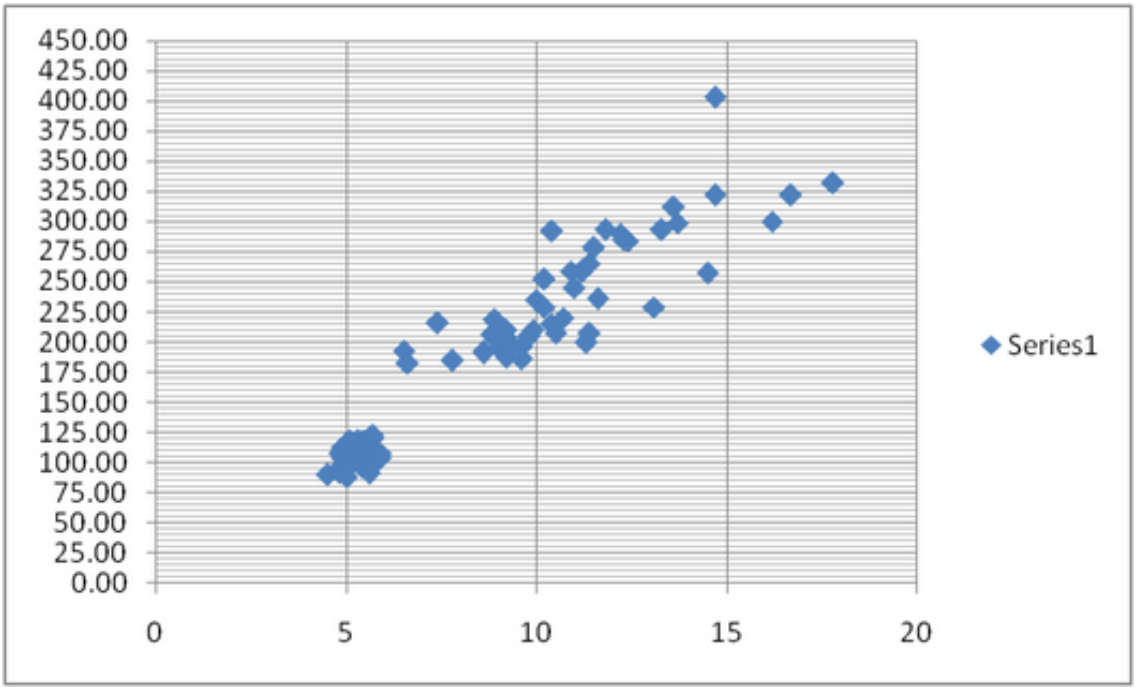

Fig. 1. The correlation between HbA1C and FBG was investigated.The concentration of FBG increases with the increase of HbA1C.

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Table 2Correlation between HBA1c, fasting glucose, BMI parameter in diabetic subjects

	HBA1c	**BMI**	**FBS**
HBA1c	1	-0.17 (p=0.218)	0.88 (p<0.001)
BMI		1	-0.24 (p=0.087)
FBS			1

Data are given as mention as Person's correlation coefficient, r (p value summary; 2 tailed) between respective parameters of diabetic subjects (n=50). P value <0.05 are considered as significant. FBS: Fasting blood glucose, HBA1C: Glycated haemoglobin , BMI: Body Mass Index.

Diabetes is a global disease with rapid increase in both developed and developing countries. Hyperglycaemia is one remarkable feature of diabetes patients. As an important indicator of long-term blood glucose control, glycated haemoglobin (HbA1c) can reflect cumulative blood glucose for 2-3 months.

The findings of this study showed a highly significant correlation between HbA1C and fasting blood glucose

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