Gestational Diabetes Mellitus and Outcome of Pregnancy among Women Attending Antenatal Care Clinic in North Western Nigeria

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ABSTRACT

Background: Gestational diabetes mellitus (GDM) is any degree of glucose intolerance with onset or first recognition during pregnancy. It affects 2-10% of pregnancies and there appears to be a rising trend in its prevalence worldwide.

Objective: The aims of the study were to determine the prevalence and risk factors for gestational diabetes as well as the outcome of pregnancy among 207 consecutively recruited pregnant women. GDM was diagnosed according to the WHO criteria. All relevant data were collected and analyzed using SPSS version 20.0.

Results: The prevalence of gestational diabetes mellitus was relatively high 7.7%. Advancing maternal age (p=0.000), high parity (p=0.000) and previous history of macrosomia (RR=3.056, CI 1.208-7.728, p=0.015) were risk factors for GDM. Multivariate analysis showed that only advance maternal age as a risk factor was statistically significant across all age (p-value >0.000).

Conclusion: The outcome of pregnancy was favorable among GDM patients. Thus, multidisciplinary management of GDM patients should be upheld.

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Keywords: Gestational Diabetes Mellitus (GDM), Fasting Blood Sugar (FBS), Oral Glucose Tolerance Test (OGTT).

1. Introduction:

Gestational diabetes mellitus (GDM) is defined as any degree of glucose intolerance with onset or first recognition during pregnancy (WHO, 2009). It is a condition in which women without previously diagnosed diabetes mellitus exhibit high blood glucose levels during pregnancy (especially during the third trimester). A woman is diagnosed with having gestational diabetes when the glucose intolerance continues beyond 24-28 weeks of gestation. The prevalence of gestational diabetes (GDM) is increasing all over the world (Hall et al., 2011). Sub-Saharan Africa, like the rest of the world, is experiencing an increasing prevalence of diabetes alongside other non-communicable diseases (WHO, 2004). However, a global prevalence of between 0.6-13.7percent has been recorded (WHO, 2009). Prevalence is most often reported as 2-6% of pregnancies in studies in Europe (Buckley et al., 2012).

Reported rates of gestational diabetes range from 2 to 10 percent of pregnancies in the United States (NDIC, 2011). Importantly, the prevalence of GDM in the United States is increasing, probably because of increasing rates of overweight and obesity (Getahun et al., 2008; Kim et al., 2010). An average prevalence of 4.45 percent was found in the U. K (Cashin, 2011). In Finland, the prevalence of GDM is higher than in the other European countries with a value of 10-11% (Lawrence et al., 2008; Baraban et al., 2008). Among Chinese, the prevalence of gestational diabetes mellitus increased by 2.8 times during 1999–2008. It rose from 2.4% to 6.8%. (Zhang et al., 2011).

In Nigeria, Wokoma et al. (2001) found a prevalence of 2.98% in a Nigerian antenatal population12. Studies found a prevalence of 1.7% in Enugu (Ozumba et al., 2004), 4.8% in Ebonyi (Ewenighi et al., 2013) 8.3% in

Jos (Anzaku & Musa, 2013), 16.1% in Ilorin (Olarinoye et al., 2004) 12.0% in Lagos (Adegbola & Ajayi, 2008) and Ibadan 13.9% (Kuti et al., 2011). These studies support the previous findings that prevalence of GDM and OGTT result differ by region. (Lawrence et al., 2008; Seshiah et al., 2008). Gestational diabetes is an important public health issue, because women with a history of GDM and their offspring both have a higher risk of type II diabetes (Kim et al., 2002) Women with gestational diabetes mellitus have a 35-60% chance of developing diabetes mellitus over 10-20 years after pregnancy (NDIC, 2011).

2. Methodology:

The study was a prospective study. Sokoto, the capital city of Sokoto State is situated in the North Western region of Nigeria. Usmanu Danfodiyo University Teaching Hospital (UDUTH), Sokoto, is a tertiary health institution situated in Sokoto metropolis. The hospital is among the second generation of Teaching Hospitals in the country. Pregnant women booking for antenatal care were recruited after obtaining their informed consent. Inclusion criteria include the gestational age of 16 weeks or above. Exclusion criteria include patients that were unwilling to participate in the study, and patients coming for follow up.

2.1. Sample Size

The minimum sample size was determined by using the formula:

$$n = z^2pq/d^2 \text{ where}$$

n = minimum sample size required

z = standard normal deviate at 95% confidence level (1.96)

For this study, p= estimated proportion of variable of interest in the population = 13.9%[18] (i e 0.139) (Kuti et al., 2011)

d= tolerable alpha error or precision = 0.05

q = complementary probability of p (q = 1 – p)

p= 0.139

d= 0.05

z= 1.96

q=1- 0.139 = 0.861

Sample size $n = (1.96)^2 \times 0.139 \times 0.861 / 0.0025$

n= 183.9 approximately 184 subjects. To accommodate for non-response and rejection of participation, the estimated sample size, n, was divided by 0.89 (with the anticipation of an 89% response rate, R). Thus $n_s = n/R = 184/0.89 = 206.7$ approximately 207 subjects (Araoye, 2003).

2.2 Study Protocol

Study clients were recruited at 18 to 28 weeks of gestation. A minimum of 25 patients was recruited at each booking clinic. A self-administered structured questionnaire was used to obtain bio-data and other relevant information. Measurements of weight and height were taken and body mass index calculated. Routine booking investigation was requested for and in addition, oral glucose tolerance test (OGTT) was administered at 24-28weeks gestation. No special dietary precaution was taken before the OGTT was performed since they were on an average African diet, rich in carbohydrates. Study subjects were advised to fast for at least 8hrs overnight and blood samples were taken 8.00am the next morning in the clinic or departmental laboratory. They were allowed to rest for 5-10 minutes before the commencement of the test. A specimen of venous blood was taken for the fasting sugar before 75g of anhydrous glucose was then given to each subject in 250mls of water to ingest over 5minutes. Subsequently, venous samples were taken after 30minutes, 1hour and 2hours intervals. During the test, clients were discouraged from activities and eating any food but could drink water. Plasma glucose was determined using glucose oxidase test. Any client whose plasma glucose exceeded any two- threshold- values was diagnosed as having GDM based on the WHO criteria. Normal OGTT is a value of 0(fasting blood glucose) <7mmo/L or 2hrs postprandial blood sugar <7.8mmol/L. Study subject with a value of 2hrs postprandial up to 7.7mmol/L with one or more risk factor for GDM are screened in the third trimester. Those with frank GDM were also screened in the puerperium.

Gestational diabetes mellitus is diagnosed based on the 2006 WHO criteria for diabetes if one or more of the following criteria are met**.**

- Fasting (0 minute) plasma glucose ≥7mmol/l (126 mg/dl).
- 2-hour plasma glucose ≥7.8mmol/l (140 mg/dl) following a 75g oral glucose load.

2.3. Analysis of Data

The findings were subjected to standard statistical tests using SPSS version 20. The result was displayed in the form of tables and charts. Chi-square and t-test were used to ascertain the level of statistical significance and p-value of less than 0.05 was considered statistically significant. The identified risk factors were subjected to multivariate analysis (logistic regression).

2.4. Ethical Consideration

The research proposal was submitted to the Ethics committee of UDUTH and formal approval for the conduct of the research was obtained. Only those patients who gave verbal consent were recruited for the study.

3. Results

A total of 904 patients were booked during the study period. An average of 80 patients was seen at each booking clinic. The number of patients recruited for the study was 207. Majority, 185 (89.4%) had 2hrs postprandial value <7.7mmol/L, 6(2.9%) had borderline 2hrs postprandial (7.7mmol/L) while 16(7.7%) had values suggestive of frank gestational diabetes mellitus (GDM) i.e. 2hrs postprandial ≥7.8mmol/L. Thus, the prevalence of GDM in

the study group was 7.7% (Figure 1). A total of 16 patients that were found to have GDM were subjected to OGTT at 6 weeks post-delivery. 4(25%) had abnormal value while 12(75%) had normal value based on the WHO criteria used stated earlier.

The age range of the study group was between 17 – 42 years with a mean age of 28.2±5.5 years. The mean age of women with normal OGTT was lower (27.79±5.27) than that of women with GDM (33.31±5.54) and this was statistically significant with p value=0.00 (Table 1).

Table 1: *Mean age of normal OGTT and GDM patients.*

Age	Normal OGTT	GDM	Confidence Interval	Statistic & p values
15 – 19	12(6.3%)	1(6.3%)		
20 – 24	42(22.0%)	0(0%)		t = - 4.014
25 – 29	69(36.1%)	2(12.5%)	-8.244,	df= 205
30 – 34	45(23.6%)	4(25.0%)	-2.812	p value=0.000
35 – 39	21(11.0%)	8(50.1%)		
40 – 44	2(1.0%)	1(6.3%)		
Total	191	16		
Mean	27.79 ± 5.27	33.31 ± 5.54		

Majority of the study subjects were of the Hausa/Fulani tribe making up 70% and 63% of the normal OGTT group and GDM group respectively. This was not statistically significant. Among the women with normal OGTT, 89.4% had some form of formal education while 93.8% of those with GDM had same. However, this was also, not significant statistically. Housewives made up the bulk of the study participants as 64.4% in the normal OGTT group and 62.5% in the GDM group were housewives. Civil servants made up 26.2% of the normal OGTT group and 25.0% of the GDM group while 9.4% and 12.5% were business women in both groups respectively. This difference in the occupational status of the women in both groups was not statistically significant. A few (10.5%) and (18.5%) of the spouses in the normal OGTT and GDM groups respectively did not have any form of formal education. The majority had primary, secondary or tertiary education but this did not have any significance statistically (Table 2).

The parity of the women ranged from 0 to 12 with a mean parity of 3.35±2.05. The majority, (87.5%) of the GDM group were grand multiparous women. This finding was statistically significant with a p-value of 0.00. The GA at booking ranged between 18 and 28 weeks with a mean gestational age at booking of 24.9 ± 2.3 weeks. The majority, (94.2%) with normal OGTT had spontaneous vaginal delivery while (5.8%) had a caesarean section. Among the GDM group, (93.8%) had a vaginal delivery and (6.2%) had a caesarean section. This was statistically significant; p-value = 0.00. Out of the 195 patients who had a vaginal delivery, 9 patient had home delivery and 3 patients delivered on their way to the hospital and 183 patients had hospital delivery.

Table 2: *Socio-demographic characteristics of the study group.*

Socio-demographic characteristics	Normal OGTT	GDM	Statistic & p values
TRIBE			
Hausa/Fulani	133(70.0%)	10(63.0%)	
Igbo	26(14.0%)	3(18.8%)	X=4.960
Yoruba	16(8.4%)	3(18.8%)	df=5
Others	16(8.4%)	0(0%)	p value=0.421
Total	191	16	
Educational Status			
None	8(4.2%)	0(0%)	
Quranic	13(6.8%)	1(6.25%)	X=4.527
Primary	70(37.0%)	10(62.5%)	df=4
Secondary	59(30.9%)	3(18.8%)	p value=0.339
Tertiary	41(21.5%)	2(12.5%)	
Total	191	16	
Occupation			
Housewife	123(64.4%)	10(62.5%)	X=0.161
Civil servant	50(26.2%)	4(25.0%)	df=2
Business woman	18(9.4%)	2(12.5%)	P value=0.923
Total	191	16	
Educational Status (Spouse's)			
Quranic	20(10.5%)	3(18.5%)	
Primary	38(19.9%)	3(18.5%)	X=1.281
Secondary	51(26.7%)	3(18.5%)	Df=3
Tertiary	82(43.0%)	7(43.8%)	P value=0.738
Total	191	16	

Table 3: *Obstetric Characteristic of the study group*

Obstetric Characteristics	Normal OGTT	GDM	Statistic & p values
Parity			
Nulliparous (para 0)	44(23.0%)	0	X=29.778
Multiparous (para 1-4)	102(53.4%)	2(12.5%)	df=2
Grand multiparous (≥5)	45(23.6%)	14(87.5%)	p value=0.000
Total	191	16	
Mode of Delivery			
SVD	180(94.2%)	15(93.8%	X=210.077
Caesarean section	11(5.8%)	1(6.2%)	df= 4
Total	191	16	P value=0.00

The mean BMI was 27.3±5.87kg/m^2 and 30.27±6.03kg/m^2 for the normal OGTT and the GDM groups respectively. This was not statistically significant. A previous history of fetal macrosomia was present in 43.8% of the GDM group and in 18.3% of the normal OGTT group and this was statistically significant. However, a family history of diabetes mellitus and a family history of hypertension were not significant risk factors for GDM among the study group (Table 4).

Table 4: *Risk factors for GDM.*

Risk Factors	Normal OGTT	GDM	RR	CI	p values
BMI (kg/m²)					
Normal (18.9-24.9)	139(72.8%)	10(62.5%)	1.041	0.944-1.147	0.379
Overweight/ Obese (25-≥ 30)	52(27.2%)	6(37.5%)			
Mean	27.30±5.87	30.27±6.03			
Total	191	16			
Previous Hx of macrocosmic baby					
Yes	35(18.3%)	7(43.8%)	3.056	1.208-7.728	0.015
No	156(81.7%)	9(56.3%)			
Total	191	16			
Family Hx of DM					
Yes	39(20.4%)	5(31.3%)	0.951	0.848 1.065	0.309
No	152(80.0%)	11(68.8%)			
Total	191	16			
Family Hx of HBP					
Yes	51(27.0%)	2(12.5%)	1.058	0.984-1.139	0.211
No	140(73.3%)	14(88.0%)			
Total	191	16			

There were 4 still births among the study group and all occurred within the normal OGTT group. None of the women with GDM had a still birth and this was statistically significant (p value=0.00). The mean birth weight of the babies born to the normal OGTT group was 3.11±0.48kg while that of the GDM group was 3.47 ± 0.45. This was statistically significant (p-value 0.005).

Table 7: *Fetal characteristics among the study group*

Fetal Outcome	Normal OGTT (%)	GDM (%)	Statistic & p values
Live births	187(98.0%)	16(100%)	X=209.345
Still births	4(2.09%)	0 (0%)	df=4
Total	191	16	P=0.00
Fetal Weight			
< 2.5 kg	7 (3.8%)	0(0%)	t= - 2.864
2.5 - < 4 kg	163(90.5%)	13(81.3)	df = 194
≥ 4 kg	10(5.6%)	3(18.8)	p= 0.005
Mean	3.11± 0.48	3.47 ± 0.45	
Total	180	16	

There was no maternal death recorded among the study group.

4. Discussion

The prevalence of GDM was 7.7% in this study. This prevalence is within the global prevalence 0.6-13.7% (WHO 2009) and agrees with that of 8.4% in Jos (Anzaku & Musa, 2013), Nigeria and 7.1% (Rajput et al., 2013) in Haryana, India. Other studies are a departure from our finding with low value (Wokoma et al., 2001; Ozumba et al., 2004; Egwenighi et al 2013) and markedly high values reported (Egwenighi et al 2013; Anzaku & Musa, 2013; Olarinoye et al 2004). The relatively high prevalence of GDM in this study may be due to the rising trend world over, the diagnostic criteria used and possibly maternal malnutrition.

In this study, the prevalence of gestational diabetes rose with advancing maternal age which was statistically significant (t=-4.014 CI -8.244, -2812, p value= 0.00). This progressive rise was also observed in the studies conducted in Abakaliki (Egwenighi et al 2013) India (Nilofer et al., 2012) but was not noted in the studies at Jos (Anzaku & Musa, 2013) and Owerri (Nwaokoro, 2014). GDM appears more frequently in pregnancy after 30 years because of age-related metabolic changes and it is rare before 20 years. The confluence of conditions more commonly seen at older ages such as pregnancy-induced hypertension increased body mass, and dyslipidemias increase the risk of GDM (Etchegoyen et al., 2001; (Cárdenas Goicochea SJ et al 2004).

In this study, tribe, occupation and educational status of both couples did not influence the risk of GDM.

The mean parity of the study group was 3.35±2.05. There was a strong association between GDM and maternal parity. There was a rising prevalence of GDM with increasing parity which was statistically significant (p value=0.00). This is in tandem with the work in Owerri(Nwaokoro, 2014) but not with the work in Abakiliki, Jos, and Ibadan (Anzaku & Musa, 2013)(Egwenighi et al 2013, Modupe A. K et al 2011). Women with higher parity tend to be of advanced age. Such women are prone to having dyslipidemia, hypertension, and obesity which are recognized risk factors for GDM.

Interestingly, a previous history of delivery of a macrocosmic baby also showed a strong association with GDM which was statistically significant (RR 3.056, CI 1.208-7.728, p-value 0.015). This finding was also noted in the study at Jos (Anzaku & Musa, 2013) but was not seen at Abakaliki (Egwenighi et al 2013)

Intuitively, BMI, family history of hypertension and family history of diabetes did not show any statistically significant relationship with the risk of GDM. This agrees with the finding in Abakiliki (Egwenighi et al 2013) and Saudi Arabia (Al-Rowaily & Abolfotouh, 2010) but disagrees with that in Jos (Anzaku & Musa, 2013)

Using statistical analysis (chi-square), advanced maternal age, high parity and previous history of macrosomia were risk factors identified to be associated with Gestational Diabetes mellitus. Subjecting these risk factors to further multivariate analysis (logistic regression) to check for independent risk factors, maternal age was statistically significant (p < 0.000) across all age groups. The previous history of fetal macrosomia was however not statistically significant (p-value 0.061) 95% CI (0.051 –

1.071). Thus, the previous statistical significance obtain might have been due to confounding effect of maternal age on the relationship between the previous history of fetal macrosomia and GDM. Maternal parity of 2 and 4 were found to be statistically significant ($p < 0.003$ and 0.016) respectively on logistic regression. This two may also have been responsible for previous statistically significant relationship obtained between maternal parity and GDM with the earlier statistical test (chi-square).

The fetal outcome among the group with GDM in this study was satisfactory with no perinatal mortality recorded (p value=0.00). The mean Apgar score of the GDM and the non-GDM group were 7 & 9 and 7 & 8 at 1st and 5th minute respectively. There were 2 cases of mild birth asphyxia recorded for the GDM study group. Among the non-GDM, 2 babies had severe asphyxia and 4 cases of moderate birth asphyxia were recorded. 2 cases of intrauterine fetal death were also recorded among the Non-GDM group. In this study, however, the mean birth weight of babies of GDM mothers was significantly higher than that of women with normal OGTT (p-value 0.005). Patients with GDM have a higher chance of developing babies with birth weight more than 4kg mainly due to hyperglycemia associated with GDM. Perhaps without treatment more cases of fetal macrosomia would have been recorded. Also, the caesarean delivery rate was also higher in the GDM group (p=0.00). These findings were also the same as those of other workers (Nilofer et al., 2012)

A total of 3 babies of the GDM subjects were admitted in the special care baby unit for observation on account fetal macrosomia. They were discharged after 24hrs of observation. 7 babies of the non-GDM subjects were admitted due to risk for sepsis (1 babies) and birth asphyxia (6 babies). The good fetal outcome in this study was probably due to the meticulous multidisciplinary approach to their management.

Overall, maternal and fetal outcomes were satisfactory among patients with gestational diabetes in this study. Based on the protocol for the management of GDM in our center, 13(81.3%), in the GDM group achieved normoglycemia on diet only while 3(19.7%) had a combination of diet and insulin. Fetal macrosomia occurred in only 2(15.4%) managed on diet alone and in 1(33.3%) managed on a combination of diet and insulin. This favorable outcome among the GDM group agrees with findings by some workers (Nilofer et al., 2012) but is a departure from the work of others (Ozumba et al., 2004), which revealed adverse outcome associated with GDM.
There was no maternal death recorded among the study group, however, 25% of the patients with GDM had abnormal values of OGTT at six weeks post-delivery.

5. Conclusion

The prevalence of GDM among our antenatal population was 7.7% which was relatively high but within the global range. The multidisciplinary approach helps to improve pregnancy outcome.

Conflicts of Interest:
Authors declared no conflicts of interest.

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