Investigation of Hyperglycaemia and Associated Factors among Pregnant Women Attending Antenatal at Mulago Hospital, Directorate of Obstetrics and Gynaecology, Kawempe.

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Abstract Introduction: This study aimed at establishing the prevalence and factors associated with hyperglycemia in pregnancy among women attending treatment at antenatal care at the Directorate of obstetrics and gynaecology at Kawempe under the following objectives; to determine the prevalence of hyperglycemia in pregnancy, to establish the factors associated with hyperglycemia in pregnancy.
Methods: The study was cross-sectional and experimental in design that recruited 333 participants from age 18 years and above. The consented participants filled a questionnaire that was taking history and demographics. A blood sample was taken for blood glucose testing and a urine sample was also collected. Data was entered in Epidata 3.1 and exported to SPSS 17.0 for analysis. Descriptive statistics and multivariate analysis was used to determine prevalence and factors associated with hyperglycemia in pregnancy
Results: Laboratory tests revealed that the prevalence of hyperglycemia was 25.3% (84). The following factors were significantly associated with hyperglycemia in pregnancy; age37 years and above (p-value 0.013* OR 2.34), and high Body Mass Index (BMI) (p-value 0.002* OR 3.744). Gravidity of 3-4 times (p-value 0.003*OR3.782), >=5 times (p-value <0.001*and OR3.099), parity of >=5 children (p-value 0.003*OR 3.642), first degree hyperglycaemia (P-value <0.031*OR 5.152), high blood pressure during this pregnancy (0.012*OR 3.622) and high blood pressure while not pregnant (p-value 0.012*OR 1.274).
Conclusion and recommendations:
Gestational hyperglycemia is common among women attending care at the directorate of Obstetrics and Gynecology at Kawempe. the commonest factors associated with hyperglycemia in pregnancy are high Body mass index, history of hypertension, history of hyperglycemia, high parity high gravidity, there is no relationship between hyperglycemia and sexually transmitted diseases like HIV, and syphilis.

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1   Background

During pregnancy, endocrine and metabolic changes occur that may predispose some women to hyper-glycemia, especially those whose pancreatic function cannot overcome these diabetogenic changes while pregnant (Butte *et al.,* 2016). According to Crowthel et al., (2012), hyperglycemia during pregnancy puts women at a higher risk of adverse outcomes like fetal macrosomia, obstructed labor, birth injuries, and maternal and prenatal mortality (Dodd et al., 2014). Coupled with the above, is the long-term health impact of increased risk of developing type 2 diabetes. Cumulative risks of incident diabetes in gestational hyperglycaemic patients ranging from 2.6% to over 70% within 5–10 years of delivery have been reported (Chodick, *et al.*,2010). Moreover, their offspring have a higher prevalence of childhood obesity and an overweight and higher risk of developing type 2 DM later in life (Dabelea, 2013).

Hyperglycaemia is one of the most common medical disorders seen in women encountered in preg-nancy. The International Diabetes Federation (IDF) estimates that one in six live births (16.8%) is to women with some form of hyperglycemia in pregnancy. Of them, 84% are gestational diabetes mellitus (GDM), while 16% may be due to diabetes in pregnancy (either pre-existing diabetes—type 1 or type 2—which antedates pregnancy or is first identified during testing in the index pregnancy (IDF, 2013). The gestational hyperglycemia prevalence corresponds with the prevalence of impaired glucose tolerance (IGT) and type 2 diabetes mellitus (T2DM) in any given population. Unfortunately, the age of onset of pre-diabetes and diabetes is declining, whereas childbearing age is increasing. Moreover, overweight and obesity are increasing in women of reproductive age; thus, more women who are entering pregnancy have risk factors that make them vulnerable to hyperglycemia during pregnancy. GDM is associated with a higher incidence of cesarean deliveries, shoulder dystocia, birth trauma, hypertensive disorders of pregnancy (including pre-eclampsia), and these women are at higher risk for development of T2DM (Moshe et al., 2015).

According to Hod et al., (2015), the perinatal and neonatal morbidities also increase; the latter include macrosomia, neonatal hypoglycemia, birth injury, polycythemia, and hyperbilirubinemia. Moreover, offspring in utero, if exposed to maternal hyperglycemia may remain at higher risks for childhood obesity and diabetes later in life. By early detection, aggressive management and adequate education protects both the mother and offspring of this diabetic mother (WHO, 2013)

The prevalence of gestational hyperglycemia has been reported to vary between 1%–28% in different regions of the world. The International Diabetes Federation (IDF) estimates that one in six live births (16.8%) are to women with some form of hyperglycemia in pregnancy; 16% of these may be due to Diabetes in pregnancy (Butte *et al.*, 2016). A south Indian study showed the prevalence to be 13.9%. It was 17.8% in Urban, 13.8% in semi-urban, and 9.9% in rural Indian women. Among the women with GDM, 12.4% were detected within 16 weeks of pregnancy, 23% between 17 and 23 weeks, and the remaining 64.6% at more than 24 weeks of pregnancy. However, in Uganda, there is no country data available about factors associated with gestational hyperglycemia (Nakabuye *et al*., 2017). However, the estimate modeled using data from other countries and specific country characteristics showed the prevalence of raised fasting blood glucose among females aged ≥25 years as 6.5%; the prevalence of raised blood pressure among women aged ≥25 years as 39.6% and women aged ≥20 years who are obese are about 4.9% (WHO, 2017). This is predictive of gestational hyperglycemia and its related events (Hedderson *et al*.,2012). Gestational hyperglycemia has far-reaching effects on the mother and the baby with the likelihood of getting obstetric complications and growth disorders.

2   Methodology:

Study design

This was a cross-sectional study design

Study site/area

This study was conducted at Mulago National Referral Hospital, Kawempe, in the directorate of obstet-rics and gynecology. The hospital has a bed capacity of over 1500. It is a tertiary care facility and a teaching hospital. It serves the suburbs around Kampala and referrals from all over the country as well as the Great Lakes region and South Sudan.

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Journal of Obstetrics and Gynaecology@SJHR–Africa.

3

Study population

The study was carried out on pregnant women attending care at the directorate of obstetrics and gynecology at Kawempe.

Sample size determination

Sample size had been estimated using the Kish and Leslie formula of 1965 for descriptive studies sample size calculation.

Where;

Is the number of respondents required for the study

Is the value corresponding to a 95% confidence interval or risk level (1.96)

p = 31.9 %, the reported prevalence of pregnant women with hyperglycemia

q:1-p

d=the study will accommodate an error of 5%.

n=333 participants

Sampling method

The participants were selected randomly. All pregnant women attending care were assigned random numbers. Anyone who obtained an even number was selected until the required number of 333 was reached.

Inclusion criteria

The main inclusion criteria were the state of being pregnant, above 18 years of age, and attending care from the Directorate of obstetrics and gynecology during the study period. Also, the participant should have made an informed consent to participate in the study.

Exclusion criteria

Non-pregnant women and those who declined to consent were excluded from the study.

Study instrument

A pretested and standardized questionnaire was used to collect demographic data and all data necessary to the study associated factors.

Variables

The study's independent variables included socio-demographic characteristics like age, sex, smoking, alcohol intake, occupation, BMI. The dependent variables were random blood glucose and urine glucose levels.

Procedure

After the consent process, the ladies were requested to fill a questionnaire with the help of the study assistants. The consented participants were sent for a urine sample and afterward, random blood glucose was determined using a glucometer.

Quality control

The questionnaire was pretested and translated into the most frequently used local language at the facility (that is, Luganda). The questionnaires and data sheets were cross-checked for completeness daily. Data were double entered into the data software (EPI-DATA 3.1) to minimize errors.

Data management and analysis

Questionnaires were cross-checked after each day of data collection to make certain the correctness and completeness of the collected data. Data were then entered into Epidata 3.1, cleaned, and also double cross-checked to minimize errors. Data were stored in a computer hard drive and a backup made on a flash drive. After the data entry process and checking, it was then exported to STATA 13.0 for analysis. Statistical tests of significance were performed including Pearson Chi-square and regression analysis to identify variable relationships. Results were presented in tables and graphs.

Ethical consideration

An introductory letter to the head of the Directorate of Gynaecology and Obstetrics was obtained from the department. Informed consent was sought from the participants before enrolment in the study after a thorough explanation of the nature of the study risk and benefits. Confidentiality was maintained by coding data with numbers and not patient names. Study files were kept under lock and key.

Dissemination of results

Table 1. Shows the socio-demographic characteristics of the respondents

Variable	Items	Frequency	Percent
	18-27 years	189	56.7
Age	28-37years	80	24
	37 and above	64	19
	Not educated	75	22.5
Education	Primary level	125	37.5
level	Secondary Level	83	25
	Tertiary Level	33	10.0
	Peasant Farmer	108	32.5
	Business person	16	5.0
Occupation	Student	92	27.5
	Formal employment	33	10.0
	House wife	66	20.0

Table 2. Shows the **Obstetric H istory**

Number of pregnancies carried by the participant	Frequency	Percentage
Once	23	7
2-4 times	124	36
≥5 times	194	57
Current living children		
1 child	30	11
2-4 children	111	44
≥5 children	164	45
No of ANC before delivery		
1-3 times	213	64.0
4-6 times	120	36.0

Four copies of the study report were printed and distributed to Mulago Hospital, Directorate of Obstetrics and gynecology, Research and ethics committee, examination purposes, and the fourth copy will be for the supervisor.

3   Results:

Socio-demographic characteristics of the respondents

N=333

Majority of the respondents 56.7% (189) were between 18-27 years of age. This was followed by 24% (80) of those between 28 – 37 years of age. Only 18% (64) were either 37 years of age, or were above this age. Majority of the respondents 37.5% (125) had attained primary level followed by 25% (83) secondary level. At least 22.5% (75) had not attained any level of formal education. Only 10% (33) had attained tertiary level education.

The study found out that majority respondents 32.5% (108) were peasant farmers by occupation, 27.5% (92) were students, 20% (66) were housewives, 10% (33) were in formal employment and only 5%(16) were business women.

Obstetric H istory

N=333

Majority of the respondents 57% (194) had gravidity of ≥5 times, followed by 36% (124) 2-4 times, and 7% (23) of first gravida. Majority of the respondents at 45%(164) had parity of ≥5, 44% (111) 2-4 and 11%(30) had a single child.

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Journal of Obstetrics and Gynaecology@SJHR–Africa.

5

Table 3. Shows the demographic characteristics and association with hyperglycaemia in pregnancy

Variables	Descriptive	OR (95% confidence Interval)	P-value
Age			
18-27 years	189 (56.7)	2.10(0.6-1.8)	0.813
28-37years	80(24)	3.13(2.0-4.0)	0.532
37 and above	64 (19)	2.34(0.3-3.0)	**0.013***
Occupation			
Peasant Farmer	108 (32.5)	1.274(0.6-2.8)	0.553
Business person	16(5.0)	1.425(0.8-2.7)	0.278
Student	92 (27.5)	1.010(0.6-1.8)	0.973
Formal employment	33 (10.0)	1.337(0.6-3.2)	0.507
House wife	66 (20.0)	0.749(0.3-1.8)	0.507
Level of education			
Not educated	75(22.5)	1.671(0.6-4.5)	0.314
Primary level	83(25.0)	0.938(0.3-2.5)	0.899
Secondary Level	125 (37.5)	1.337(0.6-3.2)	0.507
Tertiary Level	33(10.0)	0.749(0.3-1.8)	0.507
BMI			
High	80(24.0)	3.744(1.6-8.7)	**0.002***
Low	75 (22.5)	1.274(0.6-2.8)	0.853
Normal	178 (53.4)	1.425(0.8-2.7)	0.378

Prevalence of hyperglycaemia in Pregnancy

N=333

The study found out that majority of the respondents 60.6% (202) had not had any history of hypergly-caemia. However, 22.3% (74) had had a history of hyperglycaemia, while those who did not know their earlier status were 17.1% (57) without the a history of hyperglycaemia.

Factors associated with Hyperglycaemia in pregnancy

Demographic characteristics

Demographic characteristics and association with hyperglycaemia in pregnancy

The study found out the following demographic features as significantly associated with hyperglycaemia in pregnancy; those who were 37 years or older (p-value 0.013* OR 2.34), and high Body Mass index (BMI) (p-value **0.002* OR** 3.744).

Obstetric history and its association with hyperglycaemia

Obstetric history associated with hyperglycaemia in pregnancy

The study found out the following obstetric history as significantly associated with hyperglycaemia in pregnancy; gravidity of 3-4 times (p-value **0.003* OR**3.782), ≥5 times (p-value **<0.001***and **OR**3.099), and parity of ≥5 (p-value **0.003***OR 3.642).

History of Hyperglycaemia and hypertension

History of hypertension and hyperglycaemia and its relationship with hyperglycaemia in pregnancy

The study found out the following history of hyperglycaemia and hypertension as significantly associ-ated with hyperglycaemia in pregnancy; first degree hyperglycaemia (P-value **<0.031***OR 5.152), high blood pressure during this pregnancy (**0.012***OR 3.622) and high blood pressure while not pregnant (p-value **0.012***OR 1.274)

STIs and Hyperglycaemia in pregnancy

The study found no significant relationship between hyperglycaemia in pregnancy and STIs such as HIV and Syphilis.

4   DISCUSSION

Prevalence hyperglycemia in pregnancy

Table 4. Shows Obstetric history associated with hyperglycaemia in pregnancy

Gravidity			
Once	23 (7)	1.274(0.6-2.8)	0.553
2-4 times	124(36)	3.782(1.6-9.1)	**0.003***
>=5 times	194(57)	3.099(1.7-5.5)	**<0.001***
Parity			
1 child	30 (11)	1.471(0.6-4.5)	0.314
2-4 children	111(44)	0.738(0.3-2.5)	0.899
>=5 children	164(45)	3.642(1.6-8.7)	**0.003***
Gestation age at first ANC			
18-27 years	189 (56.7)	1.310(0.6-3.0)	0.522
28-37years	80(24)	0.885(0.4-2.0)	0.773
37 and above	64 (19)	5.152(2.5-10.8)	**<0.001***
Number of ANC visits before delivery			
1-3 times	213(64.0)	1.374(0.6-2.8)	0.653
4-6 times	120(36.0)	1.425(0.8-2.7)	0.578

Table 5. Shows History of hypertension and hyperglycaemia and its relationship with hyperglycaemia in pregnancy

First degree relative with high blood glucose levels			
Yes	49 (14.7)	5.152(2.5-10.8)	**<0.031***
No	187 (56.1)	1.274(0.6-2.8)	0.523
Do not know	97 (29.1)	1.425(0.8-2.7)	0.478
History of hypertension			
High blood pressure during pregnancy			
Yes	134(40.2)	1.274(0.6-2.8)	0.724
No	199	1.010(0.6-1.8)	0.579
High blood pressure during this pregnancy			
Yes	97 (29.1)	3.622(1.6-8.7)	**0.012***
No	236 (70.8)	1.254(0.6-2.8)	0.824
High blood pressure while not pregnant	38(16)		
Yes	47	1.274(0.6-2.8)	**0.012***
No	286	1.010(0.6-1.8)	0.579

Table 6. Relationship between hyperglycaemia in pregnancy and STIs

Presence of STIs			
HIV	21(6.3)	8.590(4.3-17.0)	0.701
Syphillis	27 (8.1)	1.103(0.5-1.7)	0.123

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Journal of Obstetrics and Gynaecology@S JHR–Africa.

7

Blood samples were taken from the pregnant women and laboratory tests for blood glucose were done and a urine glucose test was also done. Laboratory tests revealed that 25.3% (84) had hyperglycemia, 66.5% (221) had normal glucose levels in the blood and 8.2 % (27) had low blood glucose levels. Hyperglycaemia was found to be at 25.3% and this is higher than the global prevalence that was estimated at 16.9% by the World Health Organisation in 2013. as the highest prevalence was 25.0% in South–East Asia and the lowest 10.4% in North America and the Caribbean Region in 2013. Low- and middle-income countries contribute 90% of the cases in the world (WHO, 2013). Therefore, several women carrying pregnancies with such high hyperglycemia pose a risk to the babies they carry. However, what is more, disturbing is the fact that the majority of the women do not attend ANC to have a blood sugar test done. This study for example found out that fewer women 36.0 % (120) attend more than 4 times at ANC. This low ANC attendance is cited in complicating several obstetric adverse events like hypertension, eclampsia leading to low birth weights, complicated deliveries, and sometimes maternal deaths. According to the International Diabetes Federation (IDF), 16.8% of pregnant women have some form of hyperglycemia in pregnancy (Butte *et al*.,2016). This is lower than 25.3% as observed in this study. Therefore, hyperglycemia in pregnancy is a common phenomenon in Uganda and it needs urgent interventions. However, its link to maternal death has not been established.

Gestational hyperglycemia associated factors

A multivariate analysis was done to determine what could be the factors that associate with the observed hyperglycemia of 25.3% among pregnant women. The study found maternal age of 37 years and above (p-value 0.013* OR 2.34), and high Body Mass Index (BMI) (p-value **0.002* OR** 3.744) as being significantly associated with hyperglycemia. These findings agree with the study by Seshiah et al (2015) where gestational diabetes mellitus had the highest prevalence in women with a BMI greater than 25, with 28.4% in the urban area, 23.8% in the semi-urban area, and 16.1% in the rural area. Also, Seshiah et al (2015) found out that a family history of diabetes was associated with the prevalence of GDM in India. Based on multiple logistic regression analysis taking all 3 areas into consideration, family history and BMI greater than 25 were found to have a significant independent association (P<0.001) with GDM.

Seshiah et al (2015) findings are consistent with the findings in this study where it was found out that a history of hyperglycemia and hypertension is significantly associated with hyperglycemia in pregnancy; first-degree hyperglycemia (P-value **<0.031***OR 5.152), high blood pressure during this pregnancy (**0.012***OR 3.622) and high blood pressure while not pregnant (p-value **0.012***OR 1.274). Therefore, those with a history of factors that predispose to hyperglycemia in pregnancy may have the condition worsen if not handled well during the pregnancy. For example, management of hypertension in pregnancy should always be done for those mothers with hypertension as this can lead to hyperglycemia.

Also, this study found out the following obstetric history as significantly associated with hyperglycemia in pregnancy; gravidity of 3-4 times (p-value **0.003*OR**3.782), >=5 times (p-value **<0.001*** and **OR**3.099), parity of >=5 children (p-value **0.003***OR 3.642). According to Berger et al (2012), the following can lead to gestational hyperglycemia; obesity, older age, multi-parity, excessive weight gain during pregnancy, short stature, polycystic ovarian syndrome (PCOS), family history of diabetes mellitus in first degree relatives, a history of abortion, fetal loss, macrosomia, preeclampsia, and multifoetal pregnancy. However, more studies need to be done to qualify gravidity and parity as key associated factors to caution women who wish to have as many babies as possible. The study found no significant relationship between hyperglycemia in pregnancy and STIs like HIV/AIDS and syphilis.

5   Conclusions

Gestational hyperglycemia is common among women attending care at the directorate of Obstetrics and Gynaecology at Kawempe. The commonest factors associated with hyperglycemia in pregnancy were high body mass index, history of hypertension, history of hyperglycemia, high parity, and high gravidity. There is no relationship between hyperglycemia and sexually transmitted diseases like HIV/AIDS and syphilis. There was also a significant number of women who had hypoglycemia.

Recommendations

Routine screening for urine and blood glucose levels should be done for every pregnant woman who visits the ANC. New policy guidelines for maternal care should include researched guidelines on hyperglycemia in pregnancy.

Areas for further investigation.

More studies should be done to find out how parity and gravidity contribute to hyperglycemia in pregnancy. Also, research needs to be done on the life of babies born to mothers with hyperglycemia to further document the effects of the condition.

Fasting blood samples should be used in the coming studies to accurately diagnose the condition.

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Investigation of Hyperglycaemia and Associated Factors among Pregnant Women Attending Antenatal at Mulago Hospital, Directorate of Obstetrics and Gynaecology, Kawempe.

Journal of Obstetrics and Gynaecology@SJHR–Africa.

9

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