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RESEARCH ARTICLE

Gestational Diabetes Mellitus: Assessing the Reliability of Risk Factor-Based Screening in a Rural Nigerian Hospital

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ABSTRACT
Implementation of the 2013WHO diagnostic criteria for Gestational Diabetes Mellitus (GDM), with lower threshold values required for the diagnosis of GDM, may be associated with further rise in the number of missed cases, especially among "low risk women". This prospective study determined the proportions of women with GDM who were low risk. A hundred and seventeen pregnant women of gestational age 24-32weeks were screened with 50-g glucose challenge Test (GCT) and their GDM risk factor status noted. GCT positive women had 75-gOGTT, using 2013WHO GDM diagnostic criteria. The prevalence of GDM was 7.7% and about 55% of women with GDM had "low risk" status. There was no significant difference in the plasma glucose values of low risk and high risk women. With more than 50% of women with GDM being low risk, risk factor-based screening approach may be very unreliable in screening for GDM.

KEYWORDS: Gestational Diabetes Mellitus, 2013 WHO GDM Diagnostic Criteria, Risk Factor Based Screening, Universal Screening.

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INTRODUCTION

The global prevalence of diabetes mellitus continues to escalate affecting about 350million individuals worldwide[1]. A move from the African culture to the western pattern of diet and general lifestyle may explain why disease conditions, previously considered uncommon, like diabetes mellitus, are currently assuming epidemic proportions in the Nigerian environment[2]. Diabetes mellitus, a major cause of perinatal and maternal morbidity and mortality, complicates about 3%-14% of all pregnancies[3]. About 85% of diabetes among pregnant women is due to gestational diabetes mellitus[1].

Hyperglycemia-related short and long term dysfunctions are not only confined to women with Type1 or Type2 diabetes mellitus (T1DM or T2DM respectively) before gestation, but are also observed in women with GDM[2]. Mothers with GDM are at risk of having gestational hypertension, preeclampsia and caesarean delivery[4]. Babies born from GDM women are at risk of being macrosomic, developing congenital abnormalities and T2DM later in life[5,6]. In addition, women with a history of GDM are also at significantly higher risk of developing subsequent type 2 diabetes mellitus (T2DM) and cardiovascular diseases, later in life[7].

The GDM diagnosis affords the obstetrician an opportunity to intervene with strategies to reduce GDM-associated perinatal and maternal morbidity and mortality in pregnancy and also to prevent and/or delay the onset of diabetes and its associated long-term complications later in life[8]. GDM is thus a disease of public health importance. However, low and middle income countries face unique challenges in screening for hyperglycaemia in pregnancy[9] and thus employ risk based screening for GDM. Risk based screening helps many health centres in these regions manage limited health resources.

In response to findings from the Hyperglycemia and Adverse Pregnancy Outcome (HAPO) study[10], the WHO

reviewed the threshold values required for the diagnosis of Gestational Diabetes Mellitus (GDM) in 2013[11]. These new glucose threshold values for diagnosis are lower than the 1999 version of WHO's criteria and reflect blood glucose cut-off points above which adverse pregnancy outcome is likely to occur[11]. Its implementation has been associated with increase in the prevalence of GDM in many populations. In the light of the lower threshold values needed to diagnose GDM in the 2013 WHO criteria, there is obvious need to re-evaluate independent risk factors for GDM and the blood glucose pattern of both low-risk and high-risk women.

This study identified risk factors for GDM, determined the proportion of women with GDM that are low risk and compared the glucose pattern of pregnant women at high risk of GDM with that of pregnant women at low risk of GDM in a rural antenatal population universally screened for GDM using the 2013 WHO diagnostic criteria.

MATERIALS & METHODS

A total of 117 consecutive consenting pregnant women, who presented for antenatal care at 24-32weeks gestational age were recruited for the study. Women with known pre-gestational diabetes mellitus and pregnant women on drugs that can affect glucose tolerance such as steroids, beta-adrenoceptor agonists like salbutamol were excluded from the study.

A structured proforma was used to obtain relevant data from each patient. Data obtained from the study participants included age, religion, educational status, occupation, parity, gestational age and history of GDM in previous pregnancies, previous history of macrosomic baby, history of recurrent miscarriages, pre-pregnancy or booking weight, history of diabetes in first degree relative, previous baby with congenital abnormality and previous unexplained still birth. Their height, weight and blood pressure were measured using standard methods.

A load of 50 grams of glucose in 250mls of water was given to each participant to drink within 5minutes from time zero, without prior dietary restriction, at any time of the day, regardless of whether or not they were fasting and 2mls of venous blood sample was obtained aseptically from a prominent vein on their forearm into a fluoride oxalate specimen bottle 1 hour from the noted time zero. Plasma glucose level of the blood samples obtained was determined by the glucose oxidase enzyme system[12]. Patients were labelled as screened positive for plasma glucose levels ≥ 140 mg/dl (7.8mmol/l) and screened negative when < 140 mg/dl. After one week all patients screened positive had 75-g OGTT.

The 75-g OGTT test was performed in the morning after 8-14 hours overnight fast. A 5-10 minutes rest period was ensured before commencement of the test in a comfortable waiting area provided for the duration of the test. The study participants were instructed to avoid exercise during the procedure. Blood samples were collected in fluoride oxalate sample bottles. A blood sample was collected for measurement of fasting glucose before the test was undertaken. A glucose load of 75 grams anhydrous glucose was given orally in a total fluid volume of 250-300mL. The glucose drink was consumed over a 5 minute period. Timing for the rest of the test commenced at the beginning of ingestion and further blood samples were collected at one and two hours from the commencement of the glucose load and the plasma glucose concentrations were measured. The test (other than the fasting sample) was invalid if the patient vomited during the procedure and such patients were rescheduled to repeat the test within the next one week. Plasma glucose estimation of all the taken blood samples was determined using the glucose oxidase enzyme system using Randox kits (Randox Laboratories Limited, UK). Glucose tolerance status was determined based on the 2013 WHO GDM diagnostic criteria using 75-g OGTT[11].

For the 2013 WHO diagnostic criteria, diagnosis of GDM was made using 75-g OGTT when one or more of the following results are recorded: Fasting plasma glucose ≥ 5.1-6.9mmol/L; 1-hour post 75-g oral glucose load ≥ 10mmol/L; 2-hour post 75-g oral glucose load ≥ 8.5-11.0mmol/L[11].

The GDM risk of participants was noted. High risk for GDM in this study was defined as the presence of one or more of the following risk factors[13]: previous history of delivery of macrosomic baby, previous history of unexplained IUFD/Stillbirth, family history of diabetes mellitus in a first degree relative, weight of ≥ 90kg in current pregnancy and/or the presence of glycosuria in current pregnancy. In this study, low risk for GDM was defined as the absence of all the following risk factors[13]: previous history of delivery of macrosomic baby, previous history of unexplained IUFD/Stillbirth, family history of diabetes mellitus in a first degree relative, weight of ≥ 90kg in current pregnancy and/or the presence of glycosuria in current pregnancy. The Research and Ethics Committee of the Federal Teaching Hospital, Ido-Ekiti, Ekiti State, Nigeria, approved the study protocol.

The data and information obtained from the study participants were processed using statistical package for social sciences version 20 (SPSS Inc., Chicago, Illinois, USA). Frequency tables were generated. Associations between variables were tested using Chi-square, Fisher's exact and t-test as appropriate. Logistic regression analysis was used to determine independent risk factors associated with GDM.The level of statistical significance was set at p value < 0.05 at 95% Confidence Interval.

RESULTS

The prevalence of gestational diabetes was 7.7%, 6.4% of low-risk women and 10.3% of high-risk women developed GDM (Table 1).

Table 1: Prevalence of GDM using 2013 WHO diagnostic criteria

Risk of GDM	(n) %
Low Risk (78)	(5) 6.4%
High Risk (39)	(4) 10.3%
Overall Prevalence (N=117)	(9) 7.7%

N = Total number of study participants,
n = Number of participants who developed GDM

Obstetrics and clinical characteristics were similar in women who had GDM and women without GDM. (Table II)

Previous history of delivery of macrosomic baby, unexplained IUFD, BMI > 25 and multi-gravidity independently predicted GDM. (Table III).

By risk stratification, 55.6% of the women with GDM were low risk compared to 44.4% who were high risk (Table IV). When classified by risk status there was no significant difference when women who developed GDM were compared with women who did not develop GDM (Table IV).

There was no significant difference in the mean fasting, 1-hour and 2-hour 75g-OGTT plasma glucose values of low risk and high-risk women (Table V).

Table II: Obstetric and Clinical characteristics of GDM and Non-GDM women.

Variables	Non-GDM N = 108 (%)	GDM n = 9 (%)	χ^2	P value
Parity				
Nulliparous	34 (31.5)	1 (11.1)		0.187*
Multiparous	74 (68.5)	8 (88.9)		
Screening EGA				
First trimester	0 (0.0)	0 (0.0)		0.068*
Second trimester	45 (41.7)	1 (11.1)		
Third trimester	63 (58.3)	8 (88.9)		
Unexplained IUFD				
Yes	9 (8.3)	1 (11.1)		0.566*
No	99 (91.7)	8 (88.9)		
Previous Macrosomia				
Yes	11 (10.2)	2 (22.2)		0.262*
No	97 (89.8)	7 (77.8)		
Spontaneous Miscarriage				
Yes	27 (25.0)	3 (33.3)		0.418*
No	81 (75.0)	6 (66.7)		
Family History of Diabetes				
Yes	11 (10.2)	1 (11.1)		0.636*
No	97 (89.8)	8 (88.9)		
Body Mass Index				
Normal	31 (28.7)	1 (11.1)		0.292*
Overweight	46 (42.6)	6 (66.7)		
Class I Obesity	14 (13.0)	2 (22.2)		
Class II Obesity	17 (15.7)	0 (0.0)		

N- Total number of women without GDM using the 2013 WHO diagnostic criteria
n- Total number of women with GDM using the 2013 WHO diagnostic criteria

Table III: Binary logistics regression showing risk factors of GDM

Variables		OR	95% CI	P value
Gravidity	Primigravida	1	0.23 – 3.72	**0.049**
	Multigravida	1.07		
Body Mass Index > 25	No	1	0.61 – 6.89	**0.031**
	Yes	2.54		
Family History of Diabetes	Yes	1.45	0.68 – 3.08	0.331
	No	1		
Unexplained IUFD	Yes	2.54	1.27 – 5.10	**0.008**
	No	1		
Previous Macrosomia	Yes	2.79	1.38 – 5.63	**0.004**
	No	1		

OR = Odds Ratio, CI = Confidence Interval, IUFD = Intrauterine Fetal Death, GDM = Gestational Diabetes Mellitus

Table IV: Risk Stratification of GDM and Non-GDM women

Risk of GDM	Non-GDM (108) (c %)[r %]	GDM (9) (c %)[r %]	P value
Low Risk (75)	70 (64.8) [93.3]	5 (55.6) [6.67]	
High Risk (42)	38 (35.2) [90.5]	4 (44.4) [9.5]	0.412*

*Fisher's exact test applied, (c %) – column percentage, [r %] – row percentage

Table V: Mean plasma glucose level in low risk versus high risk women.

Variables	Low Risk	High Risk		
	Mean ± SD (mmol/L)	Mean ± SD (mmol/L)	t-test	p-value
50-g GCT	5.9 ± 1.3	6.1 ± 1.4	0.848	0.397
75-g OGTT Fasting	5.3 ± 1.4	5.5 ± 1.7	0.432	0.670
75-g OGTT 1-hour	7.6 ± 1.1	7.5 ± 1.6	0.111	0.912
75-g OGTT 2-hour	6.7 ± 1.4	6.5 ± 1.6	0.328	0.747

Independent samples t-test applied

DISCUSSION

The prevalence of GDM was 7.7% and is comparable with the findings of 8.3% and 8.1% reported by Anzaku et al[14] in Jos and Olagbuji et al[15] in Ekiti. This study found that among low risk women, the prevalence of GDM was 6.4% and 10.3% among high risk women. Moses et al, in an Australian study, found a GDM prevalence of 4.8% in low risk women[16]. Kuti et al[17] in Ibadan, reported a prevalence of 13.9% in high risk women only.

Unexplained IUFD, previous macrosomia, multi-gravidity and BMI >25 were independent risk factors of GDM in this study. A hospital based study in 2014 by Fawole et al at the University College Hospital, Ibadan found that only previous history of macrosomia marginally independently predicted GDM[13]. However, Kuti et al in 2009, also at the University College Hospital, Ibadan had previously noted that family history of DM and diagnosis of GDM in previous pregnancies were consistently and strongly associated with a GDM diagnosis in index pregnancy[17]. Tan et al in University of Malaya, Kuala Lumpur, Malaysia found that maternal age and anthropometry, family history and obstetric history were not independent predictors of GDM[18]. This discrepancy in the findings of this study with those of Tan et al is probably because diagnosis of GDM was made using 1999 WHO criteria, whereas 2013 WHO diagnostic criteria was employed in this study.

A greater proportion (90.4%) of high risk did not develop GDM in this study, while a high proportion (55.6%) of women with GDM were low risk (Table IV). Buchanan et al[19] noted that about 40-60% of women with GDM had no demonstrable risk factor which agrees with our findings in this study. Poyhonen et al found that 47% of women with GDM who would have been missed in screening by risk factors only[20]. However, Olagbuji et al noted that 19.8% of women with GDM were low risk, much lower than 55.6% found in this study[15]. This may be due to the fact that majority (73.3%) of their study population were high risk.

There was no significant difference in the mean fasting, 1-hour and 2-hour plasma glucose values of low risk and high risk women when the 2013 WHO criteria was used to diagnose GDM.

Despite identified independent risk factors of GDM and relatively higher prevalence of GDM in high risk women compared to low risk women, more than 50% of GDM cases would be undiagnosed if risk-factor based screening approach was employed. This suggests that the risk-factor based screening is unreliable if the 2013 WHO GDM diagnostic criteria is used.

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AUTHORS' CONTRIBUTIONS

The participation of each author corresponds to the criteria of authorship and contributorship emphasized in the Recommendations for the Conduct, Reporting, Editing, and Publication of Scholarly work in Medical Journals of the International Committee of Medical Journal Editors. Indeed, all the authors have actively participated in the redaction, the revision of the manuscript, and provided approval for this final revised version.

COMPETING INTERESTS

The authors declare no competing interests with this case.

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