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Prediction of Gestational Diabetes Mellitus in Early Pregnancy: Is Abdominal Skin Fold Thickness 20 mm or More an Independent Risk Predictor?

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Abstract

Background: Gestational Diabetes Mellitus (GDM) is associated with several maternal and perinatal complications. Early detection and treatment can improve pregnancy outcomes. Objectives: To determine the prevalence, risk factors and predictors of GDM in early pregnancy at the University of Port Harcourt Teaching Hospital, (UPTH), Port Harcourt Nigeria. Methods: A cohort of 235 mothers who registered for antenatal care between 15 - 18 weeks of gestation at UPTH was prospectively studied. Their socio-demographic data, examination findings, anthropometric measurements, fasting blood sugar at booking and OGTT results at 28 weeks gestation were collated and entered into PC with SPSS for windows version 21.0 which was also used for the analysis. Variables were expressed as absolute numbers, percentages or means with standard deviations and significant differences determined using chi square test or the student "t" test as appropriate. The level of significance was set at $P < 0.05$. Results: Of the 235 participants, 35 (14.9%) developed GDM. Women who had GDM were significantly older ($P = 0.001$), had higher weight ($t = 2.95$, $P = 0.01$), BMI ($t = 2.29$, $P = 0.02$), abdominal skin fold thickness ($t = 4.15$, $P = 0.001$), blood pressure ($t = 3.38$, $P = 0.001$) compared to women who did not. Previous history of GDM was significantly different between two groups as $\chi^2 = 93.56$ and $P = 0.001$. Abdominal skin fold thickness and prior GDM history were found to be independent predictors of GDM on application of multiple logistic regression analysis. Conclusion: The prevalence of GDM in Port Harcourt is 14.9% and major risk factors are obesity, previous GDM history, advanced age and hypertension. Abdominal skin fold thickness ≥ 20 mm is an independent predictor. The risk of developing GDM can be

predicted in early second trimester using algorithm incorporating risk factor screening and anterior abdominal wall skin fold thickness estimation.

Keywords

Gestational Diabetes Mellitus, Risk Factors, Detection, Early Pregnancy, Port Harcourt

1. Introduction

Gestational Diabetes Mellitus (GDM) has been defined as glucose intolerance of variable severity with onset or first recognition during pregnancy [1]. Pregnancy complicated by untreated or poorly treated diabetes is associated with high maternal and peri-natal mortality and several other complications including glucose intolerance and diabetes later in life for both mother and offspring [2] [3]. Early detection and treatment remarkably improves pregnancy outcomes.

The prevalence of GDM ranges from 1% to 14% [4], depending on the population studied and the screening strategies and diagnostic criteria used [5]. The prevalence in the united kingdom, united states, and among European countries was estimated to be 5%, 3% - 7% and 2% - 6% respectively [6] [7] [8]. Approximately, 135,000 cases of GDM are diagnosed annually in the USA and the prevalence in low risk population ranges from 1.4% to 2.8% while in high risk population, the prevalence is 3.3% [9].

In Nigeria, the prevalence of diabetes mellitus in pregnancy varies but is generally <3/1000 deliveries [10]. Various workers have reported 0.74 per 1000 deliveries, 1.7 and 98 per 1000 pregnancies [11] [12]. Previous studies in Port Harcourt reported GDM prevalence of 0.3% and 2% [13] [14].

Higher prevalence of GDM has been reported in African, Asian, Indian and Hispanic women [15] [16] [17]. Other documented risk factors are advanced maternal age, high parity, obesity, polycystic ovarian syndrome (PCOS), multiple pregnancy, family history of diabetes, history of congenital malformation, still birth, macrosomia and previous GDM [18].

Obesity, one of the major risk factors for GDM can be assessed by measuring the absolute weight, body mass index (BMI), waist circumference and or skin fold thickness.

Weight ≥ 90 kg in pregnancy is classified as obesity [19]. Overweight and obesity are also defined respectively as BMI 25.0 - 29.9 and ≥30 kg/m^2.

Waist circumference is the most practical tool used by clinicians to evaluate patient's abdominal fat, though Computed tomography [20] and magnetic resonance imaging are more accurate but are impracticable for routine clinical use.

Fat located in the abdominal region is associated with a greater health risk than peripheral fat. Abdominal fat appears to be an independent risk predictor when BMI is not markedly increased [21] [22]. The National Heart, Lung and Blood Institute (NHLBI) defined abdominal obesity as waist circumference,

greater than 40 inches (102 cm) in men, and waist circumference greater than 35 inches (88 cm) in women, preferably measured at the superior border of the iliac crest [23] [24] [25] [26] [27].

Obesity can also be assessed by estimating skin fold thickness at the biceps, triceps, sub-scapular region, anterior abdominal wall and supra iliac region, values of ≥20 mm are considered obese.

GDM poses a risk to mother and child. A large case control study found that GDM was linked to a limited group of birth defects (when compared with pre-existing diabetes) and that this association was generally limited to women with a high body mass index (BMI) > 25 kg/m^2 [28].

The hyperglycemia and adverse pregnancy outcome (HAPO) study showed that maternal hyperglycemia increased the risk of several outcomes; birth weights greater than the 90th percentile, primary cesarean delivery, premature delivery, shoulder dystocia or birth injury, clinical neonatal hypoglycemia, intensive neonatal care, hyper-bilirubinemia and pre eclampsia [11]. The HAPO study further highlighted the importance of maternal glycemia on offsprings' birth weights, demonstrating a linear relationship between maternal fasting plasma glucose and oral glucose tolerance test (OGTT) at 1 hour and 2 hours with birth weight ≥ 90th percentile. The result indicated that it would be beneficial to both mother and baby to identify the presence of maternal glucose intolerance early enough so that management can be commenced as soon as possible [29].

In early part of pregnancy, (*i.e.* first trimester and first half of second trimester) fasting and post-prandial glucose concentrations are normally lower than in normal non pregnant women [30]. This fact makes screening with blood glucose estimation in early pregnancy unreliable, necessitating the need for determining other methods of screening and predicting GDM in early pregnancy.

The International Association of Diabetes and Pregnancy Study Group (IADPSG) carefully analyzed the HAPO and other studies and recommended a one step, 75 g OGTT for all women not already known to be diabetic at 24 - 28 weeks gestation with the diagnosis of GDM made when FBS estimates is $\underline{\geq}$5.1 mmol/L, Blood sugar estimates 1hr post oral glucose ingestion $\underline{\geq}$ 10 mmol/L or Blood sugar estimation 2 hrs post oral glucose ingestion of $\underline{\geq}$8.5 mmol/L. Similar values have been accepted by the WHO though slightly modified as a range [31].

It has since been advocated that the future direction should focus on the early prediction and effective preventive measures before the development of GDM. This is so as to decrease the associated short and long term maternal and perinatal complications.

There is paucity of studies on determination of predictors of GDM in early pregnancy in our environment. There has also not been any prospective study in UPTH in recent times on gestational diabetes mellitus using the new WHO diagnostic criteria. This preliminary study was done to provide update on the prevalence, risk factors and predictors of GDM in early pregnancy in Port Harcourt, southern Nigeria.

2. Materials and Methods

The University of Port Harcourt Teaching Hospital (UPTH) is an 800 bed hospital located in Port Harcourt, the oil rich capital city of Rivers state, Southern Nigeria. It is a tertiary health institution that provides all levels of health care services for Rivers state and catchment states of the Niger delta Area.

The Obstetrics and Gynecology department of UPTH has 5 firms designated A-E each made up of consultants and rotating residents. It has an annual delivery rate of over 2500 babies. On the average between 50 - 100 patients book for antenatal care every week in the hospital and the antenatal clinics run every working day, with each day assigned to a particular firm.

At presentation, the patients are registered for antenatal care and are guided to choose a convenient day of the week (Monday-Friday), for subsequent visits.

The patients' sociodemographic data and medical history are carefully obtained and the blood pressure, weight and height measured and urinalysis performed. Routine antenatal investigations are also done. The results are recorded on a specially designed antenatal card which also has a section for documenting the summary of clinical examination. The patient is then evaluated by the doctor and thereafter given appointment for subsequent visit.

The hospital has a chemical pathology laboratory with modern equipment, including auto-analysers and various biochemistry investigations are carried out in the laboratory including glucose estimations.

Ethical clearance was given by Hospital's Ethics committee and informed consent obtained from individual patient.

This preliminary study was conducted between 1st April and 31st May 2015. The study sample consisted of 250 consecutive consenting women who were between 15 and 18 weeks of gestation at booking during the study period.

Those who did not give consent, have HIV infection, pre-gestational diabetes mellitus, multiple gestation and those who are acutely or chronically ill at booking as well as those with uncertain dates were excluded from the study.

A pro forma was designed to record participants' sociodemographic data, medical history, anthropometric measurements, clinical and laboratory characteristics including age, tribe, educational status, parity, LMP, EDD, gestational age, past obstetric history, family history, height, weight, BMI, abdominal circumference, skin fold thickness, urinalysis, fasting blood sugar at booking and OGTT results at 28 weeks of gestation amongst others.

Five research assistants who are resident doctors in the department and a dedicated laboratory scientist in the department of chemical pathology were recruited and trained for the study.

The research assistants recruited patients who met the inclusion criteria daily from the antenatal clinic and transferred the data in their antenatal cards to the proforma.

The participants were clinically examined. Their heights were measured in metres and weights in kilograms and body mass indices measured using the

formula: maternal weight (Kg)/height (M^2).

The maternal abdominal circumference at the level of the iliac crest was measured using a measuring tape graduated in centimetres. The anterior abdominal skin fold thickness was measured at the level of the umbilicus using the Harpenden skin fold calipers (validated to values ≤ 80 mm: holten Ltd, felin y gigfram, Cross well UK).The findings from the preliminary clinical assessment were entered into the pro forma as well.

The patients were asked to return at 7:00 am the following day after enrolment in a fasted state. The research assistants took 3 - 5 ml of venous blood from them and put in a fluoride oxalate containing anti-coagulant bottle and sent to the chemical pathology laboratory for fasting blood glucose estimation.

The participants were followed through the antenatal period and at 28 weeks of gestation they had oral glucose tolerance test.

They presented at 7:00 am on an appointed day in a fasted state. Blood specimens for fasting blood sugar were taken at 8:00 am. Following ingestion of 75 g of glucose in 250 ml of water, blood was collected from a peripheral vein at 1 hour and 2 hours and put in fluoride oxalate bottle for glucose estimation using glucose oxidase method and read spectrophotometrically by the dedicated laboratory scientist.

Diagnosis of gestational diabetes following the 75 g 2-hour oral glucose tolerance test was defined according to World Health Organization (WHO) criteria 2013; fasting blood glucose = 5.1 mmol/l or 1 hour glucose ≥ 10.0 mmol/l or 2 hour glucose = 8.5 mmol/l.

All results of investigations were further entered into the pro-forma.

Absolute weight ≥ 90 kg, BMI ≥ 30 kg/m^2, abdominal circumference ≥ 88 cm and skin fold thickness ≥ 20 mm are regarded as obesity.

The data were collated and entered into PC with SPSS for windows version 21.0 software which was also used for the analysis. Categorical variables were expressed as absolute numbers and percentages and significant differences were determined using the chi square test while continuous variables were presented as means with standard deviations and significant differences were determined with the student "*t*" test. The level of significance was set at $P < 0.05$. Associations were expressed as relative risk (RR) and 95% confidence interval. A scatter plot was used to determine the most appropriate correlation test for the regression model which aided in determining the relationship between the risk factors and GDM. This chosen regression model further aided in determining the percentage contribution of each risk factor to the development of GDM. The Receiver Operating Curve was used to determine the influence of each risk factor on predicting GDM.

3. Results

Of the 250 pregnant women recruited, 235 eventually completed the study while 15 of them were lost to follow up, giving an attrition rate of 6%.

Of the 235 mothers who participated, 35 (14.9%) were diagnosed with GDM, all of whom were obese, while the remaining 200 participants did not have GDM.

The socio-demographic characteristics of women who had GDM compared with those who did not are shown in Table 1. In general, women with GDM were older (t = 34.18, P = 0.001) and more often multiparous (t = 30.39, P = 0.01), compared to women who did not have. However, majority (57%) of the women who had GDM had tertiary education. This was statistically significant as t = 5.59, P = 0.02.

Table 2 shows the comparison of some clinical predictors with OGTT results.

Table 1. Sociodemographic characteristics of participants with and without GDM.

Maternal characteristics	Number and percentage of patients with GDM (N = 35)	Number and percentage of patients without GDM (N = 200)	$t^{\#}$ or χ^2	P value
Age (years)				
18 - 25	2 (5.7%)	37 (18.5%)	3.52	0.07
26 - 30	5 (14.3%)	60 (30%)	3.68	0.06
31 - 40	12 (34.3%)	86 (43%)	0.93	0.78
35+	16 (45.7%)	17 (8.5%)	34.18*	0.001
Occupation				
Civil servant	16 (45.7%)	64 (32.0%)	2.50	0.11
Trader	11 (31.4%)	56 (28.0%)	0.17	0.75
House wife	4 (11.4%)	52 (26.0%)	3.48	0.08
Students	1 (2.9%)	18 (9.0%)	1.51	0.20
Artisan	3 (8.6)	10 (5.0%)	0.73	0.65
Educational status				
No formal education	7 (20.0%)	62 (31.0%)	1.74	0.73
Primary	2 (5.6%)	20 (10.0%)	0.65	0.55
Secondary	6 (17.4%)	46 (23.0%)	0.59	0.53
Tertiary	20 (57.0%)	72 (36.0%)	5.59*	0.02
Ethnic group				
Ikwerre	10 (28.6%)	65 (33.0%)	0.21	0.21
Ogoni	7 (20.0%)	33 (17.0%)	0.27	0.22
Ijaw	2 (5.7%)	18 (9.0%)	0.41	0.29
Others	16 (45.7%)	84 (42.0%)	0.65	0.61
Parity				
0	9 (26.0%)	81 (40.5%)	1.00	0.65
1	13 (37.0%)	107 (53.5%)	3.19	0.08
2 or more	13 (37.0%)	12 (6%)	30.39*	0.001

[$]Data shown as mean and standard error of the mean, or n (%). */[#]Comparisons are differences in the mean or n.

Table 2. Comparison of some clinical predictors by OGTT test result (WHO 2013).

Maternal characteristics	Number and percentage of patients with GDM (N = 35)	Number and percentage of patients without GDM (N = 200)	$t^{\$}$ or χ^2	*P* value
Height (m)	1.65 ± 0.05	1.65 ± 0.04		
Weight (kg)	95.56 ± 0.12	97.24 ± 0.20	2.95#	0.01
BMI (kg/m^2)	35.34 ± 0.11	36.14 ± 0.01	2.29#	0.02
Waist circumference (cm)	108.00 ± 1.30	107.80 ± 1.40	0.12	0.32
Abdominal skinfold (mm)	38.20 ± 1.10	32.30 ± 0.91	4.15#	0.001
SBP (mmHg)	124.10 ± 2.10	119.00 ± 0.19	3.38#	0.001
DBP (mmHg)	76.20 ± 0.99	71.50 ± 0.90	3.43#	0.001
Previous GDM	20/35 (57.1%)	5/200 (2.5%)	93.56*	<0.001
Previous history of congenital anomaly	1 (2.9%)	8 (4%)	0.11	0.25
Maternal weight ≥ 90 kg	17 (48.6%)	15 (7.5%)	42.72*	<0.001
Heavy glycosuria	1 (2.9%)	3 (1.5%)	0.33	0.35
Previous macrosomic baby	5 (14.3%)	22 (11%)	0.33	0.36

[$]data shown as mean and standard error of the mean, or n (%); */#comparisons are differences in the mean or n.

Women who developed GDM had significantly higher weight (t = 2.95, P = 0.01), BMI value (t = 2.29, P = 0.02), abdominal skin fold thickness (t = 4.15, P = 0.001), systolic blood pressure (t = 3.38, P = 0.001), diastolic blood pressure (t = 3.43, P = 0.001) compared to women who did not have GDM.

Of the 35 participants who developed GDM, 20 (57%) had previous history of GDM, while 5 (2.5%) who did not develop GDM, had a previous history of GDM. History of previous GDM was significantly different between two groups as χ^2 = 93.56 and P = 0.001. There was significant difference in maternal weight greater than or equal to 90 kg between both groups (χ^2 = 42.72, P = 0.001). No significant difference was found for height, waist circumference (t = 0.12, P = 0.32), previous history of congenital anomaly (χ^2 = 0.11, P = 0.25), heavy glycosuria (χ^2 = 0.33, P = 0.35) and previous macrosomic baby (χ^2 = 0.33, P = 0.36).

Statistical evaluation of association of the risk factors with GDM showed significant value for previous history of GDM (RR = 11.20, 95% CI: (0.05 - 0.15), P = 0.000) and abdominal skin fold thickness greater than 20 mm (RR = 7.50, 95% CI: (4.97 - 16.17), P = 0.00), as illustrated in Table 3. However, association between GDM and history of DM in first degree relative (RR = 1.03, 95% CI: (0.37 - 2.51)), unexplained still birth (RR = 0.67, 95% CI: (0.49 - 4.59)), recurrent pregnancy losses (RR = 0.48, 95% CI: (0.52 - 8.06)), previous history of congenital anomaly (RR = 0.47, 95% CI: (0.21 - 8.82)), glycosuria (RR = 1.70, 95% CI: (0.11 - 3.31)), previous macrosomic baby (RR = 1.3, 95% CI: (0.33 - 1.84)) were not significant.

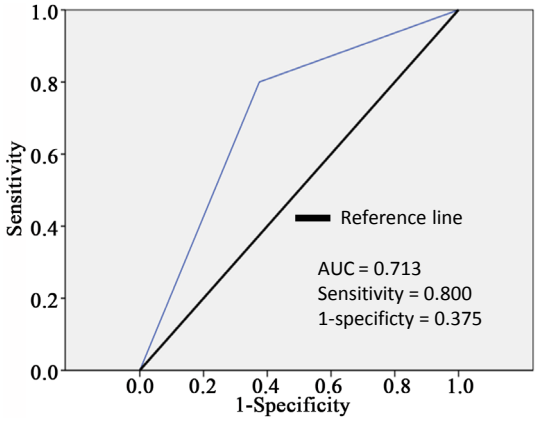
Table 3. Relationship between each risk factor and GDM.

Risk	N (%)		RR	95% CI (Lower-upper)	*P* value
	GDM	No GDM			
History of DM in first degree relative					
YES	4 (11.4)	22 (11.0)	1.03	0.37 - 2.51	0.57
NO	31 (88.6)	178 (89.0)			
Unexplained still birth					
YES	3 (8.6)	26 (13.0)	0.67	0.49 - 4.59	0.34
NO	32 (91.4)	174 (87.0)			
Recurrent pregnancy losses					
YES	2 (5.7)	24 (12.0)	0.48	0.52 - 8.06	0.22
NO	33 (94.3)	176 (88.0)			
Previous history of congenital anomaly					
YES	1 (2.9)	8 (4.0)	0.47	0.21 - 8.82	0.60
NO	34 (97.1)	192 (96.0)			
Heavy glycosuria					
YES	1 (2.9)	3 (1.5)	1.70	0.11 - 3.31	0.48
NO	34 (97.1)	197 (98.5)			
Previous macrosomic baby					
YES	5 (14.3)	22 (11.0)	1.30	0.33 - 1.84	0.37
NO	30 (85.7)	178 (89.0)			
Previous history of GDM					
YES	20 (57.1)	5 (2.5)	11.20	0.05 - 0.15	0.000
NO	15 (42.9)	195 (97.5)			
Abdominal skin fold > 20 mm					
YES	14 (40.0)	10 (5.0)	7.50	4.97 - 16.17	0.000
NO	16 (45.7)	190 (95.0)			

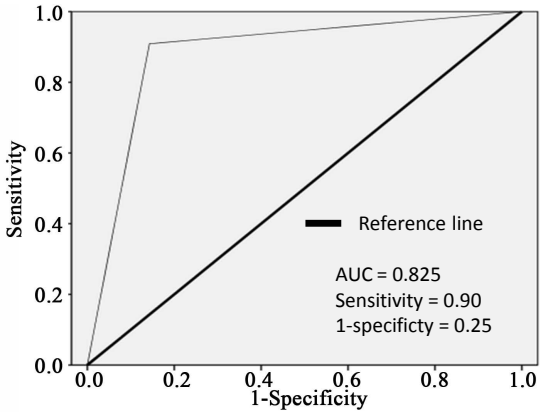
N = Number of participants; RR = Relative risk; CI = Confidence interval.

On application of multiple logistic regression analysis to the significant risk factors associated with GDM, a previous history of GDM and abdominal skin fold thickness were found to be independent predictors of GDM. Maternal weight ≥ 90 kg was marginally significant as shown in Table 4.

The receiver-operating curve (ROC) analysis showed increase in the area under the curve (AUC) when abdominal skin fold was included to the prediction model of GDM (Figure 1(a)). Thus addition of the criterion "abdominal skin fold" to the prediction model increase AUC above the values achieved with clinical measures or other risk factors alone. This model showed an increase of the AUC from 0.713 (for BMI, SBP, DBP, previous history of DM, abdominal skin fold, maternal weight greater than or equal to 90 kg) (Figure 1(a)) to 0.883 when



(a)



(b)

Figure 1. Receiver-operating curve and summaries using the model with the variables (previous history of DM, maternal weight greater than or equal to 90 kg). AUC = area under the receiver-operating curve.

Table 4. Multivariate logistic regression of independent predictors of GDM.

Risk	OR	95% CI (Lower-upper)	*P* value
Previous history of GDM			
YES	0.02	0.01 - 0.06	0.000
NO			
Abdominal skin fold > 20 mm			
YES	21.71	8.33 - 56.63	0.000
NO			
BMI > 30 kg/m^2			
YES	0.59	0.24 - 1.50	0.19
NO			
Maternal weight ≥ 90 kg			
YES	0.40	0.16 - 0.98	0.045
NO			
SBP (mmHg)	1.05	0.86 - 1.26	1.06
DBP (mmHg)	1.10	0.99 - 1.45	1.23

OR = Odds ratio; BMI = Body mass index.

combined with abdominal skin fold (**Figure 1(b)**). Importantly, the exclusion of BMI, systolic blood pressure and diastolic blood pressure did not significantly change the AUC.

4. Discussion

The prevalence of gestational diabetes in this study is 14.9% using the WHO 2013/Modified IADPSG criteria [31]. This prevalence is slightly higher than the quoted range of 1% - 14% [4] and is over 7 times higher than the previously reported prevalence rate in Port-Harcourt [13]. Israel and co-workers had found that, of the 2% who developed GDM in their study, all were obese while none from the non-obese group became diabetic [13]. This significant association of GDM and obesity was also demonstrated in this study as all the participants who developed GDM were obese. This finding is well established and has been demonstrated by several authors [32]. This higher prevalence may be attributed to the new diagnostic values for GDM following the outcome of the HAPO study from which the IADPSG criteria was derived and further modified by WHO in 2013 [31]. In times past various countries and institutions had used varied criteria in making a diagnosis of GDM and this gave varied results. Previously WHO had diagnosed GDM at plasma fasting Glucose of 7 mmols/l and above or 2hr value of ≥7.8 mmol/l after a 75 g OGTT, but currently following the outcome of the HAPO study attempts have been made at harmonizing the different diagnostic criteria. WHO has adopted the IADPSG criteria though with slight modifications; Fasting blood glucose of ≥5.1 mmol/l, 1 hr post 75 g OGTT of ≥10 mmol/l or 2 hrs value of ≥8.5 mmols/l. values greater than this are considered as frank diabetes mellitus in pregnancy. The current diagnostic values are quite low compared to previous values and may be responsible for the increased prevalence of GDM. This increase in prevalence rate may also be attributable to the rising trends in obesity worldwide [24]; including in Port Harcourt, the capital city of oil rich Rivers sate of Nigeria.

The finding from this study on early 2nd trimester screening for GDM show that well recognized maternal risk factors can be combined into a model in which each risk factor is attributed its appropriate weight and the performance of screening is improved by combining maternal risk factors with abdominal wall obesity estimation. The study confirmed that risk factors for the development of GDM include increased maternal age, Parity, weight and BMI as reported by other researchers [33].

Following multiple regression analysis, only a previous history of GDM and increased abdominal skin fold thickness of ≥20 mm were found to be independent predictors of GDM. Cheung et al in their study had also reported a previous history of GDM as the strongest predictor of GDM [34].

On further application of regression analysis to develop a prediction model, the area under the receiver-operating curve was 0.713 for maternal risk factors alone which showed a significant change when anterior abdominal skin fold

thickness of ≥20 mm was added to it. This resulted in an improved prediction at 0.825. The exclusion of BMI, Systolic blood pressure and diastolic blood pressure did not significantly change the area under the curve (AUC).

The UK Pregnancies Better Eating and Activities Trials (UPBEAT) study, suggested a limited potential role for taking detailed maternal anthropometry as an aid to gestational diabetes prediction [35]. The UPBEAT trial had assessed; Skin-fold thickness at the biceps, triceps, sub-scapular and supra-iliac region [35] but failed to also examine the abdominal skin fold thickness.

In this study, the combination of maternal risk factors alone resulted in a sensitivity of 80% and specificity of 37% for predicting GDM using the AUC. This has shown an improvement of the predictive value of risk factor screening alone when compared with previous studies such as the Health assessment report which showed low sensitivity of 50% - 69% and specificity 58% - 68% when maternal risk factors alone for prediction of GDM was used [36]. This improvement in the predictive ability of risk factors screening as seen in this study may be explained by the small sample size used in the study. Also the sensitivity of the risk factor screening for GDM when combined with abdominal wall skin fold thickness increased to 90% with a specificity of 25%.

This study was limited by the small sample size as well as the fact that it is a hospital based research and cannot be transposed to the general population. Multicentre based studies and or community based studies are generally preferable but are both cumbersome and expensive in design and implementations.

This study was done in the University of Port Harcourt Teaching Hospital, Port Harcourt which is the largest referral health facility in Rivers state and a leading tertiary hospital in Southern Nigeria. Therefore given a permissible error margin, the results of this study should give the true reflection of the association of maternal risk factors for GDM, abdominal wall obesity and prediction for GDM.

5. Conclusions

The prevalence of GDM in Port Harcourt is 14.9% and major risk factors are obesity, previous history of GDM, advanced age multiparity and hypertension. Abdominal skin fold thickness ≥ 20 mm and prior history of GDM are independent risk predictors.

The study also demonstrated that the risk of developing GDM can be predicted in early second trimester using algorithm incorporating risk factor screening and anterior abdominal wall skin fold thickness estimation. A combination of risk factor screening for GDM and abdominal skin fold thickness estimation measured in the early 2nd trimester may provide a useful approach to the prediction of GDM. Validation in a large prospective study is required to determine the usefulness of the algorithm in clinical practice. Identifying a high risk group could potentially allow preventive measures before the development of GDM. Women with previous history of GDM and/or anterior abdominal wall

skin fold thickness of ≥20 mm should be screened for GDM at 16 - 18 wks, using the OGTT, then repeated at 24 - 32 weeks if the initial screen is negative.

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