Prevalence of Gestational Diabetes Mellitus and Predisposing Factors among Pregnant Women Attending Antenatal Clinic at Kawolo General Hospital. A Cross-sectional Descriptive Study.

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Abstract

Background

Globally, the prevalence of Hyperglycemia first detected in pregnancy (Gestational Diabetes Mellitus) varies from 1 - 28 %. 16.2 % of women have some form of hyperglycemia, of which GDM is about 85.1%. 87.6% of GDM accounts are in low- and middle- income countries. Hyperglycemia in pregnancy is estimated to affect 21.4 million (16.9%) of live births, with GDM accounting for 16% of these cases. In Kawolo General Hospital, pregnant women aren't screened for blood glucose during antenatal visits, thus the need and relevance of investigating GDM, according to WHO recommendation.

Methodology:

A total of 334 participants were recruited by systematic random sampling, in a cross-sectional study. Blood and urine samples were collected. RBS, OGTT, and urine glucose tests were done. Data was analyzed using STATA version 13 to determine the prevalence and association between the risk factors of GDM among the respondents.

Results

The study revealed the prevalence of GDM as 4.5. Hypertension and elevated blood pressure were significantly associated with GDM, with p values of 0.00 and 0.01 respectively among women of various ages, gravida and trimester. Majority of the participants were aged 18 to 25 years (58.7%). over 86.5% were married. 56.9% had secondary education. (38.9%) were unemployed. (34.4%) were Catholics. (46.1%) had normal body mass index with average body weight of 65 Kgs and 160cm (height). 70.6% had normal blood pressure. 21.56% had elevated blood pressure. (56.6%) had their protein uptake. Vitamins (100%) was high, moderate for carbohydrates (70.1%) and 96.4% low for fats.

Conclusion

The prevalence and associated factors among pregnant women who attended the antenatal clinic was revealed, thus need for screening and treatment of both high blood pressure and high blood glucose levels.

Recommendations:

There's need to advice and sensitize them to complete all the antenatal visits and create awareness among pregnant women.

Keywords: Gestational Diabetes Mellitus, Prevalence, Associated Risk Factors, Screening, Kawolo General Hospital, Date Submitted: 2022-07-22 Date Accepted: 2022-08-07

1. Background

Gestational Diabetes Mellitus (GDM) is defined as hyperglycemia first detected in pregnancy (1). The definition of GDM has evolved and currently WHO recommends that hyperglycemia detected any time during pregnancy should further be subdivided as Diabetes Mellitus in Pregnancy (DIP), or GDM. A pregnant woman whose hyperglycemia is first detected during pregnancy qualifies as being with Gestational Diabetes Mellitus. GDM includes pregnant women who meet the WHO criteria for diagnosis of impaired glucose intolerance. Most women, revert to normal glucose metabolism after delivery of their babies, but not DIP which is pre-existing diabetes before pregnancy (1).

GDM is associated with higher risk of negative pregnancy outcomes which include, higher rates of cesarean section, birth trauma, higher risk of obstructed labour due to large babies, hypertensive disorders of pregnancy and increased risk of developing diabetes and cardiovascular disease in the future. The prenatal complications are birth trauma due to shoulder dystocia, macrosomia, neonatal hypoglycemia, hyperbilirubinemia and increased risk of prenatal death (2).

Globally, the prevalence of GDM varies from 1 - 28 %, depending on the screening methods, diagnostic criteria and population characteristics (3). The International Diabetes Federation (4) shows that about 16.2 % of women had some form of hyperglycemia during pregnancy, of which GDM shares about 85.1% of the load. The majority, 87.6% of GDM accounts are in low- and middle-income countries, where access to maternal care is always limited. Hyperglycemia in pregnancy has been estimated to affect 21.4 million (16.9%) of live births, with gestational diabetes accounting for 16% of these cases. 4.3 million (16.0%) cases of live birth affected with hyperglycemia are in Africa from the total estimation of a study done (5).

The occurrence of GDM in Sub-Saharan Africa has been found to be 14%, (6). Studies carried out show that GDM varies among African regions to a certain extent. In East Africa, it is at 6%, and 14% in West Africa (7).

In developing countries like Uganda, there is still need to prioritize the relevance of investigating GDM from the maternal and child health care perspective. According to World Diabetes Foundation, among the 11,069 pregnant women screened in Luweero in 2017, 10% of the mothers had GDM and 15.6% in South Western Uganda (8). Half of the populations of the pregnant women who develop GDM do not have known risk factors(9). This contributes to late diagnosis with prominent signs and symptoms, while others die without diagnosis. Complications of hyperglycemia are likely to rise in the near future if this is left unattended to.

This created need to conduct this study to determine the prevalence of GDM and its associated factors among pregnant women since there's no study that has ever been done at Kawolo General Hospital.

2. Methods

Cross-sectional, laboratory based descriptive study where data was collected from women attending antenatal clinic

The study was conducted at Kawolo General Hospital, from 10^{th} may 2021 to 13thth may, and from 24th to 27^{th} may 2021, we recruited the mothers as well as cleaning the data until 26^{th}, the last date 27 was for those who needed to return for fasting blood glucose.

Study population comprised of all pregnant women who attended the antenatal clinic at Kawolo general hospital, were between 18 to 45 years of age, non-diabetic, and consented willingly. Data about them was obtained verbally as well as from their antenatal cards, to confirm eligibility, and the selection of the participants done by systematic sampling.

Some of the potential sources of bias include; design bias, where our research was around pregnant, non-diabetic women, and attending Kawolo

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general hospital, selection bias, where the process of selection of the participants was based on the inclusion and exclusion criteria for example non pregnant females didn't qualify and those who refused to consent.

The study size comprised of 334 eligible participants. The sample size was determined by the formula that was derived by Kish L. (Kish, 1965).

$$n = \frac{Z^2 P(1-P)}{W^2}$$

Where;

n= calculated sample size

Z= the statistically desired level of confidence, corresponding to 95% confidence interval (1.96)

W= desired level of precision, that is the sampling error (+/-5%)

P= estimated prevalence from previous studies, 31.9% (10) at 95% CI using Kish and Leslie formula.

1-P= (1-0.319) = 0.681

Therefore, substituting in the above formula gives;

$$n = \frac{1.96^2 X 0.319 X 0.681}{0.05^2}$$

n= 334 participants.

Therefore, 334 pregnant women were recruited into the study

Semi-structured questionnaires and the antenatal register were used to collect data on knowledge about antenatal, socio demographics and associated risk factors among the study participants. The antenatal register was used to record information about every pregnant woman. Both the antenatal register and laboratory register were used to record results.

The researchers explained to the participants the purpose of the study in English and later translated in Luganda for easy understanding to obtain informed consent. The interviewer-administered questionnaire was conducted in a private consultation room and the information given by the participants recorded. Blood samples were taken for glucose estimation. Participants with random blood glucose levels greater than 140mg/dl were subjected to an Oral Glucose Tolerance Test as a confirmatory test and results recorded.

Participants were prepared for the test. A finger prick was used to collect capillary blood and urine specimen was also collected for OGTT.

Confidentiality was ensured using study ID and participants' initials. Validity and reliability of the data was done by crosschecking the names of the mothers on antenatal cards with the antenatal register. The Glucometer machine was quality controlled, externally, by running samples on our glucometer, and running same samples on another glucometer from an accredited laboratory and comparing the results. Internally, it was done by running known standards of normal, high, and low values as per the standard operating procedure (SOPs).

Glucose strips were checked for expiry date, and damage, which could compromise the quality of results.

The questionnaire was pretested among the fellow classmates and workmates to check the validity of the questionnaire.

Pregnant mothers had their RBS taken using a blood glucose meter. The Results were interpreted immediately from the values displayed by the glucometer, and participants who had RBS levels: $\geq$ 140 mg/dl and fasting Blood Sugar levels: $\geq$ 100mg/dl were subjected to OGTT. Those with 2 hours post Blood Glucose load $\geq$ 140mg/dL and Urine Glucose Level 0 - 0.8mmol/L were considered to have GDM.

All the data collected was edited, processed and entered in the computer Microsoft. STATA version 13 was used for Univariate and Bivariate analysis. Univariate analysis was used for descriptive statistics like age, level of education. Bivariate analysis was used to make association between risk factors and GDM where the variables had a P value of $<$0.05 at 95% confidence interval.

3. Results:

The flow chart showing the selection and eligibility categorization.

Majority of the women were aged 18 to 25 years, 58.7%; (196/334), 86.5%; (289/334) were

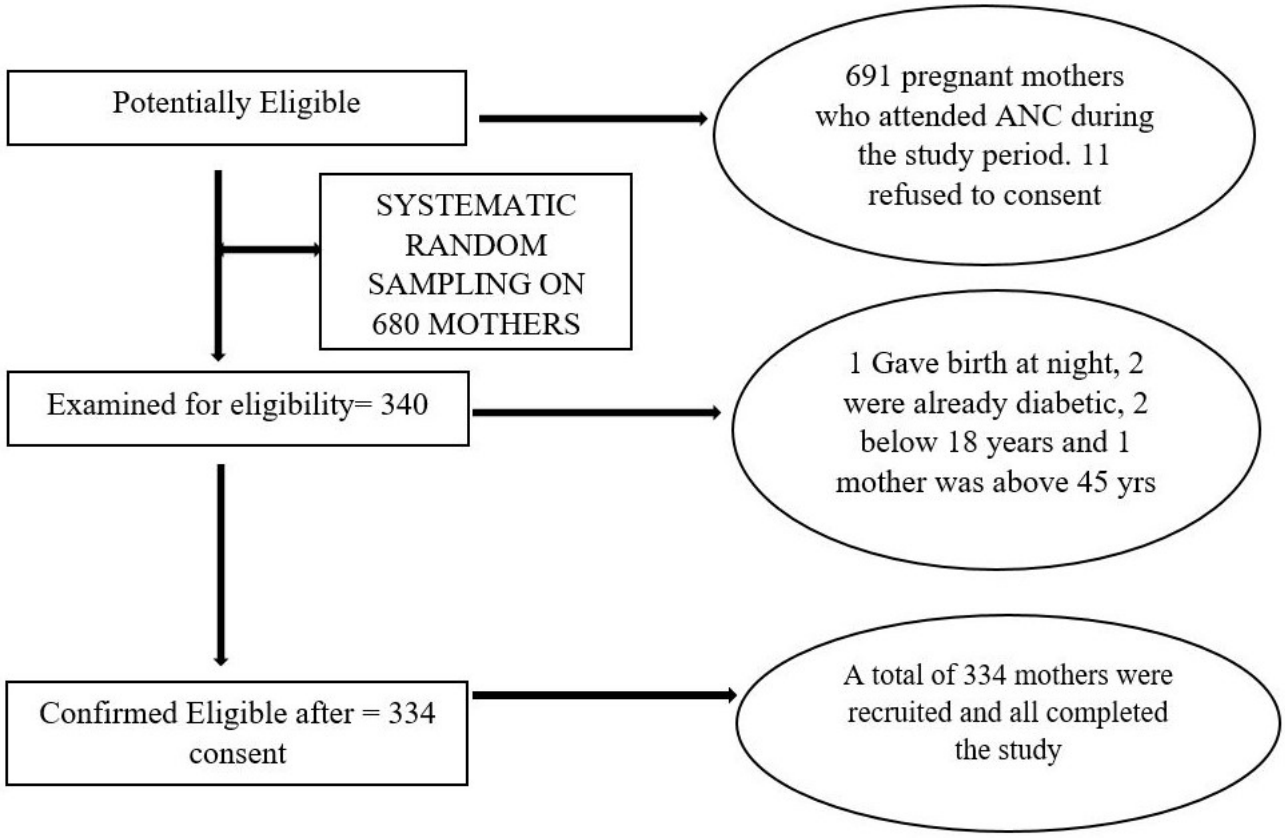

Figure 1: The flow chart showing the selection and eligibility categorization.

married and 56.9%; (190/334) had attained secondary education. With regard to occupation, a slightly higher percentage, 38.9%; (130/334) of women were unemployed, 29.0%; (97/334) engaged in business and 16.2%; (54/334) were employed. A higher percentage, 34.4%; (115/334)) of these women were Catholics by religion, while 29.6%; (99/334) were protestants and about 19.5%; (65/334) were Muslims. (Table 1)

Basing on body mass index, a higher proportion 46.1%;(155/334) of the women had a normal range, followed by 34.1%; (114/334) that were overweight, 16.5%; (55/334) obese and about 2.9%; (10/334) underweight. The respondents had an average weight and height of 65 Kgs and 160 cm respectively. For blood pressure, 70.7% of the women had normal blood pressure and 21.6% had elevated blood pressure. This is also clearly shown by an average of 112 systolic and 70 diastolic.

The study assessed behavioral factors that could be associated with GDM. Majority of the women exercised often 69%; (232/334), 91%; (304/334) didn't drink alcohol and 99%; (332/334) didn't smoke cigarettes.

Nutrient uptake among women was assessed since diet may be protective or increase the risk of GDM

• Proteins; Majority had high uptake 56.6%; (189/334) followed by moderate uptake 38.3%; (128/334). This is shown by a high percentage of women taking meat 78.1%; (261/334) beans 90.7%; (303/334), Groundnuts 89.5%; (299/334), eggs 72.2%; (241/334) and milk 70.9%; (237/334).

• Carbohydrates; Majority of the respondents 70.1%; (234/334) had moderately carbohydrate rich food, where a higher proportion reported taking posho 85.93%; (287/334), rice 87.7%; (293/334), matooke 91.3%; (305/334), cassava 68.1%; (228/334) and potatoes 74.3%; (248/334)

a less percentage 33.8%; (113/334) took millet often.

• Vitamins; all the women took foods rich in vitamins such as fruits 88.9%; (297/334) and greens 89.5%; (299/334)

• Fats; uptake of fats was low, where majority reported not taking blue band 87.4%; (292/334), cow-boy and Kimbo 92.2%; (308/334) each. A higher percentage 90.4%; (302/334) was taking cooking oil often

Biological factors associated with GDM were assessed. Majority 81.1%; (271/334) of the women had heard of diabetes. Majority 75.8%; (253/334) had never tested for diabetes and a high proportion 75.8%; (253/334) of women reported not having/knowing someone among their family members with diabetes. Over 93.1%; (311/334) of the respondents had carried one to five pregnancies and a slightly higher percentage 46.4%; (155/334) were in their second trimester, followed by 36.5%; (122/334) in the third trimester and 17.1%; (57/334) in the first trimester.

Women without still birth were 96.7%; (323/334), 9.6%; (32/334) delivered a baby of greater than 4 Kilograms and 5.1%; (17/334) had preterm birth. About 17.4%; (58/334) had ever had a miscarriage and 5.7%; (19/334) developed hypertension during pregnancy.

RBS test was done and results showed that on average women had 5.34(96.12) mmol/l (mg/dl) of glucose levels. 17 respondents presented high glucose levels of 7.7(138.6) mmol/l (mg/dl) and above. The fasting blood glucose tests for the 17 women was averagely 5.71(102.78) mmol/l. After 30 minutes another test was done, and the average results for the women were 10.89 mmol/l (mg/dl). One hour after a pregnant woman taking 75g of glucose powder in 300 mls of drinking water, another blood sugar test was done. Average results showed, women had 9.91(178.38) mmol/l (mg/dl), and lastly after 2 hours the 17 women were further subjected to another blood glucose test. Results revealed that on average, women had 7.87(141.66) mmol/l(mg/dl) of glucose, though 2 women had glucose levels less than 7.7 mmol/l. Urine samples from these pregnant women showed urine glucose of 0.0mmol/l (Table 2).

The blood glucose tests done at different intervals and the tests results, revealed that nearly 4.5% (15 women) of the 334 women attending the antenatal care at Kawolo General Hospital that participated in the study had Gestational Diabetes Mellitus.

Majority were between 18 – 25 years 46.7%; (7/15), then 26 – 35 years 40%; (6/15), below 18 years 13.3%; (2/15), those between 36 – 45 and above 45 years never had GDM.

The most affected trimester was 2^{nd} trimester 46.7%; (7/15), followed by 3^{rd} trimester 33.3%; (5/15) and then 1^{st} trimester had 20%; (3/15).

Basing on the chi-square p-values, none of the socio demographic characteristics that is age, marital status, education level, occupation and religion of respondents was significantly associated with Gestational Diabetes Mellitus.

Body mass index of the respondents was not significantly associated with GDM among pregnant women ($p - val > 0.05$).

Blood pressure was significantly associated with GDM among pregnant women where 11.1% of the pregnant women with elevated blood pressure had GDM, as compared to only 2.97% of the women with normal blood pressure ($p - val < 0.05$). (Table 3)

Exercising, drinking alcohol and smoking cigarettes were not significantly associated with GDM.

GDM was significantly associated with hypertension where 21.1%; of the women that had ever developed hypertension during pregnancy had GDM as compared to only 3.49% of the women that had never developed hypertension during pregnancy($p - val < 0.05$).

GDM was not significantly associated with other biological factors in the study such as number of pregnancies carried, trimester, delivering a baby with over 4 kilograms, preterm birth and miscarriage

GDM was not significantly associated with diet of pregnant women attending ANC at Kawolo General Hospital

Among factors considered, women with hypertension before, and blood pressure were significantly associated with GDM, with women that

had ever developed hypertension during pregnancy having 9.28 times the odds of having GDM than women that had never developed hypertension ($OR = 9.28; 95\%CI : 2.27, 37.83$)

Age and body mass index of the women were not significantly associated with GDM.

Hypertension among pregnant women remained independently associated with GDM,

Blood pressure among women was significantly associated with GDM, with women that had elevated blood pressure having 5.06 times the odds of having GDM than women that had normal blood pressure($OR = 5.06; 95\%CI : 1.64,\ 15.55$).

A binary regression model was used to determine factors that were significantly associated with GDM among the women. Only significant factors at 10% ($P < 0.1$) from bivariate analysis using Chi-Square test and age were considered in the logistic regression model (Table 4)

4. Discussion:

Prevalence of GDM

From the study, the prevalence of GDM was 4.5, the results were in agreement with reported findings in other studies in Rwanda with 3.2% (11), 39% and Ethiopia at 4.2% (12). This could have been due to the fact that the studies were done in a place where the women's occupations are either peasant or small-scale business which requires them to be physically active. The study is in disagreement with other studies in Uganda because the result is lower; 31.9% (9) and 15.6% in South Western Uganda (8). This could have been attributed to the difference in diagnostic criteria. Other studies conducted with higher prevalence are, in Sub-Saharan Africa 14% (6), 6% for East Africa (13), and 14% in West Africa (7). The prevalence was highest in Central Africa 20.4% and lowest in Northern Africa 7.5% Sub-regions (14). This also could have been attributed to the difference in diagnostic criteria.

Generally, the prevalence obtained in this study was lower than the universal ranges i.e. from 8% to 20.7% among all pregnancies in different populations across the African continent, but within the global range of 3 to 16% across the world (15). This could have been attributed to the screening of all pregnant women who consented, irrespective of the weeks of pregnancy.

Proportion of pregnant women with Gestational Diabetes Mellitus

Out of the 334 pregnant women who participated in the study, 15 were found to be having GDM as shown by the laboratory test results.

Proportion of the most affected trimester

The most affected was 2^{nd} trimester, with a total of 155 women, 7 participants had GDM making a percentage of 4.52%, the 3^{rd} trimester was the second most affected where out of the 122, 5 participants had GDM making a percentage of 4.1%.

Predisposing factors to Gestational Diabetes Mellitus

Women who previously had hypertension and elevated blood pressure were significantly associated with GDM.

This is in agreement with a study done by (16) which showed that gravidas with hypertension had a 3.598 times higher risk of developing GDM than gravidas without hypertension. The prevalence of GDM in pregnant women with hypertension was 2.6 times than gravidas without hypertension.

Social demographic, behavioral and biological characteristics such as diet, BMI, were not associated with GDM

Majority of participants moderately took food rich in proteins compared to carbohydrates, vitamins and fats. This is consistent with findings in a study by (17) and could be attributed to the availability of protein rich foods. The most affected age was 18-25 years. This is in disagreement with the findings by (18) where advance maternal age was the risk factor for GDM. BMI was normal for most pregnant women, which is in disagreement with findings by (19) were gestational BMI gain from conception to 15–20 weeks of gestation are correlated with an increased risk of GDM. This could have been attributed to the universal screening where even mothers who were less than 15 weeks were screened. The study also revealed that there was no significant association

Table 1: **Distribution of respondents by socio demographic characteristics**

Characteristics	**Frequency (n)**	**Percentage (%)**
Age (Years)		
Below 18	20	5.9
18-25	196	58.7
26-35	105	31.4
36-45	11	3.2
Above 45	2	0.6
Marital status		
Single	38	11.4
Married	289	86.5
Divorced	1	0.3
Separated	6	1.8
Education level		
Uneducated	3	0.9
Primary	100	29.9
Secondary	190	56.9
Certificate	22	6.6
Tertiary/University	19	5.7
Occupation		
Peasant	53	15.9
Business woman	97	29.0
Employed	54	16.1
Unemployed	130	38.9
Religion		
Protestant	99	29.6
Catholic	115	34.4
Muslim	65	19.5
Pentecostal	46	13.8
Others	3	2.7

Table 2: **Laboratory test results for gestational diabetes mellitus among women**

Test	**Mean**	**Median**	**St. Dev**	**Min**	**Max**	**Obs**
RBS (mmol/L)	5.34	5.1	1.17	3.3	11.6	334
Fasting blood glucose	5.71	5.7	0.32	4.8	63	17
After 30 minutes	10.89	10.9	0.64	10	12.4	17
After 1 hour	9.91	10	0.59	8.6	11	17
After 2 hours	7.87	7.9	0.59	6.5	9.4	17

Table 3: **The association between GDM, BMI and blood pressure among pregnant women**

Factor	N	Gestational diabetes mellitus		p-value
		N	%	
Body mass index				
Underweight	10	0	0.0	
Normal	155	8	5.2	0.15
Overweight	114	2	1.8	
Obese	55	5	9.1	
Blood pleasure				
Normal	236	7	2.9	0.02*
Elevated	72	8	11.1	

Table 4: **Logistic regression results of factors associated with GDM among women**

Variable	OR	Se (OR)	95% CI	p-value
Age (Years)				
18-25	Ref.			
26-35	1.36	0.79	(0.43,4.28)	0.59
Ever developed hypertension				
No	Ref.			
Yes	9.28	6.65	(2.27,37.83)	0.00*
Blood pressure				
Normal	Ref.			
Elevated	5.06	2.89	(1.64,15.55)	0.01*
Body mass index				
Normal	Ref.			
Overweight	0.29	0.23	(0.63,1.37)	0.12

of GDM with family history of diabetes although a study by (20) suggested that family history with diabetes may be more relevant to the risk of GDM in nulliparous women than in parous ones.

Exercises during pregnancy did not also have any significant association with GDM as the study revealed. This is in contrast to a study done by (21) where exercise during pregnancy decreases the occurrence of GDM in women.

The study revealed that smoking and alcoholism were not significantly associated with GDM. This is because most of the women in the study were not engaged in these activities This is in agreement with a study done by (22). Although given other possible pregnancy complications and adverse birth outcomes induced by alcohol use, women who have been pregnant and are planning to become pregnant should quit drinking alcohol (23). The relationship between maternal smoking and GDM is inconclusive but smoking before pregnancy is associated with an increased risk of GDM requiring insulin therapy (24).

Study limitations

Due to referral bias the pregnant women who participated in the study, could not be associated with the study population. This is because, the study was conducted at the district hospital which serves a population beyond the catchment area. Pre-pregnancy BMI was not taken yet it is the standard. Instead, BMI of the mothers was taken at the time of the study.

5. Conclusion

Study results highlighted the importance of random blood glucose testing as a point of care test for every antenatal visit thus early detection of hyperglycaemia.

New information about the prevalence and risk factors associated with hyperglycaemia in the community of Lugazi town, Buikwe district was also revealed.

Therefore, the results of this study provided preliminary information which is relevant in advocating for routine screening of GDM for every antenatal visit, creating awareness to reduce on the complications of late diagnosis and maternal mortality caused due to GDM. This can be possible by lobbying for funds from health care providers.

6. List of Abbreviations

ACOG : American College of Obstetricians and Gynecologist

ADA: American Diabetes Association

ANC: Antenatal Care

BMI: Body Mass Index

CDC: Centre for Disease Control and Prevention

CI: Confidence Interval.

DIP: Diabetes in pregnancy

FBS: Fasting Blood Sugar

FRC: Faculty Research Committee

GDM: Gestational Diabetes Mellitus

HMIS: Health Management Information System

IADPSG: International Association of Diabetes and Pregnancy Study Groups

ID: Identification

IDF: International Diabetes Federation

MCH: Mother Child Health

Mg/dl: Milli grams per deciliter

Mml/L: Milli mol per liter

MUST: Mbarara University of Science and Technology

OGTT: Oral Glucose Tolerance Test.

RBS: Random Blood Sugar

SOPs: Standard Operating Procedures

UIAHMS: Uganda Institute of Allied Health and Management Sciences

WDF: World Diabetes Foundation

WHO: World Health Organization

WHS: World Health Statistics

Declarations

Ethics approval and consent to participate

• Approval letter was obtained from the Faculty Research Committee (FRC) of the Faculty of Medicine of Mbarara University of Science and Technology. Introduction letter to the study site from the department of Medical Laboratory Science was obtained.

• Permission to conduct the study was obtained from the Medical Superintendent of Kawolo General Hospital and the antenatal clinic in-charge. Informed consent was sought from all participants after explaining to them the nature of the study in the languages best understood. Only those who were willing to participate were included in the study. All data was kept confidential in computers with passwords. Files, laboratory books, forms, data base and case report forms were kept in lockers.

• There was use of study identification (ID) numbers and participants' initials instead of actual respondents' names throughout the study activities.

Consent for publication

Not Applicable

7. Availability of data and materials

Data produced is available on Kobo collect Application version v1.29.3

8. Competing interests

No competing interests.

9. Funding

No funding was associated, we are requesting for a waiver.

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Contributions

"I.K and C.O. 'designed the concept and drafted the manuscript'; C.M. 'prepared the figures'; K.K. 'arranged the ethical approval and gathered data for the study'; A.N. 'reviewed the existing journals' policy'; E.M. and Y.M. 'contributed to writing of the final version of the manuscript.

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Appendix B. Publisher details:

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