JOGECA 2014; 26(1): 10-14

Screening strategies for gestational diabetes mellitus at the Aga Khan University Hospital, Nairobi: A cross sectional study

Muriithi FG[1], Sequeira E[2], Kunyiha N[3], Stones W[4]

[1]Department of Obstetrics and Gynaecology, University of Oxford, UK
[2]Department of Obstetrics and Gynaecology, Aga Khan University Hospital, Nairobi, Kenya
[3]Department of Medicine (Diabetes, Endocrinology & Metabolism), Aga Khan University Hospital, Nairobi, Kenya
[4]Ann Gloag Chair of Global Health Implementation, School of Medicine, University of St Andrews, UK

Correspondence to: Dr. F.G. Muriithi, Level 3, The Womens' Centre, John Radcliffe Hospital, Headington, Oxford OX3 9DU. Email: francis.muriithi@obs-gyn.ox.ac.uk, fragithae@gmail.com

Abstract

Background: Universal screening strategy for gestational diabetes mellitus offers biochemical screening to all women irrespective of risk factor status while selective strategy screens only those with risk factors. The Aga Khan University Hospital adopted a selective screening protocol by consensus. This study compares both strategies and the prevalence of risk factors for gestational diabetes.
Objectives: To compare screening strategies for gestational diabetes mellitus and determine the risk factors associated with gestational diabetes mellitus at The Aga Khan University Hospital, Nairobi.
Methods: A cross-sectional study of 185 participants recruited at ≤ 28 weeks of pregnancy at Aga Khan University Hospital, Nairobi. All had risk factor assessment, a two-step screening with 50 g 1 hour glucose challenge test then a 2 hour 75 g OGTT for those with abnormal 50g 1 hour challenge test.
Results: Prevalence of an abnormal screening test in a group with risk factors was 12.0% (95% CI: 6.0% to 17.9%) and in the group without risk factors it was 19.1% (95% CI: 9.5% to 28.7%). GDM prevalence was 1.08% and impaired glucose tolerance 8.65%. Obesity was the commonest risk factor (35.7% with BMI > 30). The data suggests negative correlations though not statistically significant for fasting glucose levels (Pearson correlation coefficient, r = -0.06, p-value = 0.42) and one hour post glucose load (Pearson correlation coefficient, r = -0.11, p-value = 0.58) with BMI. A positive correlation between BMI and blood glucose levels at 2 hours was also not statistically significant (Pearson correlation coefficient, r = 0.07, p-value = 0.36).
Conclusion: There was no evidence of a difference between the screening strategies. Obesity was the commonest risk factor in the screened population. There was no significant positive correlation of BMI to measured fasting, 1hr and 2hour glucose levels. This defies known expectations and may be a subject for future research.

Keywords: Gestational diabetes mellitus, Universal, Selective, Screening, Obesity.

Introduction

Gestational Diabetes Mellitus (GDM) is carbohydrate intolerance resulting in hyperglycaemia of variable severity with onset or first recognition during pregnancy (1). Approximately 7% of all pregnancies are complicated by GDM. The prevalence may range from 1 to 14% of all pregnancies, depending on the population studied, its clinical characteristics and the diagnostic tests employed (2). The reported prevalence of gestational diabetes in Africa ranges between 0 in Tanzania, 9.2% in Ethiopia and 8.8% in South Africa (3). A population based study to estimate the prevalence of glucose intolerance and associated risk factors in rural and urban populations of different ethnic groups in Kenya reported a nationwide prevalence of diabetes of 4.2% and of impaired glucose tolerance of 12.0% (4).

Hyperglycaemia in pregnancy is associated with a higher incidence of adverse maternal and fetal outcomes than is seen in normal pregnancy. These include morbidity and mortality during pregnancy and childbirth but also long term sequelae of developing obesity and type 2 diabetes mellitus for both mother and baby. Within 10 years of developing GDM, half of the women develop type II diabetes mellitus (5,6). Therefore, the diagnosis of GDM offers a unique opportunity to identify individuals who will benefit from early preventive and therapeutic interventions after pregnancy such as diet and exercise so as to normalize their weight to delay or even possibly prevent the onset of diabetes. Those identified as at risk for future diabetes can be educated regarding regular future screening for early detection in subsequent pregnancies or in screening for type 2 diabetes mellitus.

Screening for impaired glucose tolerance in pregnancy is an important first step in bringing at risk individuals into a position to benefit from lifestyle and therapeutic interventions. However, the best screening

strategy is not universally agreed upon. The variation in guidelines and recommendations is largely due to a lack of consensus on a clear benefit of one screening strategy over the other and variation in risk factors among different populations (7). Currently, National Institute for Health and Care Excellence (NICE) guidance in the UK advice a selective screening strategy and a single step 75gOGTT, American College of Obstetricians and Gynaecologists (ACOG) advices on a selective approach with a 2 step glucose tolerance test while the Royal Australian College of Obstetricians and Gynaecologists (RANZCOG) advice universal single step 75g OGTT(8-10).

The main strategies for screening in pregnancy are 'universal' where all pregnant women undergo a biochemical screening test for GDM, and a 'selective' approach where only those women considered to be at high risk are screened (11,12). The different biochemical screening tests used include urinalysis for glycosuria, a random blood glucose estimation, fasting blood glucose estimation, and oral glucose tolerance tests (12). The 2010 Cochrane systematic review included findings from four trials involving 3972 women and recommended further research to determine the most appropriate screening strategy for GDM (6). Limited published data are available with regard to GDM screening in African populations although the regional context is one of a substantial increase in diabetes in general, probably as a result of changing diet and lifestyles in emerging economically secure urban communities.

This study aimed to compare selective and universal screening approaches for gestational diabetes mellitus in an antenatal population receiving antenatal care at the Aga Khan University Hospital, Nairobi.

Materials and Methods

A cross-sectional study of 185 participants recruited at ≤ 28 weeks of pregnancy at Aga Khan University Hospital, Nairobi. All had risk factor assessment by memory recall and review of past medical records where available, a two-step screening with 50 g 1 hour glucose challenge test then a 2 hour 75g OGTT for those with abnormal 50g 1 hour challenge test.

The study was conducted in 2012 at The Aga Khan University Hospital, Nairobi's antenatal clinic. At the time of the study, the clinic utilised a selective screening strategy the entry point being two or more risk factors for gestational diabetes.

Study participants were enrolled at or before 28 weeks of pregnancy. Risk factor determination was carried out at booking by patient report and a review of clinical records where available. Women whose pregnancy had progressed beyond 28 weeks, and those with chronic illnesses or medication that could alter glucose metabolism and those with diabetes mellitus were excluded from the study.

Sample size estimation was guided by a previous study in Limpopo province of South Africa where the combined prevalence of Gestational Impaired Glucose Tolerance (GIGT) and Gestational Diabetes Mellitus (GDM) was 8.8% (7.3% GIGT; 1.5% GDM) (3). The prevalence of gestational diabetes in the low risk populations is estimated at between 0.1 and 2.8% (3). Based on this, a sample size of 185 was calculated with a 90% power to detect 14% prevalence at 5% significance level.

All data were analysed using Statistical Package for Social Sciences (SPSS 12) for Windows. Data analysis involved use of the precoded data and descriptive statistics like cross tabulation, frequency ranges and mean. Chi-squared test was used for proportions and p-value for significance. Pearson correlation coefficient for risk factor analysis.

The research protocol was approved by the Aga Khan University Research Ethics Committee before the study began. All the recruited participants had their written consent to participate sought then their risk factors for gestational diabetes were assessed using a checklist (Table 2). They were then grouped into those with and without risk factors.

Both groups underwent screening with a non-fasting 50g oral glucose load, the O'Sullivan test. It was offered at between 24 and 28 weeks for mothers booked as being at risk. A cut off of 7.8mmol/l glucose reading at 1hr was used. Those below the cut off required no further screening while those above the cut off were offered a 2 hour 75g OGTT as per the hospital's screening protocol. The OGTT was performed after a 10 to 12 hour fast and unrestricted carbohydrate diet in the preceding 3 days. Women were advised not to exercise or smoke during the test. The 75g glucose solution was taken in less than five minutes and plasma glucose measurements taken hourly for 2 hours.

International Association of Diabetes and pregnancy Study Group (IADPSG) cut offs were adopted for interpretation as follows; fasting: 5.1mmol/l, 1hour: 10.0mmol/l and 2 hour: 8.5mmol/l. One or more of these values from a 75g OGTT must be equalled or exceeded for the diagnosis of GDM. Those with results indicative of gestational diabetes or impaired glucose tolerance were referred for follow up at a combined physician-obstetrician and dietician clinic. Those with normal screening and diagnostic tests were followed up in the antenatal clinic in accordance with routine hospital practice.

Results

Two hundred and thirty eight qualifying participants were invited to participate in the study. Two hundred and seven (87%) participants consented and were enrolled into the study. Ten (4.8%) participants withdrew their consent to participate and 12 (5.8%) participants did not attend scheduled visits. Complete data on 185 (89.4%) consecutive participants were analysed. The characteristics of the participants are summarised in Table 1.

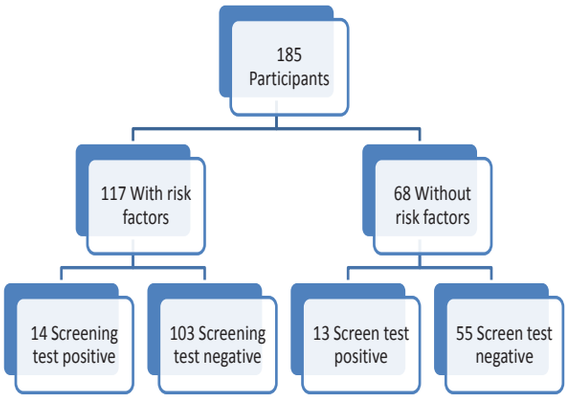
Table 1: Characteristics of the participants

Characteristic	Variable	(%) (n=185)
Age (years)	<35	85.4
	>35	14.6
BMI	<30	64.3
	≥30	35.7
First degree relative with diabetes	Father	25.4
	Mother	14.1
	Brother	1.1
	Sister	0.0
	None	59.5
Gravidity	1	51.4
	2	30.8
	3	10.8
	4	6.5
	5	0.5

A total of 117 (63.2%) study participants reported at least one risk factor and 68 (36.7%) had no risk factors. Fourteen out of 117 women with and 13 out of 68 women without risk factors screened positive. Prevalence in the 'risk factor present' group was 12.0% (95% CI: 6.0% to 17.9%) and prevalence in the 'no risk factor' group was 19.1% (95% CI: 9.5% to 28.7%). Combined group prevalence was 14.6%.

Figure 1 illustrates the participants flow and results. Overall, twenty seven participants (14.6% of all recruited) had an abnormal 50g OGTT. These 27 participants underwent further testing with the confirmatory 75g oral glucose tolerance test. Ten (5.4% of all recruited) had a normal result, two (1.08% of all recruited) met criteria for gestational diabetes mellitus and 16 (8.65% of all recruited) met criteria for impaired glucose tolerance.

Figure 1: Screening chart



Prevalence (No risk factor group): 19.1% (95% CI: 9.5 to 28.7)
Prevalence (Risk factor group): 12.0% (95% CI: 6.0 to 17.9)

Prevalence of risk factors is summarised in Table 2. High Body Mass Index (BMI) was the most common known associated risk factor found in this population with 119 (64.3%) having a BMI in the obese category. The data suggests negative correlations though not statistically significant for fasting glucose levels (Pearson correlation coefficient, r = -0.06, p-value = 0.42) and one hour post glucose load (Pearson correlation coefficient, r = -0.11, p-value = 0.58) with BMI.

Table 2: Prevalence of risk factors

Risk factor	Prevalence (%)	95% CI
Polycystic ovarian syndrome	4.3	1.3 to 7.2
Previous gestational diabetes	0.5	0.0 to 1.6
Previous baby with weight >4kg	5.4	2.1 to 8.6
Previous unexplained fetal death	4.9	1.7 to 8.0
Previous fetal anomalies	0.5	0.0 to 1.6
Diabetes in one or several first-degree relatives	35.1	28.1 to 42.1
BMI > 30	35.7	28.8 to 42.6
Overall prevalence of risk factors (at least 1 risk factor)	63.2	56.2 to 70.1

Figure 2: Fasting Blood Sugar (mmol/dl)

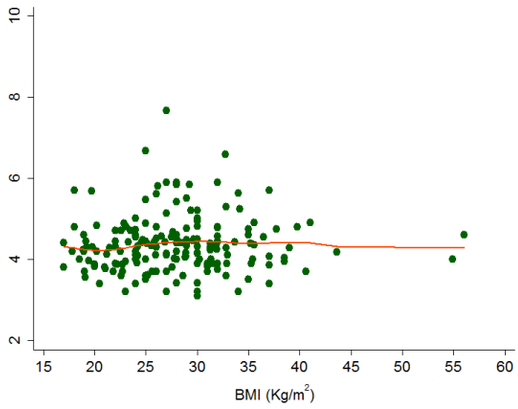


Figure 3: Blood glucose levels (mmol/dl) one hour post load

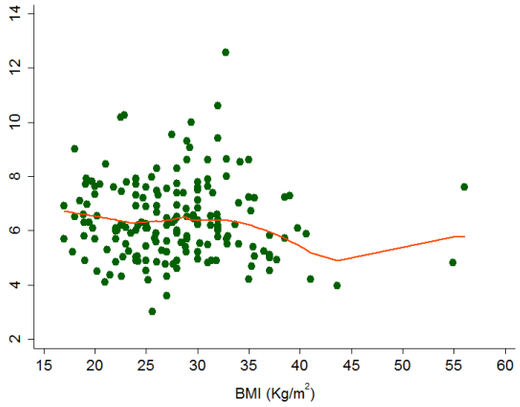
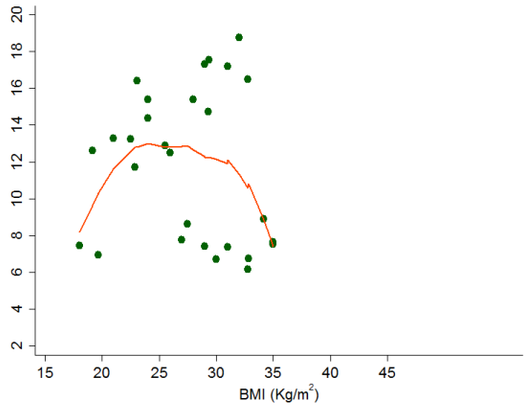


Figure 4: Blood glucose levels (mmol/dl) two hours post load



A positive correlation between BMI and blood glucose levels at 2 hours was also not statistically significant (Pearson correlation coefficient, r = 0.07, p-value = 0.36).

Discussion

In this study, the prevalence of Gestational Impaired Glucose Tolerance (GIGT) and Gestational Diabetes Mellitus (GDM) was 9.7%; 8.7% Gestational Impaired Glucose Tolerance (GIGT); 1.1% (GDM). These findings are consistent with other African studies (3,4). Universal and selective screening strategies for the detection of GDM were evaluated.

It was observed that 36.8% of all participants did not have any risk factors for GDM and hence would not have been offered screening with the selective screening strategy. This would have meant that 13 of the 27 participants (48.1%) who eventually screened positive for diabetes would have otherwise been missed if only participants with risk factors had been screened. This phenomenon has been noted by other working groups on screening and diagnosis of gestational diabetes mellitus. The most recent is the Australian working group that showed up to 25% of cases in their set up may be missed via a selective 2 step process (10).

The actual clinical endpoints to determine the clinical impact of missed screening was not addressed in this study. These include neonatal data and outcomes of babies in each arm of the study.

The overlap in the 95% confidence interval implies that there is no evidence of a difference in prevalence among these two groups. The study findings indicate that at the lower bound of confidence interval, at least 9.5% of women with no risk factors will be given a diagnosis of impaired glucose tolerance or actual gestational diabetes. This may be of clinical significance as the Hyperglycaemia and Adverse Pregnancy Outcomes (HAPO) study reported that even transient hyperglycaemia may have adverse effects on the fetus and neonate. This and other studies have led to the formulation of current World Health Organisation (WHO) guidelines that take the position of universal screening using the one-step 75-g OGTT. The stance WHO takes is based on increasing patient compliance with decreasing cost of health care. They argue that by using the two-step process, many patients will not undergo complete testing due to a multitude of barriers to care (13,14). Our findings together with the WHO guidelines provide a basis for a policy that all women without pre-gestational diabetes mellitus at 24–28 weeks of pregnancy must be tested for GDM that is, by universal screening.

From this study, family history of diabetes mellitus, previous birth weight > 4kg, IUFD and BMI were the most prevalent and may be relevant in selective screening models. While the rest are historical and non modifiable, Body Mass Index (BMI) is the most prevalent modifiable risk factor through diet and exercise.

Of all participants, 126 (68.1%) had BMI > 24.9 and would be classified as being at risk of glucose intolerance. If BMI was to be a standalone risk factor, one would expect about two thirds of all participants to have at least glucose intolerance. Higher maternal BMI, independent of maternal glycaemia, is strongly associated with increased frequency of pregnancy complications, in particular those related to excess fetal growth and adiposity and to pre-eclampsia. The combination of GDM and obesity shows a greater risk of adverse pregnancy outcomes than either GDM or obesity alone (15,16). High BMI is a risk factor for GDM and GDM is a risk factor for a high BMI.

BMI is a modifiable risk factor by dietary and lifestyle initiatives (14).

Changing the method of GDM screening, for another of greater detection, can be expected to influence the global frequency of related perinatal complications (due to the present detection of GDM in cases that would have escaped diagnosis with the prior less sensitive screening method). Universal screening for gestational diabetes would lead to a greater public awareness of GDM and of its recommended treatment. The pearsons correlation for BMI and glucose levels was not statistically significant. We recommend future studies powered to assess this observation.

Conclusion

There was no evidence of a difference between the screening strategies. Obesity was the most common known associated risk factor in the screened population. There was no significant positive correlation of BMI to measured fasting, 1hour and 2hour glucose levels. This defies known expectations and may be a subject for future research.

Acknowledgements

This work was undertaken in part fulfilment of the requirements for the degree of MMed (Obstetrics & Gynaecology) at the Aga Khan University, Nairobi and was funded by the University.

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