



# The Case for Early and Universal Screening for Gestational Diabetes Mellitus: Findings from 9314 Pregnant Women in a Major City in Nigeria

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## ABSTRACT

**Introduction:** Risk-based screening has been replaced by universal screening as the recommended course of care for gestational diabetes mellitus (GDM). As of 2016, no state in Nigeria had implemented a policy of universal screening for GDM. This research aimed to assess findings from a universal screening programme and its implication for scaling up universal and early screening for GDM.

**Methods:** This was a descriptive cross-sectional study conducted in Rivers State Nigeria between February 2017 and January 2020. Multistage

sampling was used to recruit 9314 pregnant women from 30 primary, secondary, and tertiary health facilities in the state. An interviewer-administered structured questionnaire was used by trained healthcare workers to collect socio-demographic, obstetric and medical information. All study participants had a plasma glucose test on their first hospital visit and a diagnosis made using the World Health Organization (WHO) criteria. Data obtained was analysed using the IBM Statistical Package for Social Sciences (SPSS) version 23.

**Results:** Most women [5683 (61.0%)] were aged 25–34 (mean  $29.60 \pm 5.64$ ) years. The preva-

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lence of GDM in this study was 5.2% with a prevalence of GDM in the first, second and third trimesters of 4.9%, 4.2% and 6.7%, respectively. The prevalence of GDM among persons with a family history of diabetes was 13.2% (97 persons) while 4.6% (391 persons) without family history were diagnosed with GDM. Gestational age, family history of diabetes and age group were found to be significant predictors of GDM among the study participants after adjusting for confounding variables.

**Conclusion:** The practice of universal screening was useful in identifying GDM in 1 out of 20 pregnant women in the study sample. Screening at all trimesters was useful in identifying GDM. There is an urgent need to scale up early and universal screening for GDM across sub-Saharan Africa.

**Keywords:** Pregnancy; Gestational diabetes mellitus; Universal screening

### Key Summary Points

As of 2016, no state in Nigeria was implementing a policy of universal screening for gestational diabetes mellitus (GDM) despite the international guidelines for universal screening for GDM

This research assessed findings from a universal screening programme and its implication for scaling up universal and early screening for GDM

The practice of universal screening was useful in identifying GDM in 1 out of 20 pregnant women in the study sample

Universal screening identified GDM at all trimesters of pregnancy and among women without any family history of diabetes mellitus among the study sample

Risk-based screening would have missed many women with GDM, underscoring the need to scale up early and universal screening for GDM across sub-Saharan Africa

## INTRODUCTION

The prevalence of gestational diabetes mellitus (GDM) in pregnancy has steadily increased parallel to the increase in the prevalence of overweight, obesity and type II diabetes mellitus among women [1]. GDM poses a threat to the health and safety of mothers and children with negative outcomes such as macrosomia, unexplained foetal deaths in offspring and risk of type II diabetes in mothers [2]. Adequate diagnosis and management of hyperglycaemia are, therefore, necessary to prevent and control these untoward outcomes [3]. Early detection of GDM is expected to lead to early management and subsequently result in better pregnancy outcomes [4, 5].

A risk-based screening had been the traditional approach to identifying GDM. It entails a review of risk factors like overweight or obesity, family history of diabetes, previous obstetric history of big babies, a previous incident of hyperglycaemia in pregnancy or a previous history of poor obstetric outcomes [2–5]. The main argument for risk-based screening is that subjecting all pregnant women to screening for hyperglycaemia is not cost-effective. Unfortunately, the challenge with risk-based screening is its low sensitivity for the detection of GDM. This means that many cases of GDM and hyperglycaemia in pregnancy go undetected with continued negative consequences for mother and baby [4, 6–10].

Risk-based screening has long been replaced by universal screening as the recommended course of care by the International Federation of Gynaecology and Obstetrics (FIGO), International Diabetes Federation (IDF) and the World Health Organization (WHO) strongly recommend universal screening. The international recommendations also state that screening should occur during the first encounter between a pregnant woman and the antenatal clinic [8, 9].

Unfortunately, as of 2016, no state in Nigeria was implementing a policy of universal screening for GDM even though this has been recognized as best practice since 2013. In addition,

risk-based screening is routinely practised at 28 weeks of gestation in Nigeria [10, 11].

The Medical Women's Association of Nigeria (MWAN) is a non-governmental organization and professional body of female medical and dental doctors with a focus on improving health outcomes for women and children. In 2016, MWAN Rivers obtained support from the World Diabetes Foundation (WDF) to pilot access and advocacy interventions for the control of gestational diabetes mellitus (GDM) in Rivers State, Niger Delta Region of Nigeria. One of these interventions is the implementation of universal screening for GDM. This research aimed to assess findings from the project's universal screening programme and its implication for scaling up universal and early screening for hyperglycaemia across the country and the rest of sub-Saharan Africa.

## METHODS

### Study Design

The study was a descriptive cross-sectional survey.

### Study Area and Study Sites

This study was carried out in Rivers State Nigeria. Rivers State is in the oil-rich zone of Nigeria, called the Niger Delta Region. The study was carried out in health facilities across the primary, secondary and tertiary levels of health administration in all senatorial districts of the state.

### Study Population

The study recruited all pregnant women who were receiving antenatal care from the selected health facilities in Rivers State, Niger Delta Region, from February 2017 to January 2020. During this period a total of 9314 women with completed data entry forms were studied.

### Sampling Technique

Sampling was done using a multi-stage technique. The first stage (stratified sampling) involved selecting one local government area (LGA) per senatorial district via a simple random sampling method from the listing of the LGAs in each senatorial district in the state. Two LGAs (Obio-Akpor and Port Harcourt LGA) were then purposively included in the sample because they make up the capital city of Rivers State and host the two tertiary institutions in the state. The second stage involved selecting health facilities from the primary and secondary levels via simple random sampling. This was done using the list of health facilities (both private and public) obtained from the Rivers State Primary Healthcare Management Board and the Rivers State Hospitals Management Board as the sampling frame. A total of 28 primary and secondary health facilities and the two tertiary health facilities in the state were included in the study. The final stage involved recruiting all women attending antenatal clinics (ANC) in the selected facilities.

### Study Instrument and Data Collection

An interviewer-administered structured questionnaire was used by trained healthcare workers to collect information from the women attending ANC. This questionnaire was in both paper and Open Data Kit (ODK) format and addressed socio-demographic characteristics such as age, education and marital status; obstetric and medical history included trimester, parity, history of diabetes and history of hypertension. Monitoring and evaluation were periodically carried out with twice-monthly site visits and monthly data collection, analysis and review.

### Screening Protocol

All pregnant women visiting the selected facilities were screened on their first hospital visit. Those with normal results were re-screened at the 24th–28th weeks of pregnancy. Screening of blood glucose was done via capillary blood with

the Accu-Check Active (Model: GB) Roche Glucometer. All measurements of blood glucose were done in mmol/l. At least five health workers per facility (laboratory technologists, nurses, and medical doctors) were trained on data collection and use of glucometers for screening. A pregnant woman was determined to have a positive screening test for GDM if the fasting plasma glucose was  $\geq 5.1$  mmol/l or if the random plasma glucose was  $\geq 8.5$  mmol/l in line with WHO criteria. Anyone with a positive screening test had venous blood collected for laboratory confirmation [12, 13].

### Data Analysis

The data collected were entered into Microsoft Excel Worksheet 2016 version and were analysed using the IBM Statistical Package for Social Sciences (SPSS) version 23. All descriptive statistics were reported as frequency and proportions for categorical variables and as means with standard deviations for continuous variables. Chi-square test of association and logistic regression were carried out to determine associations and predictors of GDM. The results were presented as odds ratio (95% confidence interval). The level of significance ( $\alpha$ ) set at 0.05;  $p$  value  $< 0.05$  was statistically significant.

### Ethical Considerations

Ethical approval was obtained from the University of Port Harcourt Teaching Hospital (ADM/90S.II/VOLXI/396) while permission to conduct the study was obtained from all the contributing institutions, the Rivers State Primary Health Care Management Board, Rivers State Hospitals Management Board, the University of Port Harcourt Teaching Hospital (UPTH) and the Rivers State University Teaching Hospital. All participants were informed of the benefits and risks of the study. They were assured of voluntary withdrawal from the study, confidentiality and anonymity of their data. Written informed consent to participate was obtained from all study participants and the study was conducted in accordance with the Declaration of Helsinki.

## RESULTS

The most represented age bracket was the age category 25–34 years with 5683 (61.0%) participants. The mean age of participants was  $29.60 \pm 5.64$  years. Married women constituted

**Table 1** Socio-demographic and obstetric characteristics

Variables	Frequency ( <i>n</i> = 9314)	Per cent (%)
Age in years		
15–24	1827	19.6
25–34	5683	61.0
35–44	1733	18.6
$\geq 45$	71	0.8
Mean age	$29.60 \pm 5.64$ years	
Marital status		
Single	513	5.5
Married	8743	93.8
Divorced/ separated	43	0.5
Widow	15	0.2
Educational status		
No formal education	157	1.7
Primary	531	5.7
Secondary	5370	57.6
Tertiary	3256	35.0
Parity		
0	2229	23.9
1–2	5048	54.2
$\geq 3$	2037	21.9
Gestational age		
First trimester	1220	13.1
Second trimester	4576	49.1
Third trimester	3518	37.8

**Table 2** Past medical and family history of study participants

Variables	Frequency (n)	Per cent (%)
Diabetes status (n = 9314)		
Diabetic	119	1.3
Not diabetic	9195	98.7
Family history of diabetes (n = 9314)		
Yes	733	7.9
No	8581	92.1
Diabetic close relative (n = 733)		
Father	377	51.4
Mother	331	45.2
Sibling	25	3.4
Known hypertensive (n = 9314)		
Yes	160	1.7
No	9154	98.3
Family history of hypertension (n = 9314)		
Yes	929	10.0
No	8385	90.0
Relative with hypertension (n = 929)		
Father	345	37.1
Mother	562	60.5
Sibling	22	2.4

8743 (93.9%) of the sample while 5370 (57.7%) participants had secondary school education (Table 1). Among the participants, 5048 (54.5%) had one to two children, while 2037 (22.0%) had at least three. Most study participants were screened during the second (4576, 49.1%) and third trimester (3518, 37.8%), respectively (Table 1). Only 1.3% of study participants had type 2 diabetes, while 7.9% had a family history of diabetes and 9.9% had a family history of hypertension (Table 2).

The prevalence of GDM in this study was 5.2%. Almost half of the study participants were screened during the second trimester [4382 (47.1%)], while the first trimester had the lowest number of participants screened (1160, 12.5%). The prevalence of GDM was highest among participants screened in the third trimester (234, 6.7%) and lowest among those screened in the second trimester (194, 4.2%). The prevalence of GDM among persons with a family history of diabetes was 13.2% (97 persons) while 4.6% (391 persons) were diagnosed with GDM despite a negative family history of diabetes (Table 3).

There was a significantly higher proportion of persons with GDM who had tertiary education compared with persons without GDM ( $\chi^2 = 15.64$ ;  $p = 0.001$ ), a significantly higher proportion of persons with GDM in the third trimester of pregnancy compared to persons in other trimesters ( $\chi^2 = 23.60$ ;  $p < 0.001$ ) and a significantly higher proportion of persons with a positive family history of diabetes among

**Table 3** Stage of pregnancy, family history of diabetes and GDM prevalence GDM status (n = 9314)

Variable	Normal (%)	GDM positive (%)	Total
Trimester (weeks)			
First trimester (0–13)	1160 (95.1)	60 (4.9)	1220 (100.0)
Second trimester (14–26)	4382 (95.8)	194 (4.2)	4576 (100.0)
Third trimester (27–40)	3284 (93.3)	234 (6.7)	3518 (100.0)
Family history of diabetes			
Yes	636 (86.8)	97 (13.2)	733 (100.0)
No	8190 (95.4)	391 (4.6)	8581 (100.0)
Total	8826 (94.8)	488 (5.2)	9314 (100.0)

**Table 4** Association among socio-demographics, family history, gestational age and prevalence of GDM among study participants

	Normal (%)	GDM (%)	Chi-square ( <i>p</i> value)
Age group (years)			
15–24	1751 (19.8)	76 (15.6)	14.7 (0.002)*
25–34	5395 (61.1)	288 (59.0)	
35–44	1615 (18.3)	118 (24.2)	
≥ 45	65 (0.7)	6 (1.2)	
Education			
No formal	147 (1.7)	10 (2.0)	15.64 (0.001)*
Primary	503 (5.7)	28 (5.7)	
Secondary	5129 (58.1)	241 (49.4)	
Tertiary	3047 (34.5)	209 (42.8)	
Marital status			
Single	486 (5.5)	27 (5.5)	2.0 (0.57)
Married	8286 (93.9)	457 (93.6)	
Separated	41 (0.5)	2 (0.4)	
Divorced	13 (0.1)	2 (0.4)	
Gestational age			
1st trimester	1160 (13.1)	60 (12.3)	23.60 (< 0.001)*
2nd trimester	4382 (49.6)	194 (39.8)	
3rd trimester	3284 (37.2)	234 (48.0)	
Family history of diabetes			
Yes	636 (7.2)	97 (19.9)	102.40 (< 0.001)*
No	8190 (92.8)	391 (80.1)	

\**p* < 0.05

those with GDM compared to those without ( $\chi^2 = 102.40$ ;  $p < 0.001$ ) (Table 4). Gestational age, family history of diabetes and age group were found to be significant predictors of GDM ( $p < 0.001$ ) among the study participants after adjusting for confounding variables (Table 5).

## DISCUSSION

The major findings from this project revealed that 1 in 20 women had GDM, GDM was

prevalent in all trimesters of pregnancy, and women with a positive family history of diabetes were three times more likely to develop GDM. This study also found that screening women before 20 weeks of gestation and screening persons without positive family history provided a good yield of persons with GDM.

While a 2001 study in a tertiary institution in the south-south of Nigeria recorded a GDM prevalence of 0.3% [14], a recent systematic review and meta-analysis of GDM studies in

**Table 5** Predictors of GDM among study participants

Variable	COR (95% CI)	<i>p</i> value	AOR (95% CI)	<i>p</i> value
Family history of DM				
Yes	3.2 (2.5–4.0)	< 0.001	3.14 (2.50–4.00)	< 0.001*
No (reference)				
Age group (years)				
15–34 years	1.45 (1.18–1.80)	0.001	1.35 (1.10–1.70)	0.006*
35 years and above (reference)				
Marital status				
Not married	0.96 (0.66–1.40)	0.83	0.88 (0.60–1.29)	0.52
Married (reference)				
Education				
Secondary/tertiary	1.06 (0.76–1.50)	0.73	1.18 (0.84–1.67)	0.35
None/primary (reference)				
Trimester at screening				
First and second trimester	1.56 (1.30–1.87)	< 0.001	1.54 (1.28–1.85)	< 0.001*
Third trimester (Reference)				

COR crude odds ratio, AOR adjusted odds ratio

\*Significant associations

Nigeria carried out between 2008 and 2019 demonstrated a prevalence ranging between 0.7 and 35.6% with a pooled prevalence of 11.0% for the country and 5.5% in the south-south [15]. Even studies in the same geographical region have taken a wide range of values depending on the study design, diagnostic criteria used and the time of the study [10, 16–18]. What is clear however is that there has been a steady increase in the prevalence of gestational diabetes. This increase has been attributed to increased exposure to risk factors, better diagnostic tools and better screening policies [15, 19]. This underscores the need for strategic, universally acceptable interventions for prevention, early detection and treatment of GDM [20]. Our intervention, which models the WHO and FIGO recommendations for universal screening, provided such interventions [21].

It is common knowledge that the risk of GDM is higher among persons with a family history of diabetes. Our study corroborates this by determining a three-fold increase in the risk of GDM among those with a family history of diabetes compared to those without. However, the prevalence of GDM among persons without a family history of diabetes was close to the study population prevalence. If risk-based screening had been employed almost 1 in 20 persons found to have GDM may have been missed. This finding negates the risk-based screening strategy still employed in Nigeria even in the light of the evidence and international guidelines that favour universal screening [6, 10, 13].

Guidelines indicate 24–28 weeks of gestation as the recommended time to screen for GDM [15]. Our study found the highest yield of GDM prevalence to be in the third trimester of

pregnancy. However, we also found significant yield in the first and second trimesters, respectively. This supports the philosophy of early screening. Screening pregnant women at first contact with repeat screening during the second or third trimester ensures that no one with GDM is missed [22]. The strengths of this study lie in its large sample size and a robust collection of data from 30 health care facilities across primary, secondary and tertiary levels over 3 years. The study is, however, limited to one state in the country and using capillary plasma glucose as a screening tool. Though the sensitivity of plasma glucose is lower than that of venous blood glucose, the international consensus is that it is acceptable in resource-poor settings as first screening and even diagnosis [13, 23].

## CONCLUSION

The practice of universal screening was useful in identifying GDM in 1 out of 20 pregnant women in the study sample. Screening at all trimesters was useful in identifying GDM. There is a need to scale up early and universal screening for GDM across sub-Saharan Africa.

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**Disclosures.** Rosemary Ogu, Omosivie Maduka, Vetty Agala, Precious Obuah, Faithwin Horsfall, Esther Azi, Cecilia Nwibubasa, Ufuoma Edewor, Ibimonye Porbeni, Osita John, Ngozi Orazulike, Dango Kalio, Kenneth Okagua, Clement Edet, Agiriye Harry, Henry Ugboma and Claribel Abam have nothing to disclose.

**Compliance with Ethics Guidelines.** Ethical approval was obtained from the University of Port Harcourt Teaching Hospital (ADM/90S.II/VOLXI/396) while permission to conduct the study was obtained from all the contributing institutions, the Rivers State Primary Health Care Management Board, Rivers State Hospitals Management Board, the University of Port Harcourt Teaching Hospital (UPTH) and the Rivers State University Teaching Hospital. All participants were informed of the benefits and risks of the study. They were assured of voluntary withdrawal from the study, confidentiality and anonymity of their data. Written informed consent to participate was obtained from all study participants and the study was conducted in accordance with the Declaration of Helsinki.

**Data Availability.** The datasets for this study are available by request to the corresponding author.

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