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MATERNAL-FETAL MEDICINE

Prevalence and associated risk factors for gestational diabetes in Jos, North-central, Nigeria

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Abstract
Objective The study aimed at determining the prevalence and associated risk factors for gestational diabetes mellitus (GDM) among antenatal women attending the Jos University Teaching Hospital (JUTH), Jos, Nigeria.
Methods A cross-sectional study was done between February and April 2009 among 265 pregnant women enrolled from the antenatal clinic of JUTH. Screening was done between 24 and 28 weeks' gestation with a 50 g, 1-h glucose challenge test (GCT). Those with plasma glucose concentration >7.8 mmol/l were then given 75 g oral glucose tolerance test (OGTT) to confirm the diagnosis of GDM. Plasma glucose measurements were performed with glucose oxidase method. GDM was diagnosed according to the WHO criteria. All relevant data including demographic information, obstetric history, and risk factors for GDM, GCT and OGTT results were collected and analyzed using Epi Info version 3.5.1, CDC, Atlanta, USA.
Results Of the 265 pregnant women enrolled, 253 subjects were eligible for screening out of which, 28 (11.1 %) had positive GCT >7.8 mmol/l. The prevalence of GDM was 8.3 % (21/253); 95 % CI 5.2–12.4. The pattern of glucose tolerance in the study population indicated that 232 (91.7 %) had normal glucose tolerance, 6.7 % had impaired glucose tolerance (IGT) while 1.6 % had overt diabetes. Previous history of fetal macrosomia was independently associated with GDM (adjusted OR 11.1; 95 % CI 2.93–42.12, $P = 0.0004$).
Conclusion The prevalence of GDM was relatively high among our antenatal population. Women with previous history of fetal macrosomia have a higher likelihood of having GDM and should be screened.

Keywords Gestational diabetes mellitus · OGTT · Fetal macrosomia

Introduction

Gestational diabetes mellitus (GDM) is defined as any degree of glucose intolerance with onset or first recognition during pregnancy [1, 2]. This does not exclude glucose intolerance that may have antedated pregnancy and regardless of whether glucose intolerance returns to normal after delivery.

GDM is associated with increased maternal and fetal morbidity and mortality and the degree of these adverse outcomes comparable to those of pre-gestational diabetes mellitus [3, 4]. Depending on the type of population and the diagnostic criteria used, GDM complicates about 4 % of all pregnancies worldwide with a prevalence range of 1–14 % [5, 6]. Researchers in American, European and Asian settings have reported a prevalence of 1–9 % [7–9]. However, prevalence value as high as 11.6 % has been reported from Lagos, Nigeria [10].

GDM usually occurs between 24 and 28 weeks of gestation as a result of increased insulin resistance in the second trimester [1, 2, 6]. The glucose levels rise in women who are unable to produce enough insulin to adapt to the increased insulin resistance [11].

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Risk factors for the onset of GDM include previous history of unexplained intra-uterine fetal death (IUFD), previous/current fetal macrosomia, previous history of GDM and gross fetal malformations [11, 12]. Increasing maternal age, family history of diabetes and overweight are also risk factors for gestational diabetes as well as pregnant women with current polyhydramnios and glycosuria [11, 13].

Pregnancy-related morbidity and mortality in GDM include fetal macrosomia, intra-uterine fetal death, neonatal metabolic abnormalities (hypoglycemia, polycythemia, hyperbilirubinemia) and birth trauma [14]. The perinatal mortality rate is increased tenfold in pregnancies complicated by GDM [15]. Women with GDM are also at increased risk of operative delivery, hypertensive disorders and development of frank diabetes later in life [16].

Rarely women with impaired glucose tolerance (IGT) in pregnancy may deteriorate rapidly to overt diabetes or occasionally, ketoacidosis may develop [11].

There are considerable variations in the screening and diagnosis of GDM, when to screen and to whom it should be applied [11, 17]. Universal and risk factor-based screening has been advocated but advocates of universal screening claim that one-third to half of women with GDM will be missed if traditional risk factors are used for screening GDM [11]. Currently GDM is diagnosed using either two- or one-step method involving initial screening procedure or direct application of the diagnostic 75 or 100 g oral glucose tolerance test (OGTT). Diagnosis is based on American Diabetes Association (ADA) or World Health Organization (WHO) diagnostic criteria [13, 18].

GDM is associated with immediate and late fetal, neonatal and maternal complications and reports suggest that the perinatal morbidity and mortality can be reduced to levels similar to that of non-diabetic women if properly managed [19]. The prevalence of GDM and its associated risk factors have not been documented in our setting. This study was done to fill these gaps in knowledge on this important pregnancy-related condition in our clinical setting.

Methodology

This cross-sectional study was done at the antenatal clinic of Jos University Teaching Hospital, Jos, Nigeria between February and April 2009.

The study population was sampled from the source population of women attending the antenatal clinic in Jos based on the inclusion criteria. A total of 265 eligible pregnant women were randomly selected using a computer generated random number table. Pregnant women with pre-existing diabetes mellitus and those on steroids were excluded from the study.

Data collection

After enrollment of eligible subjects, a structured questionnaire was administered to obtain baseline socio-demographics and relevant obstetric data such as age, parity, gestational age. Participant's weight and blood pressure were also measured and documented for subsequent analysis.

They were then educated regarding the procedure for the screening test and were screened between 24 and 28 weeks' gestation using the 1-h 50 g glucose challenge test (GCT) without prior fasting. Women that booked for antenatal care before 24 weeks' gestation were given a date for the screening test to be carried out. Those who had 1-h plasma glucose value >7.8 mmol/l were scheduled for a diagnostic 75 g OGTT after a fast of between 10 and 12 h. Glucose load was dissolved in 250 ml of water and each subject was instructed to ingest it over 5 min. For each woman, fasting blood sample was taken before the glucose load and thereafter, venous blood samples were collected half hourly up to the 2 h time point.

The glucose loads were weighed using a triple beam balance (Ohaus® Model) and the plasma glucose levels were measured with a spectrophotometer (Optima, model SP-100) using glucose oxidase method.

The WHO criteria for the diagnosis of diabetes using 75 g glucose load was used and participants with a 2 h glucose plasma value ≥7.8 mmol/l were diagnosed as having GDM [18]. The results were recorded on each subject's questionnaire for subsequent interpretation and analysis.

Data analysis

The data were analyzed using 2008 EPI-Info 3.5.1 (CDC, Atlanta, GA, USA). Descriptive statistics was done and test of association between categorical variables were carried out using Chi square test or Fisher exact test where applicable. Student *t* test was used to compare means of continuous variables.

The data of women with GDM were compared with those without GDM. Factors found to be significant in univariate analysis were included in a multiple logistic regression model to identify independent risk factors after controlling for potential confounding variables. A *P* value of <0.05 was considered statistically significant.

Ethical consideration

Ethical approval was provided by the Human Subjects Research Ethics Committee (HREC) of the Jos University Teaching Hospital, Jos, Nigeria.

Results

During the 12-week study period 95.5 % (253/265) of the pregnant women recruited for the study completed the study procedure. Twenty-eight (11.1 %) of the women had a positive 50 g GCT out of which 21 of them had GDM after the 75 g OGTT, giving a point prevalence of 8.3 % (95 % CI 5.2–12.4) GDM in our study population. This point prevalence was made up of 6.7 % (17/253) with IGT while 1.6 % (4/253) had overt diabetes mellitus.

Figure 1 shows the pattern of glucose tolerance in the antenatal population. The mean gestational age at screening for GDM was 25.9 ± 1.6 weeks. The mean age of the women with GDM and that of the controls was 31.2 ± 5.8 and 28.6 ± 5.6 years, respectively ($P = 0.04$). The age range of women with GDM was 21–40 years while that of controls was 19–42 years. Table 1 shows the socio-demographic characteristics of the study population. Over one-third (38.1 %) of those with GDM were grand-multiparous. The mean weights of GDM and control subjects were 73.2 ± 18.3 and 65.6 ± 12.1 kg ($P = 0.01$) with a range of 45.0–104.5 kg for GDM subjects and 46.0–98 kg for the controls. Table 2 shows the clinical findings of the women with GDM compared with the controls.

Nine (3.6 %) of the women without GDM had hypertension/pre-eclampsia while none of the women with GDM had the condition.

Table 3 shows that maternal age ≥31 years, obesity (weight >90 kg), history of fetal macrosomia, polyhydramnios, and current glycosuria were significantly associated with a higher likelihood for GDM on univariate analysis (P values <0.05). However, in a multivariate logistic regression with sequential backward elimination and adjusting for confounding variables, only previous history of fetal macrosomia was identified as an independent risk factor for GDM (adjusted OR 11.1, 95 % CI 2.93–42.12, $P = 0.0004$).

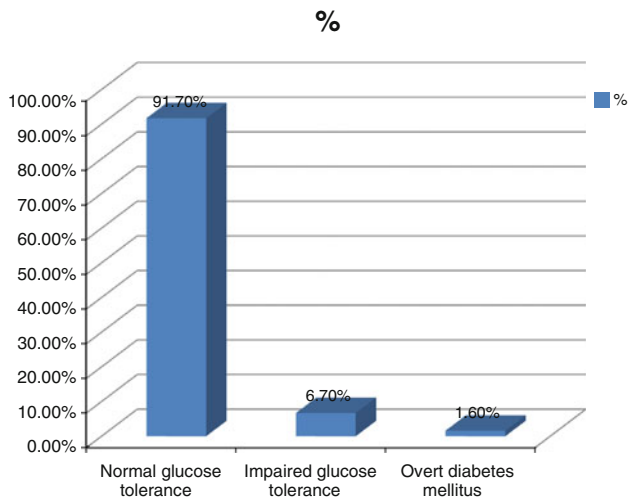

Fig. 1 Pattern of glucose tolerance among the study population

Discussion

Our study showed a point prevalence of 8.3 % GDM among antenatal population of a University Teaching Hospital in Jos, Nigeria. This prevalence was far higher than earlier studies in Nigeria which found the prevalence of 4.5 % GDM using the NDDG criteria and 0.298 % using combination of criteria including fasting blood sugar in Lagos and Port Harcourt respectively [10, 20]. The prevalence found in our study cohort approaches the 11.6 % GDM found by authors who studied antenatal population in Lagos, south-western Nigeria using the same WHO criteria [10]. This supports the assertion that the prevalence of GDM is influenced by the diagnostic method and the study population [5, 6] which in this study consisted of pregnant women from diverse ethnic groups. The Lagos study used the 75 g OGTT for diagnosis of GDM which has a better sensitivity and more likely to detect more cases of GDM compare to our study where a screening procedure (GCT)

Table 1 Some socio-demographic characteristics of the subjects

Characteristics	All subjects	GDM subjects	Non-GDM subjects
Age groups (years)			
<20	16 (6.3)	0 (0)	16 (6.9)
20–25	66 (26.1)	5 (23.8)	61 (26.3)
26–30	83 (32.8)	6 (28.6)	77 (33.2)
31–35	54 (21.3)	6 (28.6)	48 (20.7)
36–40	30 (11.9)	4 (19.0)	26 (11.2)
41–45	4 (1.6)	0 (0)	4 (1.7)
Ethnic groups			
Hausa	116 (45.9)	13 (62.0)	103 (44.4)
Berom	32 (12.6)	0 (0)	32 (13.8)
Fulani	20 (7.9)	0 (0)	20 (8.6)
Igbo	18 (7.1)	4 (19.0)	14 (6.1)
Yoruba	9 (3.6)	0 (0)	9 (3.9)
Others[a]	58 (22.9)	4 (19.0)	54 (23.2)
Educational status			
Uneducated	8 (3.2)	3 (14.3)	5 (2.2)
Primary	56 (22.1)	7 (33.3)	49 (21.1)
Secondary	131 (51.8)	9 (42.9)	122 (52.6)
Tertiary	58 (22.9)	2 (9.5)	56 (24.1)
Religion			
Islam	161 (3.6)	17 (81)	144 (62.1)
Christianity	93 (36.4)	4 (19)	88 (37.9)

Values are *n* (%)

[a] Others (ethnic groups) included Afizere, Eggon, Irigwe and Anaguta

Table 2 Comparison of the clinical findings of GDM and non-GDM subjects

Characteristics	GDM *N* (SD)	Non-GDM *N* (SD)	*P* value	Remark
Weight (kg)	73.2 (±18.3)	65.6 (±12.1)	0.01‡	S
Blood pressure				
SBP (mmHg)	110.3 (±13.2)	113.5 (±12.3)	0.25‡	NS
DBP (mmHg)	69.5 (±10.7)	68.3 (±10.4)	0.60‡	NS
Height (m)	1.58 (±0.04)	1.60 (±0.05)	0.15‡	NS
Religion				
Islam	17	144		
Christianity	4	88	0.06*	NS

Values in brackets indicate SD

SBP systolic blood pressure, *DBP* diastolic blood pressure, *S* significant, *NS* not significant

‡ *t* test, * Chi square

Table 3 Risk factors for GDM on univariate analysis

Characteristics	GDM	Non-GDM	*P* value	Remark
Age (years)	31.2 (±5.8)	28.6 (±5.6)	0.04‡	S
Family history of diabetes	2	23	0.64†	NS
	19	209		
Obesity	4	8	0.01†	S
	17	224		
History of IUFD	0	8	0.49†	NS
	21	224		
History of fetal macrosomia	6	6	<0.001†	S
	15	226		
History of fetal congenital malformation	0	2	0.84†	NS
	21	230		
Polyhydramnios	2	0	0.01†	S
	19	232		
Glycosuria	13	0	<0.001†	S
	8	232		

S significant, *NS* not significant

‡ *t* test, † Fisher exact test

with 80 % sensitivity was done before subjecting those positive to a confirmatory 75 g OGTT for diagnosis of GDM.

Also studies from Sri Lanka, Plymouth, UK and Toronto, Canada reported lower GDM prevalence rates of 5.5, 1.8 and 3.78 %, respectively [9, 21, 22]. Though higher prevalence rates of GDM are expected compared to the finding in this study as a result of the lower threshold value of 7.2 mmol/l used for a positive GCT, the lower prevalence rates may be attributed to the differences in methodologies where 100 g OGTT was used for diagnosis of GDM and the obstetric population. This lower threshold value for a positive GCT detects more cases of GDM as a result of its higher sensitivity of 90 % in identifying GDM. Though the same methods were used as in this study for screening of GDM, the prevalence rate is higher than 7.2 % reported from Porto Alegre, Brazil [23]. This may be attributed to the racial and ethnic differences and a reflection of different glycemic responses in these study populations.

The pattern of glucose tolerance in this study population was markedly different from that reported from Ilorin, Nigeria with values of 14.7, 64.7 and 5.88 % for normal glucose tolerance, IGT and overt diabetes, respectively [24]. The methodology used in the Ilorin study included the use of a 100 g OGTT. Additionally, the study population comprised those suspected of having GDM and were referred to the metabolic clinic for confirmation. This methodology could be responsible for the higher prevalence reported in their study population when compared to the prevalence found in our study. This pattern is also slightly different from the one reported from Lagos where 88.7, 8.7 and 2.9 % of the women were found to have normal glucose tolerance, IGT and overt diabetes, respectively [10]. Though 75 g OGTT was used in both studies, the different pattern reported may be a result of the direct use of the 75 g OGTT on the subjects without a prior screening test as done in our study and differences in glucose homeostasis between the study groups may be contributory. The mean age of 31.2 years in this study is comparable to that reported in two separate studies in Nigeria, Lagos and Port Harcourt [10, 20].

Of the risk factors for GDM, our study found history of previous fetal macrosomia as the only independent risk factor for GDM (adjusted OR 11.1; 95 % CI 2.93, 42.12, $P = 0.0004$). Our study finding is compared with report of other studies elsewhere [23, 25]. Although other risk factors of GDM were not found to be significant in the multivariate model, these were probably a result of the shorter duration of the study and/or influenced by unknown confounding factors in the study population. A larger study is needed to identify other risk factors for GDM in our clinical setting.

We noted some limitations of our study. First, we focused on pregnant women attending a tertiary academic medical centre in one institution in Nigeria which could limit the generalizability of our study findings to only the study population in Nigeria. We also conducted a one time-point assessment for GDM and could not follow the women to determine birth outcomes and subsequent OGTT after delivery. We therefore cannot claim causal association between GDM and the risk factor identified in our study.

We, however, conclude that the prevalence of GDM in our cohort attending a tertiary academic medical centre in Nigeria is relatively high (8.3 %) and women with previous history of fetal macrosomia should be screened routinely for GDM. This may help to detect women with GDM early especially those with overt diabetes mellitus and gives opportunity for early intervention and improve obstetric outcomes.

Conflict of interest The authors declare no conflict of interest.

References

1. America College of Obstetricians and Gynaecologists (2001) Gestational diabetes. Obstet Gynecol 98:528–538
2. Diagnosis and classification of Diabetes mellitus (2006) Diabetes. Care 29(Suppl 1):S43–S48
3. Oladokun A, Aimakhu CO, Awolude OA, Olayemi O, Adeleye J (2003) Pregnancy outcome in diabetic patients at the University College Hospital, U.C.H., Ibadan. Trop J Obstet Gynaecol 20:52–55
4. Farrel T, Neale L, Cundy T (2002) Congenital Malformations in the offsprings of women with type 1, type 2 and gestational diabetes. Diabetes Med 19:322–326
5. American Diabetes Association (1998) Position statement. Gestational diabetes mellitus. Diabetes Care 21(Suppl 1):S60–S61
6. Jovanovic L, Pettitt DJ (2001) Gestational diabetes mellitus. JAMA 286:2516–2518
7. Getahun D, Nath C, Ananth CV, Chavez MR, Smulian JC (2008) Gestational diabetes in the United States: temporal trends 1989 through 2004. Am J Obstet Gynecol 168:521–525
8. Di Cianni G, Volpe L, Lencioni C, Miccoli R, Cuccuru I, Ghio A et al (2003) Prevalence and risk factors for gestational diabetes assessed by universal screening. Diabetes Res Clin Pract 62:131–137
9. Siribaddana SH, Deshabandu R, Raiapakse D, Silva K, Fernando DJ (1993) The prevalence of gestational diabetes in a Sri Lankan antenatal clinic. Ceylon Med J 43:88–91
10. Olarinoye JK, Ohwovoriole AE, Ajayi GO (2004) Diagnosis of gestational diabetes mellitus in Nigerian pregnant women—comparison between 75 and 100 g oral glucose tolerance tests. West Afr J Med 23:198–201
11. Akanji AU (2003) Update: diagnosis, pathogenesis and management of gestational diabetes mellitus. Ann Ib Postgrad Med 1:46–57
12. Xiong X, Saunders LD, Wang FL, Demianzuk NN (2001) Gestational diabetes mellitus: prevalence, risk factors, maternal and infant outcomes. Int J Gynaecol Obstet 75:221–228
13. American Diabetic Association (2001) Gestational diabetes mellitus. Diabetes Care 24(Suppl 1):S77–S79
14. Aberg A, Westbom L, Kallen J (2001) Congenital Malformations among infants whose mothers had gestational diabetes or pre-existing diabetes. Early Hum Dev 61:85–95
15. Rudge MVC, Calderon IMP, Ramos MD, Abbade JF, Rugolo LMS (2000) Perinatal outcome of pregnancies complicated by diabetes and by maternal daily hyperglycemia not related to diabetes. Gynecol Obstet Invest 50:108–112
16. Russel C, Dodds L, Armson BA, Kephart G, Joseph KS (2008) Diabetes mellitus following gestational diabetes: role of subsequent pregnancy. BJOG 115:253–259
17. Sermer M (2003) Does screening for gestational diabetes mellitus make a difference? Can Med Assoc J 168:429–431
18. World Health organization. Diabetes mellitus. Report of a WHO study group. Technical report series 727, WHO, Geneva, 1985
19. Seshiah V, Cynthia A, Balaji V, Balaji MS, Ashalata S, Sheela R et al (2008) Detection and care of women with gestational diabetes mellitus from early weeks of pregnancy results in birth weight of newborn babies appropriate for gestational age. Diabetes Res Clin Pract 80:199–202
20. Wokoma FS, John CT, Eyindah CE (2001) Gestational diabetes mellitus in a Nigerian antenatal population. Trop J Obstet Gynaecol 18:56–60
21. Janghorbani M, Stenhouse E, Jones RB, Millward A (2006) Gestational diabetes in Plymouth, U.K: prevalence, seasonal variation and associated factors. J Reprod Med 51:128–134
22. Sermer M, Naylor CD, Farine D, Kenshole AB, Ritchie JW, Gare DJ et al (1998) The Toronto Tri-Hospital gestational diabetes project. A preliminary review. Diabetes Care 21(Suppl 2): S33–S42
23. Schimidt MI, Duncan BB, Reichelt AJ, Branchtein L, Matos MC, Spichler E et al (2001) Gestational diabetes mellitus diagnosed with a 2-h 75 g oral glucose tolerance test and adverse pregnancy outcomes. Diabetes Care 24:1151–1155
24. Oparinde DP, Oghagbon EK, Adebisi SA, Adebayo TO, Iyanda AA, Okesina AB et al (2006) Oral glucose tolerance test (OGTT) in Ilorin, Nigeria. Trop J Health Sci 13:15–19
25. Zargar AH, Sheikh MI, Bashir MI, Masoodi SR, Laway BA, Wani AL et al (2004) Prevalence of gestational diabetes mellitus in Kashmiri women from the Indian subcontinent. Diabetes Res Clin Pract 66:139–145