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Original Article

Oral Glucose Tolerant Test (OGTT) as a Diagnostic Tool for Diabetes in the First Trimester of Pregnancy in the Core Niger Delta - Implementing the WHO Recommendation

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Abstract

Background: Early screening and detection of diabetes mellitus in pregnancy will reduce the complications associated with the condition and improve pregnancy outcome. **Aim of the study:** To implement the WHO 2014 recommendation by screening for and diagnosing diabetes in the first trimester of pregnancy. **Methods:** The study was of a cross-sectional design carried out between January 2020 and August 2020 at the University of Port Harcourt Teaching (UPTH) and Rivers State University Teaching Hospital (RSUTH). Three hundred and five consecutive pregnant women attending the antenatal clinic at 8 to 13^{+6} weeks of pregnancy were recruited for the study. Patients' socio-demographic information, anthropometric measurements, medical, obstetric and gynaecological history were recorded on a predesigned proforma. Blood was taken for oral glucose tolerance test (OGTT). Data was analysed, using the Statistical Package for Social Sciences (SPSS) version 20. Ethical approval for the study was obtained from the Research Ethics Committee of the UPTH and RSUTH. **Results:** Using only fasting blood glucose (FBG) as a diagnostic criterion, 83 (27.2%) and 7 (2.35) out of the 305 participating patients were diagnosed with gestational and pre-gestational diabetes respectively. With 1-hr and 2-hr plasma glucose only 6 new cases [5 cases of gestational diabetes mellitus (GDM) and 1 case of pre-gestational diabetes] were added to the already diagnosed cases that were picked up, using FPG. In total, the number of patients that had GDM was 83+5 = 88 and those that had pre-gestational diabetes were 7+1 = 8 out of the 305-study population. Therefore, the prevalence of diabetes was 31.48% constituting 28.85% for GDM and 2.62% for pre-gestational. **Conclusion:** The high prevalence of diabetes 31.48% in the core Niger Delta was a wake-up call for a search for predisposing or causative factors and prevention of the condition.

Keywords: Oral Glucose Tolerant Teat, Diagnostic Tool for Diabetes, First Trimester of Pregnancy, Core Niger Delta, WHO Recommendation

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Introduction

Diabetes mellitus can be defined as a metabolic disorder of numerous aetiologies characterized by chronic hyperglycaemia with disturbance of carbohydrate, fats and protein metabolism leading to faults in insulin secretion, action or both.[1] It is classified into pre-gestational namely (Type I or insulin-dependent and Type II or non-insulin-dependent diabetes) and gestational diabetes.

The International Association of Diabetes and Pregnancy Study Groups (IADPSG) in 2008 recommended the diagnostic criteria for gestational diabetes mellitus GDM at any stage in pregnancy on the basis of the HAPO study. [2, 3] The diagnostic criteria were as follows: fasting glucose of ≥5.1mmol/L, 1-hour plasma glucose ≥ 10.0mmol/L and 2-hours plasma glucose ≥ 8.5 mmol/L on 75 g oral glucose tolerance test (OGTT). To diagnose overt or pre-gestational diabetes in pregnancy, the diagnostic criteria were as follows: FPG=7.0 mmol/l or HBA1c=6.5% or Random plasma glucose = 11.1 mmol/l with confirmation with FPG or HBA1c.

The IADPSG criteria resulted in a considerable increase in GDM prevalence of 17.8%, a detection rate of 83% for adverse outcome and a positive predictive value of 16%. [3] At least one of the thresholds must be equalled or exceeded to make a diagnosis of GDM. Measuring FPG alone identified 8.3% of the cohort as having GDM. Adding measurement of the 1-h plasma glucose identified an additional 5.7%; adding the 2-h plasma glucose measurement identified another 2.1% of the cohort. [2, 3] In 2013 the WHO adopted the IADPSG criteria and was further reaffirmed in 2014.[4, 5] The guidelines have not been adopted worldwide. However, in our Teaching Hospital, University of Port Harcourt Teaching Hospital (UPTH), the new recommendation has been adopted.

About 415 million adults worldwide suffer from diabetes mellitus. [6] In the United States, the prevalence was 14%, and equals 200,000 cases annually. [7] In Nigeria the prevalence of the disease among antenatal women rose from 0.3% in the 1980s to as high as 15.3% in 2014. [8] A previous study in the same tertiary centre where the present study was carried out on first trimester screening for diabetes mellitus using only fasting blood glucose had prevalence of 21.2% and 2.4% for GDM and pre-gestational diabetes respectively. The total prevalence of the disease in the first trimester was 23.6%. [9]

The rapid rise in the prevalence of diabetes mellitus in pregnancy and its associated adverse pregnancy outcomes underscore the urgent need for early and rapid diagnosis of the disease both in low- and high-income countries. It would help in decreasing maternal and perinatal morbidity and mortality associated with it and also in arresting the increase in the prevalence of the disease in children delivered by mothers with gestational diabetes mellitus and in their future generations.[7]

This study aimed to implement the WHO 2014 recommendations by screening and diagnosing diabetes in the first trimester of pregnancy and thereby ascertaining its prevalence in the core Niger Delta.

Methodology

Study area -The study was carried out at the University of Port Harcourt Teaching Hospital and the Rivers State University Teaching Hospital. The first was a 755-bed hospital located at Alakahia in Obio-Akpor local government area of Rivers state, South-South Nigeria. It provides tertiary healthcare services for Rivers State. The obstetrics and gynaecology department were staffed with twenty-seven Consultants and other Personnel. The subjects for the study were drawn from the antenatal clinic which ran every day of the week, Monday to Friday.

Study design - The study was of a descriptive cross-sectional design carried out between January and August 2020.

Inclusion criteria - All pregnant women who gave consent for the study irrespective of their age, attending antenatal clinic at 8 to 14 weeks of pregnancy.

Exclusion criteria - Patients who had no ultrasonographic estimation of gestational age at between 8 and 14 weeks of pregnancy, known pre-existing diabetes mellitus and patients having babies with fetal genetic and chromosomal abnormalities or intervention, requiring morphological assessment.

Sampling techniques - Consecutive women attending the antenatal clinic that satisfied the inclusion criteria were counselled about the research project, verbal informed consent obtained and sampled for the study. .

Study procedure **–** A predesigned proforma was used to record the socio-demographic, anthropometric measurements, obstetric and other clinical findings for each patient. Pregnant women that did not fully understand English language were provided with interpreters. Blood for oral glucose tolerance test (OGTT) was taken from all the participants in the study. The WHO 2014 diagnostic criteria for interpretation of OGTT results were applied. [5] Women with gestational diabetes were treated according to a standard protocol.

Patients also had standard first trimester ultrasound scan from 8 to 14 weeks of pregnancy in the foetal medicine unit of the hospital. The ultrasound scan was meant to confirm foetal viability, date the pregnancy, identify any major foetal abnormalities and confirm the number of foetuses. Pregnancy was followed up and managed, using the Nigerian national guidelines for antenatal care. Specifically, they were seen 4-weekly until 28 weeks, 2-weekly till 36 weeks and then weekly till delivery. Patients were given malaria prophylaxis and Tetanus immunization as per national protocol.

Sample size calculation **-** The sample size of 305 was calculated using sample size formula for descriptive cross-sectional study with a prevalence of 23.6%, precision of 5%, and standard normal deviation of 1.96 at 95% confidence interval. The 23.6% was taken from a prevalence study that was conducted at the University of Port Harcourt Teaching hospital, using fasting blood glucose. [9]

$n = Z^2 \times PQ / d^2$
Where,
n = sample size
Z = the proportion of normal distribution corresponding to the required significance Level (5%), which is 1.96
P = the prevalence of gestational diabetes in the first trimester of pregnancy in the previous study in 2018[19]
Q = (1.00-P)
d = precision of 0.05
$n = 1.96^2 \times 0.236 \times (1- 0.236) / 0.05^2 = 3.8416 \times 0.236 \times 0.764 / 0.0025 = 277.06 = 277.$
If the attrition rate was considered to be 10%, the study sample size of 305 (277 + 28) was reached.

Data analysis
The socio-demographic, clinical and anthropometric data and blood tests results of the patients were entered into an Excel file, cleaned and then uploaded onto Statistical Package for Social Sciences (SPSS) version 20 with which data were analysed. The data were presented in prose format, frequency distribution tables, and charts as appropriate. Quantitative variables were summarized using means and standard deviation while qualitative variables were expressed as frequencies and proportions.

Ethical consideration
Ethical approval for the study was obtained from the Research Ethics Committee of the University of Port Harcourt Teaching Hospital. The ethical clearance certificate number was UPTH/ADM/90/S.II/VOL.XI/902. Clearance was also received from the Ethics Committee of RSUTH. All participating pregnant women were adequately counselled and a verbal consent obtained, before enrolment. The study was carried out under strict confidentiality.

Results

Three hundred and fifteen patients were recruited for the study. Ten patients were left out because they could not continue with oral glucose tolerance test. The age range of the study population was 19 - 43 years with a mean age of 30.99± 4.31 years. The socio-demographic characteristics of the participants were as shown in Table 1.

Table 1: Socio-Demographic and Anthropometric Characteristics Of The Participants

Variables (N = 305)	Frequency	Percentage
Age category		
≤24years,	19	6.2
25 – 29 years	95	31.1
30 – 34 year	124	40.7
35 – 39 years	57	18.7
≥40 years	10	3.3
Marital status		
Single	6	2.0
Married	294	96.4
Separated/divorced	5	1.6
Educational level		
Secondary	45	14.8
Tertiary	260	85.2
Employment status		
Unemployed	52	17.0
Employed	253	83.0
Smoking		
Yes	0	0.0
No	305	100.0
Alcohol intake		
Yes	23	7.5
No	282	92.5
BMI		
Underweight	1	0.3
Normal	51	16.7
Overweight	121	39.7%
Class I	94	30.8%,
Class II	24	7.9%
Class III	14	4.6%

The summary results of the oral glucose tolerance test among the study population are as shown in Table 2, and Figures 2 and 3.

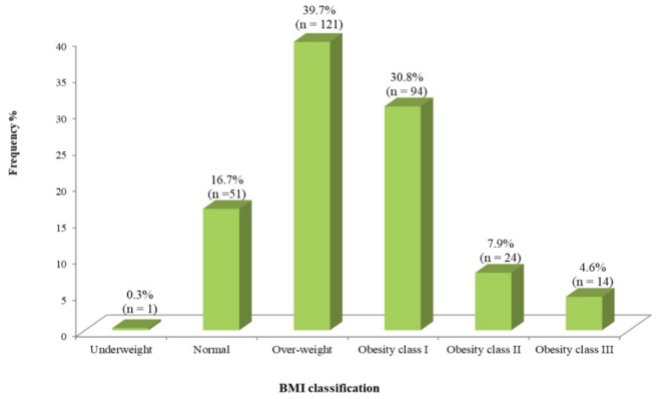

Figure 1: BMI Classification of The Study Population

Table 2: Summary of The Results of Oral Glucose Tolerance Test Among the Pregnant Women in Their First Trimester

	Blood glucose (mmol/L)	
Time interval	Mean ± SD	Median (range)
Zero hour (Fasting blood glucose)	4.83±0.98	4.70 (3.20 – 13.80)
One-hour	7.80±1.88	7.70 (3.80 – 19.80)
Two-hour	6.46±1.58	6.20 (2.40 – 19.80)

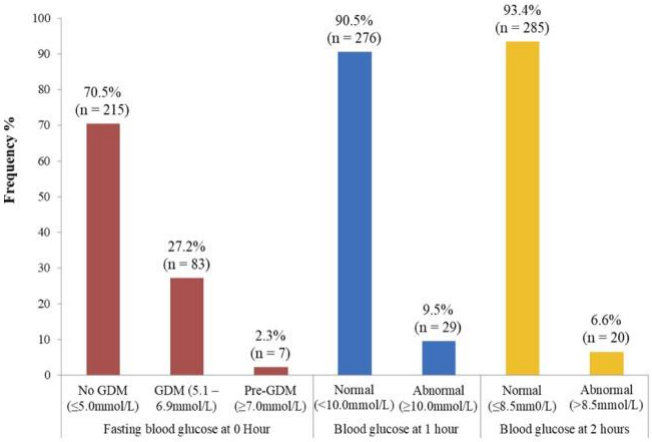

Figure 2: Distribution of Blood Glucose Levels at Different Time Intervals Among the Participants

Using only FBG as a diagnostic criterion, 83 (27.2%) and 7 (2.35) out of the 305 participating patients were diagnosed with gestational and pre-gestational DM respectively. Using 1-hour plasma glucose, 29(9.5%) participants were diagnosed with diabetes in pregnancy, out of which 5 were among the 7 patients that were already diagnosed with pre-gestational diabetes, using the FPG test and the rest 24 patients were diagnosed with GDM. Only additional 5 (1.64%) patients with GDM that were

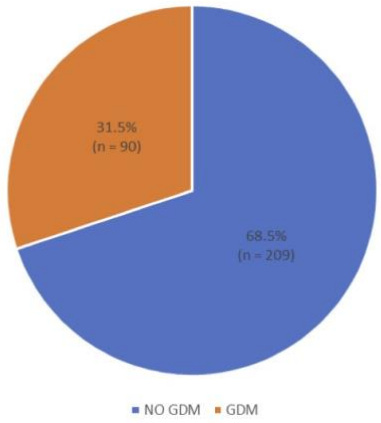

Figure 3: showing the prevalence of GDM among pregnant women in their first trimester

missed when using only the FPG were picked up when 1-hr glucose was used as a diagnostic criterion. Furthermore, I-hour glucose was false negative in 2 (28.57% of the total 7) and 59 (71.08% of 83) patients who had pre-gestational and gestational diabetes respectively diagnosed with FBG only.

When using 2-hr plasma glucose as a diagnostic criterion, 20(6.6%) participants had diabetes in pregnancy, out of which 2 had pre-gestational diabetes while 18 had GDM; I case of pre-gestational diabetes and 2 cases of GDM that were missed when using FPG were picked up. However, it added only I case of GDM to the diabetic cases that were already diagnosed, using the FPG and the I-hour glucose and changed 1 case that was diagnosed GDM with 1-hour glucose to pre-gestational diabetes. Two (2)-hour plasma glucose was associated with a false negative diagnosis for 2 cases of GDM and also for 3 cases of pre-gestational diabetes that were already diagnosed with FPG.

Therefore, with 1-hour and 2-hour plasma glucose only 6 new cases of abnormal glycaemia were added to the already diagnosed abnormal cases that were picked up, using FPG. Out of that figure, one of the 5 GDM cases that were not picked up by FPG but diagnosed, using 1-hour glucose was modified to pre-gestational diabetes by 2-hour glucose. In general, the prevalence of diabetes was 83+5 = 88 (28.85%), 8 (2.62%) and 96 (31.48%) patients out of the total 305

study population for GDM, pre-gestational and for both respectively.

Discussion

The study was prompted by the high and rising prevalence of diabetes in the Niger Delta as demonstrated in the previous studies that were carried out in the same tertiary health facility where the present study was executed. [8-10] The prevalence of diabetes mellitus generally was also on the increase globally. Therefore, early screening, diagnosis of the disorder and offering a suitable and adequate care to women who had DM early in pregnancy could largely positively impact on the health of mother, foetus, the neonate and the general population at large. It would also help in arresting the increase in the prevalence of the disorder in children delivered by mothers with gestational diabetes mellitus and in their future generations.[7]

The results of the study were different from two of the previous work that was published from the same hospital (UPTH). [8, 11] The prevalence of diabetes was 31.5% in the present study. The differences lied in the fact that the present study was centred on diabetes in the first trimester while the two previous ones concentrated on diabetes in the second and third trimesters of pregnancy.

The prevalence of gestational and pre-gestational diabetes in another previous study from the same tertiary centre where the present study was conducted were 21.2% and 2.4% respectively. [9] There must be a reason for such a disparity in results; could it be environmental factor, diet, body composition? the gestational age of the pregnancy? the diagnostic methods and criteria used? etc. Another designed research project would be needed to answer the question.

The present study was undertaken during the covid-19 pandemic lockdown when many people had a sedentary life-style. People were forced to stay at home and not much physical activities were carried out during this period, much body weight accumulated and this was seen in the study population - 121 patients (38.7%) were overweight and 94 (30.8%), 24 (7.9%) and 14 (4.6%) had class I, II and II obesities, respectively. Furthermore, the high prevalence of the disease as shown in the present study may be explained by the peculiarities of the core Niger Delta where the study took place. The Delta had been tagged region of environmental degradation by the UNEP. [12] That may be a precedence for a search for new environmental biomarkers of the disease in the Delta.

The prevalence found in the present study was higher than the 4.8% recorded in Jos which is one of the state capitals in Nigeria, [13] 14 % in the United States, [14] 6.8% and 10.4% in China, 9.9% in Sri Lanka, 9.8% in Bangladesh and 27.5% recorded in India. [15] The findings were also in contrast to the findings of the IADPSG 2010 review of HAPO study of 2008. [2, 3] The review showed that measuring FPG alone identified 8.3% of the cohort as having GDM. Adding measurement of the 1-h plasma glucose identified an additional 5.7%; adding the 2-h plasma glucose measurement identified another 2.1% of the cohort. Among the HAPO cohort, 11.1% had only one elevated result, 3.9% had two elevated results, and 1.1% had elevation of all three results. Thus, by these new criteria, the total incidence of GDM was 17.8%; the FPG plus 1-h plasma glucose levels identified a large majority of these individuals. [3] The high prevalence of DM in the present study had shown important reason why women should have an early screening for GDM in pregnancy.

Limitations

This study was carried out between January and August 2020 at the peak of the covid-19 pandemic and therefore, was affected by lockdown that was introduced in Rivers State. Most patients could not attend antenatal clinic during the lockdown as movement was restricted. That delayed the work so much that it was stretched beyond June. Also, the study was carried out in a tertiary institution and therefore those in the rural areas were not captured.

Another limitation was sample collection time which lasted for two hours; most women were in a hurry to leave the hospital while some could not tolerate hunger for two hours, having fasted overnight. Collection of the blood samples more than once as was needed in OGTT was a problem as some women who gave consent found it difficult to withstand the needle prick for more than once. Some of the patients found it difficult to swallow the glucose drink and hence dropped out of the study.

Conclusion and Recommendations

The high prevalence of diabetes recorded among pregnant women in the first trimester 31.5% underscored the need for universal early screening for

DM, using the OGTT in the first trimester as most cases are asymptomatic and most of the assault to the baby can occur early in pregnancy, waiting to screen later in pregnancy in the late second and 3rd trimester may not benefit those with pre-gestational DM. It was necessary that enough resources (human and financial) were allocated to diabetic care in pregnancy. In situations where there were inadequate healthcare resources, at least FPG should be offered to patients. Women should be encouraged to register for antenatal care early in first trimester as early detection can be achieved for effective treatment and outcome. Physical activity of women before and during pregnancy and modification of diet should be encouraged as obesity was on the increase.

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