

**SCREENING FOR GESTATIONAL DIABETES MELLITUS IN A PRIMARY CARE  
SETTING, EAST TRINIDAD, 2018-2020**

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## ABSTRACT

**Background:** The prevalence of Gestational Diabetes Mellitus (GDM) in primary care in Trinidad is expected to rise with the increasing prevalence of type 2 Diabetes Mellitus and associating risk factors such as overweight/obesity, and with the adoption of the International Association of Diabetes and Pregnancy Study Groups (IADPSG) recommendations on GDM screening.

**Aim:** The objective of this study was to determine the prevalence of GDM in primary care using IADPSG criteria. The secondary objectives were to determine primary care physicians' adherence to the IADPSG recommendations in the diagnosis of GDM and identification of risk factors associated with GDM.

**Methodology:** A cross sectional study was conducted from January 2018 to December 2020 at three public primary care health centres in East Trinidad. Data collected from the antenatal health records included demographic data, risk factors for GDM such as advanced maternal age, self-reported ethnicity, family history of Diabetes Mellitus, history of GDM in previous pregnancy, previous fetal macrosomia, obesity, weight gain in pregnancy, the recommendation of the screening test at booking visit and at 24-28 weeks gestation and the oral glucose tolerance test readings.

**Results:** Of the 256 health records sampled, 78.9% of the women performed the GDM screening test. The estimated prevalence of GDM in primary care in East Trinidad, 2018-2020 was 9.90% (95% CI 6.15-14.9%). Of the women who met the criteria for GDM, 60% were diagnosed as GDM cases by the health care providers. Chi-squared tests showed that GDM was significantly associated with Age  $\geq 25$  years ( $p=0.006$ ), East Indian ethnicity ( $p=0.02$ ) and

Family History of DM ( $p<0.001$ ). Hyperglycaemia in Pregnancy was significantly associated with Age  $\geq 35$  years ( $p=0.03$ ), Family History of DM ( $p=0.012$ ) and GDM in previous pregnancy ( $p<0.001$ ). Binary logistic regression demonstrated the following significant ( $p<0.05$ ) predictors of GDM: Age  $\geq 25$  years, unadjusted Odds Ratio 6.22 (95% CI 1.40-27.6) and Family History of DM, unadjusted Odds Ratio 3.28 (95% CI 1.16-9.29).

**Conclusion:** Implementation of the IADPSG guidelines has almost tripled the prevalence of GDM in Trinidad. Of women attending the antenatal clinics in primary care, one of every ten women screened positive for GDM in East Trinidad 2018-2020. Health care providers should have continuous medical education to ensure adherence to the guidelines to enable identification and early management of persons with GDM.

## **List OF ACRONYMs**

ADA American Diabetes Association

ANC Antenatal Clinic

APGAR Appearance, Pulse, Grimace, Activity, Respiration score

BMI Body Mass Index

CASP Critical Appraisal Skills Programme

C&C Carpenter and Coustan criteria

CI Confidence Interval

CME Continuing Medical Education

DIP Diabetes in Pregnancy

DM Diabetes Mellitus

ERHA Eastern Regional Health Authority

FIGO International Federation of Gynaecology and Obstetrics

FPCF Finite Population Correction Factor

FPG Fasting Plasma Glucose

GDM Gestational Diabetes Mellitus

GRADE Grading of Recommendations Assessment, Development and Evaluation

HAPO Hyperglycaemia and Pregnancy Outcomes study

IADPSG International Association of Diabetes and Pregnancy Study Groups

IDF International Diabetes Federation

IGT Impaired Glucose Tolerance

KAP Knowledge Attitudes Practices

OGTT Oral Glucose Tolerance Test

MOH Ministry of Health

NDDG National Diabetes Data Group

NICE National Institute of Clinical Excellence

NICU Neonatal Intensive Care Unit

PCPII Primary Care Physician II

REC Research Ethics Committee

RHA Regional Health Authority

SGEHC Sangre Grande Enhanced Health Centre

SIPS Perinatal Information System

SPSS Statistical Package for the Social Sciences

STEPS WHO Stepwise approach to Surveillance

TT Trinidad and Tobago

WHO World Health Organisation

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## INTRODUCTION

Hyperglycaemia in pregnancy (HIP) is defined as hyperglycaemia first detected at any time during pregnancy and sub-classified as diabetes in pregnancy (DIP) and gestational diabetes mellitus (GDM).<sup>1</sup> HIP is the most common metabolic disturbance affecting pregnancy.<sup>1</sup> GDM is defined as “any degree of glucose intolerance with onset or first recognition during pregnancy,” that does not meet the criteria for a diagnosis of diabetes mellitus as per the criteria for a non-pregnant patient.<sup>2</sup>

In 2019 the global prevalence of HIP was 15.8%, with GDM accounting for 12.8% and DIP 2.6% according to the IDF Diabetes Atlas.<sup>3,4,5</sup> The reported prevalence of HIP is highly variable globally between countries and from year to year due to many confounding factors: definitions of HIP, access to universal screening, variable screening practices, and the diagnostic criteria applied.<sup>6-11</sup> The prevalence of risk factors for GDM in the population such as increasing maternal age, obesity, and the prevalence of pre-existing diabetes are also contributors.<sup>12</sup>

The Latin American & Caribbean Declaration on Hyperglycaemia in Pregnancy, November 2017 recognises HIP as a significant public health challenge that affects maternal and child health and the future burden of type 2 diabetes.<sup>13-16</sup>

Maternal hyperglycaemia promotes fat deposition leading to macrosomia which is directly related to difficult vaginal delivery with shoulder dystocia, nerve palsies and fractures.<sup>14-17</sup> GDM is also associated with neonatal hypoglycaemia, hyperbilirubinemia, polycythaemia, hypocalcaemia and respiratory distress syndrome.<sup>18</sup> Long term fetal outcomes of GDM include adult obesity, diabetes and metabolic syndrome, at a rate of two to eight times that seen in the offspring of mothers without GDM.<sup>13-15,19</sup>

Short term maternal outcomes of GDM include excess weight gain, labour induction, shoulder dystocia, increased caesarean birth, pre-eclampsia or hypertension in pregnancy.<sup>14, 17, 20</sup> Long term maternal outcomes include an increased rate of cardiovascular disease, metabolic syndrome and diabetes mellitus.<sup>14,16-20</sup> Approximately half of all patients with GDM will develop diabetes mellitus within a decade.<sup>16-18, 20</sup>

Identifying and treating women with HIP is an opportunity to improve pregnancy outcomes and to improve the health of a mother and her child.<sup>21</sup> In 2017, a national standardised protocol for GDM screening and management was implemented in Trinidad and Tobago from the Ministry of Health (MOH), Directorate of Women's Health, in which the WHO and the IADPSG diagnostic criteria (fasting-92mg/dl, 1h postprandial-180mg/dl, 2h postprandial-153 mg/dl) was recommended for the universal screening of all pregnant women as a one- step 75g glucose OGTT in their initial visit and repeated at 24-28 weeks of gestation, if initially normal.<sup>22, 23</sup>

The Ministry of Health's guidelines included universal screening compared to risk-based as our population in Trinidad is already at higher risk due to the high proportion of persons with risk factors for GDM such as East Indian ethnicity, overweight or obese, previous macrosomia/GDM, advanced maternal age and family history of Diabetes Mellitus.<sup>12</sup> This is supported by findings from the national 2011 STEPS study.<sup>23,24</sup>

In 2018, Lutchmansingh F et al. demonstrated that based on the IADPSG guidelines (universal screening and one step 75g OGTT) the prevalence of GDM among women attending tertiary care in North Trinidad was 14.1% compared to 4.36% prevalence of GDM among women attending tertiary care in North Trinidad as reported by Clapperton et al, 2008 in which risk

factor screening was applied.<sup>25-27</sup>

Literature on the prevalence of GDM among pregnant women in the primary care setting of Trinidad was lacking.<sup>25-28</sup> The prevalence of GDM in tertiary care may be an overestimation of the prevalence in primary care as the population of pregnant women attending tertiary care may have a higher proportion of risk factors for GDM than those attending primary care.<sup>24,28, 29</sup>

The findings of this study would provide estimates of the burden of GDM in primary care that is the prevalence of GDM in the primary care setting and not the referral rate of women with GDM to tertiary care. A proof of concept study can be conducted to pilot a more feasible and cost-effective model of GDM screening, diagnosis and initial primary care management in Trinidad.<sup>30-33</sup>

Health care policy makers would be guided by the study findings to increase dedicated resources and health education of women attending antenatal clinics and health care providers in primary care as it expected that the prevalence of GDM should increase fourfold with the application of the IADPSG criteria.<sup>34,35</sup> Lifestyle interventions during pregnancy, with continuity after delivery, will help reduce progression to type 2 diabetes and the development of cardiovascular disease.<sup>17, 19, 29,34</sup>

## AIMS

To determine the proportion of women with GDM in a primary care setting and its predictors.

## OBJECTIVES

### To determine:

- a) The proportion of women screened for GDM among the women attending primary care antenatal clinics in East Trinidad, 2018-2020 according to the Ministry of Health guidelines.
- b) The proportion of women attending the Antenatal clinic in East Trinidad, 2018-2020 who met the IADPSG criteria for GDM at **booking visit** and at **24-28 weeks gestation**.
- c) **The prevalence of risk factors** among women attending the primary care antenatal clinic in East Trinidad, 2018-2020.
- d) The significance **of the association** of the risk factors with the occurrence of GDM among women attending the primary care antenatal clinic in East Trinidad, 2018-2020.

## **METHODS**

### **Setting**

Health care in Trinidad and Tobago can be accessed publicly via one of the five Regional Health Authorities, Eastern, North Central, North West, South West and Tobago or privately. However, due to the low socio-economic status and the remoteness of the catchment area of the Eastern Regional Health Authority (ERHA), it was assumed that all pregnant women in the catchment area attended the antenatal clinics in the public system.

Health care delivery in the Eastern region spanned the largest geographical area of all the Regional Health Authorities however had the second smallest catchment population when compared to the other five (5) Authorities. Approximately 114, 776 persons accessed health care via the ERHA. The ERHA 's catchment covered approximately one third of Trinidad. Of the two counties, County St. Andrew/St. David and County Nariva/Mayaro, there were 16 Health Centres, 1 District Health Facility and 1 District Hospital.

Findings from the study were expected to inform public health policy makers and would impact on the strategies developed and implemented in order to meet the health requirements of the populace of Eastern Trinidad.

Figure 1: Health Administration Map of Trinidad and Tobago



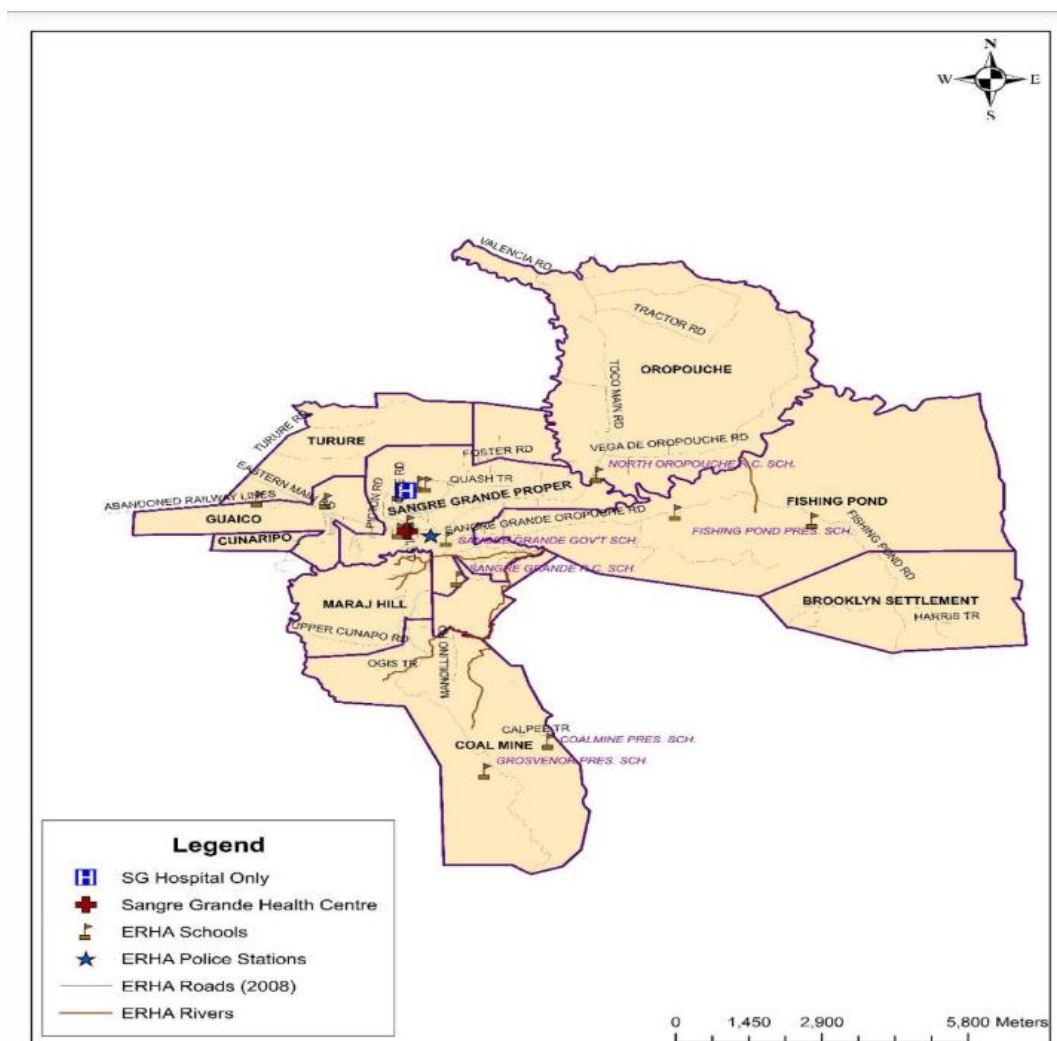
Data from the Central Statistical Office and the Public Health Observatory showed that the characteristics of persons in the catchment were generally similar in all health centres such as:

- Ethnicity: 44% East Indian, 29% African, 26% Mixed compared to the general population which had a distribution of 37%, 28% and 32% respectively
- 60% of the Primary care attendees were female.

There was reduced variability in the screening practices for GDM in the health centres as the primary care physicians in each county were not fixed to one health centre but rotated to all. Thus, the study findings from the Sangre Grande, Valencia and Cumuto Health centres can be generalised to all 16 health centres in the ERHA. The Sangre Grande Enhanced Health Centre (SGEHC) was strategically chosen as it serves the largest catchment of 35 285 persons and was

situated closest to the Sangre Grande Hospital where all women with GDM were referred to for further management. The health centres from two smaller catchment areas, Valencia and Cumuto, were selected to ensure that the study findings were representative of the screening practices in primary care regardless of size of catchment population and proximity to tertiary health care.

Figure 2: Map of the Catchment Area of the Sangre Grande Enhanced Health Centre



## **STUDY DESIGN**

A cross sectional study was designed in which the health records of a proportionally representative sample of women attending antenatal clinic were reviewed.

### **Patient selection**

The target population was all pregnancies of adult women in East Trinidad, January 2018 to December 2020. The inclusion criterion was all women  $\geq 18$  years old attending the antenatal clinic at the Cumuto, Valencia and Sangre Grande Enhanced Health Centres. The antenatal records were reviewed from booking visit to delivery. Exclusion criteria included pre-existing clinical diabetes, and patients who were not attended by a primary care physician.

### **Data Source/Management**

Data was collected from the primary care antenatal records using a de novo instrument (Appendix 1) based on the Ministry of Health of Trinidad and Tobago's Diabetes Mellitus and Pregnancy Clinical guidelines (IADPSG recommendations).<sup>22,31</sup>

The data collection instrument was reviewed for face and content validity by 2 Endocrinologists and 1 Primary Care Physician. Ten antenatal files were chosen randomly to assess construct validity of the instrument. Two medical records clerks on duty were responsible for reviewing the patient registry (electronic and hard copy) to confirm if OGTT appointments were given. One phlebotomist on duty verified if the patient had performed the OGTT. The data collected was reviewed by a Public Health Specialist and an Endocrinologist for further refinement of the instrument.

## **Variables**

The investigate variables included predisposing factors to GDM: demographic data such as age, self-reported ethnicity, family history of Diabetes Mellitus, history of gestational diabetes mellitus in previous pregnancy, previous macrosomic baby weighing 4.5kg or above, BMI, weight gain in pregnancy up to 24-28 weeks gestation. Other variables were the recommendation of screening at booking visit and at 24-28 weeks gestation, OGTT readings, diagnosis of GDM and referral to tertiary care.

Anthropometrics was measured by a trained Enrolled Nursing Assistant: After the patient removed her footwear, the height was measured with the patient's back touching the stadiometer. The reading was taken at the level of the top of the patient's head.

Weight was measured using a calibrated electronic scale. After removal of shoes and heavy jackets, the patient was asked to stand still in the centre of the scale with feet apart

Body Mass Index (BMI) was calculated using the formula  $BMI = \text{weight in kg} / \text{squared height in m}^2$ .

Investigations: Random capillary sugars were tested by a trained Enrolled Nursing Assistant using a validated and calibrated hand-held glucometer.

Vene-sampling for the oral glucose tolerance test was performed by a trained phlebotomist on a scheduled date at the health centre. Prior to booking, patients were advised to fast 8 to 12 hours before the test. An 8-ounce solution of 75g of glucose was given to the patient after the fasting plasma glucose sample was taken. One and two -hour samples post prandial plasma glucose samples were then collected. The blood samples were sent from the Health Centre to the Sangre Grande Hospital's laboratory on the same day where it was processed in a calibrated,

validated automatic biochemistry analyser, Mindray BS-800.

### Sample size

The Monthly Report of Community Services from the Public Health Observatory, ERHA reported the total number of antenatal attendees for the period which was used as the denominator for calculating the rate of detection of GDM for the period 2018-2020.

Testing the null hypothesis: The proportion of women with GDM in primary care is the same as the tertiary care estimate of 14.1%.

Alternate hypothesis: The proportion of women with GDM in primary care is different from the tertiary care estimate of 14.1%.

Using Sample Size:  $n = \frac{Z^2 p(1-p)}{d^2}$

Where:  $\alpha = 5\%$  is the level of significance

$Z = Z$  statistic for the standard normal deviate for a two-sided  $\alpha = 1.96$

$P =$  expected prevalence or proportion of GDM in Trinidad = 14.1%.<sup>26</sup>

$d = 5.00\%$  is the precision or the total width of confidence interval.

$$n = \frac{Z^2 p(1-p)}{d^2} = \frac{1.96^2 \times 0.141 \times (1-0.141)}{0.05^2} = 186$$

Estimated sample size:  $n = 186$

### Finite population correction factor (FCP)

$$n = \frac{n_0}{[1 + n_0/N]}$$

As derived from the Community Health Services Utilisation Services Report from the Public Health Observatory of the ERHA, where N= 4313 is the total number of patients who attended the Valencia, Cumuto and Sangre Grande Enhanced Health Centre antenatal clinics in 2018-2020,  $n/N > 0.05$ .

$$n = \frac{186}{1 + \frac{186}{4313}} = 179 \text{ patients}$$

**Sample size adjusted for a finite population is 179 patients.**

**Inflating for Missing data:** Assuming missing data = 30%

$$n^* = n / [1 - (x/100)] = \frac{179}{1 - \frac{30}{100}} = 255 \text{ patients}$$

A minimum sample size of 255 patient files was chosen proportionally from the health centres as shown in Table 1 below.

**Table 1: The number of patients attending Antenatal clinics per Health centre 2018-2020.**

| Health centre          | #Antenatal clinic attendees<br>2018-2020 | #Files needed from<br>1/1/2018-31/12/2020 |
|------------------------|------------------------------------------|-------------------------------------------|
| Sangre Grande Enhanced | 2413                                     | 142                                       |
| Valencia               | 1483                                     | 88                                        |
| Cumuto                 | 417                                      | 25                                        |

|              |             |            |
|--------------|-------------|------------|
| <b>Total</b> | <b>4313</b> | <b>255</b> |
|--------------|-------------|------------|

The population was sampled via systematic sampling of antenatal clinic attendee list for each health centre from January 2018 to December 2020.

$$k = \frac{N}{n}$$

$k$  = systematic sampling interval

$N$  = population size

$n$  = sample size

Sampling interval = Population size / sample size = 4313 / 255 = 16

Firstly, the sampling interval was calculated as that of 16<sup>th</sup> antenatal file. As is the usual protocol for the Registration of patients at all clinics in each health center, patients attending the antenatal clinics were registered in a log book at each health center at the time of booking visit. The names of the patients entered in this log book are entered conveniently by the Medical Records department as the patient presents to the clinic that is by first come first served basis there is no special pattern to the register.

The medical records clerks randomly selected a starting point between 1 and the sampling interval of 16 on the enumerated list of patients in the month of January 2018. Every 16<sup>th</sup> patient from that starting point was selected.

## Statistical Methods

Data was entered in Microsoft® Excel® 2019 version 1808 and analysed by Statistical Package

for the Social Sciences, IBM® SPSS® version 25. A descriptive analysis was conducted such as the calculation of means and confidence intervals for normally distributed continuous variables, median and interquartile range of non-normally distributed variables. Continuous variables were converted to binary categories. Frequencies or percentages was calculated for categorical variables, with between group comparisons for GDM/HIP done using Chi-square test.

Binary logistic regression analysis was done to determine the extent of association the investigate risk factors had with GDM. Exposure to Risk factors for GDM included advanced maternal age, East Indian ethnicity, family history of DM, previous GDM/fetal macrosomia, overweight/obesity. Outcome variables considered for investigation included the proportion of clinic attendees who were screened for GDM and the prevalence of GDM that is the proportion of participants who met the MOH criteria for GDM among ANC attendees in the booking visit and between 24-28 weeks of gestation.

### **Ethical Issues**

Vulnerable populations such as children and people with impaired mental capacity were not included in the study. There was no intervention nor change in the clinical consultation in the research as such informed consent was waived as the research presented no more than minimal risk to participants. The waiver of informed consent did not adversely affect the rights and welfare of the pregnant women attending antenatal clinic as only the medical records files were accessed. Women who tested positive for GDM were referred to tertiary care in accordance to the guidelines from the Ministry of Health. Dietary advice and educational counselling were implemented at the time of diagnosis as usual care at the primary care level.<sup>34</sup>

Privacy and confidentiality of the data collected was maintained. The data collection tool was coded with a unique identifier to ensure the anonymity of the research subject. The computer used for data entry and analysis was password protected and accessible to the researcher only.

The research proposal was approved by the research ethics committees of the University of the West Indies, St. Augustine campus (Ref:CREC-SA.0800/03/2021) and the Eastern Regional Health Authority of Trinidad and Tobago (see Appendices 4 & 5).

## RESULTS

Of the 257 antenatal files sampled, one person was excluded due to pre-existing DM in pregnancy as shown in Figure 3 below. Of the 256 files included, 78.9% of the women attending antenatal clinic were screened according to the MOHTT guidelines. Fifty four persons were not screened for GDM.

Figure 3: Flow Chart on the Numbers Sampled for the Study Population

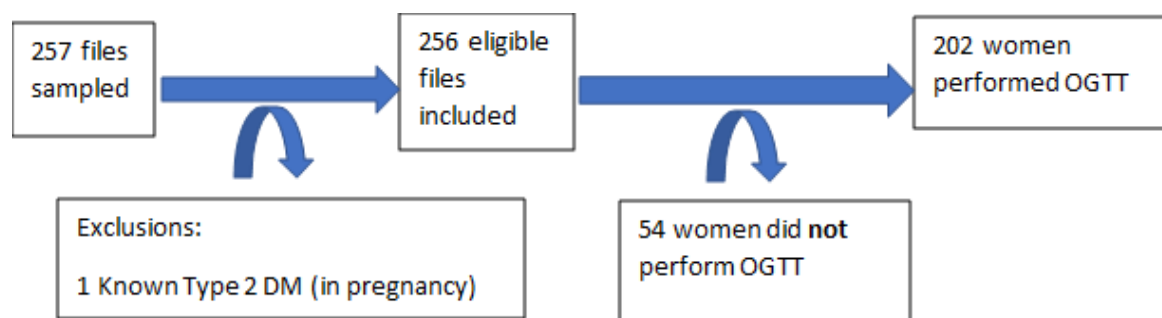


Table 2: Profile of the Women who were Not screened for GDM in Primary Care

| Characteristics                              | Description                                               |
|----------------------------------------------|-----------------------------------------------------------|
| Age years, Mean $\pm$ SD(Range)              | 29.04 $\pm$ 6.39* (range18-41)                            |
| BMI kg/m <sup>2</sup> , Mean $\pm$ SD(Range) | 27.7 $\pm$ 6* (range17-42)                                |
| Total Parity                                 | median 1.50; mean 2.02 ( $\pm$ 1.68)*; mode1; range (0-7) |
| Ethnicity, n(%)                              |                                                           |
| African                                      | 17 (31.4%)                                                |
| East Indian                                  | 10 (17.9%)                                                |
| Mixed                                        | 20 (35.7 %)                                               |
| Hispanic                                     | 2 (3.7%)                                                  |
| Family History of DM, n(%)                   | 32 (57.1%)                                                |
| History of Fetal Macrosomia, n(%)            | 2 (3.7%)                                                  |
| History of GDM, n(%)                         | 3 (5.5%)                                                  |

\*Standard Deviation

As shown in Table 2 above, the 54 women attending antenatal clinics in primary who did not perform the Oral Glucose Tolerance Testing were of mean age 29 years old, mean BMI 27

kg/m<sup>2</sup>, mean number of previous pregnancies 2, roughly on third of the women were of Mixed ethnicity (African and East Indian) or African ethnicity. More than half of the women who did not perform the OGTT had a family history of Diabetes Mellitus. Table 3 below demonstrates the health care providers' non-adherence to MOH guidelines in providing universal screening for GDM at the first visit.

Table 3: Reasons for no OGTT testing at Primary Care Antenatal Clinics

| <b>Reasons why women were not screened for GDM, n=54</b> | <b>Number</b> | <b>%</b> |
|----------------------------------------------------------|---------------|----------|
| Referred to Tertiary Care Antenatal Clinic               | 32            | 53.3%    |
| Defaulted from clinic                                    | 9             | 16.6%    |
| Missed appointment                                       | 7             | 12.9%    |
| Not requested by Medical Doctor                          | 5             | 9.26%    |
| Vomiting                                                 | 1             | 1.85%    |

At the first visit to primary care, women identified as high risk pregnancies at the booking visit were redirected to tertiary care and discharged from primary care management. They did not perform the OGTT at the primary care setting. At the booking visit, three women at pog <24/40 were found to have DM in pregnancy and referred to tertiary care for further management as seen below in Table 4.

Table 4: The OGTT findings for women screened for GDM at Booking visit and by period of gestation (pog).

| <b>Screened</b>      | <b>Booking visit<br/>pog&lt;24/40</b> | <b>Booking visit<br/>pog ≥24/40</b> | <b>2<sup>nd</sup> Screen at<br/>pog ≥24/40</b> | <b>Total women<br/>screened<br/>pog ≥ 24/40</b> |
|----------------------|---------------------------------------|-------------------------------------|------------------------------------------------|-------------------------------------------------|
| Not tested           | 63                                    | 10                                  | 72                                             | 82                                              |
| Normoglycemia        | 118                                   | 45                                  | 64                                             | 109                                             |
| DM in pregnancy      | 3                                     | 0                                   | 0                                              | 0                                               |
| Total GDM            | 12                                    | 1                                   | 7                                              | 8                                               |
| Missed GDM diagnosis | 5                                     | 1                                   | 2                                              | 3                                               |

|              |     |    |    |     |
|--------------|-----|----|----|-----|
| Total tested | 133 | 46 | 71 | 117 |
|--------------|-----|----|----|-----|

The proportion of women attending the Antenatal clinic in East Trinidad, 2018-2020, who met the IADPSG criteria for GDM at **pog<24/40** was **9.02%** (95%CI 4.75-15.2). At **pog<24/40**, 41.6% (95%CI 15.2-72.3) of the women who met the criteria for GDM were correctly identified by health care providers.

The proportion of women attending the Antenatal clinic in East Trinidad, 2018-2020, who met the IADPSG criteria for GDM at **booking visit (both pog<24/40 and pog≥24/40)** was **7.26%** (95%CI 3.92-12.1). At the booking visit, 53.8% (95%CI 25.1-80.8) of the women who met the criteria for GDM were correctly identified by health care providers.

The proportion of women attending the Antenatal clinic in East Trinidad, 2018- 2020, who met the IADPSG criteria for GDM at **pog≥24/40** (women at booking visit at **pog ≥24/40** and women with second screen at **pog ≥24/40**) was **6.84%** (95%CI 3.0-13.0) and 62.5% (95%CI 24.5-91.5) of these women were correctly identified as GDM by the health care providers. Nil women met the threshold for DM in pregnancy at **pog ≥24/40**.

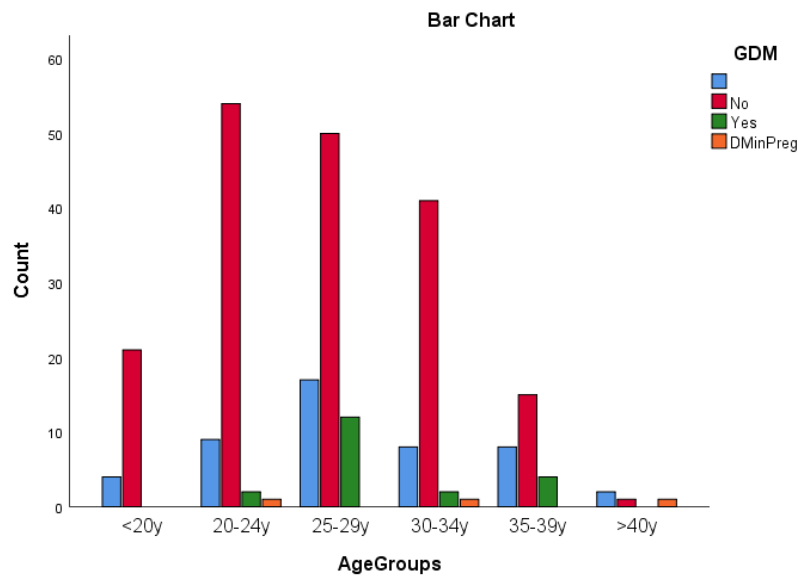
The total proportion of women who **screened positive for GDM** among the women attending the antenatal clinic of Eastern Trinidad 2018-2020 was **9.90%** (95%CI 6.15-14.9). Overall, 40%(95%CI 19.1-63.9) of all the women who met the threshold for GDM were not identified by the health care providers. The proportion of women attending the Antenatal clinic in East Trinidad, 2018- 2020 diagnosed as **DM in Pregnancy** was **1.97%** (95%CI 0.54-4.97). The proportion of women attending the Antenatal clinic in East Trinidad, 2018-2020 diagnosed as **HIP** was **11.8 %** (95%CI 7.72-17.1).

**Table 5: The prevalence and association of GDM Risk Factors for GDM and HIP**

| <b>Risk factors for GDM</b>               | <b>Prevalence in sample population</b> | <b>GDM p-value</b> | <b>HIP p-value</b> |
|-------------------------------------------|----------------------------------------|--------------------|--------------------|
| Known DM in first degree relative         | 50.5%; 95% CI (43.4-57.6%)             | <0.001             | 0.018              |
| Ethnicity:                                |                                        |                    |                    |
| East Indian                               | 22.8%, 95% CI (17.2-29.2%)             | 0.02               | 0.603              |
| African                                   | 27.2%; 95% CI (21.2-33.9%)             | 0.61               | 0.114              |
| Mixed                                     | 35.2%, 95% CI (28.6-42.1%)             | 0.68               | 0.313              |
|                                           |                                        |                    | 0.817              |
| Maternal age older than 35years           | 9.90%, 95% CI 6.15-14.9%               | 0.11               | 0.031              |
| BMI > 25 kg/m <sup>2</sup>                | 62.3%, 95% CI 52.0-72.9%               | 0.17               | 0.123              |
| Macrosomia in previous pregnancy          | 5%; 95% CI 2.42-9.0%                   | 0.27               | 0.407              |
| GDM in previous pregnancy                 | 1%, 95%CI 0.12-3.57%                   | 0.64               | <0.001             |
| High Parity (≥5)                          | 3.47%, 95% CI 1.40-7.01%               | 0.09               | 0.22               |
| Gestational weight gain in excess (>12kg) | 34.2%; 95% CI 26.6-42.4%               | 0.98               | 0.985              |

The mean age of the women attending antenatal clinic was 27y (95%CI 21.2-32.8y) as shown in Table 5 above. Women aged 35years and older were found to be significantly ( p=0.031) more likely to develop HIP compared to women aged less than 35years.

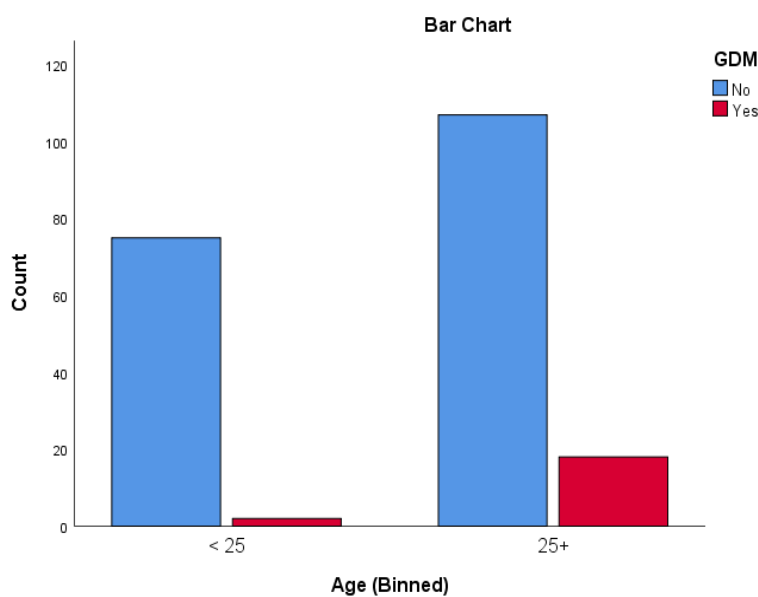
Figure 4: Bar Chart of Distribution for women diagnosed with GDM by Age Groups



The age group of 25-29years had the highest proportion of GDM as shown in Figure 4 above.

The women of the age 25 and over were more likely to develop GDM compared to women under the age of 25 (  $p=0.006$ ) as shown in Figure 5 below.

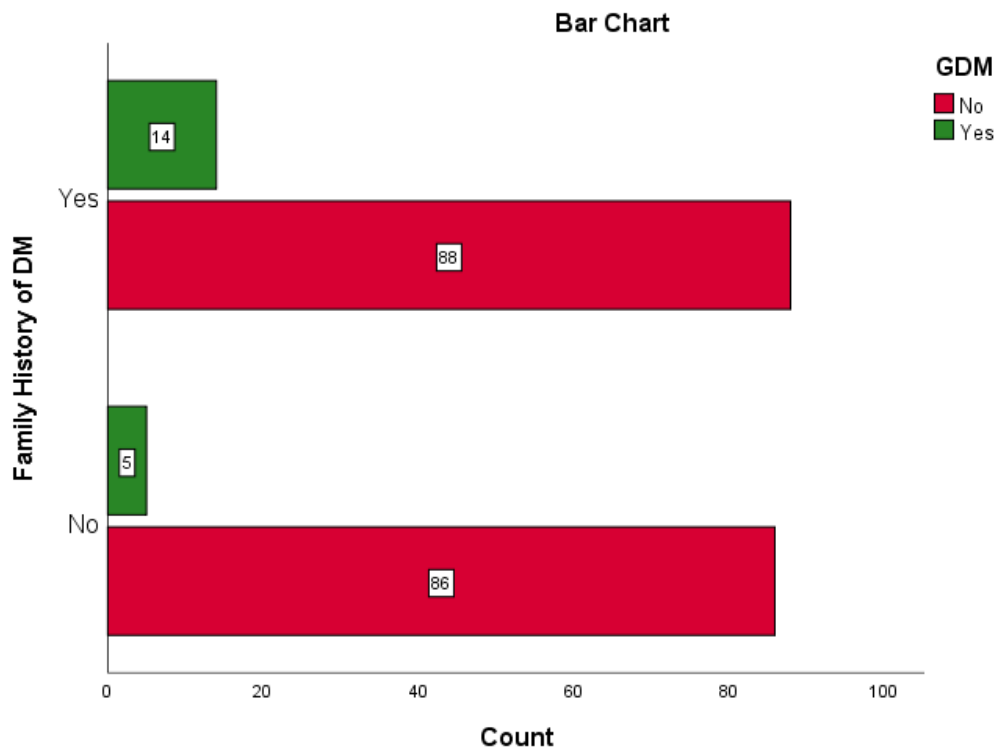
Figure 5: Distribution of women identified with GDM categorised by Age  $\geq 25$ years



More than half of the sample population had a family history of diabetes mellitus as shown in

Figure 6 below.

Figure 6: The Distribution of women with GDM by Family History of DM



Of the women with GDM, 70% (95%CI 45.7-88.1%) had a history of a family history of DM and 73.9% (95%CI 51.6-89.8%) of the women with HIP had a family history of DM (  $p=0.061$ ) and was significantly associated with GDM (  $p<0.001$ ).

Of the available BMI measurements recorded, the mean BMI of the sample population was 27.2 kg/m<sup>2</sup>(CI 21.2, 33.2). 62.3% (95%CI 52.0-72.9%) of the population was overweight or obese (BMI $\geq$ 25kg/m<sup>2</sup>) as shown in Table 5 above. There was no statistically significant association between overweight and obese women with GDM compared to women with BMI<25kg/m<sup>2</sup>.

In addition, Table 5 shows that the mean gestational weight gain in pregnancy was

9.42kg( $\pm$ 5.56). Weight gain in pregnancy was strongly associated with GDM although not significant ( $p=0.085$ ). Excessive weight gain  $>12$ kg in pregnancy occurred in 34.2% (95%CI 26.6-42.4%) of the population, however was not significantly associated with GDM ( $p = 0.985$ ) nor HIP ( $p=0.157$ ).

Figure 7: Distribution of women with GDM by Ethnicity

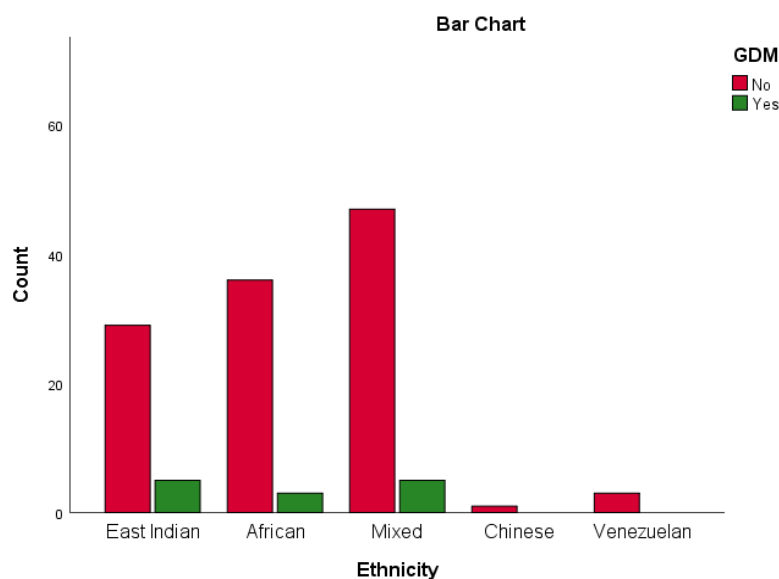
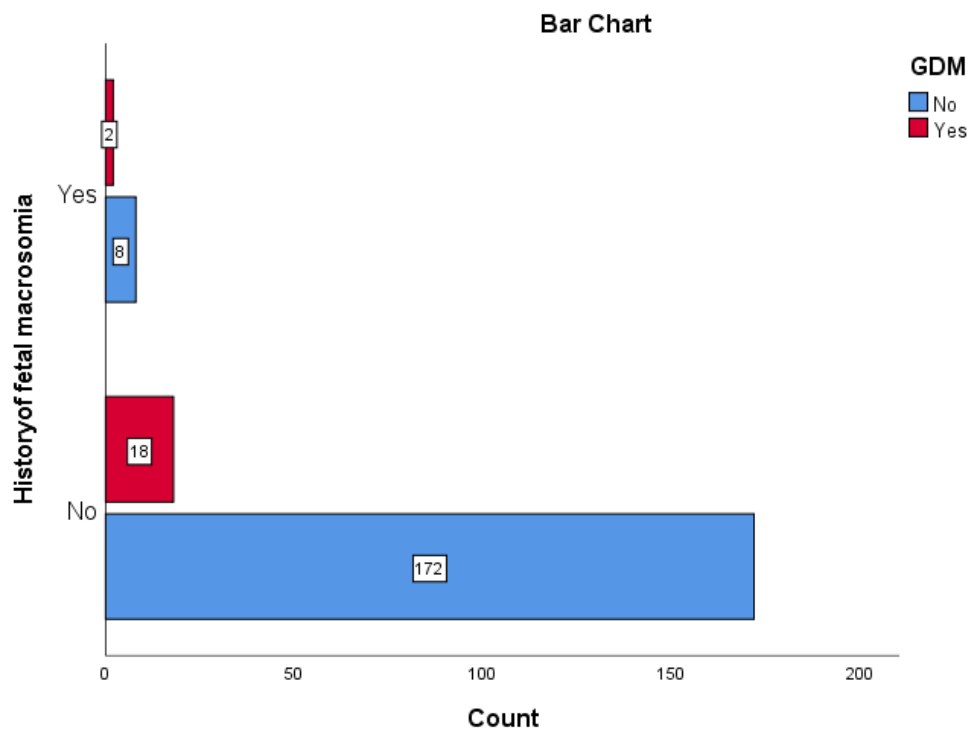


Figure 7 showed that the sample population was comprised of persons of the following Ethnicity: East Indians 22.8% (95%CI 17.2-29.2%), Africans 27.2% (95%CI 21.2-33.9%), Mixed (East Indian and African) 35.2% (95%CI 28.6-42.1%), Chinese 0.5% (95%CI 0.01-2.73%) and Hispanic (Venezuelan) 2.48% (95%CI 0.81–5.68%). East Indian ethnicity was significantly associated with GDM ( $p=0.027$ ) nor HIP ( $p=0.072$ ).

As shown in Figure 8 below, 10% (95%CI 1.24-31.7%) of the women with GDM had history of Fetal Macrosomia but no significant association with GDM ( $p=0.279$ ) nor HIP ( $p=0.511$ ).

Figure 8: The Distribution of women with GDM by History of Fetal Macrosomia



The median number of prior pregnancies the women was 1 with a mode of 1, and a range of 0–6. Grand multiparity (Parity $\geq$ 5) was not significantly associated with GDM ( $p=0.09$ ) nor HIP ( $p=0.22$ ).

Binary Logistic regression performed for the following predictor variables: Age, BMI at booking visit, Weight Gain in pregnancy, Family history of Diabetes Mellitus, history of Fetal Macrosomia, previous Gestational Diabetes, Parity, and Ethnicity, as shown in Table 6 below.

The following predictors were significantly associated with GDM ( $p<0.05$ ): Maternal age  $\geq 25$  years unadjusted OR 6.22; Family History of DM unadjusted OR 3.28 and BMI when adjusted for pog at booking visit OR 1.12.

Table 6: Binary Logistic Regression: Predictors of GDM

| Predictor Variable                                                                                                                                           | Unadjusted Odds Ratio<br>(95% Confidence Interval)                 | P value                 |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------|-------------------------|
| Age $\geq 25$ years<br>No <sup>#</sup><br>Yes                                                                                                                | 1<br>6.22 (1.40-27.6)                                              | 0.016                   |
| Age $\geq 35$ years<br>No <sup>#</sup><br>Yes                                                                                                                | 1<br>2.57 (0.77-8.65)                                              | 0.125                   |
| Age (year)                                                                                                                                                   | 1.08(0.99-1.18)                                                    | 0.058                   |
| Family History of DM<br>No <sup>#</sup><br>Yes                                                                                                               | 1<br>3.28 (1.16-9.29)                                              | 0.025                   |
| BMI (kg/m <sup>2</sup> )<br>*adjusted for pog at booking visit<br>*adjusted for pog at booking visit, East Indian Ethnicity                                  | 1.09 (0.99-1.22)<br>1.12 (1.01-1.24)<br>1.14 (1.02-1.27)           | 0.076<br>0.034<br>0.026 |
| BMI $\geq 23$ kg/m <sup>2</sup><br>No <sup>#</sup><br>Yes<br>*adjusted for pog at booking visit<br>*adjusted for pog at booking visit, East Indian Ethnicity | 1<br>2.13 (0.43-10.49)<br>2.13 (0.43-10.62)<br>3.94 (0.46 – 33.94) | 0.353<br>0.358<br>0.211 |
| BMI $\geq 25$ kg/m <sup>2</sup><br>No <sup>#</sup><br>Yes                                                                                                    | 1<br>2.87(0.58-14.2)                                               | 0.196                   |

|                                                           |                   |       |
|-----------------------------------------------------------|-------------------|-------|
| *adjusted for pog at booking visit                        | 3.60 (0.72-18.02) | 0.119 |
| *adjusted for pog at booking visit, East Indian Ethnicity | 6.63 (0.79-56.43) | 0.084 |
| East Indian Ethnicity                                     |                   |       |
| No <sup>#</sup>                                           | 1                 |       |
| Yes                                                       | 2.41 (0.82-7.08)  | 0.108 |
| African Ethnicity                                         |                   |       |
| No <sup>#</sup>                                           | 1                 |       |
| Yes                                                       | 0.51 (0.14-1.89)  | 0.311 |
| Mixed Ethnicity                                           |                   |       |
| No <sup>#</sup>                                           | 1                 |       |
| Yes                                                       | 0.87 (0.29-2.55)  | 0.797 |
| Parity                                                    | 1.21(0.89-1.63)   | 0.213 |
| Weight gain in pregnancy (kg)                             | 0.97(0.88-1.07)   | 0.516 |
| GDM in previous pregnancy                                 |                   |       |
| No <sup>#</sup>                                           | 1                 |       |
| Yes                                                       | 4.02 (0.35-46.19) | 0.264 |
| Fetal macrosomia in previous pregnancy                    |                   |       |
| No <sup>#</sup>                                           | 1                 |       |
| Yes                                                       | 2.04 (0.41-10.23) | 0.388 |

As seen in Table 7 below, the following predictors were significantly associated with HIP ( $p < 0.05$ ): Maternal Age  $\geq 25$  years, unadjusted OR 4.67 and Family History of DM, unadjusted OR 3.32; BMI, adjusted for pog at booking visit OR 1.12.

Table 7: Binary Logistic Regression: Predictors of HIP

| Predictor Variable                                        | Unadjusted Odds Ratio (95% Confidence Interval) | P value |
|-----------------------------------------------------------|-------------------------------------------------|---------|
| Age $\geq 25$ years                                       |                                                 |         |
| No <sup>#</sup>                                           | 1                                               |         |
| Yes                                                       | 4.67 (1.34-16.92)                               | 0.016   |
| Age $\geq 35$ years                                       |                                                 |         |
| No <sup>#</sup>                                           | 1                                               |         |
| Yes                                                       | 2.88 (0.94-8.79)                                | 0.063   |
| Age                                                       | 1.09 (1.02-1.18)                                | 0.025   |
| Family History of DM                                      |                                                 |         |
| No <sup>#</sup>                                           | 1                                               |         |
| Yes                                                       | 3.32 (1.17-9.41)                                | 0.024   |
| BMI                                                       | 1.11 (1.001-1.23)                               | 0.047   |
| *adjusted for pog at booking visit                        | 1.12 (1.01-1.24)                                | 0.032   |
| *adjusted for pog at booking visit, East Indian Ethnicity | 1.14 (1.02-1.27)                                | 0.024   |
| BMI $\geq 23$ kg/m <sup>2</sup>                           |                                                 |         |
| No <sup>#</sup>                                           | 1                                               |         |
| Yes                                                       | 2.22 (0.45-10.92)                               | 0.326   |
| *adjusted for pog at booking visit                        | 2.21 (0.44-11.00)                               | 0.215   |
| *adjusted for pog at booking visit, East Indian ethnicity | 4.17 (0.48- 36.0)                               | 0.194   |
| BMI $\geq 25$ kg/m <sup>2</sup>                           |                                                 |         |
| No <sup>#</sup>                                           | 1                                               |         |
| Yes                                                       | 3.29 (0.67-16.08)                               | 0.140   |
| *adjusted for pog at booking visit                        | 3.70 (0.74-18.48)                               | 0.111   |

|                                                           |                    |       |
|-----------------------------------------------------------|--------------------|-------|
| *adjusted for pog at booking visit, East Indian           | 6.90 (0.81-58.74)  | 0.077 |
| East Indian Ethnicity                                     |                    |       |
| No <sup>#</sup>                                           | 1                  |       |
| Yes                                                       | 2.33 (0.79-6.82)   | 0.122 |
| African Ethnicity                                         |                    |       |
| No <sup>#</sup>                                           | 1                  |       |
| Yes                                                       | 0.51 (0.14-1.91)   | 0.320 |
| Mixed (East Indian and African) Ethnicity                 |                    |       |
| No <sup>#</sup>                                           | 1                  |       |
| Yes                                                       | 0.88 (0.30-2.58)   | 0.818 |
| Parity                                                    | 1.22 (0.92-1.62)   | 0.158 |
| GrandMultiparity (Parity≥5)                               |                    |       |
| No <sup>#</sup>                                           | 1                  |       |
| Yes                                                       | 3.37 (0.61-18.475) | 0.161 |
| Weight gain in pregnancy                                  | 0.97 (0.87-1.07)   | 0.516 |
| *adjusted for pog at booking visit, East Indian Ethnicity | 0.93 (0.81-1.06)   | 0.285 |
| GDM in previous pregnancy                                 |                    |       |
| No <sup>#</sup>                                           | 1                  |       |
| Yes                                                       | 4.04 (0.35-46.46)  | 0.262 |
| Fetal Macrosomia in previous pregnancy                    |                    |       |
| No <sup>#</sup>                                           | 1                  |       |
| Yes                                                       | 2.05 (0.41-10.29)  | 0.384 |

## DISCUSSION

The proportion of women with GDM in East Trinidad at the primary care antenatal clinics in January 2018 to December 2020 was 9.90% (95% CI 6.15-14.9%) and 11.8% (95% CI 7.72-17.1%) for HIP. The study findings will contribute to the gaps in local literature as previously the prevalence of GDM in Trinidad was reported for patients attending tertiary care only.<sup>3, 25, 26</sup> Employment of the IADPSG criteria has yielded a higher prevalence of GDM 9.9% as lower maternal glycemic thresholds were utilised compared to 4.3 % obtained by Clapperton et al in which the higher thresholds in the 1999 WHO criteria were used.<sup>23, 26</sup> The 1999 WHO criteria recommended that GDM screening be conducted for women who were at higher risk for GDM such as women with previous history of GDM/fetal macrosomia, maternal obesity/overweight, advanced maternal age, grandmultigravidae.<sup>1, 4, 5</sup>

The St. Carlos Gestational Diabetes Study was a prospective cohort study comparing the difference in GDM risk factors and maternal and fetal outcomes of using the CC (O'Sullivan followed by 100g OGTT) compared to the IADPSG (one step 75g OGTT) criteria between 24 and 28 weeks of gestation.<sup>36</sup> The study demonstrated a 3.5-fold increase in GDM (35.5% vs 10.6%) in the study population- tertiary care setting in Madrid, Spain and the subsequent reduction in negative maternal and fetal outcomes.<sup>36</sup>

The use of IADPSG diagnostic criteria (lower threshold compared to 1999 WHO criteria) and universal screening (versus selectively screening high risk persons as in the 1999 WHO recommendations), a higher prevalence of GDM was expected.<sup>1, 4, 5, 32, 36</sup> In 2012, Agarwal et al concluded that universal application of the IADPSG guidelines would increase the cost of screening by 42%.<sup>31</sup> However, laboratory workload and associated cost would decrease by 36% due to the one-step approach used.<sup>31</sup> Duran et al in the St. Carlos Gestational Diabetes Study

concluded that the increased treatment cost of GDM would be offset by reduced surgical delivery and NICU admissions which were both costly.<sup>36</sup> A reduced maternal progression to type 2 diabetes mellitus postpartum and cardiovascular disease were also beneficial to women's health and would be cost saving.<sup>36</sup>

Locally, in 2018 using the IADPSG criteria, a GDM prevalence of 14.1% was reported for women attending the tertiary care antenatal clinics of two hospitals in North Trinidad.<sup>25</sup> The population of women attending tertiary care clinic was expected to have a higher prevalence of risk factors for GDM compared to the proportion of women attending the primary care clinic. Hence, the lower GDM estimate of 9.9% was consistent with the findings from the previous study done in the tertiary care setting using the same criteria in Trinidad.<sup>25</sup>

The IADPSG guidelines recommend universal screening for GDM at 24-28 weeks' gestation.<sup>23</sup> Identifying those who meet the IADPSG criteria from the booking visit in a high-risk population as in Trinidad would allow earlier implementation of GDM management and hence reduce the associated complications both short and long term such as increased instrumental or surgical deliveries and maternal and fetal development of Diabetes Mellitus.<sup>34</sup>

The Ministry of Health of Trinidad and Tobago had mandated that GDM screening by the IADSPG diagnostic criteria should be applied to women who first attend antenatal clinic regardless of gestational age and at 24-28weeks gestation.<sup>22</sup> A higher proportion of women who met the threshold for GDM were tested at  $\text{pog} < 24$  weeks than at  $\text{pog} \geq 24/40$  weeks. Early identification of GDM is beneficial as the Trinidad population is at high risk of developing hyperglycaemia in pregnancy due to the increasing prevalence of risk factors of metabolic disease.<sup>24</sup> According to the national NCD risk factor survey, more than half of the adult female population of Trinidad and Tobago was shown to be overweight or obese.<sup>24</sup> This may be due

to the increased sedentary lifestyle such as reduced physical activity and increased consumption of high fat high carbohydrate diet from cheaper, readily available high calorie fast foods.

Women of the age  $\geq 25$  years, of East Indian ethnicity and a family history of Diabetes Mellitus were demonstrated to be significantly associated with GDM in this study. Maternal age  $\geq 35$  years was not significantly associated with GDM in this study likely due to the small number of women  $\geq 35$  years. Pregnant women aged  $\geq 35$  years are termed Advanced Maternal Age, they are considered as having a high-risk pregnancy. At the booking visit in primary care, all high risk pregnancies are referred to the tertiary care clinic, as such in this study the number of persons aged  $\geq 35$  years was not sufficient enough to demonstrate a relationship with GDM. A large prospective study can be designed including pregnant women from both primary and tertiary care settings, would be adequately powered to demonstrate the association of advanced maternal age with GDM. GDM in previous pregnancy and advanced maternal age/maternal age  $\geq 35$  years were significantly associated with HIP. These findings were consistent with local and international studies.<sup>25-28</sup> The majority (78.9%) of the women attending the antenatal primary care clinics were screened for GDM. At the first visit to primary care, high-risk pregnancies would be referred to the tertiary setting and would not have performed an OGTT performed in primary care.

Health care providers' non adherence to screening guidelines was demonstrated in the inability to attain universal screening at booking visit and failure to accurately identify all cases of GDM from the OGTT findings. Of the women who met the diagnostic criteria for GDM, 40% were missed by the health care providers. Women who met the criteria for DIP were not misclassified by the health care providers.

The binary logistic regression analyses did not indicate a strong significant causal relationship

between GDM and the following predictor variable: Maternal overweight/obesity, advanced maternal age, GDM in previous pregnancy, history of fetal macrosomia, excessive weight gain in pregnancy and ethnicity. Evidence from a highly powered study can better demonstrate the association between predictors and GDM. The association of predictors with GDM may lose significance due to a non-uniform relationship at extremes of the variable for instance, age variable gained significance from age  $\geq 25$  years. The HAPO study powered its' study to investigate OGTT values as a predictor of adverse pregnancy outcomes namely as macrosomia, primary caesarean delivery, clinical neonatal hypoglycaemia and hyperinsulinemia.<sup>14</sup> Hence, a large prospective cohort study can be conducted in East Trinidad, in which women diagnosed with GDM can be followed to demonstrate causal relationships between GDM or associated adverse outcomes with risk factors and/or novel factors, and to identify confounders.

The following recommendations should be considered based on the findings of the study: improved communication between primary and tertiary care to ensure that all high-risk pregnancies referred from primary care would have performed the OGTT and receive appropriate care in a timely manner. In the postpartum period, women with a history of GDM should be referred for follow up testing for hyperglycaemia in primary care. Establishment of a secondary care centre, dedicated to antenatal care for GDM, would provide the necessary linkage for primary and tertiary antenatal care and reduce the burden imposed on the single tertiary care facility. Women with DM in pregnancy or other high risk conditions requiring specialist management should be referred to the tertiary care facility.

Health care providers should receive retraining or continuous medical education on clinical guidelines to reduce any variability in GDM screening practices and to improve diagnostic accuracy.<sup>1,6,7,9,10,22</sup> Regular clinical audits can be conducted to monitor health care providers' adherence to the national guidelines for GDM screening and appropriate interpretation of

screening test to avoid misclassification of GDM cases. Electronic medical records such as PAHO SIPS+ should be employed at all levels of health care to ensure standardisation of medical records, to limit missing information on important prognostic factors such as Ethnicity, history of DM in first degree relative, history of GDM in previous pregnancies, negative fetal adverse events. Health promotional lectures should be administered prenatally and in the antenatal clinics to educate on GDM to increase patients' compliance with the request for OGTT and lifestyle modification to reduce the incidence of GDM.

## **LIMITATIONS**

Limitations of this cross sectional study include difficulty to demonstrate causality due to inability to demonstrate temporal sequence, missing data due to incomplete records, loss to follow up due to drop-outs; and the difficulty to control for confounders in investigating the relationship between risk factors and the diagnosis of GDM.<sup>37</sup> A prospective cohort study can be performed where women attending a prenatal clinic or well women clinic can be assessed at baseline and then followed at intervals until enrolment in the antenatal clinic and identifying those who have been diagnosed with GDM. Electronic medical records can be employed to ensure standardisation of data entry in the health records such as SIPS+.

There was inconsistent data entry in the health care records by health care professionals such as missing data on ethnicity, booking BMI, birth weights of previous pregnancies, and family history of Diabetes Mellitus. To combat the challenges faced by missing data the sample size was inflated by 30%. Approximately 21.1% of the health records sampled after meeting the inclusion criteria did not perform the OGTT in primary care. At the booking visit, more than half of these women were identified as High-Risk Obstetric cases and referred to the tertiary

care antenatal clinic according to the Ministry of Health guidelines. These women would have been at high risk of developing GDM for instance 2 women had a history of DM in pregnancy, previous GDM and 4 women had advanced maternal age. Therefore, the inability to capture an OGTT reading for this population in primary care would lead to an underestimation of the true prevalence of GDM in primary care. Triangulating their OGTT readings performed at the Sangre Grande Hospital, the only tertiary care facility in East Trinidad would have been able to address the missing data from primary care health records. However, sampling from one data source, the primary care health records was recommended to ensure the feasibility of the proposed study.

## **CONCLUSION**

Using the IADPSG criteria, the prevalence of women with GDM in primary care is estimated to be approximately 1 in every 10 women in Trinidad. Health care providers should have continuous medical education to provide targeted health promotional or education for prenatal high-risk populations such as women  $\geq 25$  years old, of East Indian ancestry, previous GDM and family history of DM to ensure universal screening and compliance with updated guidelines and to implement early management of GDM. Public health specialists should establish a GDM registry for the entire RHA to provide evidence to create hypotheses on novel and traditional risk factors, and to monitor and evaluate the effectiveness of treatment options and to follow up on both maternal and fetal short- and long- term outcomes.

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## APPENDIX 1: Data Collection Tool

|                                 |                             |
|---------------------------------|-----------------------------|
| Patient Registration #<br>..... | Date of collection<br>..... |
| Date of Birth<br>.....          | Age<br>.....                |
| Health center<br>.....          | Researcher<br>.....         |

| Variables                                       | Subject 1 | Subject 2 | Subject 3 |
|-------------------------------------------------|-----------|-----------|-----------|
| Unique Identifier                               |           |           |           |
| Date of Booking Visit                           |           |           |           |
| Ethnicity                                       |           |           |           |
| Weight, at booking visit                        |           |           |           |
| BMI, at booking visit                           |           |           |           |
| Blood Pressure(mmHg), at booking visit          |           |           |           |
| Random Blood Sugar (mg/dL), at booking visit    |           |           |           |
| Family History of Diabetes Mellitus             |           |           |           |
| Gravidity, Parity                               |           |           |           |
| History of macrosomia (in previous pregnancies) |           |           |           |
| History of GDM (in previous pregnancies)        |           |           |           |
| Estimated date of delivery                      |           |           |           |
| Gestational Age, at booking visit               |           |           |           |

|                                                 |  |  |  |
|-------------------------------------------------|--|--|--|
| OGTT requested at booking visit                 |  |  |  |
| Gestational Age, at first OGTT                  |  |  |  |
| Booking OGTT Fasting (mg/dL)                    |  |  |  |
| Booking OGTT 1h Postprandial (mg/dL)            |  |  |  |
| Booking OGTT 2h Postprandial (mg/dL)            |  |  |  |
| OGTT requested at 24-28wks                      |  |  |  |
| Weight gain at 24-28weeks (kg)                  |  |  |  |
| Gestational Age, at second OGTT                 |  |  |  |
| 24-28 wk OGTT Fasting (mg/dL)                   |  |  |  |
| 24-28 wk OGTT 1h Postprandial (mg/dL)           |  |  |  |
| 24-28 wk OGTT 2h Postprandial (mg/dL)           |  |  |  |
| Diagnosis of Gestational Diabetes Mellitus made |  |  |  |
| Co-morbidities                                  |  |  |  |
| Referral to tertiary care                       |  |  |  |

## **APPENDIX 2: CRITICAL APPRAISAL OF LITERATURE (4 article critique)**

The GRADE and CASP were utilised as tools for the critical review of articles.<sup>38,39</sup>

**FIRST ARTICLE:** Utz B, Assarag B, Essolbi A, Barkat A, Delamou A, De Brouwere V. Knowledge and practice related to gestational diabetes among primary health care providers in Morocco: Potential for a defragmentation of care? *Primary Care Diabetes II* (2017) 389-396.<sup>7</sup>

**PURPOSE/PROBLEM STATEMENT:** The goal was to assess the knowledge and practices of general practitioners, nurses and midwives working at primary care facilities in Morocco regarding screening and management of GDM. The reasons for conducting the study include the worldwide prevalence was 15% and the significant fetal and maternal complications of GDM if untreated. The research is relevant as the results are expected to contribute to the development of future strategies that focus on strengthening the primary care level and thus improving access to GDM screening, management and follow-up. The terms are defined conceptually. The operational definition of GDM by diagnostic criteria is not stated. Significance of the study is stated as the potential to contribute to the development of future strategies that focus on strengthening the primary health care level by improving access to GDM screening, management and follow-up.

**LITERATURE REVIEW:** A synthesis of the literature was done which demonstrated the burden of GDM, maternal and fetal complications of untreated GDM. The clinical management of GDM was also discussed such as the need for insulin, self-monitoring of glucose levels and the indications for Caesarean section. The researcher has identified gaps in knowledge as there is no consensus on GDM screening in Morocco.

**METHODOLOGY:** The qualitative design was appropriate. The data collection was well

described such as MCQs related to general knowledge about GDM, experience with affected patients, open ended questions: providers' knowledge about screening (who, when and how to screen), management practices, previous training on GDM. The study was described in sufficient detail to allow a replication study. Supplementary data was also available in the online version.

**RECRUITMENT:** Randomly selected public health centers in Morocco, in which opportunistic sampling of Health care providers who were present and agreed to participate in the assessment. There is a potential for bias as the researcher-participant relationship is not understood.

**ETHICAL CONSIDERATION:** Ethical approval was granted but it is unclear how the rights of the participants were protected. On the other hand, participants were not coerced to answer the study questions.

**FINDINGS:** 56.8% of doctors reported being taught about GDM during their studies whereas only 23.3% of the nurses and midwives stated that they did receive any pre-service training on GDM. Major contributions of this study are the dire need for training of medical and nursing on the screening, diagnosis and management of GDM. Nurses and midwives lacked training in GDM although they are the first health care providers for pregnant women.

**IMPLICATIONS:** Management of GDM at the primary care level can reduce access barriers and improve follow-up. Screening at primary care with the use of capillary glucose testing would be more feasible, economic, timely than venesampling and processing at tertiary care level. Management of uncomplicated GDM at tertiary care level is a waste of resources, time, money and delays the initiation of management as patients await long appointment times leading to drop out. Primary care providers should be sufficiently trained to provide nutritional

counselling etc.

**LIMITATIONS:** The findings of the study are based on subjective view of the health care providers which may be influenced by the fear of it used in performance appraisals and recall bias.

## **SECOND ARTICLE:**

Clapperton M, Jarvis J, Mungrue K. Is Gestational Diabetes Mellitus an Important Contributor to Metabolic Disorders in Trinidad and Tobago? *Obstetrics and Gynecology International* Volume 2009, Article ID 289329, 6 pages. DOI10.1155/2009/289329.<sup>26</sup>

**PURPOSE/PROBLEM STATEMENT:** The research objective is clearly stated: To investigate the incidence of Gestational Diabetes Mellitus at the Mt. Hope Women's Hospital and to describe its epidemiological pattern. Reasons for conducting the study included the potential adverse outcomes of GDM to both mother and fetus, the high burden of disease for GDM in the US the risk of GDM mother to become type 2 diabetics after delivery and the high number of persons living with type 2 Diabetes Mellitus (DM).

GDM was defined by WHO both conceptually as carbohydrate intolerance resulting in hyperglycemia of variable severity with onset or first recognition during pregnancy, and operationally as a fasting plasma glucose level  $\geq 7.0\text{mmol/L}$  or a casual plasma glucose  $\geq 11.1\text{mmol/L}$  confirmed on a subsequent day.

**LITERATURE REVIEW:** The literature review revealed no published data on the prevalence of GDM in Trinidad and Tobago. The researcher used this rationale for conducting this study in order to measure the occurrence of GDM and its impact on the delivery of care, particularly enhanced screening and intervention at the primary care level and guide policy and decision

making especially when allocating resources.

**DESIGN:** A retrospective observational study (Jan 2005 to Dec 2007) was conducted in which files were systematically selected from the birth registry. The design can appropriately answer the research questions, but it would not have sampled the population of women who had miscarriages (with or without GDM). Therefore, the prevalence of GDM calculated was that of GDM reported among women who gave birth in a tertiary center and not the true prevalence of GDM in Trinidad and Tobago as it can only be generalized to the sample population. Furthermore, GDM is associated with fetal abnormalities and poor maternal outcomes therefore the GDM prevalence may be under-reported in this study by excluding pregnant women who did not successfully deliver. A prospective pilot study (January to May 2008) was conducted to validate their study findings in which current patients on the ward were followed daily until delivery to determine their GDM status and outcome measurement as birth weight.

**SETTING:** A teaching hospital of the University of the West Indies: Mt Hope Women's Hospital.

**POPULATION/SAMPLE:** Pregnant women who gave birth.

**METHODS:** A sample size of 720. Variables analysed were age, ethnicity, BMI of mother, family history of diabetes, history of GDM, obstetric history, birth weight and APGAR score of infants.

**MAIN OUTCOME MEASURE:** (1) Incidence of cases of GDM, (2) Impact of the measured variable. Chi-squares, odds ratios and logistic regression were performed.

**RESULTS:** The incidence of GDM was 4.31% (95% CI 2.31%, 6.31%). The proportion of GDM patients for the years 2005, 2006 and 2007 were 1.67%, 4.58% and 6.67%, respectively.

Age range (35-39years), Obesity (BMI> 30kg/m<sup>2</sup>), Ethnicity (South East Asians), Family history of diabetes and a history of GDM were determined risk factor. The findings are compatible and consistent with international research. Associations between GDM and (1) Mode of delivery and (2) APGAR score of the baby were found. The study finding is outstandingly meaningful for clinical decisions as it revealed that women with GDM are 3.72 times more likely to have a C-section than women without GDM. The APGAR findings were not significant as this is also compatible with the sample population as pregnant women who had a miscarriage were not included in the study.

**DISCUSSIONS & CONCLUSION:** There was an apparent increase in the incidence of GDM. Additional studies should be conducted to measure the occurrence of GDM in Trinidad and Tobago. Logical implications made by the researcher included the recommendation for screening for type 2 diabetes mellitus in the postpartum and annually. In addition, the need for larger studies to be conducted is appropriate to establish the trends of GDM in the background of the obesity epidemic.

### **THIRD ARTICLE:**

Ofra et al. Screening and Diagnosis of Gestational Diabetes Mellitus. *Diabetes Care* 35:1894-1896, 2012.<sup>30</sup>

**CLEAR STATEMENT OF PURPOSE:** The objective is clearly stated and researchable. The researcher intends to study the implications of implementing the IADPSG recommendations for screening and diagnosis of GDM in Israel and explore alternative methods for identifying women at risk for adverse pregnancy outcomes. The reasoning for this study is because the yield and practicality of screening methods may differ according to prevalence of risk factors

and availability of health care resources. The terms were conceptually defined in the Introduction and operationally in the Methods.

**LITERATURE REVIEW:** The researcher discussed the classic literature on the pre-existing GDM screening criteria in which high risk pregnant women at 24-28 weeks gestation undergo a 50g glucose challenge then 100g OGTT for positive responders. The cut-offs were based on the maternal risk of later developing type2 diabetes rather than the immediate risk of adverse pregnancy outcomes. The current literature from the Hyperglycemia and Adverse Pregnancy Outcomes (HAPO) study was addressed. HAPO showed that there is an association between fasting and post-load plasma glucose levels and adverse pregnancy outcomes even in the previously normal range of the previous criteria.

**DESIGN:** Adverse outcome rate were calculated and compared for women who were positive according to 1) IADPSG criteria, 2) IADPSG criteria with a Fetal Macrosomia Diagnosis Risk Score that is risk stratification for fetal macrosomia based on maternal BMI, height and parity, or 3) screening with BMI or fasting blood glucose (FPG) at 28-32 weeks of gestation, 4) two step screening approach, using FPG for all pregnant women and a further OGTT for those at higher risk of fetal macrosomia.

**CONGRUENCE OF PURPOSE, DESIGN AND METHOD:** 8.3% of the Israeli HAPO participants met the IADPSG criteria for GDM. Applying the same threshold, 8.3% of the participants exceeded 89 mg/dl for fasting plasma glucose and 33.5 kg/m<sup>2</sup> for BMI.

**APPROPRIATE SAMPLING PROCEDURES:** All Israeli participants from the HAPO study were recruited.

**STATISTICAL PROCEDURES APPROPRIATE:**

**Table 1—Rate (95% CIs) of adverse outcomes detected using three alternative risk markers: IADPSG criteria for GDM diagnosis, FPG, and BMI\***

|                              | IADPSG<br>negative | IADPSG<br>positive | FPG $\geq 89$<br>mg/dL | BMI $\geq 33.5$<br>kg/m <sup>2</sup> |
|------------------------------|--------------------|--------------------|------------------------|--------------------------------------|
| <i>n</i>                     | 2,930              | 277                | 277                    | 278                                  |
| FM†                          | 7.6 (6.6–8.6)      | 16.4 (12.0–20.8)   | 18.8 (14.2–23.2)       | 17.3 (12.8–21.8)                     |
| Pre-eclampsia/<br>eclampsia‡ | 1.2 (0.8–1.6)      | 1.8 (0.6–4.2)      | 2.2 (0.8–4.7)          | 4.3 (2.3–7.4)                        |

\*None of the differences in outcome rates between the IADPSG-positive, FPG  $\geq 89$  mg/dL, and BMI  $\geq 33.5$  kg/m<sup>2</sup> groups were statistically significant. Continuity-adjusted  $\chi^2$  test (after adjustment for overlapping membership): FM: IADPSG vs. FPG,  $P = 0.37$ ; IADPSG vs. BMI,  $P = 0.83$ ; FPG vs. BMI,  $P = 0.71$ . Pre-eclampsia/eclampsia: IADPSG vs. FPG,  $P > 0.9$ ; IADPSG vs. BMI,  $P = 0.07$ ; FPG vs. BMI,  $P = 0.14$ . †FM was defined as birth weight  $> 90$ th percentile, adjusted for sex and gestational age. Birth weight percentiles were calculated for the Israeli participants' offspring, using national birth weight standards (15). ‡Pre-eclampsia was defined as systolic blood pressure  $\geq 140$  mmHg or diastolic blood pressure  $\geq 90$  mmHg on  $\geq 2$  occasions a minimum of 6 h apart, and proteinuria of  $\geq 1+$  on a dipstick test or a protein level in the urine of  $\geq 300$  mg for a 24-h period (9).

**Table 2: The rate of adverse outcomes using the IADPSG diagnostic thresholds for GDM, FPG  $\geq 89$ mg/dL and BMI  $\geq 33.5$ kg/m<sup>2</sup>.**

Using the thresholds, IADPSG criteria, FPG, BMI and the identified similar proportions of fetal macrosomia.

**FINDINGS:** 20% of the women with an FPG  $< 89$ mg/dL who had a risk score  $\geq 200$  had an FM rate of 17.5%, like that for women with an FPG  $> 89$ mg/dL. A two-step screening approach was performed as follows: all pregnant women would have an FPG test, with levels  $> 89$  mg/dL defining GDM. Among women with an FPG  $< 89$  mg/dL, those with a risk score  $\geq 200$  would undergo OGTT, with GDM determined according to post load IADPSG thresholds.

**IMPLICATIONS:** The researcher reported that instead of universal OGTT, only 18.5% of the pregnant women would undergo an OGTT, and the proportion diagnosed with GDM would increase to 9.5% compared to 8.3%. The researcher concluded that universal OGTT would impose excessive burden in low resource setting and promote over-treatment. This article

enables one to question the feasibility and validity of adopting the IADPSG guidelines in Trinidad and Tobago where laboratory supply is limited, and clinics are overwhelmed.

**LIMITATIONS:** The findings of this study have limited generalisability in our setting as our ethnic composition is different to that of Israel. In Trinidad and Tobago, more than one third of the population are of South East Asian ethnicity which confers a higher risk to developing GDM compared to the African or Mixed counterparts. Therefore, if our baseline population is at a higher risk for GDM, then unique cut-offs for FPG and BMI will need to be determined or the IADPSG criteria may be warranted.

#### **FOURTH ARTICLE:**

Jones SM, Wilson C. Audit on outcome of midwife-led gestational diabetes care. British Journal of Midwifery. December 2010. Vol 18, No12.<sup>8</sup>

1. Did the study address a focused issue? Yes: The objective was to compare the pregnancy outcomes of gestational diabetic women who received midwife-led care to those who received specific treatment from multidisciplinary teams and to determine the progress of gestational diabetes mellitus (GDM) to type 2 diabetes mellitus (DM). The population studied was from the antenatal diabetes clinic at an East London maternity unit. A retrospective study was designed in which 291 women with GDM who attended the postnatal diabetic educational clinic 6 weeks following childbirth. The risk factors studied was ethnicity, attendances at clinics. The outcomes measured were mode of deliveries, macrosomia, prematurity neonatal admissions, progression to type 2 DM. This is an

inappropriate study design. A randomised controlled trial would have been well suited for investigating the effect of a midwife led care for women with GDM compared to a multidisciplinary team on fetal and maternal outcomes.

2. Was the cohort recruited in an acceptable way: Unsure. The sampling method was not stated, this will compromise the generalizability of the findings because of the potential of selection bias. The author noted that the target population had a high proportion of patients of South East Asians ethnicity i.e. from Bangladesh.

3. Was the exposure accurately measured to minimise bias? No. Classification bias cannot be excluded as the definition for GDM was not defined neither conceptually nor operationally. This leads one to wonder which diagnostic criteria was used to classify women as GDM.

“Intervention” included new guidelines for managing diabetes (diagnostic criteria not stated), training for community midwives (educational material not supplemented), weekly educational groups for patients.

4. Was the outcome accurately measured to minimise bias? Unsure. Subjective measurement was used for classifying ethnicity. Objective measurements were used for birth weight and the diagnosis postpartum type 2 DM by WHO (1999) criteria.

5. All confounding factors were not identified such as maternal BMI at 24-28 weeks,

previous history of GDM, pre-existing DM in pregnancy.

6. The follow-up of subjects was too short i.e. until 6 weeks post-partum. Risk of attrition bias as there was no account of women who were lost to follow-up as the women who were lost to follow-up may have different outcomes than those available for assessment.

7. Study findings: Ethnicity-the highest proportion of GDM were Bangladeshi and African compared to Caucasian; Clinic attendances during the first 6 months were reduced by 50% with significantly shorter waiting times; Mode of deliveries: 62% vaginal, 31% caesarean section and 6% of women with GDM had assisted deliveries; Macrosomia-1%; Premature babies-4.1%; 4.1% progression to type 2DM at 6weeks post-partum.

8. The results were not precise. Statistical analysis describing the level of significance or confidence intervals for the results were not reported.

9. I have limited confidence in the results. Even though the reduction in clinic attendance is a big effect, there is a possibility that it can be due to bias, chance or confounding. The design and methods of this study are sufficiently flawed to make the results unreliable.

10.Implications of the study. The researcher has stated that since this study all women from minority ethnic groups will be screened for GDM. This finding is consistent with international literature. However, this study does not provide sufficiently robust evidence to recommend changes to clinical practice or within health policy decision making.

## CONCLUSION:

Clinical decision making is guided by evidence- based research. Articles with robust data and international consensus like the HAPO study should not be diluted by articles with low GRADE or quality. The fourth article was included to demonstrate the need to critically appraise literature.

Published data on GDM based on IADPSG is constantly evolving. Literature review should therefore be a continuous process on the measurement of the impact of this disease. One can firmly conclude that gestational diabetes mellitus is a significant contributor to morbidity and mortality to all persons as it is a predictor of Diabetes Mellitus to both sexes and is of high importance for further research.<sup>33</sup>

## APPENDIX 3: CERTIFICATE OF COMPLETION



### THE UNIVERSITY OF THE WEST INDIES School for Graduate Studies and Research

#### CERTIFICATE OF COMPLETION OF THESIS/RESEARCH PAPER/PROJECT REPORT/CASEBOOK/CLINICAL RESEARCH PROJECT

*Section A of this form is to be completed by the Student and Section B by both the Supervisor and Head of Department. It must accompany the thesis/research paper/project report/casebook/clinical research project when being submitted to the Campus Office of Graduate Studies and Research for examination.*

#### Section A:

Name of Student: \_\_\_\_\_ Dr. Artee Bridgelal-Gonzales \_\_\_\_\_

Faculty in which Student is registered: \_\_\_\_\_ Medical Sciences \_\_\_\_\_

Degree Programme: \_\_\_\_\_ Doctor of Medicine in Family Medicine \_\_\_\_\_

Title of Thesis/Research Paper/Project Report/Casebook/Clinical Research Project (the Submission):  
\_\_\_\_\_ Screening for Gestational Diabetes Mellitus in a Primary Care Setting, East Trinidad, 2018-  
2020 \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

#### Declaration of Word Length and Ownership of Work

1. Word length of the Submission: \_\_\_\_\_ Text 5121 \_\_\_\_\_

*A candidate will not normally exceed the word limit prescribed in the Thesis Guide. Any candidate wishing to exceed this limit must apply for permission to the Campus Committee for Graduate Studies and Research through his/her supervisor, and confirmation of suspension of Regulations must be attached.*

2. Style Manual used: \_\_\_\_\_ Vancouver \_\_\_\_\_

3. I confirm that the work presented in the Submission is my own and all references are cited according to accepted University of the West Indies' conventions. I have submitted my Thesis/Research Paper/Project Report/Casebook/Clinical Research Project for checking by the following plagiarism detection software:

\_\_\_\_\_ Turnitin \_\_\_\_\_  
—

**and have made all necessary amendments.**

4. Consistent with The University of the West Indies' policy on Plagiarism, I agree that the University has the right to use plagiarism detection software to check the electronic version of the Submission.

Artee Bridgelal-Gonzales \_\_\_\_\_ Date 20/08/2022

Signature of Student

Date

## Section B:

I hereby certify that:

- a) Dr./Mr./Ms. Dr. Artee Bridgelal-Gonzales \_\_\_\_\_  
(Name in Full)  
is a registered Student of The University of the West Indies.
- b) he/she has completed his/her Thesis/Research Paper/Project Report/Casebook<sup>#</sup>/Clinical Research Project<sup>#</sup>.
- c) five (5) identical copies of the Submission<sup>†</sup>, or (4) identical copies of the Submission<sup>†</sup>, as the requirement may be, have been produced in accordance with the Regulations of The University of the West Indies
- d) the work has been checked for plagiarism and proper use of citation and referencing.
- e) the work has been completed to my satisfaction and is acceptable for examination\*.

\* Format of the copies shall be as specified in the Regulations for Postgraduate Clinical Programmes.

† Select as appropriate. One of these copies should be electronic, submitted on a CD/DVD (in edit-enabled format/Microsoft Word format), and certified by the Supervisor.

\* If the Supervisor does not consider that the work has been completed to his/her satisfaction and is acceptable for examination, he/she should strike through the statement in part e) and write appropriate comments below.

Supervisor's Comments (when declining to agree to part e): \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

\_\_\_\_\_  
Name of Supervisor Signature of Supervisor Date

\_\_\_\_\_  
Name of Co-Supervisor Signature of Co-Supervisor Date

\_\_\_\_\_  
Name of Head of Department Signature of Head of Department Date

## APPENDIX 4: Approval from UWI's Research Ethics Committee



THE UNIVERSITY OF THE WEST INDIES

ST. AUGUSTINE, TRINIDAD AND TOBAGO, WEST INDIES

CAMPUS RESEARCH ETHICS COMMITTEE

TELEPHONE: (1-868) 662-2002 ext. 62755 E-mail: [campusethics@sta.uwi.edu](mailto:campusethics@sta.uwi.edu)

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March, 8 2021

**Dr. Artee Bridgelal-Gonzales**  
Public Health and Primary Care Department  
Faculty of Medical Sciences  
Email: [artee.bridgelal@gmail.com](mailto:artee.bridgelal@gmail.com)

Dear Dr. Artee Bridgelal-Gonzales,

**Ref: CREC-SA.0800/03/2021**

**Title: Screening for Gestational Diabetes Mellitus in a Primary Care Setting, East Trinidad, 2018-2020.**

I am pleased to advise that your application for research on the above captioned topic has met the criteria for Exemption from Review from the Campus Research Ethics Committee, St. Augustine.

Sincerely,



Professor Jerome De Lisle  
Chair  
Campus Research Ethics Committee

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Digitally generated by UWIScholar

## APPENDIX 5: Approval from the ERHA's Research Ethics Committee



## APPENDIX 6: TURNITIN SELF CHECK TOOL CERTIFICATE

|                    |                                                                                                                                                                                                                                                                           |              |                |
|--------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|----------------|
| GDMJuly17          |                                                                                                                                                                                                                                                                           |              |                |
| ORIGINALITY REPORT |                                                                                                                                                                                                                                                                           |              |                |
| 7%                 | 4%                                                                                                                                                                                                                                                                        | 5%           | 1%             |
| SIMILARITY INDEX   | INTERNET SOURCES                                                                                                                                                                                                                                                          | PUBLICATIONS | STUDENT PAPERS |
| PRIMARY SOURCES    |                                                                                                                                                                                                                                                                           |              |                |
| 1                  | Hema Divakar, Shelly Dutta, Rita Singh, Poorni Narayanan, Asha Hegde, Bhagyashree Kulkarni, Divakar G.V. "GESTATIONAL DIABETES MELLITUS- TESTING IN THIRD TRIMESTER- NEW DATA AND FRESH THINKING", Journal of Evidence Based Medicine and Healthcare, 2017<br>Publication |              | 1%             |
| 2                  | www.ijphrd.com<br>Internet Source                                                                                                                                                                                                                                         |              | 1%             |
| 3                  | obgyn.pericles-prod.literatumonline.com<br>Internet Source                                                                                                                                                                                                                |              | <1%            |
| 4                  | "A Practical Manual of Diabetes in Pregnancy", Wiley, 2010<br>Publication                                                                                                                                                                                                 |              | <1%            |
| 5                  | Tamara Joy Phiri, Marianne Kasiya, Theresa J Allain. "Full Prevalence Of Gestational Diabetes In Urban Women In Blantyre, Malawi: A Cross Sectional Study And Comparison Of Who And IADPSG Criteria", Research Square Platform LLC, 2019                                  |              | <1%            |

| Publication |                                                                                                                                                                                                                                                                     |      |
|-------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|
| 6           | <a href="https://scholarworks.umass.edu">scholarworks.umass.edu</a><br>Internet Source                                                                                                                                                                              | <1 % |
| 7           | "Oral and Poster Presentations", The Journal of Maternal-Fetal & Neonatal Medicine, 2009<br>Publication                                                                                                                                                             | <1 % |
| 8           | <a href="https://research.ohiou.edu">research.ohiou.edu</a><br>Internet Source                                                                                                                                                                                      | <1 % |
| 9           | <a href="https://mejfm.com">mejfm.com</a><br>Internet Source                                                                                                                                                                                                        | <1 % |
| 10          | <a href="https://Bmcpediatr.Biomedcentral.Com">Bmcpediatr.Biomedcentral.Com</a><br>Internet Source                                                                                                                                                                  | <1 % |
| 11          | <a href="https://assets.researchsquare.com">assets.researchsquare.com</a><br>Internet Source                                                                                                                                                                        | <1 % |
| 12          | Submitted to National postgraduate Medical College of Nigeria<br>Student Paper                                                                                                                                                                                      | <1 % |
| 13          | <a href="https://jisppd.com">jisppd.com</a><br>Internet Source                                                                                                                                                                                                      | <1 % |
| 14          | John Punnose, Rajeev Kumar Malhotra, Komal Sukhija, Asha Sharma, Prassan Vij, Rashika M. Rijhwani, Naimaa Choudhary. "Prevalence of 'Hyperglycemia in pregnancy' remained stable between 2006 and 2015, despite rise in conventional risk factors: A hospital based | <1 % |

study in Delhi, North India", Diabetes  
Research and Clinical Practice, 2021  
Publication

|    |                                                                                           |      |
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# GDMJuly17

by Artee Bridgelal-Gonzales

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## INTRODUCTION

Hyperglycaemia in pregnancy (HIP) is defined as hyperglycaemia first detected at any time during pregnancy and sub-classified as diabetes in pregnancy (DIP) and gestational diabetes mellitus (GDM).<sup>1</sup> HIP is the most common metabolic disturbance affecting pregnancy.<sup>1</sup> GDM is defined as "any degree of glucose intolerance with onset or first recognition during pregnancy," that does not meet the criteria for a diagnosis of diabetes mellitus as per the criteria for a non-pregnant patient.<sup>2</sup>

In 2019 the global prevalence of HIP was 15.8%, with GDM accounting for 12.8% and DIP 2.6% according to the IDF Diabetes Atlas.<sup>3,4,5</sup> The reported prevalence of HIP is highly variable globally between countries and from year to year due to many confounding factors: definitions of HIP, access to universal screening, variable screening practices, and the diagnostic criteria applied.<sup>6-11</sup> The prevalence of risk factors for GDM in the population such as increasing maternal age, obesity, and the prevalence of pre-existing diabetes are also contributors.<sup>12</sup>

The Latin American & Caribbean Declaration on Hyperglycaemia in Pregnancy, November 2017 recognises HIP as a significant public health challenge that affects maternal and child health and the future burden of type 2 diabetes.<sup>13-16</sup>

Maternal hyperglycaemia promotes fat deposition leading to macrosomia which is directly related to difficult vaginal delivery with shoulder dystocia, nerve palsies and fractures.<sup>14-17</sup> GDM is also associated with neonatal hypoglycaemia, hyperbilirubinemia, polycythaemia, hypocalcaemia and respiratory distress syndrome.<sup>18</sup> Long term fetal outcomes of GDM include adult obesity, diabetes and metabolic syndrome, at a rate of two to eight times that seen in the offspring of mothers without

GDM.<sup>13-15,19</sup>

Short term maternal outcomes of GDM include excess weight gain, labour induction, shoulder dystocia, increased caesarean birth, pre-eclampsia or hypertension in pregnancy.<sup>14, 17, 20</sup> Long term maternal outcomes include an increased rate of cardiovascular disease, metabolic syndrome and diabetes mellitus.<sup>14,16-20</sup> Approximately half of all patients with GDM will develop diabetes mellitus within a decade.<sup>16-18, 20</sup>

Identifying and treating women with HIP is an opportunity to improve pregnancy outcomes and to improve the health of a mother and her child.<sup>21</sup> In 2017, a national standardised protocol for GDM screening and management was implemented in Trinidad and Tobago from the Ministry of Health (MOH), Directorate of Women's Health, in which the WHO and the IADPSG diagnostic criteria (fasting-92mg/dl, 1h postprandial-180mg/dl, 2h postprandial-153 mg/dl) was recommended for the universal screening of all pregnant women as a one- step 75g glucose OGTT in their initial visit and repeated at 24-28 weeks of gestation, if initially normal.<sup>22, 23</sup>

The Ministry of Health's guidelines included universal screening compared to risk-based as our population in Trinidad is already at higher risk due to the high proportion of persons with risk factors for GDM such as East Indian ethnicity, overweight or obese, previous macrosomia/GDM, advanced maternal age and family history of Diabetes Mellitus.<sup>12</sup> This is supported by findings from the national 2011 STEPS study.<sup>23,24</sup>

In 2018, Lutchmarsingh F et al. demonstrated that based on the IADPSG guidelines (universal screening and one step 75g OGTT) the prevalence of GDM among women attending tertiary care in North Trinidad was 14.1% compared to 4.36% prevalence of GDM among women attending tertiary care in North Trinidad as reported by Clapperton et al, 2008 in which risk factor screening

was applied.<sup>25-27</sup>

Literature on the prevalence of GDM among pregnant women in the primary care setting of Trinidad was lacking.<sup>23-28</sup> The prevalence of GDM in tertiary care may be an overestimation of the prevalence in primary care as the population of pregnant women attending tertiary care may have a higher proportion of risk factors for GDM than those attending primary care.<sup>24,28,29</sup>

The findings of this study would provide estimates of the burden of GDM in primary care that is the prevalence of GDM in the primary care setting and not the referral rate of women with GDM to tertiary care. A proof of concept study can be conducted to pilot a more feasible and cost-effective model of GDM screening, diagnosis and initial primary care management in Trinidad.<sup>30</sup>

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Health care policy makers would be guided by the study findings to increase dedicated resources and health education of women attending antenatal clinics and health care providers in primary care as it expected that the prevalence of GDM should increase fourfold with the application of the IADPSG criteria.<sup>34,35</sup> Lifestyle interventions during pregnancy, with continuity after delivery, will help reduce progression to type 2 diabetes and the development of cardiovascular disease.<sup>17,</sup>

19, 29,34

## AIMS

4

To determine the proportion of women with GDM in a primary care setting and its predictors.

## OBJECTIVES

4

To determine:

- a) The proportion of women screened for GDM among the women attending primary care antenatal clinics in East Trinidad, 2018-2020 according to the Ministry of Health guidelines.
- b) The proportion of women attending the Antenatal clinic in East Trinidad, 2018-2020 who met the IADPSG criteria for GDM at booking visit and at 24-28 weeks gestation.
- c) The prevalence of risk factors among women attending the primary care antenatal clinic in East Trinidad, 2018-2020.
- d) The significance of the association of the risk factors with the occurrence of GDM among women attending the primary care antenatal clinic in East Trinidad, 2018-2020.

## METHODS

### Setting

Health care in Trinidad and Tobago can be accessed publicly via one of the five Regional Health Authorities, Eastern, North Central, North West, South West and Tobago or privately. However, due to the low socio-economic status and the remoteness of the catchment area of the Eastern Regional Health Authority (ERHA), it was assumed that all pregnant women in the catchment area attended the antenatal clinics in the public system.

Health care delivery in the Eastern region spanned the largest geographical area of all the Regional Health Authorities however had the second smallest catchment population when compared to the other five (5) Authorities. Approximately 114, 776 persons accessed health care via the ERHA. The ERHA 's catchment covered approximately one third of Trinidad. Of the two counties, County St. Andrew/St. David and County Nariva/Mayaro, there were 16 Health Centres, 1 District Health Facility and 1 District Hospital.

Findings from the study were expected to inform public health policy makers and would impact on the strategies developed and implemented in order to meet the health requirements of the populace of Eastern Trinidad.

Figure 1: Health Administration Map of Trinidad and Tobago



Data from the Central Statistical Office and the Public Health Observatory showed that the characteristics of persons in the catchment were generally similar in all health centres such as:

- Ethnicity: 44% East Indian, 29% African, 26% Mixed compared to the general population which had a distribution of 37%, 28% and 32% respectively
- 60% of the Primary care attendees were female.

There was reduced variability in the screening practices for GDM in the health centres as the primary care physicians in each county were not fixed to one health centre but rotated to all. Thus, the study findings from the Sangre Grande, Valencia and Cumuto Health centres can be generalised to all 16 health centres in the ERHA. The Sangre Grande Enhanced Health Centre (SGEHC) was strategically chosen as it serves the largest catchment of 35 285 persons and was situated closest

to the Sangre Grande Hospital where all women with GDM were referred to for further management. The health centres from two smaller catchment areas, Valencia and Cumuto, were selected to ensure that the study findings were representative of the screening practices in primary care regardless of size of catchment population and proximity to tertiary health care.

Figure 2: Map of the Catchment Area of the Sangre Grande Enhanced Health Centre



## **STUDY DESIGN**

A cross sectional study was designed in which the health records of a proportionally representative sample of women attending antenatal clinic were reviewed.

### **Patient selection**

The target population was all pregnancies of adult women in East Trinidad, January 2018 to December 2020. The inclusion criterion was all women  $\geq 18$  years old attending the antenatal clinic at the Cumuto, Valencia and Sangre Grande Enhanced Health Centres. The antenatal records were reviewed from booking visit to delivery. Exclusion criteria included pre-existing clinical diabetes, and patients who were not attended by a primary care physician.

### **Data Source/Management**

Data was collected from the primary care antenatal records using a de novo instrument (Appendix 1) based on the Ministry of Health of Trinidad and Tobago's Diabetes Mellitus and Pregnancy Clinical guidelines (IADPSG recommendations).<sup>22,31</sup>

The data collection instrument was reviewed for face and content validity by 2 Endocrinologists and 1 Primary Care Physician. Ten antenatal files were chosen randomly to assess construct validity of the instrument. Two medical records clerks on duty were responsible for reviewing the patient registry (electronic and hard copy) to confirm if OGTT appointments were given. One phlebotomist on duty verified if the patient had performed the OGTT. The data collected was reviewed by a Public Health Specialist and an Endocrinologist for further refinement of the instrument.

Data was collected from the primary care antenatal records using a de novo instrument (Appendix 1) based on the Ministry of Health of Trinidad and Tobago's Diabetes Mellitus and Pregnancy Clinical guidelines (LADPSG recommendations).<sup>22,38</sup>

The data collection instrument was reviewed for face and content validity by 2 Endocrinologists and 1 Primary Care Physician. Ten antenatal files were chosen randomly to assess construct validity of the instrument. Two medical records clerks on duty were responsible for reviewing the patient registry (electronic and hard copy) to confirm if OGTT appointments were given. One phlebotomist on duty verified if the patient had performed the OGTT. The data collected was reviewed by a Public Health Specialist and an Endocrinologist for further refinement of the instrument.

#### **Variables**

The investigate variables included predisposing factors to GDM: demographic data such as age, self-reported ethnicity, family history of Diabetes Mellitus, history of gestational diabetes mellitus in previous pregnancy, previous macrosomic baby weighing 4.5kg or above, BMI, weight gain in pregnancy up to 24-28 weeks gestation. Other variables were the recommendation of screening at booking visit and at 24-28 weeks gestation, OGTT readings, diagnosis of GDM and referral to tertiary care.

Anthropometrics was measured by a trained Enrolled Nursing Assistant: After the patient removed her footwear, the height was measured with the patient's back touching the stadiometer. The reading was taken at the level of the top of the patient's head.

Weight was measured using a calibrated electronic scale. After removal of shoes and heavy jackets, the patient was asked to stand still in the centre of the scale with feet apart

17

Body Mass Index (BMI) was calculated using the formula  $BMI = \text{weight in kg} / \text{squared height in m}^2$ .

Investigations: Random capillary sugars were tested by a trained Enrolled Nursing Assistant using a validated and calibrated hand-held glucometer.

Vene-sampling for the oral glucose tolerance test was performed by a trained phlebotomist on a scheduled date at the health centre. Prior to booking, patients were advised to fast 8 to 12 hours before the test. An 8-ounce solution of 75g of glucose was given to the patient after the fasting plasma glucose sample was taken. One and two -hour samples post prandial plasma glucose samples were then collected. The blood samples were sent from the Health Centre to the Sangre Grande Hospital's laboratory on the same day where it was processed in a calibrated, validated automatic biochemistry analyser, Mindray BS-800.

#### **Sample size**

The Monthly Report of Community Services from the Public Health Observatory, ERHA reported the total number of antenatal attendees for the period which was used as the denominator for calculating the rate of detection of GDM for the period 2018-2020.

Testing the null hypothesis: The proportion of women with GDM in primary care is the same as the tertiary care estimate of 14.1%.

Alternate hypothesis: The proportion of women with GDM in primary care is different from the tertiary care estimate of 14.1%.

Using Sample Size:  $n = \frac{z^2 p(1-p)}{d^2}$

Where:  $\alpha = 5\%$  is the level of significance

$Z = Z$  statistic for the standard normal deviate for a two-sided  $\alpha = 1.96$

$P =$  expected prevalence or proportion of GDM in Trinidad = 14.1%.<sup>26</sup>

$d = 5.00\%$  is the precision or the total width of confidence interval.

$$n = \frac{Z^2 p(1-p)}{d^2} = \frac{1.96^2 \times 0.141 \times (1-0.141)}{0.05^2} = 186$$

Estimated sample size:  $n = 186$

#### Finite population correction factor (FCP)

$$n = \frac{n_0}{[1 + (n_0/N)]}$$

As derived from the Community Health Services Utilisation Services Report from the Public Health Observatory of the ERHA, where  $N = 4313$  is the total number of patients who attended the Valencia, Cumuto and Sangre Grande Enhanced Health Centre antenatal clinics in 2018-2020,  $n/N > 0.05$ .

$$\frac{186}{1 + \frac{186}{4313}} = 179 \text{ patients}$$

**Sample size adjusted for a finite population is 179 patients.**

**Inflating for Missing data:** Assuming missing data = 30%

$$n^* = n / [1 - (x/100)] = \frac{179}{1 - \frac{30}{100}} = 255 \text{ patients}$$

A minimum sample size of 255 patient files was chosen proportionally from the health centres as

shown in Table 1 below.

**Table 1: The number of patients attending Antenatal clinics per Health centre 2018-2020.**

| Health centre          | #Antenatal clinic attendees<br>2018-2020 | #Files needed from<br>1/1/2018-31/12/2020 |
|------------------------|------------------------------------------|-------------------------------------------|
| Sangre Grande Enhanced | 2413                                     | 142                                       |
| Valencia               | 1483                                     | 88                                        |
| Cumuto                 | 417                                      | 25                                        |
| <b>Total</b>           | <b>4313</b>                              | <b>255</b>                                |

The population was sampled via systematic sampling of antenatal clinic attendee list for each health centre from January 2018 to December 2020.

$$k = \frac{N}{n}$$

$k$  = systematic sampling interval

$N$  = population size

$n$  = sample size

Sampling interval = Population size / sample size = 4313 / 255 = 16

Firstly, the sampling interval was calculated as that of 16<sup>th</sup> antenatal file. As is the usual protocol for the Registration of patients at all clinics in each health center, patients attending the antenatal clinics were registered in a log book at each health center at the time of booking visit. The names

of the patients entered in this log book are entered conveniently by the Medical Records department as the patient presents to the clinic that is by first come first served basis there is no special pattern to the register.

The medical records clerks randomly selected a starting point between 1 and the sampling interval of 16 on the enumerated list of patients in the month of January 2018. Every 16<sup>th</sup> patient from that starting point was selected.

#### **Statistical Methods**

Data was entered in Microsoft® Excel® 2019 version 1808 and analysed by Statistical Package for the Social Sciences, IBM® SPSS® version 25. A descriptive analysis was conducted such as the calculation of means and confidence intervals for normally distributed continuous variables, median and interquartile range of non-normally distributed variables. Continuous variables were converted to binary categories. Frequencies or percentages was calculated for categorical variables, with between group comparisons for GDM/HIP done using Chi-square test.

Binary logistic regression analysis was done to determine the extent of association the investigate risk factors had with GDM. Exposure to Risk factors for GDM included advanced maternal age, East Indian ethnicity, family history of DM, previous GDM/fetal macrosomia, overweight/obesity. Outcome variables considered for investigation included the proportion of clinic attendees who were screened for GDM and the prevalence of GDM that is the proportion of participants who met the MOH criteria for GDM among ANC attendees in the booking visit and between 24-28 weeks of gestation.

#### **Ethical Issues**

Vulnerable populations such as children and people with impaired mental capacity were not

included in the study. There was no intervention nor change in the clinical consultation in the research as such informed consent was waived as the research presented no more than minimal risk to participants. The waiver of informed consent did not adversely affect the rights and welfare of the pregnant women attending antenatal clinic as only the medical records files were accessed. Women who tested positive for GDM were referred to tertiary care in accordance to the guidelines from the Ministry of Health. Dietary advice and educational counselling were implemented at the time of diagnosis as usual care at the primary care level.<sup>34</sup>

Privacy and confidentiality of the data collected was maintained. The data collection tool was coded with a unique identifier to ensure the anonymity of the research subject. The computer used for data entry and analysis was password protected and accessible to the researcher only.

The research proposal was approved by the research ethics committees of the University of the West Indies, St. Augustine campus (Ref:CREC-SA.0800/03/2021) and the Eastern Regional Health Authority of Trinidad and Tobago (see Appendices 4 & 5).

## RESULTS

Of the 257 antenatal files sampled, one person was excluded due to pre-existing DM in pregnancy

as shown in Figure 4 below. Of the 256 files included, 78.9% of the women attending antenatal clinic were screened according to the MOHTT guidelines. Fifty four persons were not screened for GDM.

Figure 4: Flow Chart on the Numbers Sampled for the Study Population

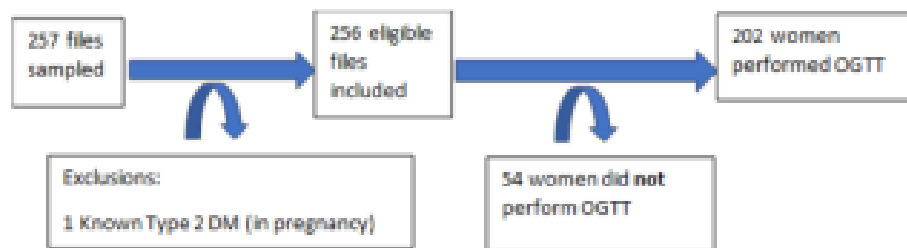


Table 2: Profile of the Women who were Not screened for GDM in Primary Care

| Characteristics                              | Description                                               |
|----------------------------------------------|-----------------------------------------------------------|
| Age years, Mean $\pm$ SD(Range)              | 29.04 $\pm$ 6.39* (range18-41)                            |
| BMI kg/m <sup>2</sup> , Mean $\pm$ SD(Range) | 27.7 $\pm$ 6* (range17-42)                                |
| Total Parity                                 | median 1.50; mean 2.02 ( $\pm$ 1.68)*; mode1; range (0-7) |
| Ethnicity, n(%)                              |                                                           |
| African                                      | 17 (31.4%)                                                |
| East Indian                                  | 10 (17.9%)                                                |
| Mixed                                        | 20 (35.7 %)                                               |
| Hispanic                                     | 2 (3.7%)                                                  |
| Family History of DM, n(%)                   | 32 (57.1%)                                                |
| History of Fetal Macrosomia, n(%)            | 2 (3.7%)                                                  |
| History of GDM, n(%)                         | 3 (5.5%)                                                  |

\*Standard Deviation

As shown in Table 2 above, the 54 women attending antenatal clinics in primary who did not perform the Oral Glucose Tolerance Testing were of mean age 29 years old, mean BMI 27 kg/m<sup>2</sup>, mean number of previous pregnancies 2, roughly on third of the women were of Mixed ethnicity (African and East Indian) or African ethnicity. More than half of the women who did not perform the OGTT had a family history of Diabetes Mellitus. Table 3 below demonstrates the health care

providers' non-adherence to MOH guidelines in providing universal screening for GDM at the first visit.

**Table 3: Reasons for no OGTT testing at Primary Care Antenatal Clinics**

| <b>Reasons why women were not screened for GDM, n=54</b> | <b>Number</b> | <b>%</b> |
|----------------------------------------------------------|---------------|----------|
| Referred to Tertiary Care Antenatal Clinic               | 32            | 53.3%    |
| Defaulted from clinic                                    | 9             | 16.6%    |
| Missed appointment                                       | 7             | 12.9%    |
| Not requested by Medical Doctor                          | 5             | 9.26%    |
| Vomiting                                                 | 1             | 1.85%    |

At the first visit to primary care, women identified as high risk pregnancies at the booking visit were redirected to tertiary care and discharged from primary care management. They did not perform the OGTT at the primary care setting. At the booking visit, three women at  $\text{pog} < 24/40$  were found to have DM in pregnancy and referred to tertiary care for further management as seen below in Table 4.

**Table 4: The OGTT findings for women screened for GDM at Booking visit and by period of gestation (pog).**

| <b>Screened</b>      | <b>Booking visit<br/><math>\text{pog} &lt; 24/40</math></b> | <b>Booking visit<br/><math>\text{pog} \geq 24/40</math></b> | <b>2<sup>nd</sup> Screen at<br/><math>\text{pog} \geq 24/40</math></b> | <b>Total women<br/>screened<br/><math>\text{pog} \geq 24/40</math></b> |
|----------------------|-------------------------------------------------------------|-------------------------------------------------------------|------------------------------------------------------------------------|------------------------------------------------------------------------|
| Not tested           | 63                                                          | 10                                                          | 72                                                                     | 82                                                                     |
| Normoglycemia        | 118                                                         | 45                                                          | 64                                                                     | 109                                                                    |
| DM in pregnancy      | 3                                                           | 0                                                           | 0                                                                      | 0                                                                      |
| Total GDM            | 12                                                          | 1                                                           | 7                                                                      | 8                                                                      |
| Missed GDM diagnosis | 5                                                           | 1                                                           | 2                                                                      | 3                                                                      |
| Total tested         | 133                                                         | 46                                                          | 71                                                                     | 117                                                                    |

The proportion of women attending the Antenatal clinic in East Trinidad, 2018-2020, who met the IADPSG criteria for GDM at  $\text{pog} < 24/40$  was 9.02% (95%CI 4.75-15.2). At  $\text{pog} < 24/40$ , 41.6%

(95%CI 15.2-72.3) of the women who met the criteria for GDM were correctly identified by health care providers.

The proportion of women attending the Antenatal clinic in East Trinidad, 2018-2020, who met the IADPSG criteria for GDM at **booking visit (both  $\text{pog} < 24/40$  and  $\text{pog} \geq 24/40$ )** was **7.26%** (95%CI 3.92-12.1). At the booking visit, 53.8% (95%CI 25.1-80.8) of the women who met the criteria for GDM were correctly identified by health care providers.

The proportion of women attending the Antenatal clinic in East Trinidad, 2018- 2020, who met the IADPSG criteria for GDM at  **$\text{pog} \geq 24/40$**  (women at booking visit at  $\text{pog} \geq 24/40$  and women with second screen at  $\text{pog} \geq 24/40$ ) was **6.84%** (95%CI 3.0-13.0) and **62.5%** (95%CI 24.5-91.5) of these women were correctly identified as GDM by the health care providers. Nil women met the threshold for DM in pregnancy at  $\text{pog} \geq 24/40$ .

The total proportion of women who **screened positive for GDM** among the women attending the antenatal clinic of Eastern Trinidad 2018-2020 was **9.90%** (95%CI 6.15-14.9). Overall, 40%(95%CI 19.1-63.9) of all the women who met the threshold for GDM were not identified by the health care providers. The proportion of women attending the Antenatal clinic in East Trinidad, 2018- 2020 diagnosed as **DM in Pregnancy** was **1.97%** (95%CI 0.54-4.97). The proportion of women attending the Antenatal clinic in East Trinidad, 2018-2020 diagnosed as **HIP** was **11.8 %** (95%CI 7.72-17.1).

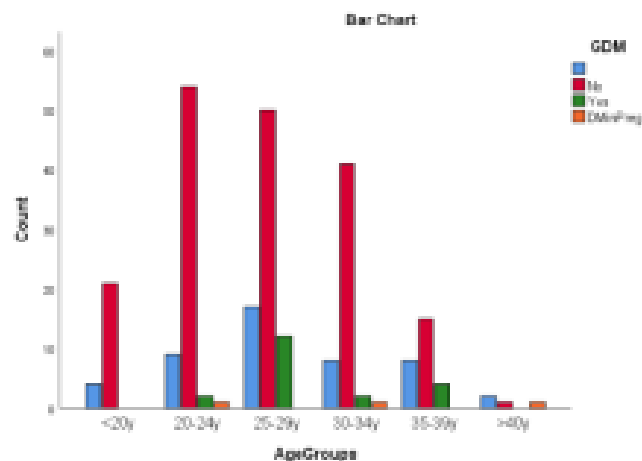
Table 5: The prevalence and association of GDM Risk Factors for GDM and HIP

| Risk factors for GDM     | Prevalence in sample population | GDM p-value | HIP p-value |
|--------------------------|---------------------------------|-------------|-------------|
| Known DM in first degree | 50.5%; 95% CI (43.4-57.6%)      | <0.001      | 0.018       |

|                                           |                            |      |        |
|-------------------------------------------|----------------------------|------|--------|
| relative                                  |                            |      |        |
| Ethnicity:                                |                            |      | 0.603  |
| East Indian                               | 22.8%, 95% CI (17.2-29.2%) | 0.02 | 0.114  |
| African                                   | 27.2%; 95% CI (21.2-33.9%) | 0.61 | 0.313  |
| Mixed                                     | 35.2%, 95% CI (28.6-42.1%) | 0.68 | 0.817  |
| Maternal age older than 35years           | 9.90%, 95% CI 6.15-14.9%   | 0.11 | 0.031  |
| BMI > 25 kg/m <sup>2</sup>                | 62.3%, 95% CI 52.0-72.9%   | 0.17 | 0.123  |
| Macrosomia in previous pregnancy          | 5%; 95% CI 2.42-9.0%       | 0.27 | 0.407  |
| GDM in previous pregnancy                 | 1%, 95%CI 0.12-3.57%       | 0.64 | <0.001 |
| High Parity (≥5)                          | 3.47%, 95% CI 1.40-7.01%   | 0.09 | 0.22   |
| Gestational weight gain in excess (>12kg) | 34.2%; 95% CI 26.6-42.4%   | 0.98 | 0.985  |

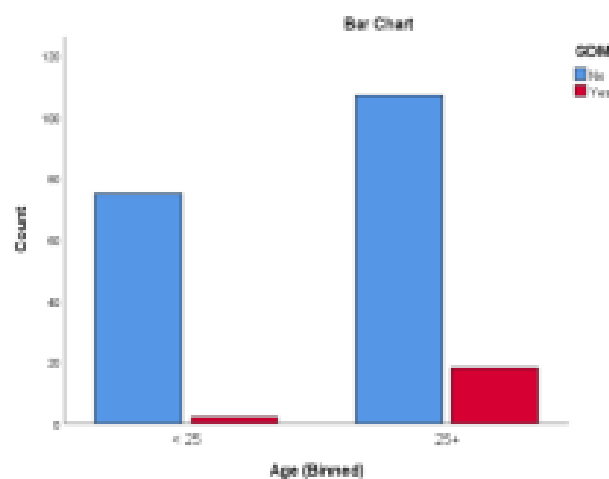
The mean age of the women attending antenatal clinic was 27y (95%CI 21.2-32.8y) as shown in Table 5 above. Women aged 35years and older were found to be significantly (  $p=0.031$ ) more likely to develop HIP compared to women aged less than 35years.

Figure 5: Bar Chart of Distribution for women diagnosed with GDM by Age Groups



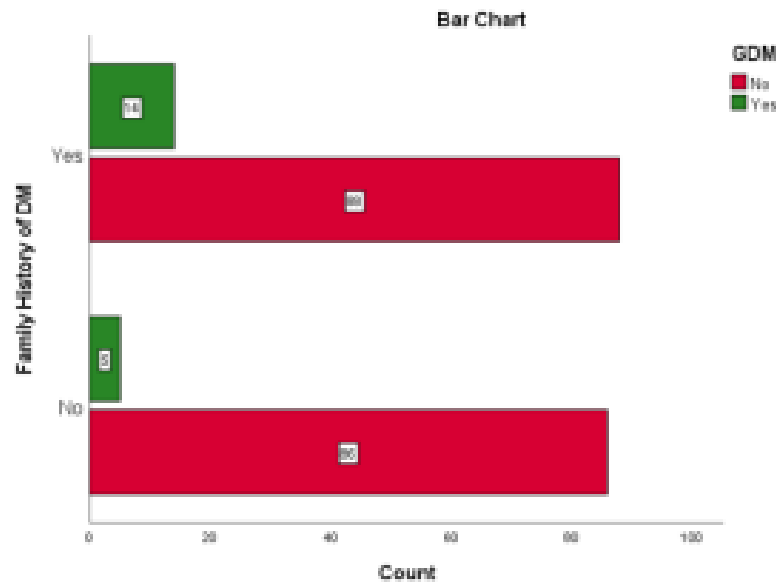
The age group of 25-29years had the highest proportion of GDM as shown in Figure 5 above. The women of the age 25 and over were more likely to develop GDM compared to women under the age of 25 (  $p=0.006$ ) as shown in Figure 6 below.

Figure 6: Distribution of women identified with GDM categorised by Age  $\geq 25$  years



More than half of the sample population had a family history of diabetes mellitus as shown in Figure 7 below.

Figure 7: The Distribution of women with GDM by Family History of DM



Of the women with GDM, 70% (95%CI 45.7-88.1%) had a history of a family history of DM and 73.9% (95%CI 51.6-89.8%) of the women with HIP had a family history of DM (  $p=0.061$ ) and was significantly associated with GDM (  $p<0.001$ ).

Of the available BMI measurements recorded, the mean BMI of the sample population was 27.2 kg/m<sup>2</sup>(CI 21.2, 33.2). 62.3% (95%CI 52.0-72.9%) of the population was overweight or obese (BMI $\geq$ 25kg/m<sup>2</sup>) as shown in Table 5 above. There was no statistically significant association between overweight and obese women with GDM compared to women with BMI<25kg/m<sup>2</sup>.

In addition, Table 5 shows that the mean gestational weight gain in pregnancy was 9.42kg( $\pm$ 5.56). Weight gain in pregnancy was strongly associated with GDM although not significant ( $p=0.085$ ). Excessive weight gain >12kg in pregnancy occurred in 34.2% (95%CI 26.6-42.4%) of the population, however was not significantly associated with GDM ( $p=0.985$ ) nor HIP ( $p=0.157$ ).

Figure 8: Distribution of women with GDM by Ethnicity

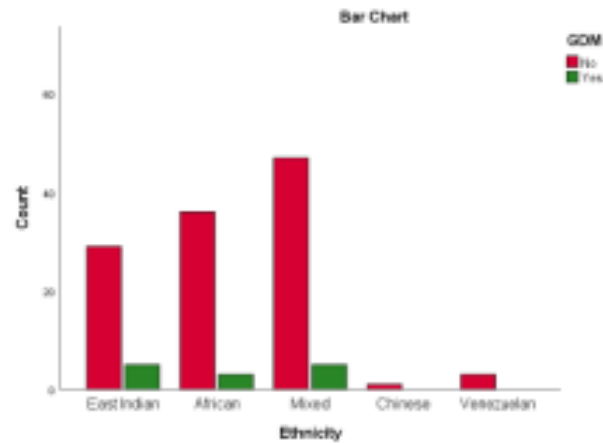
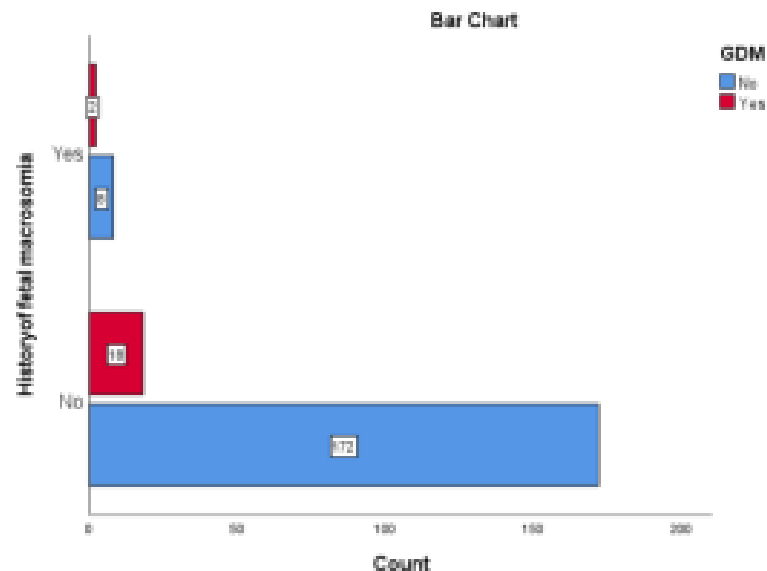


Figure 8 showed that the sample population was comprised of persons of the following Ethnicity: East Indians 22.8% (95%CI 17.2-29.2%), Africans 27.2% (95%CI 21.2-33.9%), Mixed (East Indian and African) 35.2% (95%CI 28.6-42.1%), Chinese 0.5% (95%CI 0.01-2.73%) and Hispanic (Venezuelan) 2.48% (95%CI 0.81-5.68%). East Indian ethnicity was significantly associated with GDM ( $p=0.027$ ) nor HIP ( $p=0.072$ ).

As shown in Figure 9 below, 10% (95%CI 1.24-31.7%) of the women with GDM had history of Fetal Macrosomia but no significant association with GDM ( $p=0.279$ ) nor HIP ( $p=0.511$ ).

Figure 9: The Distribution of women with GDM by History of Fetal Macrosomia



The median number of prior pregnancies the women was 1 with a mode of 1, and a range of 0–6. Grand multiparity (Parity $\geq$ 5) was not significantly associated with GDM ( $p=0.09$ ) nor HIP ( $p=0.22$ ).

Binary Logistic regression performed for the following predictor variables: Age, BMI at booking visit, Weight Gain in pregnancy, Family history of Diabetes Mellitus, history of Fetal Macrosomia, previous Gestational Diabetes, Parity, and Ethnicity, as shown in Table 6 below. The following predictors were significantly associated with GDM ( $p<0.05$ ): Maternal age  $\geq$ 25 years unadjusted OR 6.22; Family History of DM unadjusted OR 3.28 and BMI when adjusted for pog at booking visit OR 1.12.

Table 6: Binary Logistic Regression: Predictors of GDM

| Predictor Variable                                        | Unadjusted Odds Ratio<br>(95% Confidence Interval) | P value |
|-----------------------------------------------------------|----------------------------------------------------|---------|
| Age $\geq 25$ years                                       |                                                    |         |
| No <sup>a</sup>                                           | 1                                                  |         |
| Yes                                                       | 6.22 (1.40-27.6)                                   | 0.016   |
| Age $\geq 35$ years                                       |                                                    |         |
| No <sup>a</sup>                                           | 1                                                  |         |
| Yes                                                       | 2.57 (0.77-8.65)                                   | 0.125   |
| Age (year)                                                | 1.08(0.99-1.18)                                    | 0.058   |
| Family History of DM                                      |                                                    |         |
| No <sup>a</sup>                                           | 1                                                  |         |
| Yes                                                       | 3.28 (1.16-9.29)                                   | 0.025   |
| BMI (kg/m <sup>2</sup> )                                  | 1.09 (0.99-1.22)                                   | 0.076   |
| *adjusted for pog at booking visit                        | 1.12 (1.01-1.24)                                   | 0.034   |
| *adjusted for pog at booking visit, East Indian Ethnicity | 1.14 (1.02-1.27)                                   | 0.026   |
| BMI $\geq 23$ kg/m <sup>2</sup>                           |                                                    |         |
| No <sup>a</sup>                                           | 1                                                  |         |
| Yes                                                       | 2.13 (0.43-10.49)                                  | 0.353   |
| *adjusted for pog at booking visit                        | 2.13 (0.43-10.62)                                  | 0.358   |
| *adjusted for pog at booking visit, East Indian Ethnicity | 3.94 (0.46 – 33.94)                                | 0.211   |
| BMI $\geq 25$ kg/m <sup>2</sup>                           |                                                    |         |
| No <sup>a</sup>                                           | 1                                                  |         |
| Yes                                                       | 2.87(0.58-14.2)                                    | 0.196   |

|                                                           |                   |       |
|-----------------------------------------------------------|-------------------|-------|
| *adjusted for pog at booking visit                        | 3.60 (0.72-18.02) | 0.119 |
| *adjusted for pog at booking visit, East Indian Ethnicity | 6.63 (0.79-56.43) | 0.084 |
| East Indian Ethnicity                                     |                   |       |
| No <sup>a</sup>                                           | 1                 |       |
| Yes                                                       | 2.41 (0.82-7.08)  | 0.108 |
| African Ethnicity                                         |                   |       |
| No <sup>a</sup>                                           | 1                 |       |
| Yes                                                       | 0.51 (0.14-1.89)  | 0.311 |
| Mixed Ethnicity                                           |                   |       |
| No <sup>a</sup>                                           | 1                 |       |
| Yes                                                       | 0.87 (0.29-2.55)  | 0.797 |
| Parity                                                    | 1.21(0.89-1.63)   | 0.213 |
| Weight gain in pregnancy (kg)                             | 0.97(0.88-1.07)   | 0.516 |
| GDM in previous pregnancy                                 |                   |       |
| No <sup>a</sup>                                           | 1                 |       |
| Yes                                                       | 4.02 (0.35-46.19) | 0.264 |
| Fetal macrosomia in previous pregnancy                    |                   |       |
| No <sup>a</sup>                                           | 1                 |       |
| Yes                                                       | 2.04 (0.41-10.23) | 0.388 |

As seen in Table 7 below, the following predictors were significantly associated with HIP ( $p < 0.05$ ): Maternal Age  $\geq 25$  years, unadjusted OR 4.67 and Family History of DM, unadjusted OR 3.32; BMI, adjusted for pog at booking visit OR 1.12.

Table 7: Binary Logistic Regression: Predictors of HIP

| Predictor Variable                                        | Unadjusted Odds Ratio<br>(95% Confidence Interval) | P value |
|-----------------------------------------------------------|----------------------------------------------------|---------|
| Age $\geq 25$ years                                       |                                                    |         |
| No <sup>a</sup>                                           | 1                                                  |         |
| Yes                                                       | 4.67 (1.34-16.92)                                  | 0.016   |
| Age $\geq 35$ years                                       |                                                    |         |
| No <sup>a</sup>                                           | 1                                                  |         |
| Yes                                                       | 2.88 (0.94-8.79)                                   | 0.063   |
| Age                                                       | 1.09 (1.02-1.18)                                   | 0.025   |
| Family History of DM                                      |                                                    |         |
| No <sup>a</sup>                                           | 1                                                  |         |
| Yes                                                       | 3.32 (1.17-9.41)                                   | 0.024   |
| BMI                                                       | 1.11 (1.001-1.23)                                  | 0.047   |
| *adjusted for pog at booking visit                        | 1.12 (1.01-1.24)                                   | 0.032   |
| *adjusted for pog at booking visit, East Indian Ethnicity | 1.14 (1.02-1.27)                                   | 0.024   |
| BMI $\geq 23$ kg/m <sup>2</sup>                           |                                                    |         |
| No <sup>a</sup>                                           | 1                                                  |         |
| Yes                                                       | 2.22 (0.45-10.92)                                  | 0.326   |
| *adjusted for pog at booking visit                        | 2.21 (0.44-11.00)                                  | 0.215   |
| *adjusted for pog at booking visit, East Indian ethnicity | 4.17 (0.48-36.0)                                   | 0.194   |
| BMI $\geq 25$ kg/m <sup>2</sup>                           |                                                    |         |
| No <sup>a</sup>                                           | 1                                                  |         |
| Yes                                                       | 3.29 (0.67-16.08)                                  | 0.140   |
| *adjusted for pog at booking visit                        | 3.70 (0.74-18.48)                                  | 0.111   |

|                                                           |                    |       |
|-----------------------------------------------------------|--------------------|-------|
| *adjusted for pog at booking visit, East Indian           | 6.90 (0.81-58.74)  | 0.077 |
| East Indian Ethnicity                                     |                    |       |
| No <sup>a</sup>                                           | 1                  |       |
| Yes                                                       | 2.33 (0.79-6.82)   | 0.122 |
| African Ethnicity                                         |                    |       |
| No <sup>a</sup>                                           | 1                  |       |
| Yes                                                       | 0.51 (0.14-1.91)   | 0.320 |
| Mixed (East Indian and African) Ethnicity                 |                    |       |
| No <sup>a</sup>                                           | 1                  |       |
| Yes                                                       | 0.88 (0.30-2.58)   | 0.818 |
| Parity                                                    | 1.22 (0.92-1.62)   | 0.158 |
| GrandMultiparity (Parity≥5)                               |                    |       |
| No <sup>a</sup>                                           | 1                  |       |
| Yes                                                       | 3.37 (0.61-18.475) | 0.161 |
| Weight gain in pregnancy                                  | 0.97 (0.87-1.07)   | 0.516 |
| *adjusted for pog at booking visit, East Indian Ethnicity | 0.93 (0.81-1.06)   | 0.285 |
| GDM in previous pregnancy                                 |                    |       |
| No <sup>a</sup>                                           | 1                  |       |
| Yes                                                       | 4.04 (0.35-46.46)  | 0.262 |
| Fetal Macrosomia in previous pregnancy                    |                    |       |
| No <sup>a</sup>                                           | 1                  |       |
| Yes                                                       | 2.05 (0.41-10.29)  | 0.384 |

due to the one-step approach used.<sup>31</sup> Duran et al in the St. Carlos Gestational Diabetes Study concluded that the increased treatment cost of GDM would be offset by reduced surgical delivery and NICU admissions which were both costly.<sup>36</sup> A reduced maternal progression to type 2 diabetes mellitus postpartum and cardiovascular disease were also beneficial to women's health and would be cost saving.<sup>36</sup>

Locally, in 2018 using the IADPSG criteria, a GDM prevalence of 14.1% was reported for women attending the tertiary care antenatal clinics of two hospitals in North Trinidad.<sup>25</sup> The population of women attending tertiary care clinic was expected to have a higher prevalence of risk factors for GDM compared to the proportion of women attending the primary care clinic. Hence, the lower estimate of 9.9% was consistent with the findings from the previous study done in the tertiary care setting using the same criteria in Trinidad.<sup>25</sup>

The IADPSG <sup>27</sup> guidelines recommend universal screening for GDM at 24-28 weeks' gestation.<sup>23</sup> Identifying those who meet the IADPSG criteria from the booking visit in a high-risk population as in Trinidad would allow earlier implementation of GDM management and hence reduce the associated complications both short and long term such as increased instrumental or surgical deliveries and maternal and fetal development of Diabetes Mellitus.<sup>34</sup>

The Ministry of Health of Trinidad and Tobago had mandated that GDM screening by the IADSPG diagnostic criteria should be applied to women who first attend antenatal clinic regardless of gestational age and at 24-28weeks gestation.<sup>22</sup> A higher proportion of women who met the threshold for GDM were tested at  $\text{pog} < 24$  weeks than at  $\text{pog} \geq 24/40$  weeks. Early identification of GDM is beneficial as the Trinidad population is at high risk of developing hyperglycaemia in pregnancy due to the increasing prevalence of risk factors of metabolic disease.<sup>34</sup> According to the

national NCD risk factor survey, more than half of the adult female population of Trinidad and Tobago was shown to be overweight or obese.<sup>24</sup> This may be due to the increased sedentary lifestyle such as reduced physical activity and increased consumption of high fat high carbohydrate diet from cheaper, readily available high calorie fast foods.

Women of the age  $\geq 25$  years, of East Indian ethnicity and a family history of Diabetes Mellitus were demonstrated to be significantly associated with GDM in this study. Maternal age  $\geq 35$  years was not significantly associated with GDM in this study. Pregnant women aged  $\geq 35$  years are termed Advanced Maternal Age, they are considered as having a high-risk pregnancy. At the booking visit in primary care, all high risk pregnancies are referred to the tertiary care clinic, as such in this study the number of persons aged  $\geq 35$  years was not sufficient enough to demonstrate a relationship with GDM. A large prospective study can be designed including pregnant women from both primary and tertiary care settings, would be adequately powered to demonstrate the association of advanced maternal age with GDM. GDM in previous pregnancy and advanced maternal age/maternal age  $\geq 35$  years were significantly associated with HIP. These findings were consistent with local and international studies.<sup>25-28</sup> The majority (78.9%) of the women attending the antenatal primary care clinics were screened for GDM. At the first visit to primary care, high-risk pregnancies would be referred to the tertiary setting and would not have performed an OGTT performed in primary care. Health care providers' non adherence to screening guidelines was demonstrated in the inability to attain universal screening at booking visit and failure to accurately identify all cases of GDM from the OGTT findings. Of the women who met the diagnostic criteria for GDM, 40% were missed by the health care providers. Women who met the criteria for DIP were not misclassified by the health care providers.

The binary logistic regression analyses did not indicate a strong significant causal relationship

between GDM and the following predictor variable: Maternal overweight/obesity, advanced maternal age, GDM in previous pregnancy, history of fetal macrosomia, excessive weight gain in pregnancy and ethnicity. Evidence from a highly powered study can better demonstrate the association between predictors and GDM. The association of predictors with GDM may lose significance due to a non-uniform relationship at extremes of the variable for instance, age variable gained significance from age  $\geq 25$  years. The HAPO study powered its' study to investigate OGTT values as a predictor of adverse pregnancy outcomes namely as macrosomia, primary caesarean delivery, clinical neonatal hypoglycaemia and hyperinsulinemia.<sup>14</sup> Hence, a large prospective cohort study can be conducted in East Trinidad, in which women diagnosed with GDM can be followed to demonstrate causal relationships between GDM or associated adverse outcomes with risk factors and/or novel factors, and to identify confounders.

The following recommendations should be considered based on the findings of the study: improved communication between primary and tertiary care to ensure that all high-risk pregnancies referred from primary care would have performed the OGTT and receive appropriate care in a timely manner. In the postpartum period, women with a history of GDM should be referred for follow up testing for hyperglycaemia in primary care. Establishment of a secondary care centre, dedicated to antenatal care for GDM, would provide the necessary linkage for primary and tertiary antenatal care and reduce the burden imposed on the single tertiary care facility. Women with DM in pregnancy or other high risk conditions requiring specialist management should be referred to the tertiary care facility.

Health care providers should receive retraining or continuous medical education on clinical guidelines to reduce any variability in GDM screening practices and to improve diagnostic accuracy.<sup>1,6,7,9,14,22</sup> Regular clinical audits can be conducted to monitor health care providers'

adherence to the national guidelines for GDM screening and appropriate interpretation of screening test to avoid misclassification of GDM cases. Electronic medical records such as PAHO SIPS+ should be employed at all levels of health care to ensure standardisation of medical records, to limit missing information on important prognostic factors such as Ethnicity, history of DM in first degree relative, history of GDM in previous pregnancies, negative fetal adverse events. Health promotional lectures should be administered prenatally and in the antenatal clinics to educate on GDM to increase patients' compliance with the request for OGTT and lifestyle modification to reduce the incidence of GDM.

## **LIMITATIONS**

Limitations of this cross sectional study include difficulty to demonstrate causality due to inability to demonstrate temporal sequence, missing data due to incomplete records, loss to follow up due to drop-outs; and the difficulty to control for confounders in investigating the relationship between risk factors and the diagnosis of GDM.<sup>37</sup> A prospective cohort study can be performed where women attending a prenatal clinic or well women clinic can be assessed at baseline and then followed at intervals until enrolment in the antenatal clinic and identifying those who have been diagnosed with GDM. Electronic medical records can be employed to ensure standardisation of data entry in the health records such as SIPS+.

There was inconsistent data entry in the health care records by health care professionals such as missing data on ethnicity, booking BMI, birth weights of previous pregnancies, and family history of Diabetes Mellitus. To combat the challenges faced by missing data the sample size was inflated by 30%. Approximately 21.1% of the health records sampled after meeting the inclusion criteria did not perform the OGTT in primary care. At the booking visit, more than half of these women

according to the Ministry of Health guidelines. These women would have been at high risk of developing GDM for instance 2 women had a history of DM in pregnancy, previous GDM and 4 women had advanced maternal age. Therefore, the inability to capture an OGTT reading for this population in primary care would lead to an underestimation of the true prevalence of GDM in primary care. Triangulating their OGTT readings performed at the Sangre Grande Hospital, the only tertiary care facility in East Trinidad would have been able to address the missing data from primary care health records. However, sampling from one data source, the primary care health records was recommended to ensure the feasibility of the proposed study.

## **CONCLUSION**

Using the IADPSG criteria, the proportion of women with GDM in primary care is estimated to be approximately 1 in every 10 women in Trinidad. Health care providers should have continuous medical education to provide targeted health promotional or education for prenatal high-risk populations such as women  $\geq 25$  years old, of East Indian ancestry, previous GDM and family history of DM to ensure universal screening and compliance with updated guidelines and to implement early management of GDM. Public health specialists should establish a GDM registry for the entire RHA to provide evidence to create hypotheses on novel and traditional risk factors, and to monitor and evaluate the effectiveness of treatment options and to follow up on both maternal and fetal short- and long- term outcomes.