A Comparative Study to access the accuracy of DIPSI method and random plasma glucose testing as screening tests for GDM

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ABSTRACT

Background: Any degree of glucose intolerance that begins or is first noticed during pregnancy is referred to as GDM. Depending on the diagnostic standards applied and the ethnic group researched, the prevalence of GDM varies greatly. It has a negative impact on perinatal and maternal outcomes. 1–14% of people in India have GDM. There are numerous GDM diagnostic and screening procedures. Early diagnosis and treatment are crucial to averting these consequences.

Aim and Objective: The present study was aimed to compare the accuracy of DIPSI method and random plasma glucose testing as screening tests for GDM.

Methodology: After gaining approval from the Santosh University ethical committee, this prospective cohort study was carried out in the Department of Gynecology and Obstetrics at Santosh Hospital in Ghaziabad. From January 2012 to June 2013, pregnant women with singleton pregnancies who attended regular prenatal checkups between the 24th and 28th week of gestation were chosen in chronological order. In all women, the random glucose test was performed first followed by DIPSI recommended method (2 hours after a 75g oral glucose load, without regard to the time of the last meal)

Result: Out of the 700 women recruited for the study, only 576 women returned for 2-h 75-g oral glucose tolerance test (OGTT) and completed the study. he Age (mean±SD) of the participants was 25.3±3.9 . The Age (mean±SD) of women diagnosed having GDM was 27.1±4.1.

Comparison of accuracy measures resulted in higher sensitivity in favour of the DIPSI screening test compared with the random glucose test (90.2% [95% CI 78.6– 96.7] vs. 15.7% [7.1 – 28.6]). The area under the ROC curve was larger for the DIPSI test (0.97 [0.95– 0.98]) than for the random glucose test (0.76 [0.72– 0.79]).

Conclusion: Study concluded that the DIPSI approach would be used to develop a community-based public health program to screen for and diagnose GDM.

Keywords: DIPSI, GDM, Random glucose test.

INTRODUCTION

The term gestational diabetes mellitus (GDM) refers to glucose intolerance that is initially noticed during pregnancy. Obesity, changing racial/ethnic patterns of reproduction, and advanced maternal age are all contributing to an increase in the prevalence of GDM. It is anticipated that 15% of all pregnant women globally may experience GDM as a result of the global trend of rising maternal obesity [1]. India now has 63 million diabetics, which is the second-highest number in the world. It

follows that the disturbingly high prevalence of GDM in India is not surprising. Compared to Caucasian women, Indian women are more prone to acquire GDM [2]. According to regional distribution and diagnostic techniques, the prevalence of GDM in India ranged from 3.8 to 21% in various regions [3,4].

Treatment of GDM improves perinatal as well as maternal outcome [5,6] Whetherscreening for GDM will result in reduction of maternal and neonatal morbidity remainstobeestablished.Themajorityofinternationaldiabetesassociationshowever,advocates creening for GDM as desirable[7].

Currently there is no consensus on the optimal approach to screen for GDM. Several international guidelines recommend either a one-step 75-g oral glucose tolerance test (OGTT) approach, or a two-step approach in which a 50-g glucose challenge test is performed, followed by an OGTT in the event of an abnormal test result.

The Hyperglycemia and Adverse Pregnancy Outcome (HAPO) group sought to identify new screening values that would better identify pregnancies at risk for perinatal complications. The HAPO study demonstrated a positive linear relationship between screening glucose values and adverse perinatal outcomes. [8]

The Diabetes In Pregnancy Study Group India (DIPSI) guidelines for screening and diagnosis recommends that a pregnant woman after undergoing preliminary clinical examination, has to be given a 75g oral glucose load, without regard to the time of the last meal. A venous blood sample is collected at 2 hours for estimating plasma glucose by the GOD-POD method. GDM is diagnosed if 2 hr plasma glucose is ≥ 140 mg/dl. [10]

Random glucose testing is another screening procedure that is frequently used (RGT). The RGT is a straightforward, quick, and affordable test that analyzes plasma glucose at a random time, regardless of when the previous meal was consumed, and without the need for any special preparation. It is frequently used in Europe and India to screen for GDM.

The objective of the present study was to compare the accuracy of two above mentioned commonly performed single test procedures (RGT and DIPSI) as screening tests for GDM. As high accuracy, especially high sensitivity, is an important prerequisite for screening procedures, the above tests should not be used as screening test for GDM if test accuracy indeed is insufficient, even if the test is simple and inexpensive.

MATERIALS AND METHODS

After gaining ethical authorization from the Santosh University ethical council, the current study was carried out on patients who chronologically attended the antenatal clinics in the Department of Gynaecology and Obstetrics, Santosh Hospital, Ghaziabad. All women gave their informed consent. From January 2012 to June 2013, pregnant women who were 24 to 28 weeks gestation and had a singleton to multiple pregnancies were recruited for the study. Only 576 of the 700 women who were recruited for the study returned for the 2-hour, 75-g oral glucose tolerance test (OGTT) and finished the research. Weight in kilograms divided by the square of height in meters was used to compute BMI.

n all women, the random glucose test was performed first followed by Diabetes In Pregnancy Study Group India (DIPSI) recommended method (2 hours after a 75g oral glucose load, without regard to the time of the last meal). Venous blood sample were

collected for estimating plasma glucose by the glucose-oxidase method.

If the random plasma glucose measured between 24 and 28 weeks of gestation was 110 mg/dl (6.1 mmol/L), the random glucose test was considered abnormal. By DIPSI method if 2 hr plasma glucose was ≥ 140 mg/dl(7.8 mmol/L) it was considered abnormal.

The distribution of continuous variables is reported as means ±SD. We constructed two-by-two tables for abnormal and normal test results on the random glucose test and the DIPSI screening test against the OGTT. These tables reflect true-positive, false-positive, true-negative, or false-negative test results for both the random glucose test and the DIPSI test. Diagnostic accuracy (sensitivity, specificity, predictive values, and likelihood ratios) and 95% CIs were calculated. Receiver operating characteristic (ROC) analysis was used to evaluate the discriminatory power of the two screening tests. Fisher's exact test was used to compare categorical data in order to obtain a two-sided (two-tailed) P value. Medcalc (Version12.6.0) was used to examine the data.

RESULTS

Only 576 of the 700 women who were recruited for the study returned for the 2-hour 75-goral glucose tolerance test (OGTT) and finished the experiment. 576 women's data were used for the analysis. The participants' ages (meanSD) were 25.3 ± 3.9. The average age of women who were diagnosed with GDM was 27.1 ± 4.1.

Table1: Socio-demographic data distribution of the subject.

Socio-demographic data distribution		Number (%) n=576
Age Group (Years)	15-19	13(2.26%)
	20-24	251 (43.58%)
	25-29	216 (37.5%)
	30-34	90 (15.63%)
	≥ 35	6 (1.04%)
Education	Professional/ Postgraduate/Graduate	70 (12.2%)
	Intermediate/ High school/ Middle school	205 (35.6%)
	Primary School	190 (33%)
	Illiterate	111 (19.3%)
Economic Class	Upper	72 (12.2%)
	Upper Middle	188 (32.6%)
	Lower Middle	115 (20%)
	Upper Lower	40 (6.9%)
	Lower	161 (27.6%)
BMI (kg/m2)	16.9-24.9 (Normal weight)	490 (85.07%)
	25-29.9 (Over weight)	84 (14.58%)
	≥30 (Obesity)	2 (0.35%)
Family History of Diabetes	Yes	88 (15.28%)
	No	488 (84.72%)

The characteristics of the patient are shown in Table I. Women aged 20 to 24 made up 43.58% of the total population, followed by women aged 25 to 29 who made up 37.5%. Women made up only 12.2% of professionals, postgraduates, and graduates. Women made up 32.6% of the Upper Middle Class and 20% of the Lower Middle Class. The weight of 85.07% was normal. 88 women overall (15.28%) had a family history of diabetes, compared to 488 women (84.72%) who did not.

Table2: Comparison of accuracy measures between the screening tests.

AccuracyMeasures	RandomGlucosetest	DIPSITest
Sensitivity	15.7(7.1to28.6)	90.2(78.6to96.7)
Specificity	95.4(93.3to97.1)	97.5(95.8to98.7)
PositivePredictiveValue	25.00(11.49to43.41)	77.97(65.27to87.70)
NegativePredictiveValue	92.10(89.50to 94.22)	99.03(97.76to 99.68)
PositiveLikelihoodRatio	3.43 (1.63to7.24)	36.43(21.13 to 62.78)
NegativeLikelihoodRatio	0.88 (0.78to1.00)	0.10 (0.04to0.23)
AreaundertheROCcurve(AUC)	0.76(0.72 to 0.79)	0.97(0.95 to 0.98)
Allaccuracymeasuresaredisplayedwith95%CIs.		

Comparison of accuracy measures resulted in higher sensitivity in favor of the DIPSI screening test compared with the random glucose test (90.2% [95% CI 78.6– 96.7] vs. 15.7% [7.1 – 28.6]). The DIPSI test also had less false-positive test results and was therefore more specific (97.5% [95.8–98.7] vs. 95.4% [93.3 –97.1]). Positive predictive values for DIPSI tests was high as compared to Random Glucose test. Negative predictive values for both tests were comparable. The likelihood ratio of an abnormal test result was larger for the DIPSI test than for the random glucose test.
The likelihood ratio of a normal test was smaller for the DIPSI test.

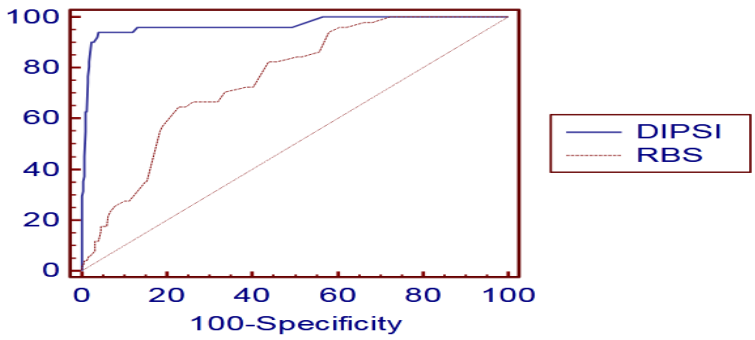
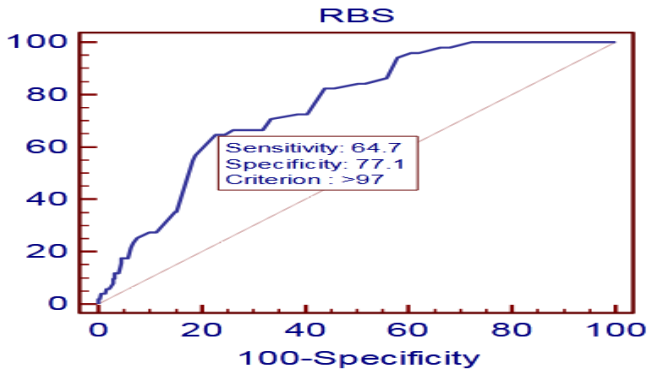


Figure 1: Comparison of ROC curve analysis of random plasma glucose test and DIPSI test for GDM

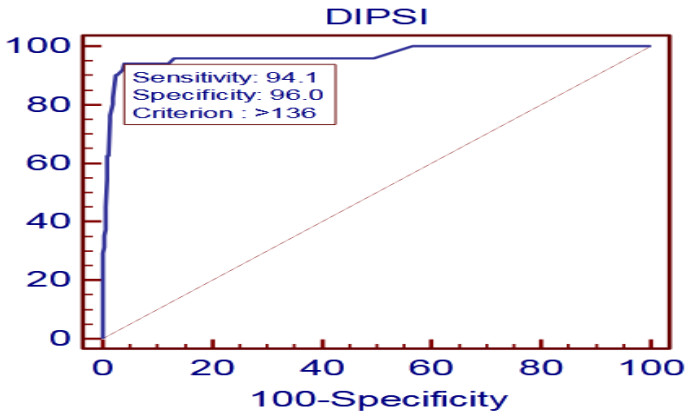
The area under the ROC curve was larger for the DIPSI test (0.97 [0.95– 0.98]) than for the random glucose test (0.76 [0.72–0.79]). There was a significant difference in the areas under the curve of the two tests of 0.21 (0.14 to 0.28)(P < 0.0001).(Fig.1)

Figure 2: ROC analysis of random plasma glucose test



Using the WHO criteria i.e., 75g OGTT (FPG ≥ 110 mg/dl [6.1 mmol/L]; 2-hour ≥ 140 g/dl[7.8 mmol/L]), the Random Blood Glucose test cut point of 97 mg/dl gave the highest sensitivity and specificity.(Fig. 2)

Figure 3: ROC analysis of DIPSI test.



Using the WHO criteria i.e., 75g OGTT (FPG ≥ 126 mg/dl [7 mmol/L]; 2-hour ≥ 140 g/dl[7.8 mmol/L]), the DIPSI test cut point of 136 mg/dl gave the highest sensitivity and specificity.(Fig. 3)

DISCUSSION

Among the 576 women who participated in the current study 51 women (8.9%) had GDM, which was validated by a 75g, 2-hour OGTT following WHO criteria. According to the DIPSI technique, 59 (10.2%) women had GDM (defined as blood glucose more than 140 g/dl at 2 hours after a one-step, fasting 75 g glucose load).

The sensitivity and specificity of the DIPSI screening test, which was conducted between 24 and 28 weeks of pregnancy, were quite high for a screening test at 90.2% and 97.5%, respectively (95% CI 95.8-98.7). DIPSI test positive predictive values ranged from 78% (65.27 to 87.70) to 99% (negative predictive values) (97.76 to 99.68).

In assessing the value of DIPSI method in the diagnosis of GDM, the area under ROC curve was 0.97 with confidence interval (CI) 0.95– 0.98. Serum glucose level

of >136mg/dl showed the highest

sensitivity and specificity equal to 94.1% and 96.0 %, respectively.

Anjalakshi et al. [54] evaluated, whether a 2-h 75 g oral glucose test done in a non-fasting state, irrespective of last meal timing, is as efficacious as 2-h 75 g oral glucose test done in the fasting state recommended by WHO in detecting GDM. The study showed all women diagnosed as GDM (n = 87) by 75 g glucose non fasting test also satisfied the diagnostic criteria of 75-g oral glucose test performed in the fasting state recommended by WHO. No difference in the plasma glucose levels of the 75 g glucose test in fasting and non-fasting state was noted, in GDM and normal glucose tolerant (NGT) pregnant women ($p > 0.05$). The rationale is that, normal glucose tolerant women are able to maintain euglycaemia despite glucose challenge due to adequate insulin response, whereas in women with GDM, impaired insulin secretion [61] increases glycemic level with a meal and the glucose challenge is expected to exaggerate the glycemic excursion. This cascading effect is advantageous as it increases specificity and eliminates false positive diagnosis of GDM. Gough et al. [62] reported that glucose concentrations during the glucose tolerance are affected little by the time since the last meal. The specificity of DIPSI method of screening was very high in our study also. Philips et al. [63] also observed that plasma glucose value with a glucose challenge test was unaffected by the time after a meal or time of the day in normal glucose tolerant non pregnant subjects.

Recently Seshiah et al. [64] in a study on 1463 consecutive pregnant women with no previous history of GDM/pre GDM showed no significant difference ($p > 0.05$) in the discordant pair of diagnosing GDM by the two criteria – DIPSI criterion, 196 (13.4%), applying IADPSG recommendation the cumulative prevalence of GDM was 14.6% (n = 214). And concluded that the disagreement in diagnosing GDM by both criteria was not significant (p= 0.21, by Mc Nemar test).In our study we evaluated DIPSI method as a screening test for GDM. In the present study the random plasma glucose measured between 24 and 28 weeks of revealed a very low sensitivity of 15.7% [95% CI 7.1 – 28.6] and a high specificity of 95.4% [95%CI 93.3 –97.1] using a threshold value of ≥110 mg/dl (6.1 mmol/L). Using this threshold GDM was present in 32(5.6%) women only. In assessing the value of RPG in the diagnosis of GDM, the area under ROC curve was 0.76 (CI) 0.72– 0.79. Serum glucose level of >94 mg/dl showed the highest sensitivity and specificity equal to 64,7% and 77.1 %, respectively.

The results of our study are similar to study done by Nasrat et al. [65].They evaluated random glucose measurement, which revealed a sensitivity of 16% and a specificity of 96% using a threshold value of 7.0 mmol/l or 6.4 mmol/l if evaluated_2 h postprandial. The study by Jowett et al. showed that the performance of the RGT is associated with timing of the test.

The sensitivity of the RGT in their study ranged from 25 to 47% for random blood glucose measurement in the same women at different times of day. As pregnancy progresses plasma glucose levels under fasting conditions drop whereas plasma glucose levels after a meal become higher [66]. As the RGT is performed at a random point in time, peak values after a meal might remain undetected. Indeed women may have normal blood glucose values with random glucose testing, but still have unnoticed (asymptomatic) periods of

hyperglycemia. Comparison of accuracy measures resulted in higher sensitivity in favor of the DIPSI screening test compared with the random glucose test (90.2% [95% CI 78.6– 96.7] vs. 15.7% [7.1 – 28.6]). The DIPSI test also had less false-positive test results and was therefore more specific (97.5% [95.8–98.7] vs. 95.4% [93.3 – 97.1]).

Positive predictive values for DIPSI tests was high as compared to Random Glucose test. Negative predictive values for both tests were comparable. The area under the ROC curve was larger for the DIPSI test (0.97 [95%CI 0.95– 0.98]) than for the random glucose test (0.76 [95%CI 0.72–0.79]). There was a significant difference in the areas under the curve of the two tests of 0.21 (0.14 to 0.28)($P < 0.0001$).It indicated that the DIPSI test was a better predictor for GDM than the random glucose test.

As high sensitivity is key to any screening test, random glucose testing is not an accurate method to screen women for GDM because five of six women with GDM would still be missed. In our study, sensitivity and specificity of the RGT seem to be not sufficient to be used as a screening test. In screening for GDM, the DIPSI procedure test is more useful than the random glucose test.

CONCLUSION

In screening for GDM, the DIPSI procedure test was more useful than the random glucose test. DIPSI procedure for screening GDM requires little preparation, without requiring the patient in fasting test and it could be applied to the entire obstetric population. Thus, DIPSI procedure would serve the purpose of implementing public health programmes to screen GDM in the community. Those with abnormal results can undergo tests for diagnosis of GDM according to WHO criterion.

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