

Original Research Article

A Comparative Study: Elevated HbA1c and Fasting Blood Sugar (FBS) Levels in Clinically Suspected Cases of Type 2 DM.

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Abstract

Background: Although glycated hemoglobin (HbA1c) has recently been incorporated as a diagnostic test in comparison by FBS by the ADA, its validity needs to be established in a community setting.

Objective: To assess the efficacy of HbA1c as a screening and diagnostic test in clinically suspected cases diabetes mellitus and comparison of statistical parameters of HbA1c and FBS.

Materials And Method: Cross sectional study was conducted in Indore, MP at IMCHRC, from July 2015- July 2017 on 430 clinically suspected cases of DM. Intervention included an FBS and HbA1c in all the subjects.

Results: Using ADA criteria of diabetes that is FBS >126mg/dl we got sensitivity of 36.59%, specificity of 96.05%, PPV of 96.08%, NPV of 32.02% and accuracy of 50.69%.

HbA1c level at 6.5% had sensitivity 91.94%, specificity 45.42%, PPV 40.57%, NPV 93.29% and accuracy 50.69%.

HbA1c level of 5.7% had an sensitivity of 96.77%, specificity 32.03%, PPV 36.58%, NPV 96.08% and accuracy 49.30%.

HbA1c level of 6.0 had sensitivity 95.97%, specificity 38.56%, PPV of 38.76%, NPV of 95.93% and accuracy 55.11% for diagnosis of DM.

Conclusion: HbA1c cut point of 6.0% had an optimal sensitivity and specificity of 95.97% and 38.76% respectively, with maximum accuracy of 55.1% and can be used as a screening test and a cutoff point of 6.5% has optimal specificity of 45.45 and NPV of 93.29% and can be used for diagnosis of diabetes. Moreover both HbA1c and FBS should be used together for screening to balance their individual weak parameters.

Keywords: HbA1c; FBS; Accuracy.

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Introduction

DM is a group of metabolic disorders which share the common underlying feature of hyperglycemia resulting from interactions between environmental factors and polygenetic inheritance. In order to

detect diabetics, usually fasting blood glucose (FBS) is suggested as the most common test with the cutoff point ≥ 126 mg/dl. FBS as a screening test, has fasting for about 8 hours and because of this, this test is not being applicable in the afternoon.

HbA1c test, which is the percentage of glycated hemoglobin, used in central labs.

It is an important marker to assess the microvascular complications and plasma glucose status for 3 month period.

Criteria for The Diagnosis of Diabetes Mellitus

- glucose blood random plus diabetes or Symptoms concentration \geq (200 mg/dL) or
- FBS \geq (126mg/ dL) or
- HbA1c \geq 6.5% or
- Plasma 2-hglucose \geq (200mg/ dL) glucose tolerance tested. oral an during)

Aims

- Comparison of accuracy of HbA1c and FBS in diagnosis of diabetes.
- Comparison of degree of association between HbA1c and FBS and also calculation of their sensitivity, specificity and predictive values.

Objectives

- Establishing an efficient screening program to detect people with undiagnosed diabetes.
- Early diagnosis of diabetes for reduction in development of complications.
- Use of HbA1c as a screening test.

Materials and methods

- The study was conducted in the department of pathology, Index Medical College Hospital, Indore.
- *Study Design:* Cross-sectional comparative study.
- *Place of Study:* Department of Pathology, Index Medical College, Hospital & Research Centre, Indore (M.P.).
- *Duration of Study:* 2 years
- *Study Population:* 430 samples from 25 yrs and above.

Inclusion Criteria

1. Patients visiting central pathology laboratory of age groups 25 yrs and above.
2. Patients agreeing with the study objectives and signing consent form.
3. Clinically suspected cases of diabetes

mellitus, freshly diagnosed cases and health checkup clients.

Exclusion Criteria

1. Patients with type 1 diabetes were excluded.
2. Patients on insulin therapy were not included.
3. Patients not willing to sign the consent forms were not included.

Methodology

- Blood sampling was performed after an overnight fast.
- The samples for FBS were collected in plain tube and for HbA1c were collected in EDTA tube.
- For HbA1c, we used bio system kit. It uses particle enhanced immuno turbimetric test as method.
- The cutoff point of 6.5% was considered as diagnostic criterion for diabetes (ADA criteria)
 - \geq 6.5% - diabetic (D1).
 - 5.7 to 6.4% - impaired or (IR1).
 - \leq 5.7% - non diabetes. (ND1)
- Samples for fasting plasma glucose were processed on the fully automatic autoanalyser "ERBA EM 360" which is based on the Glucose oxidase and Peroxidase (GOD-POD) method.
- The cutoff point of 126mg/dl was considered as diagnostic criteria for diabetes as per ADA and patients with
 - FBS \geq 126 mg/dl - diabetic (D2).
 - FBS 101 to 125 mg/dl - IFG impaired (IR2)
 - FBS \leq 100 mg/dl - non diabetics (ND2).

Observations and Results

Table 1:

Gender	Group 1 (HbA1C)			Total
	D1	IR1	ND1	
Male	162	24	58	244
Females	117	25	44	186
Total	279	49	102	430

Table 2: Comparison of Mean Values of Hb1AC

Group	Number (N)	Mean	SD	P value
D1	278	8.8	2.013	0.000
IR1	49	6.0	0.2320	
ND1	102	5.0	0.4874	

For HbA1c, ANNOVA (Analysis of Variance) was done to compare the mean value of the 278 cases under D1 had a mean value of 8.815 with SD of 2.013. IR1 had a mean value of 6.0145 with standard deviation of 0.2320, and the ND1 had a mean value of 5.0097. p value was significant.

Table 3: Comparison of Mean Value of FBS

Group	Number	Mean	SD	P value
D2	125	150.14	25.13	0.000
IR2	204	112.36	8.584	
ND2	101	88.48	8.235	

The table divides the cases into 3 groups i.e D2 (diabetic group), IR2(impaired group) and ND2 (non diabetic group).The total number of cases in D1 group are 125, IR2 with 204 cases and ND2 with 101 cases. All three groups showed a statistically significant result with p value < 0.05 and pooled standard deviation of 15.3050.

Comparison of impaired group values

Values of IR1-HbA1c

- Sensitivity = 21.72
- Specificity = 100.00
- PPV = 1.0
- NPV = 0.547
- Accuracy = 59.77

Values for IR2-FBS

- Sensitivity = 100.00
- Specificity = 54.71
- PPV = 0.217
- NPV = 1.000
- Accuracy = 59.76
- Reports on the optimum cutoff for HbA1c for diagnosing diabetes have varied worldwide. We calculated statistical parameters at cut off values of 5.7%, 6.0% and 6.5%.

Table 4:

	Parameter	Sensitivity	Specificity	Ppv	Npv	Accuracy
Present study 2017(430 cases)	HbA1c (>6.5)	92%	45%	40.5%	93%	59%
	(>6.0)	96%	38.5%	39%	96%	55%
	(>5.7)	97%	32%	36.5%	96%	51%
	FBS ≥ (126)	36.5%	96%	97%	32%	51%
Ghazanfari Z et al.(2010) (604 cases)	HbA1c(>6)	86%	77%	36%	97%	78%
	HbA1c(>6.15)	85%	79%	38%	97%	80%
	F.B.S	38%	97%	85%	79%	80%
Najeeb Q et al.(2015), 200 cases	HbA1c (>6.5%)	82.2%	74.8%	48.6%	93.5%	
	FBS >126mg/dl	51.1%	89.6%	58.9%	86.3%	

Discussion

- For the diagnosis purpose we emphasize on the accuracy and specificity of a test. Hence as per our observations, HbA1c and a higher accuracy in all the three cut off levels of ≥5.7%, ≥6.0%, and ≥6.5%. But when we compare the specificity of FBS and HbA1c, FBS has a higher specificity but with a low NPV. Hence, this shows that FBS has large number of false negatives. Therefore, we can conclude by saying that HbA1c is superior to FBS.
- For the screening purpose we emphasize more on sensitivity and NPV of a test. In our observations, we can come to a point that HbA1c has higher sensitivity and NPV. Thereby making HbA1c superior to FBS.
- HbA1c proved well against FBS in diagnosing diabetes as it diagnosed more cases i.e. 281 as diabetic by HbA1c cut off of 6.5% and 124 cases by FBS at cut off 126%.
- FBS showed large number of FN, this ought to be the reason of low sensitivity of FBS i.e 37%.
- HbA1c is a better indicator due to high sensitivity and has less number of false negatives.
- Studies by Najeeb Q et al.(2015) had similar result of high sensitivity and low specificity of HbA1c whereas studies by Hjellestad et al. (2013) have suggested the trend of lower sensitivity and higher specificity at HbA1c >= 6.5%.
- Incani et al. (2015) reported results similar to our study in an obesity clinic cohort, but lower sensitivity and PPV in a diabetes screening cohort.
- As per our study HbA1c value of 5.7% should be chosen to rule out diabetes and values of ≥6.5% should be chosen to rule in diabetes.
- The PPV of 40.5% was observed and the negative predictive value of 93% at 6.5%.

- The lower PPV showed that there are genuine concerns about the variations in HbA1c assay which need to be standardized.
- However, some of the variation could be due to the population and methodology being different.

Conclusion

- As per our study HbA1c value of 5.7% should be chosen to rule out diabetes (screening) and values of $\geq 6.5\%$ should be chosen to rule in diabetes (diagnostic).
- Moreover both HbA1c and FBS should be used together for screening to balance their individual weak parameters.

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