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Rural-Urban Differences in Adverse Pregnancy-related Outcomes Among Women with Gestational Diabetes in Central Uganda: Retrospective Comparative Cross-sectional Study

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Abstract

Purpose

We aimed to evaluate the rural-urban difference in pregnancy related outcomes and their association with rural living residence among women with Gestational Diabetes in Central Uganda.

Methods

Data from 600 women was extracted in 1:1 ratio for rural and urban living residences in Central Uganda. We obtained data on socio-demographics, clinical characteristics and adverse pregnancy related outcomes (APOs). Gestational diabetes was diagnosed according to the IADSPG/ADA guidelines. Chi-square and Mann-Whitney tests were used to compare variables between rural and urban dwellings. We used Modified Poisson regression analysis model to assess significant association between APOs and rural living residence.

Results

The median age was 27 years (IQR 21–32).There were significant prevalence differences between rural and urban health facilities for eclampsia(36.4% Vs 63.6%,p = 0.010), polyhydramnios (61.9% Vs 38.1% ,p = 0.001), premature rupture of membranes(PROM)(57.5% Vs 42.5%,p < 0.001), preterm delivery(39.5% Vs 60.5%,p < 0.001), Apgar score at 5min < 7(64.5% Vs 35.5%,p = 0.001), congenital abnormalities(71.1% Vs 28.9%,p = 0.003), neonatal hypoglycaemia(62.7% Vs 37.3%,p < 0.001) ,neonatal respiratory distress (59.4% Vs 40.6%,p < 0.001) and admission to nursery unit(55.8% Vs 44.2%,p = 0.011). Rural living residence was positively and significantly associated with PROM (APR = 1.555 CI 1.291–1.871, p < 0.001), eclampsia (APR = 1.539 CI 1.262–1.877, p < 0.001), preterm delivery (APR = 1.961 CI 1.619–2.375, p < 0.001), fetal death (APR = 1.481 CI 1.328–1.817, p < 0.001), intra uterine growth restriction (APR = 1.176 CI 0.967–1.393, p < 0.001), neonatal hypoglycemia (APR = 1.462 CI 1.217–1.757, p < 0.001) and neonatal hyperbilirubinemia (APR = 1.259, C1 1.014–1.564, p = 0.037).

Conclusion

The findings underscore the need for interventions aimed at preventing and managing adverse pregnancy related outcomes in the rural setting.

What does the study add to clinical work?

There are significant rural-urban differences in adverse pregnancy related outcomes in Uganda. Women living in rural areas are at increased likelihood of getting these outcomes. Data from this study may be

useful in designing context specific programs in screening and managing gestational diabetes in the Ugandan rural setting.

Introduction

Diabetes is increasing in pandemic proportions globally. The increment is caused by increased longevity, urbanization, industrialization, obesity, physical inactivity and stressful modern life with rapid lifestyle changes[1–4].

Irrespective of these, there are other factors that are also orchestrating this epidemic namely intrauterine exposures and gestational programming [1].Gestational programming is defined as permanent change in structure, physiology and metabolism that cause a person to develop adult life disease due to stimuli or stress happening at fetal development[1] Glucose intolerance in pregnancy which presents as gestational diabetes (GDM) is one of the stimuli that influence gestational programming[1].

There are a number of adverse pregnancy related outcomes (PROs) associated with GDM namely spontaneous abortion, macrosomia, intra uterine growth restriction (IUGR), premature rupture of membranes (PROM), neonatal hypoglycemia, hyperbilubinaemia, respiratory distress and the need for neonatal intensive care unit (NICU) admission[5].Additionally, the big babies in GDM increase rates of caesarean sections and vaginal lacerations[6].

Evidence has shown that severity and occurrence of PROs differ with the geographical location of the women with rural areas having poorer outcomes than the urban ones. This is caused by the rural-urban variation in maternal metabolic health and risk factors of diabetes [7].Other factors potentially contributing to this, are better access to prenatal care and health insurance cover[8].In rural dwellings, there are adverse social determinants of health compared to urban areas [9].Furthermore, the low education levels in the rural areas limits women's ability to take up medical knowledge, evidence based clinical care, technology and care packages leading to poor outcomes compared to urban areas[7]. Rural areas oftenly lack subspeciality diabetes care and with limited number of health workers and resources, poor pregnancy related outcomes ensure[7]

In Uganda, the disparity in pregnancy related outcomes in rural and urban health facilities is not known. Understanding the rural-urban differences in adverse pregnancy related outcomes and their association with living residence is potentially useful in designing context specific programs in screening and managing gestational diabetes in our setting.

Therefore, the current study was set out to understand whether there is a rural-urban difference in pregnancy related outcomes and their association with rural living residence in Central Uganda.

Methods

Study design

This was a retrospective comparative cross-sectional study where adverse pregnancy-related outcomes among women with GDM in rural and urban health facilities were compared and assessed if they were associated with rural living residence in Central Uganda.

Setting

We reviewed files of women diagnosed and managed for GDM in rural and urban health facilities in Central Uganda from 2016 to 2018.The Gestational Diabetes in Central Uganda program enrolled 10,000 women, with 5,000 from rural health facilities and the remainder from urban health facility. A total of 23 public and private health facilities in Luwero district constituted the rural arm of the study while Mengo hospital was regarded as urban. Pre-existing diabetes was screened for using a fasting blood glucose measurement after 8 hours of fasting before 24 weeks of amenorrhea. Gestational diabetes in this program was screened at 24 weeks of amenorrhea using an OGTT done in a one-step approach. The procedure involved asking all women to fast for 8 hours before reporting to the health facility. Their fasting blood glucose was measured by the midwives using a calibrated ACCUCHECK active glucometer after 15minutes of resting. They were then given 75grams of glucose in 300mls of clean water that was drunk over 3 minutes. Midwives again measured their glucose levels at 1 hour and 2-hour marks. Basing on the International Association of Diabetes and Pregnancy Study Groups (IADSPG)/American Diabetes Association (ADA) guidelines, GDM was diagnosed according to any of the following criteria:

0-hr (fasting) ≥ 92mg/dl,1-hr≥180mg/dl2-hr≥153mg/dl[10]

A management protocol developed by Reproductive Health Uganda and Uganda Diabetes Association was used by midwives to manage all women diagnosed with GDM. Briefly, all women were health educated about life style modification that included dietary advice and exercise program. Those women who were not controlled by life style modification after 2 weeks, they were started on pharmacotherapy with either metformin or insulin. It was mandatory for this program to have all deliveries in a health facility where there was a medical officer, theatre and a nursey. Women who were attending lower-level facilities were referred to higher facilities where there was a medical officer and nursery services. All women were followed up before, during and after delivery for pregnancy related outcomes. These included maternal outcomes (e.g. pre-eclampsia, eclampsia, oligohydramnios, polyhydramnios), intrapartum outcomes (e.g. emergency caesarian section, premature rupture of membranes, preterm delivery), perinatal outcomes (e.g. fetal death, macrosomia, intrauterine growth restriction, first- and fifth-minute Apgar score < 7) and neonatal outcomes (e.g. nursery admission, neonatal hyperbilirubinemia, neonatal hypoglycemia, neonatal respiratory distress).Six weeks after delivery, all women post GDM were screened for diabetes using a non-pregnant OGTT. Women with normal glucose tolerance were advised to continue with life style modification. Those with impaired fasting glucose, impaired glucose tolerance and type 2 diabetes were referred to respective health facilities with diabetes clinics for continual care and treatment.

Sample size

We calculated the sample size for our study using a formula by Chalan B et al 2013 [11].

$$n = \frac{r+1}{r} * \left(Z\alpha\ /2 + Z\beta\ \right)^2 * P * \frac{(1-P)}{P1-P2}$$

Where:

n=number for each group.

r=ratio of women in urban to rural facilities (r = 1, we had equal numbers of women in each group)

Zα/2: Z score of the desired confidence level (1.96 for 95% Confidence Interval)

Zβ: Z-score of desired power of 80% power. (i.e.0.84 for a power of 80%

P1: Proportion (Prevalence) in rural health facilities.

P2: Proportion(prevalence) in urban health facilities.

P: Average proportions(prevalence) (P1 + P2)/2

We used data from a study by Mdoe MB et al 2021 to calculate the sample size using the stipulated formula. In this study, the prevalence(P1) of GDM in rural areas was 20.5% while in the urban health facilities it was 31.6%[12].

Therefore:

$$n = \frac{1+1}{1} * \left(1.96 + 0.84\right)^2 * 0.205 + 0.316/2 * \frac{(1-0.2605)}{0.205-0.316}$$

We calculated 245 women for each group which we increased by 20% to offset loss of files with more than 75% of missing data on adverse pregnancy related outcomes. From this adjustment,49 women were added to each group making it 294 for each group. This number was finally rounded to 300 per each group.

Sampling

As long as the women's files had information on adverse pregnancy related outcomes, they were all eligible. During the two-year program, the files of women who left these facilities were not included. Prior to data extraction, the files were arranged sequentially. There were three Health Center IVs, seventeen Health Center IIIs, and three Health Center IIs from Luwero district. The proportion of women enrolled in

the program was 14:1.5:1. The number of files chosen from the various tiers of health facilities was determined using the same ratio. Therefore,255,27 and18 files were selected from Health Center IVs, Health Center IIIs and Health Center IIs respectively. We sequentially picked files from Mengo Hospital in order to reach the target sample size of 300.

Data collection

The Principal Investigator taught research assistants to record information in the data extraction form. The training lasted for two days at Mengo Hospital and the research protocol served as its foundation. Data was gathered by the trained research assistants. The Principal Investigator verified the data's completeness every day before entering it into the computer. After being coded and imported into Epi Data Manager, the data was exported into STATA version 16 (Statacorp LLC, College Station, Texas) for analysis. The Principal Investigator was the only one who knew the password for the computer where the extracted data was kept. We kept three copies of our data i.e. two backups and the original. Internal hard drives, external storage, and cloud storage devices were the different media types on which these copies were stored.

Variables

In this study, we assessed the rural-urban differences in the adverse pregnancy related outcomes among women with GDM and their association with rural living residence. We collected data on the following:

Independent (Predictor) Variable

The pregnant woman’s dwelling space was extracted from the files. The woman's file revealed whether she lived in an urban or rural area. The Luwero district, located 70 kilometers from Kampala, had 23 medical facilities. It was believed that the women from these medical institutes lived in remote parts of the nation. These regions are less populated than the main city and lack schools, built roads, and urban hubs. The urban population consisted of women who resided in Kampala and the surrounding areas and went to Mengo Hospital.

Dependent (Outcome) Variables

Information on medical history (family history of diabetes and hypertension), socio-demographic information (age, occupation, marital status, and educational attainment), clinical information (baseline fasting blood glucose, blood pressure, weight, height, and body mass index), and adverse pregnancy-related outcomes (pre-eclampsia, eclampsia, oligohydramnios, polyhydramnios, premature rupture of membranes (PROM),emergency caesarian section, preterm delivery, macrosomia, intrauterine growth restriction (IUGR), intrauterine fetal death (IUFD), first- and fifth-minute Apgar score <7Apgar score, congenital abnormalities, neonatal hypoglycemia, neonatal hyperbilubinaemia, respiratory distress, and

the need for neonatal nursery admission were among the dependent variables. The following steps were taken in the health facilities in order to gather the clinical characteristics:

Fasting blood glucose

A calibrated ACCUCHECK active glucometer was used to measure the women's fasting blood glucose levels after an 8-hour fast and a 15-minute rest interval.

Anthropometric measurements

In these facilities, midwives measured blood pressure, weight, and height according to conventional protocols[13][14] In short, three readings were taken using an OMRON digital blood pressure equipment, and the mother's file was updated with the average. In terms of weight, women were told to remove their shoes or slippers, jewelry, and bulky garments before weighing. A portable stadiometer was used to measure height. The height and weight were measured to the closest 0.1 inch. The midwives calculated the Body Mass Index (BMI) by dividing weight in kilos by the square of the height in meters. Standard BMI cut-offs were used to classify the women as underweight (BMI < 18.5 kg/m2), normal (BMI ≥ 18.5 < 25 kg/m2), overweight (BMI > 25 to < 30 kg/m2), and obese (BMI > 30 kg/m2)[14].

Definition of variables

Living residence

Living in Luwero, a remote area of the nation 70 kilometers from Kampala and outside of municipalities with a low population, a lot of undeveloped land, and a livelihood primarily reliant on peasant farming, was categorized as rural living[15]. Every woman who visited Luwero's facilities was regarded as a rural resident. Women who lived in Kampala and its suburbs and visited Mengo Hospital made up the urban residence.

Pre-eclampsia was defined as systolic blood pressure of 140 mm Hg or higher and/or diastolic blood pressure of 90 mm Hg or higher, along with positive proteinuria of at least 1 + or 30mg/dl using a dipstick on a random urine sample after 24 weeks of gestation [5].

Oligohydramnios was defined on ultrasound as reduced amniotic fluid volume for gestational age of less than 1cm in its vertical access[16].

Polyhydramnios was described on ultrasound as amniotic fluid volume for gestational age of more than 8cm in its vertical access [17].

Emergency caesarian section was defined as a surgical delivery procedure conducted to save the baby and the mother when their lives faced immediate threat from conditions related to GDM[18]

Premature rupture of membranes was described as breakage of membranes more than 1 hour before labor started[5]

Preterm delivery was defined as woman delivering a baby after 28 weeks but before 37 completed weeks of gestation[19].

Fetal death was described as an uninduced demise of the product of human conception before it was completely expelled or extracted from the woman irrespective of gestation duration[20].

Macrosomia was defined as a baby having a birth weight of 4 kilograms and higher at delivery[5]

Intrauterine growth restriction was when the fetus grew at a slower rate than is expected for that infant at that period[21]. This was ultrasound determined.

First and fifth-minute Apgar score > 7. This was description of the new born overall condition after delivery at 1 and 5 minutes. A score higher than 7 at these time points was described as healthy[22].

Congenital malformations were defined as single or multiple defects of body organs detected at birth or in utero[23].

Nursery admissions were defined as transfer of a new born usually preterm, low birth weight or those with birth related complications from the labor suite to the nursery unit within the first 28 days of life for monitoring, feeding support and treatment. These units also manage neonates for mild respiratory distress, jaundice and other infections that don't require intensive treatment[24].

Neonatal Hypoglycemia was described as blood glucose level of less than 40 mg/dL (2.2 mmol/L)[25].

Neonatal hyperbilirubinemia was described as a total serum bilirubin level above 5 mg per dL (86 µmol per L)[26].

Neonatal respiratory distress was defined as a symptom and sign complex irrespective of etiology that included tachypnoea, nasal flaring, grunting, retractions, irregular breathing, see saw breathing, stridor, hypoxia and cyanosis[27].

Data analysis

Following coding and entry into Epi Data Manager, the data retrieved from women's files was exported into STATA version 18 (Statacorp LLC, College Station, Texas, United States of America) for analysis. We used proportions, percentages, medians, and interquartile ranges to characterize sociodemographic and clinical features. The Chi-square test was utilized to compare categorical data between rural and urban dwellings, whereas the Mann-Whitney test was utilized to evaluate continuous variables. We used a Modified Poisson regression analysis model to investigate the relationship between residing in a rural area and adverse pregnancy-related outcomes because the prevalence of these outcomes was greater than 20%. Unadjusted prevalence ratios were obtained by the use of bi-variable analysis. The multi-variable model was used to produce the adjusted prevalence ratios along with their p-values and 95% CIs for the variables that had $p \leq 0.20$. Statistical significance was established when the p-value was less than 0.05.

Results

Overall, there were 600 women with GDM in this study. The median age was 27 years (IQR 21–32). Rural women were younger than their urban counterparts($p < 0.001$). Rural women were less educated than urban ones($p < 0.001$). Furthermore, rural women tended to be peasant farmers or unemployed compared to those in the urban areas($p < 0.001$). There was no significant difference in terms of smoking between the groups($p = 0.254$) Table 1

Table 1
Socio demographic characteristics among women with GDM in rural and urban health facilities in Central Uganda

Variable	Rural(n = 300)	Urban(n = 300)	All(N = 600)	P-value
Median Age in years (IQR)	22(19–30)	29(25–33)	27(21–32	< 0.001
Education level				
No formal education	50(89.3%)	6(10.7%)	56(9.3%)	
Primary	177(86.3%)	28(13.7%)	205(34.2%)	
O-level	58(41.4%)	83(58.9%)	141(23.5%)	
A-level	9(18.8%)	39(81.2%)	48(8.0%)	
Tertiary	6(4.0%)	144(96.0%)	150(25.0%)	< 0.001
Occupation				
Farmer	108(87.1%)	16(12.9%)	124(20.7%)	
Business	21(15.7%)	113(84.3%)	134(22.35)	
Teacher	8(17.8%)	37(82.2%)	45(7.5%)	
House wife	83(54.2%)	70(45.8%)	153(25.5%)	
None	80(90.9%)	8(9.1%)	88(14.7%)	
Other	10(17.86%)	46(82.14%)	56(9.3%)	< 0.001
Marital status				
Single	100(80.0%)	25(20.0%)	125(20.8%)	
Married	198(42.3%)	270(57.7%)	468(78.0%)	
Separated	2(28.6%)	5(71.4%)	7(1.2%)	< 0.001
Smoking	23(42.6%)	31(57.4%)	54(9.0%)	0.254
Alcohol ingestion	40(40.8%)	58(59.2%)	98(16.3%)	0.047
BMI ≥ 25Kg/m2	156(55.1%)	127(44.9%)	283(47.2%)	< 0.001
SBP≥140mmHg	5(22.7%)	17(77.3%)	22(3.7%)	0.009
DBP ≥ 90mmHg	8(26.7%)	22(73.3%)	30(5.0%)	< 0.001

O-level: Ordinary level, A-level: Advanced level, IQR: Interquartile Range, BMI: Body Mass Index, SBP: Systolic Blood Pressure, DBP: Diastolic Blood Pressure

Table 2
Medians for clinical characteristics of women with GDM in rural and urban health facilities in Central Uganda

Variable (Units)	Rural(n = 300)	Urban(n = 300)	All(N = 600)	P-value
	Median (IQR)	Median (IQR)	Median (IQR)	
Pre-eclampsia SBP (mmHg)	120(114–140)	124(110–144)	120(112–140)	0.172
Pre-eclampsia DBP (mmHg)	80(78-93.4)	80(87–98)	80(70–96)	0.3371
Birth weight (Kg)	3.2(2-4.2)	3.3(2.8–3.5)	3.2(2.1–4.1)	0.037
Apgar score at 1min < 7	6(4–8)	8(4–8)	8(4–8)	0.7616
Apgar score at 1min < 7	9(8–10)	10(9–10)	10(9–10)	0.008
Neonatal blood glucose(mmol/l)	2.0(1.8–4.5)	4.1(2.1–4.5)	3.9(1.9–4.5)	< 0.001
Neonatal bilirubin (mg/dL)	3.08(2-3.36)	3.15(2.08–4.18)	3.095(2.04–3.82)	0.044
6-week post-delivery FBG (mmol/l)	5(4.5–5.8)	5.1(4.8–6.3)	5(4.6-6)	0.001
6-week post-delivery 2hr BG (mmol/l)	7.1(6.8–8.1)	7.7(6.9–9.4)	7.4(6.8–8.4)	< 0.001
6week post-delivery HbAIC (%)	5.1(4.9–5.8)	5.45(5.1–6.2)	5.3(4.9-6.0)	< 0.001

SBP: Systolic Blood Pressure, DBP: Diastolic Blood Pressure, FBG: Fasting Blood Glucose, BG: Blood Glucose, HbAIC: Glycated haemoglobin

Regarding the prevalence of adverse pregnancy related outcomes, there were significant differences between rural and urban health facilities for eclampsia(p = 0.010), polyhydramnios (p = 0.001), premature rupture of membranes(p < 0.001), preterm delivery(p < 0.001), Apgar score at 1min < 7(p = 0.001), congenital abnormalities(p = 0.003), neonatal hypoglycaemia(p < 0.001) ,neonatal respiratory distress (p < 0.001) and admission to nursery unit(p = 0.011) (Table 2)

Table 2
Proportions of Adverse Pregnancy-related Outcomes Among Women with GDM in rural and urban health facilities in Central Uganda

Variable(units)	Rural	Urban	All	P-value
	n = 300	n = 300	N = 600	
Pre-eclampsia	113(45.6%)	135(54.4%)	248(41.3%)	0.068
Eclampsia	28(36.4%)	49(63.6%)	77(12.8%)	0.010
Oligohydramnios	107(49.1%)	111(50.9%)	218(36.3%)	0.734
Polyhydramnios	96(61.9%)	59(38.1%)	155(25.8%)	0.001
PROM	184(57.5%)	136(42.5%)	320(53.3%)	< 0.001
SVD	141(48.1%)	152(51.91)	293(48.5)	0.369
Emergency C/S	156(50.8%)	151(49.2%)	307(51.2%)	0.683
Pre-term delivery	88(39.5%)	135(60.5%)	223(37.2%)	< 0.001
Fetal death	81(72.3%)	31(27.7%)	112(18.7%)	< 0.001
IUGR	98(58.0%)	71(42.0%)	169(28.2%)	0.014
Apgar score at 1min < 7	155(54.2%)	131(45.8%)	286(47.7%)	0.05
Apgar score at 5min < 7	71(64.5%)	39(35.5%)	110(18.3%)	0.001
Congenital abnormalities	32(71.1%)	13(28.9%)	45(7.5%)	0.003
Birthweight ≥4Kg	91(55.8%)	72(44.2%)	163(27.2%)	0.081
Neonatal blood glucose < 2.2mmol/l	170(62.7%)	101(37.3%)	271(45.2%)	< 0.001
Neonatal bilirubin > 5 mg/dL	41(43.6%)	53(56.4%)	94(15.7%)	0.178
Neonatal Respiratory distress	177(59.4%)	121(40.6%)	298(49.7%)	< 0.001
Nursery admission	149(55.8%)	118(44.2%)	267(44.5%)	0.011
FBG at post 6-Week OGTT				
5.51-6.9mmol/l	38(47.5%)	42(52.5%)	80(13.3%)	0.516
> 7mmol/l	32(54.2%)	27(45.8%)	59(9.8%)	0.493
2hr BG at post 6-Week OGTT				
7.8-10.99mmol/l	49(52.1%)	45(47.9%)	94(15.7%)	0.064

PROM: Premature Rupture of Membranes, SVD: Spontaneous Vaginal Delivery, IUGR: Intra Uterine Growth Restriction, FBG: Fasting Blood Glucose, OGTT: Oral Glucose Tolerance Test, BG: Blood Glucose, HbAIC: Glycated haemoglobin

Variable(units)	Rural	Urban	All	P-value
	n = 300	n = 300	N = 600	
> 11.1mmol/l	41(60.3%)	27(39.7%)	68(11.3%)	0.021
HbAIC post 6 Week				
5.51–6.49%	47(49.0%)	49(51.0%)	96(16%)	0.409
≥ 6.5%	48(64.0%)	27(36.0%)	75(12.5%)	0.019

PROM: Premature Rupture of Membranes, SVD: Spontaneous Vaginal Delivery, IUGR: Intra Uterine Growth Restriction, FBG: Fasting Blood Glucose, OGTT: Oral Glucose Tolerance Test, BG: Blood Glucose, HbAIC: Glycated haemoglobin

Adverse pregnancy-related outcomes associated with rural living residence among women with GDM

On multivariable analysis with Modified Poisson regression, rural living residence was positively and significantly associated with pre-mature rupture of membranes (APR = 1.555 CI 1.291–1.871, P < 0.001), eclampsia (APR = 1.539 CI 1.262–1.877, P < 0.001), preterm labor (APR = 1.961 CI 1.619–2.375, P < 0.001) and fetal death (APR = 1.481 CI 1.328–1.817, P < 0.001). Furthermore, babies with intra uterine growth retardation were 17.6% more likely to be born to rural women (APR = 1.176 CI 0.967–1.393, P < 0.001) than to their urban counterparts. The likelihood of neonatal hypoglycemia (APR = 1.462 CI 1.217–1.757, P < 0.001) and hyperbilirubinemia (APR = 1.259, C1 1.014–1.564, P = 0.037) were 46.2% and 25.9% with rural borne babies than urban ones respectively. (Table 3).

Table 3
Adverse pregnancy-related outcomes associated with rural living residence among women with GDM by Modified Poisson Regression Analysis.

Variable	CPR (95% CI)	P-value	APR (95% CI)	P-value
PROM				
No	1		1	
Yes	1.378 (1.173–1.619)	< 0.001	1.555 (1.291–1.871)	< 0.001
Eclampsia				
No	1		1	
Yes	1.326 (1.095–1.605	0.004	1.539 (1.262–1.877)	< 0.001
Preterm labor				
No	1			
Yes	1.383 (1.183–1.617)	< 0.001	1.961 (1.619–2.375)	< 0.001
Fetal death				
No	1		1	
Yes	1.449 (1.201–1.712)	< 0.001	1.481 (1.328–1.817)	< 0.001
IUGR				
No	1		1	
Yes	1.185 (0.999–1.383)	< 0.001	1.176(0.967–1.393)	< 0.001
Neonatal hypoglycemia				
2.2mmol/l and above	1		1	
< 2.2mmol/l	1.623 (1.359–1.939)	< 0.001	1.462 (1.217–1.757)	< 0.001
Neonatal bilirubin				
< 5	1		1	
5 and above	1.155 (0.947–1.41)	0.156	1.259 (1.014–1.564)	0.037
EMCS				
No	1			
Yes	1.034 (0.881–1.214)	0.683	-	-
Birthweight ≥4Kg				

PROM: Premature Rupture of Membranes, IUGR: Intra Uterine Growth Restriction, EMCS: Emergency Caesarean Section

Variable	CPR (95% CI)	P-value	APR (95% CI)	P-value
No	1			
Yes	1.029 (0.872–1.214)	0.733	-	-
Congenital anomalies				
No				
Yes	0.559 (0.351–0.89	0.014	-	-
PROM: Premature Rupture of Membranes, IUGR: Intra Uterine Growth Restriction, EMCS: Emergency Caesarean Section				

Discussion

In the current study, we set out to assess whether there is a rural-urban difference in pregnancy related outcomes and their association with rural living residence in Central Uganda. Rural women compared to their urban counterparts developed eclampsia, polyhydramnios, premature rupture of membranes, preterm delivery. Additionally, their babies were born with an Apgar score at one minute of less than seven, congenital abnormalities, neonatal hypoglycaemia with a propensity for admission to the nursery unit. Among these adverse pregnancy related outcomes, rural living residence was significantly associated with pre-mature rupture of membranes, eclampsia, preterm delivery, fetal death, intra uterine growth retardation, neonatal hypoglycemia and hyperbilirubinemia.

Differences in socio-economic status underpin the disparity between rural and urban health outcomes[28].The determinants of socio-economic status are level of education, income, employment status and type of health insurance[28]. In our study, rural women were younger, less educated, peasant farmers or unemployed translating into a low socio-economic status among this cohort. The low socio-economic status may explain the adverse maternal outcomes such as eclampsia, premature rupture of membranes and poly hydramnios among the rural women in our study. Women in rural areas have limited access to quality prenatal care, health nutrition and tend to have high levels of obesity[29]. Venkantesh et al showed that women in rural areas are less educated translating into slow absorption of medical information, use of evidence-based care, technology and pregnancy care bundles leading to poorer outcomes[7]. The lack of insurance cover and low education (health literacy) in rural areas coupled with limited timely screening and consistent management of hyperglycemia lead to high occurrence of adverse pregnancy related outcomes such as pre-eclampsia, preterm birth and caesarian section deliveries[30] [7]Furthermore, health literacy predicts health related behavior. It has been shown that health improvement depends on behavioral changes such as healthy diet and quitting smoking. Women from the high socio economic class exhibit these changes before rural ones [30].Our findings have been corroborated by Linsonkova et al who showed that rural residence was associated with a 2-fold increase in rates of eclampsia, obstetric embolism and uterine dehiscence and rupture[31] However, findings from our study differ from those of Vahad Mehnoush et al who did not find an association

between rural residence and adverse maternal outcomes, this is because in Iran, women in rural areas have a higher access to prenatal care and medical insurance[28] compared to Ugandan rural health facilities where there is no medical insurance cover.

In our study, adverse neonatal outcomes namely preterm delivery, fetal death, intrauterine growth restriction, neonatal hypoglycemia and neonatal hyperbilirubinemia were associated with rural living residence. A number of factors such as maternal age, antenatal care attendance, distance to health care, participants decision making, parity, delayed referral have been identified as determinants of adverse pregnancy related outcomes [32].To this end, rural women in our study tended to be younger, less educated with a low income and probable long distances to the health facilities could have affected their attendance of antenatal care services. In the quest of attaining Millenium Development three, the WHO recommends that every pregnant woman should attend at least four antenatal visits and at most eight visits to ensure a health and safe delivery. Attendance of antenatal care is beneficial in early detection and management of pregnancy associated risks such as hypertension,diabetes,education on birth preparedness, vitamins and mineral supplementation and identification of high risk pregnancy [32].In Uganda, only 29% of pregnant women attend their first ANC within 12 weeks of pregnancy [33].Nonattendance of first ANC leads to preterm birth, low birth weight, still births and maternal mortality [32].Whereas women enrolled into the GICU program had reasonably good ANC care attendance due to its community component and involvement of men in women care ,a number of GDM women still did not complete the required 4 visits. This postulation is supported by a study conducted by Kawungezi et al that showed that majority of women in Uganda attend ANC late usually at 5.5 months of pregnancy and fail to complete the required four visits. The situation is worse in the rural areas where women are 2 times less likely to attend ANC.This inadequate utilization of ANC leads to high rates of maternal and neonatal mortality[34].Another explanation for our results is that in Ugandan rural areas, there is no medical insurance and limited number of obstetricians and pediatricians limiting access to advanced obstetric and neonatal care. Our findings have been corroborated by a study conducted by Vahd Mernoush et al where rural living residence was associated with preterm birth though the explanation for this differs from our study i.e. in Iran there is good medical insurance and obstetric services unlike our setting but the poor neonatal outcomes were determined by differences in the individual socio-economic status[28].

Our study has a number of strengths. To our knowledge, this is the first study in our setting to assess the rural-urban difference of adverse pregnancy related outcomes and their association with living residence. Since we used data from a well conducted intervention program, we had robust data to ensure good power of the study. However, being a retrospective study, its weakness stems from the fact not all variables were well documented. Despite this limitation, our study has provided important data the rural-urban difference of adverse pregnancy related outcomes and their association with rural living residence. This data may potentially be used to develop rural maternal programs in the country.

Conclusion

The current study has highlighted the rural-urban difference in adverse pregnancy related outcomes and their association with rural living residence in Central Uganda. Our findings underscore the need for maternal programs with interventions aimed at preventing and managing such outcomes among rural women in Uganda. The need for interventions such as universal education, poverty eradication, food security, transport amenities, health insurance, provision of specialist doctors and quality health care, training and skilling of lower-level health workers in the rural areas cannot be overemphasized.

Declarations

Declarations

Competing interests

We declare no competing interests.

Ethical approval and consent to participate

This study was conducted in line with the Declaration of Helsinki for human beings. The study was approved by Mengo Hospital Research Ethics Committee (approval number MH 136/07-2025). We obtained a waiver of informed consent from the Ethics Committee for the participants this being a retrospective study. The selected files were de-identified and coded to guarantee participants' confidentiality.

Consent for publication

Not applicable

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Author Contribution

WL, SN, RKM, RBN, SPN developed the study concept and methodology. RS, RBN, and WL made the plan for statistical analysis. RKM, in conjunction with RS and WL, conducted data analysis. WL, SN, RKM, RBN, DM, GN, HN, RM, SN, CS,EN, RS, AK and SPN developed the manuscript and made necessary revisions to produce the final version. All authors reviewed the manuscript.

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Data Availability

The data sets used and or analyzed during the current study are available from the corresponding author upon reasonable request.

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