BENTHAM OPEN

CrossMark

The Open Public Health Journal

Content list available at: www.benthamopen.com/TOPHJ/

DOI: 10.2174/1874944501811010001

RESEARCH ARTICLE

Diagnosis of Gestational Diabetes Mellitus in Urban Harare, Zimbabwe

Godwell Nhidza[1], Kudzaishe Mutsaka[2], Garikai Malunga[3] and Danai Tavonga Zhou[1,3,*]

[1]*Department of Medical Laboratory Sciences, University of Zimbabwe College of Health Sciences, P.O. Box AV 178, Avondale, Harare, Zimbabwe*

[2]*Department of Chemical Pathology, University of Zimbabwe College of Health Sciences, P.O. Box AV 178, Avondale, Harare, Zimbabwe*

[3]*Department of Health (Medical Laboratory Sciences), Africa University, College of Health, Agriculture and Natural Sciences, P.O. Box 1320, Mutare, Zimbabwe*

Received: August 05, 2017 Revised: November 30, 2017 Accepted: December 26, 2017

Abstract:

Introduction:

According to the WHO, Gestational Diabetes Mellitus (GDM) means glucose intolerance with onset during pregnancy. Unfortunately, women affected by GDM could suffer from Type 2 diabetes (T2DM) later while babies born to mothers with GDM are at increased risk of being too large for gestational age. This cross-sectional study screened GDM in women attending Parirenyatwa Antenatal Clinic in urban Harare, Zimbabwe using 2006 WHO diagnostic criteria.

Methodology:

Urine samples were collected from all consenting pregnant women. If urinalysis indicated glycosuria and if a woman reported clinical symptoms of GDM, random blood sugar analysis was subsequently carried out. Those suspected of having GDM due to elevated glucose (n=17) were screened with glucose load challenge the following day, after collecting the sample for fasting blood sugar. Family history of diabetes was self-reported.

Results:

Women (N=150), between 24 – 28 weeks of gestation who consented were recruited. Participants had mean age 27.2(3.5) years and about half were gradiva 1. All participants reported no maternal history of T2DM, but reported other family history of T2DM. Out of the 150 recruited and 17 tested by OGTT, 10 (6.7%) tested positive for GDM.

Conclusion:

Prevalence of GDM is lower than two similar African studies but similar to one Indian study. Of note is the fact that variations in reported prevalence, in populations from different studies could be due to different diagnostic criteria used. Results need further enquiry on larger group of pregnant women using latest 2013 WHO criteria.

Keywords: ANC, GDM, OGTT, Prevalence, Screening, Parirenyatwa, Zimbabwe.

1. INTRODUCTION

Gestational Diabetes Mellitus (GDM) is glucose intolerance with onset or first recognition during pregnancy, which

* Address correspondence to this author at the Department of Medical Laboratory Sciences, University of Zimbabwe College of Health Sciences, P.O. Box AV 178, Avondale, Harare; Department of Health (Medical Laboratory Sciences), Africa University, College of Health, Agriculture and Natural Sciences, P.O. Box 1320, Mutare, Zimbabwe; Tel: +263772566214; E-mails: danaizh@yahoo.co.uk, d.t.zhou@medisin.uino

may be due to hormonal signals originating from the feto-placental unit [1, 2]. Pregnancy is also associated with increase in beta-cell mass and increase in insulin level throughout pregnancy. However, certain pregnant women are unable to up-regulate insulin production relative to the degree of insulin resistance, and consequently become hyperglycemic, thus developing GDM [3, 4].

GDM generally has few symptoms and it is most commonly diagnosed by screening during pregnancy [5]. Diagnostic tests detect inappropriately high levels of glucose in blood samples and formal systematic testing for GDM is usually done between 24 and 28 weeks of gestation [5, 6]. To determine if GDM is present in pregnant women, a standard oral glucose tolerance test (OGTT) is performed after overnight fasting by giving 75 g anhydrous glucose in 250-300 ml water within 5 minutes [6]. Plasma glucose is measured fasting before and 2 hours after OGTT. Pregnant women, who meet WHO criteria for diabetes mellitus, or impaired glucose tolerance, during pregnancy for the first time, are classified as having GDM [6].

To our knowledgeno published study has been done on GDM in Zimbabwe though pregnant women affected by GDM pose a risk for adversities such as: eclampsia and the need for Caesarean section due to fetal macrosomia [7]. Furthermore, women who are affected by GDM have a greater chance of suffering from Type 2 diabetes later in their lives [8, 9]. Additionally, babies born to mothers with GDM are at increased risk of being too large for gestational age (which may lead to delivery complications, low blood sugar, and jaundice) [10, 11]. Hence, this study sought to diagnose GDM in women attending Parirenyatwa Antenatal Clinic (ANC), in urban Harare, Zimbabwe between January and February 2015.

2. MATERIALS AND METHODS

2.1. Study Setting

The study was conducted at Parirenyatwa Group of Hospitals in urban Harare, Zimbabwe. The antenatal out-patients' clinic from which the study participants were recruited is housed in the Mbuya Nehanda Maternity Hospital unit - an antenatal care and family planning unit of the hospital. Clinic clientele was drawn from Harare public clinics and surrounding hospitals by way of referral system and from local private obstetricians who had gained right to admit private patients into the hospital. The clinic also provides services to in-patients who are admitted into the 30 bed ante-natal for specialized care.

2.1.1. Study Design

Cross sectional study

2.1.2. Sample Size

A minimum of 150 pregnant women, calculated using the Dobson formula

$N = [Z\alpha/2/E]2\ p\ (1-p)$

Where: N = minimum sample size, Z = test statistic, α = level of significance = 0.05, E = standard error (0.05), 95% confidence interval, p = sample proportion = 0.11, q = 1-p = 0.89

Hence N= (1.96/0.05)2(0.11)(0.89)= 150

2.1.3. Inclusion Criteria

Pregnant women within the 24th to 28th gestational period

2.1.4. Exclusion Criteria

Women who were known diabetics, or who were suffering from any chronic illness

2.1.5. Sample Collection

Using hospital-specific guidelines, a random urine sample was collected from each pregnant woman participant who had consented and a urinalysis test was done on the urine sample. If the urinalysis indicated glycosuria (positive dipstick) and the participant was deemed to be presenting with symptoms of GDM, by clinicians, a blood sample for Random Blood Sugar (RBS) analysis was collected, according to the 2006 WHO GDM diagnosis guidelines. If the participant had an elevated level of glucose, above the normal range, she was then screened with the glucose load

challenge (Oral Glucose Tolerance Test or OGTT), the following day, after a sample for Fasting Blood Sugar (FBS) was collected. Patients were recruited and screened using sequential convenience sampling.

2.1.6. Data Collection

Demographic data for patients who enrolled into the study were obtained from hospital records and study participants using questionnaire-guided interviews. Data collected and recorded included: age, gravida (number of pregnancies), family history and prior history of Diabetes Mellitus (DM).

2.2. Biochemical Investigations

2.2.1. Urine Analysis

Urine analysis was performed using the glucose oxidase test. The results were recorded and urine samples discarded. Those with collected random blood glucose samples were tested on the day of collection at the Parirenyatwa Hospital Biochemistry Laboratory. Those with elevated random blood glucose were referred to Harare Hospital Gestational Diabetes Clinic, where they had to report while fasting the following day, for fasting blood glucose testing and OGTT. Calibration of machine is routinely done at the beginning of each day before any testing is carried out. Additionally, pathological and normal controls were analyzed before sample analysis on the Mindray® BS 120 analyzer. Samples were analyzed for glucose levels in plasma using the hexose kinase method.

2.2.2. Method of Data Analysis

Normally, distributed variables were summarized using mean and standard deviation. Categorical data was described using frequencies (n) and percentages. The hypothesis was tested using Poisson regression analysis and Pearson chi-square tests at 95% confidence interval. Data analysis was carried out using Stata version 10.1 (StataCorp, College Station, Texas, *USA*).

3. RESULTS

3.1. Demographics of Participants

A total of 150 pregnant women attending Parirenyatwa ANC, who were between 24 and 28 weeks of gestation were enrolled into the study. Ages of participants ranged from 16 to 35 years and mean age was 27.2 (3.5) years. Ninety-six (64%) women were less than 30 years and 46 (31%) were gradiva 1, 25% were gravida 2, 17% were gravida 3 and 27% were gravida >4. All the participants reported neither prior history of type 2 diabetes mellitus (T2DM) nor prior history of maternal DM. In contrast 133 (88.7%) of the women reported other family history of DM.

Table **1** shows distribution of GDM by age groups, gravida and family history of T2DM. Out of 150 women screened, 17 (11.3) were referred for OGTT due to suspicion of GDM. Of those tested using OGTT, 10 (6.7%) tested positive for GDM. Using chi-square tests, the prevalence of GDM did not increase with age; p=0.603 even though prevalence of GDM seemed to be more prevalent amongst women aged ≥34 years (25%) and less so in those aged 24-29 years (3.5%). The prevalence of GDM seemed highest in women with gravida 4 or more (12.2%) and lowest among gravida 2 or less (3%), but the differences did not reach statistical significance after testing using Pearson chi-squared tests, p=0.815. Higher prevalence of GDM was obtained in women who reported family history of DM than those who reported no family history of DM (17.6% *vs*.5.3%), p=0.008.

Table 1. Shows distribution of GDM by age groups, gravida and family history of T2DM.

Age group (years)	**Number tested N**	**Frequency of GDM positive cases n (%)**
<24	39	0 (0)
25-29	57	2 (4)
30-34	34	3 (9)
>34	20	5 (25)
p-value *		0.603
Gravida	**N**	**n (%)**
1	47	0 (0)
2	38	2 (5)

(Table 1) contd.....

Age group (years)	Number tested N	Frequency of GDM positive cases n (%)
3	25	3 (12)
≥4	41	5 (12)
p-value*		0.815
Family history of T2DM	**N**	**n (%)**
Negative	133	7 (5)
Positive	17	3 (18)
p-value**		0.008

GDM, gestational diabetes mellitus; T2DM, type 2 diabetes mellitus; n, number of participants
P-value* calculated using Poisson regression, P-value** calculated using Pearson chi square test

4. DISCUSSION

The prevalence of GDM at Parirenyatwa ANC was 6.7% in the current study. This was in close agreement with an Indian study of 607 women, attending ANC, with estimated prevalence of GDM of 7.1% using the standardized 2-hour 75 g OGTT as a screening test [12, 13]. Our results were slightly below the prevalence reported by a South African study, in Limpopo Province. The Limpopo study on 262 third-trimester rural women attending local clinics used 2-hour OGTT with blood collected at baseline, 30 minutes and 120 minutes. Glucose and insulin were measured and the prevalence of GDM was found to be 8.8% [14]. A similar Mozambican study enrolled 109 women and screened them using the 2-hour OGTT and prevalence of GDM was slightly higher than our result at 11% [15].

Literature shows that the global prevalence of GDM occurs in 3-10% of all pregnancies depending on the population studied, the study design and GDM diagnostic criteria used [13, 16]. The large intra-regional variations may be because there are still controversies around GDM diagnosis. For example, prior to 2006, the WHO applied the same criteria to the pregnant and non-pregnant women even though common thresholds for pregnant and non-pregnant women had been shown to be erroneous [16]. However, due to the ease of use, simplicity and global clout, the WHO criteria for GDM remained popular in most countries of the world. In order to improve GDM diagnosis, the latest WHO 2013 guideline has endorsed the International Association of Diabetes and Pregnancy Study Groups (IADPSG 2010) criteria that recommend universal screening of all pregnant women with the 75-g oral glucose tolerance test (OGTT) [16]. Yet, despite the IADPSG guideline being agreed by many global health groups, one worldwide guideline remained elusive as of 2014 and 2016 [16, 17].

WHO guidelines do not recommend the use of urinalysis, random or fasting blood sugar as the main screening tests for GDM, but due to limited resources, low income countries like Zimbabwe pre-screen pregnant women using urinalysis prior to diagnosing them for GDM using WHO-prescribed methods [6]. Hence, this study not only used urinalysis and random blood glucose tests, but also assayed samples of women suspected to have GDM using OGTT as per WHO 2006 guidelines. Our resulting prevalence was higher when compared to studies carried out in Tanzania (0%) by Swai et al [18] and South Africa by Basu et al (1.8%) [19]. The Tanzanian study by Swai et al from 1991 was carried out on 189 women in rural Tanzania and used the WHO 1985 diagnostic criteria with a cut-off of >6.7 mmol/L, 2 hours post prandial. The South African study by Basu et al did not use WHO diagnostic criteria, but used in-house criteria. It is reasonable to assume that our result was far higher than the prevalence reported in the Tanzanian study due to the lower cut-off of >6.1mmol/L that we used according to the WHO 2006 guidelines compared to the 6.7mmol/L WHO 1985 guideline used in the Tanzanian study. The difference with the 2010 South African study is mainly due to difference in diagnostic criteria. The South African study used an institutional protocol which regarded fasting or random blood glucose level greater than 8.0 or 11.0 mmol/L as GDM positivity rather than recommended WHO guidelines [6, 19].

The current study shows that risk of GDM does not increase with a woman's age. This finding is in contrast to reports from a study that was carried out in Qatar together with many other studies [20, 21]. Hence from this study we cannot conclude that gravida (number of pregnancies) is a predictor of GDM.

Most prospective and cohort studies show that family history of diabetes mellitus is one of the major risk factors for developing GDM [22]. This current report confirms that family history is associated with increased chance of gestational diabetes mellitus. In this current study population, there was no woman who reported maternal history of diabetes, in contrast to earlier studies [22, 23]. However, undiagnosed diabetes is highest in sub-Saharan Africa [24] hence maternal and family history for type 2 diabetes might not be known to many people, thus underestimating the frequency of a positive maternal and family history.

CONCLUSION

The prevalence of GDM in women at Parirenyatwa ANC was found to be 6.7% and there was no evidence for association of GDM with either age group or gravida.

Limitations

- High risk of bias due to small sample size and because some data were collected from clinical records
- Recall bias inherent with relying on participants to give information as they could not always remember or know family history of DM
- Study did not follow-up and test the women after delivery to investigate if GDM disappeared

LIST OF ABBREVIATIONS

ANC	=	Antenatal Clinic.
DM	=	Diabetes Mellitus
GDM	=	Gestational Diabetes Mellitus.
JREC	=	Joint Research Ethics Committee.
OGTT	=	Oral Glucose Tolerance Test.
T2DM	=	Type 2 Diabetes Mellitus.
WHO	=	World Health Organisation.

ETHICS APPROVAL AND CONSENT TO PARTICIPATE

The research was approved by the Joint Research Ethics Committee of the Parirenyatwa Group of Hospitals and University of Zimbabwe College of Health Sciences (JREC) after it was assured that it would be carried out according to the Declaration of Helsinki.

HUMAN AND ANIMAL RIGHTS

No Animals were used in this research. All human research procedures followed were in accordance with the ethical standards of the committee responsible for human experimentation (institutional and national), and with the Helsinki Declaration of 1975, as revised in 2008.

CONSENT FOR PUBLICATION

All the pregnant women attending Parirenyatwa ANC were informed verbally about the study and those who gave written informed consent were enrolled. Data collected was saved in password protected computers.

CONFLICT OF INTEREST

The authors declare no conflict of interest, financial or otherwise.

ACKNOWELEDGEMENTS

Parirenyatwa Group of Hospitals Antenatal Clinic staff and participating women.

Harare Central Hospital Antenatal Clinic for carrying out OGTT.

University of Zimbabwe Department of Community Medicine for statistical analysis.

REFERENCES

[1] Reinauer H, Home PD, Kanagasabapathy AS. Heuck CC for World Health Organization (2002) Laboratory diagnosis and monitoring of diabetes mellitus. Geneva: World Health Organization 2014. Available from: [http://apps.who.int/iris/handle/10665/42642]

[2] Monga A, Baker P. Physiology of pregnancy.Obstetrics by ten teachers, Philip N Baker PN, Kenny L. 19th ed. Abingdon, UK: CRC Press 2006; pp. 48-62.

[3] Catalano PM, Huston L, Amini SB, Kalhan SC. Longitudinal changes in glucose metabolism during pregnancy in obese women with normal glucose tolerance and gestational diabetes mellitus. Am J Obstet Gynecol 1999; 180(4): 903-16.
[http://dx.doi.org/10.1016/S0002-9378(99)70662-9] [PMID: 10203659]

[4] Kühl C. Aetiology of gestational diabetes. Baillieres Clin Obstet Gynaecol 1991; 5(2): 279-92.
[http://dx.doi.org/10.1016/S0950-3552(05)80098-7] [PMID: 1954714]

[5] Al-Noaemi MC, Shalaye MH. Pathophysiology of gestational diabetes mellitus: The past, the present and the future, gestational diabetes. Intech Open Science, Open Minds 2011; pp. 91-2. Available from: http://www.intechopen.com/books/gestational-diabetes

[6] World Health Organization and International Diabetes Federation (2006) Definition and diagnosis of diabetes mellitus and intermediate hyperglycaemia. Geneva: World Health Organization 2006. Available from: [http://www.who.int/diabetes/publications/Definition%20and%20diagnosis%20of%20diabetes_new.pdf]

[7] Lindsay RS. Gestational diabetes: Causes and consequences. Br J Diabetes Vasc Dis 2009; 9: 27-31.
[http://dx.doi.org/10.1177/1474651408101644]

[8] Herring SJ, Oken E. Obesity and diabetes in mothers and their children: Can we stop the intergenerational cycle? Curr Diab Rep 2011; 11(1): 20-7.
[http://dx.doi.org/10.1007/s11892-010-0156-9] [PMID: 20963519]

[9] Kim SY, England JL, Sharma JA, Njoroge T. Gestational diabetes mellitus and risk of childhood overweight and obesity in offspring: A systematic review. Exp Diabetes Res 2011; 2011: 541308.
[http://dx.doi.org/10.1155/2011/541308] [PMID: 21960991]

[10] Xiong X, Saunders LD, Wang FL, Demianczuk NN. Gestational diabetes mellitus: Prevalence, risk factors, maternal and infant outcomes. Int J Gynaecol Obstet 2001; 75(3): 221-8.
[http://dx.doi.org/10.1016/S0020-7292(01)00496-9] [PMID: 11728481]

[11] Bian X, Gao P, Xiong X, Xu H, Qian M, Liu S. Risk factors for development of diabetes mellitus in women with a history of gestational diabetes mellitus. Chin Med J (Engl) 2000; 113(8): 759-62.
[PMID: 11776065]

[12] Rajput R, Yadav Y, Nanda S, Rajput M. Prevalence of gestational diabetes mellitus & associated risk factors at a tertiary care hospital in Haryana. Indian J Med Res 2013; 137(4): 728-33.
[PMID: 23703340]

[13] American Diabetes Association Gestational Diabetes Mellitus (Position Statement), Diabetes Care. 2004; 27.(Suppl 1) : s5-s10

[14] Mamabolo RL, Alberts M, Levitt NS, Delemarre-van de Waal HA, Steyn NP. Prevalence of gestational diabetes mellitus and the effect of weight on measures of insulin secretion and insulin resistance in third-trimester pregnant rural women residing in the Central Region of Limpopo Province, South Africa. Diabet Med 2007; 24(3): 233-9.
[http://dx.doi.org/10.1111/j.1464-5491.2006.02073.x] [PMID: 17263763]

[15] Challis K, Melo A, Bugalho A, Jeppsson JO, Bergström S. Gestational diabetes mellitus and fetal death in Mozambique: An incident case-referent study. Acta Obstet Gynecol Scand 2002; 81(6): 560-3.
[http://dx.doi.org/10.1034/j.1600-0412.2002.810615.x] [PMID: 12047312]

[16] Agarwal MM. Gestational diabetes mellitus: An update on the current international diagnostic criteria. World J Diabetes 2015; 6(6): 782-91.
[http://dx.doi.org/10.4239/wjd.v6.i6.782] [PMID: 26131321]

[17] Rani PR, Begum J. Screening and diagnosis of gestational diabetes mellitus, where do we stand. J Clin Diagn Res 2016; 10(4): QE01-4.
[http://dx.doi.org/10.7860/JCDR/2016/17588.7689] [PMID: 27190902]

[18] Swai AB, Kitange HM, McLarty DG, *et al.* No deterioration of oral glucose tolerance during pregnancy in rural Tanzania. Diabet Med 1991; 8(3): 254-7.
[http://dx.doi.org/10.1111/j.1464-5491.1991.tb01581.x] [PMID: 1828741]

[19] Basu JK, Jeketera CM, Basu D. Obesity and its outcomes among pregnant South African women. Int J Gynaecol Obstet 2010; 110(2): 101-4.
[http://dx.doi.org/10.1016/j.ijgo.2010.02.020] [PMID: 20417513]

[20] Rajput R, Yadav Y, Nanda S, Rajput M. Prevalence of gestational diabetes mellitus & associated risk factors at a tertiary care hospital in Haryana. Indian J Med Res 2013; 137(4): 728-33.
[PMID: 23703340]

[21] Al-Rowaily MA, Abolfotouh MA. Predictors of gestational diabetes mellitus in a high-parity community in Saudi Arabia. East Mediterr Health J 2010; 16(6): 636-41.
[PMID: 20799591]

[22] Tabák AG, Tamás G, Péterfalvi A, *et al.* The effect of paternal and maternal history of diabetes mellitus on the development of gestational diabetes mellitus. J Endocrinol Invest 2009; 32(7): 606-10.
[http://dx.doi.org/10.1007/BF03346517] [PMID: 19498321]

[23] Mwanri AW, Kinabo J, Ramaiya K, Feskens EJ. Gestational diabetes mellitus in sub-Saharan Africa: Systematic review and metaregression on prevalence and risk factors. Trop Med Int Health 2015; 20(8): 983-1002.
[http://dx.doi.org/10.1111/tmi.12521] [PMID: 25877657]

[24] Ranchod HA, Vaughan JE, Jarvis P. Incidence of gestational diabetes at Northdale Hospital, Pietermaritzburg. S Afr Med J 1991; 80(1): 14-6. [PMID: 2063235]