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Assessment of Initial Adverse Neonatal Health Eventsand Influencing Factors Among Diabetes MellitusMothers at Ishaka Adventist Hospital, Comboni Hospital, Bushenyi, Uganda

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Abstract: Globally, poorly controlled diabetes mellitus during pregnancy increases the risk of complications especially among neonates born to mothers with diabetes mellitus. **Aim of the study:** To assess the initial adverse neonatal health events and influencing factors among diabetes mellitus mothers delivering in Ishaka Adventist Hospital and Comboni Hospital, Bushenyi, Uganda. **Methodology:** Prospective cohort study conducted among 145 women with diabetes mellitus in pregnancy who delivered at Ishaka Adventist Hospital, Comboni Hospital during the study period after obtaining an informed consent. Information was collected from sample with the help of the questionnaires which were coded and entered in MS excel. Data was analyzed by SPSS version 25. Analyzed information was presented inform of tables, and graphs in line with the study objectives. **Results:** The overall incidence of early adverse neonatal out comes among neonates born to mothers with diabetes mellitus delivering in Ishaka Adventist Hospital and Comboni Hospital was 69.3%. While non adverse neonatal outcome among neonates born to mothers with diabetes mellituswere30.7%. The most common neonatal early adverse outcome was Macrosomia representing an incidence of 45.3%. At multivariate stage, occupation (P-value=0.005), income was (P-value =0.019) at bivariate level, gestational age (P-value=0.034) at bivariate level, ANC visits at multivariate stage were (P-value=0.035) and being on treatment at bivariate level(P-value=0.006) were significant factors associated with early adverse neonatal outcome among mothers with diabetes.**Conclusion:** The composite incidence of early adverse outcomes among neonates born to mothers with diabetes mellituswashigh**.** The most common early adverse neonatal outcome was macrosomia. The risk of early adverse neonatal outcomes increased significantly with being unemployed, delivering at gestational age < 37 weeks, having< 4 ANC visits and being on treatment.

Keywords: Assessment, Neonatal Health, Diabetes Mellitus, Bushenyi, Uganda

Introduction

Diabetes which is Greek word for a siphon, meaning water passing through the body has been a recognized medical disorder over 2000 years ago (Hawthorne, 2004). Aretaeus of Cappadocia, was the first to use the term diabetes to describe the disease in the second century AD, in 17th century Thomas Willis added the term mellitus to the disease in an effort to describe the incredibly sweet taste of the urine. For women who are pregnant or at risk for conception, teratogenic factors pose a greater risk to the fetus, as these abnormalities may go undetected until birth. These malformations are the origin of the infant's postnatal illness and disability. The defects can also lead to mortality. (Garugula et al., 2021).

Considerably diabetes mellitus (DM) is a serious and chronic disease (Alam et al., 2021) and globally the number of people with diabetes have risen from 108 million in 1980 to 422 million in 2014 (World Health Organization, 2016), to 463 million people in 2019 and it is expected to rise to 578 million by 2030 and 700 million by 2045 (Saeedi et al., 2019).

Objectives

General objective

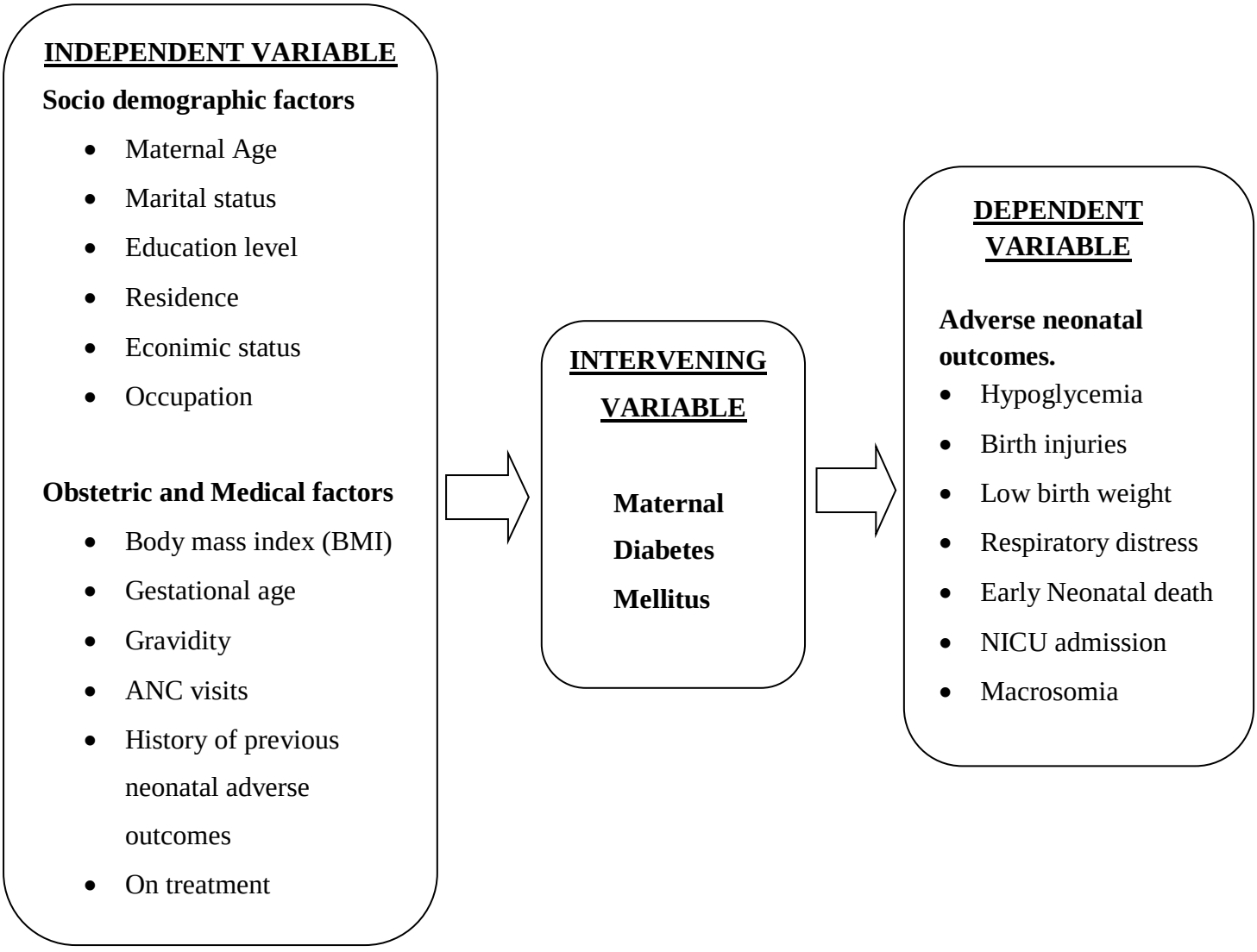
Assessment of initial adverse neonatal health events and influencing factors among diabetes mellitus mothers at Ishaka Adventist Hospital and Comboni Hospital, Bushenyi, Uganda.

Specific objectives

1. To determine the incidence of early adverse neonatal outcomes among mothers with diabetes mellitus delivering in Ishaka Adventist Hospital and Comboni Hospital, Bushenyi, Uganda.
2. To describe early adverse neonatal outcomes among mothers with diabetes mellitus delivering in Ishaka Adventist Hospital and Comboni Hospital, Bushenyi, Uganda.
3. To identify factors associated with early adverse neonatal outcome among mothers with diabetes delivering in Ishaka Adventist Hospital and Comboni Hospital, Bushenyi, Uganda.

Conceptual frame work- The dependent variables are immediate neonatal outcomes which include hypoglycemia, low birth weight, birth injuries, respiratory distress, early neonatal death, NICU admission, macrosomia likely to be influenced by independent variables such Socio demographic factors; **(**maternal age,

education level, body mass index (BMI)**,** exercise**,** economic status).Maternal Diabetes Mellitus was considered intervening variable.



Literature Review The review of literature divided in to following heading

1. **Introduction to diabetes among pregnant mothers in labor**

Over the last 14 years, the incidence of both GDM and pre-GDM in pregnancy has more than doubled, and the overall societal cost of diabetes in pregnancy is increasing (Feig et al., 2014). According to the International Diabetes Federation (IDF) estimates for 2019 (9th edition), the overall global

prevalence of diabetes in pregnancy was 15.5%, with GDM accounting for 12.8% and pre-existing diabetes accounting for 2.7% (Yuen et al., 2019).

2. **Composite incidence adverse neonatal outcomes among mothers with diabetes**

According a prospective cohort study conducted among pregnant women recruited from antenatal clinics and followed through pregnancy to delivery in Ethiopia, it was revealed that among the total of 684 newborns, 207(30.3%, 95% CI: 26.9, 33.6) had at least one type of neonatal adverse outcome. The proportion of composite adverse neonatal outcome among mothers with and without GDM was 51.7% and 25.8%, respectively (Muche et al., 2020).

3. **Description early adverse neonatal outcomes among mothers with diabetes**

A prospective hospital-based study in Bangalore, Karnataka, India found hypoglycemia, macrosomia, preterm, respiratory distress syndrome, and congenital cardiac abnormalities in diabetes mothers' newborns (Anjum & H. T., 2018).

4. **Factors associated with early adverse neonatal outcome among others with diabetes mellitus**

A prospective study that included 576 patients with GDM followed in the Diabetes and Pregnancy Unit in the Centre HospitalierUniversitaire Vaudois (CHUV), Lausanne, Switzerland, between April 2012 and October 2017 showed that pre-pregnancy BMI was inversely associated with SGA. In addition, women with pre-pregnancy BMI ≥ 25 kg/m2 were at risk being LGA and nearly doubled compared to women with BMI with < 25 kg/m2 (Antoniou et al., 2019).

Methodology

Research approach

Study Design- A prospective cohort study was conducted in mothers with diabetes mellitus in pregnancy.

Study Area- Multi-center study conducted in Ishaka Adventist Hospital and Comboni Hospital, Bushenyi, Uganda.

Population - All pregnant women in labor delivering in Ishaka Adventist Hospital and Comboni Hospital, Bushenyi, Uganda.

Sample and sampling technique - Consecutive sampling technique was used to 136 diabetic mothers who have just delivered.

Inclusion Criteria- Mothers with diabetes mellitus who delivered at Ishaka Adventist Hospital, Comboni Hospital during the study period were included in the study after obtaining an informed consent.

Exclusion Criteria- Mothers with diabetes mellitus co-existing with other medical conditions such as hypertension , mental illness and cardiac diseases were excluded.

Data Collection-Data collection was conducted by the principal investigator under supervision with the help of research

assistants.Training research assistants on the research protocol, standard operating procedures and data collection tools was considered.

Data collecting tools-Data from this study was collected with the help of the structuredinvestigator-administered pre-tested and pre-coded questionnaires with close-ended questions
together with a checklist recording early adverse neonatal outcomes.

Validity and reliability -The Questionnaires were pretested at the maternity ward of Bushenyi HC IV this aimed at assessing the suitability, practicability and reliability. To determine the Content Validity Index, the checklist was submitted to 2 experts who are the supervisors. The Stadiometer to measure height, weighing scales and glucometersfollowing were used in this study to collect the data collection.

Data Collection procedure - The Principal Investigator together with the research assistants approached pregnant women who were in labor, educated them about the study.At the ward, pregnant women were assessed for eligibility.An interviewer-administered questionnaire with closed ended questions was used to obtain data regarding bio-data of pregnant women. After birth, neonatal outcomes were recorded.

Ethical Considerations- The study was carried out only after approval by the Research and Ethics Committee of BSU, Mbarara. Approval was also sought from the administration of study hospitals where the research was conducted.

Results – The result was divided and presented in following heading

1. Socio-demographic characteristics of the study participants-

Variable	Frequency (n)	Percent (%)
Age		
< 20 years	12	8.0
20-34 years	98	65.3
≥ 35 years	40	26.7
Marital status		
Married	120	80.0
Single	22	14.7
Others	8	5.3
Monthly income (in shillings)		
< 150000	94	62.7
≥ 150000	56	37.3
Education level		
Uneducated	11	7.3
Primary	54	36.0
Secondary	65	43.3
Tertiary/university	20	13.3
Residence		
Rural	81	54.0
Urban	69	46.0

Occupation		
Unemployed	132	88.0
Employed	18	12.0

Results from table 1 show that majority of study participants were between 21-34 years of age 98(65.3%), from Urban areas 81 (54.1%), married 120 (80.0%), had secondary level of education 65(43.3%), unemployed 132(88.0%), and earned monthly income < 150000Ugshs 94(62.7%).

2. Obstetric and Medical Characteristics of the study participants

Table 1: Obstetric and Medical Characteristicsof the study participants

Variable	Frequency	Percent
ANC visits		
< 4	34	22.7
≥ 4	116	77.3
Body Mass Index		
≥ 30	29	19.3
25.29.9	61	40.7
18.5-24.9	60	40.0
Gravidity		
Primi-gravida	34	22.7
2-4	55	36.6
≥ 5	61	40.7
Gestational age		
< 37	33	22.0
≥ 37	117	78.0
History of previous neonatal adverse outcomes		

Yes	29	19.3
No	121	80.7
Treatment		
Not on treatment	72	52.0
On treatment	78	48.0
Insulin	38	25.3
Metformin	33	22.0
Insulin + metformin	5	3.3
Insulin + glibenclamide	2	1.3
Exercise		
Yes	105	70.0
No	45	30.0

Results from table 2 show that majority of participants attended ANC ≥ 4 117 (77.3%), had BMI of 25.29.9 61(40.7), were of gravidity ≥ 5 61(40.7%), delivered term (gestational age ≥ 37 weeks) 117 (78.0%), had no History of previous neonatal adverse outcomes 121 (80.7%), received no diabetic treatment 78 (52.0%), did not do exercises during pregnancy) 105 (70.0%).

3.Incidenceof early adverse neonatal outcomes amongmothers with diabetes mellitus delivering at Ishaka Adventist Hospital and Comboni Hospital.

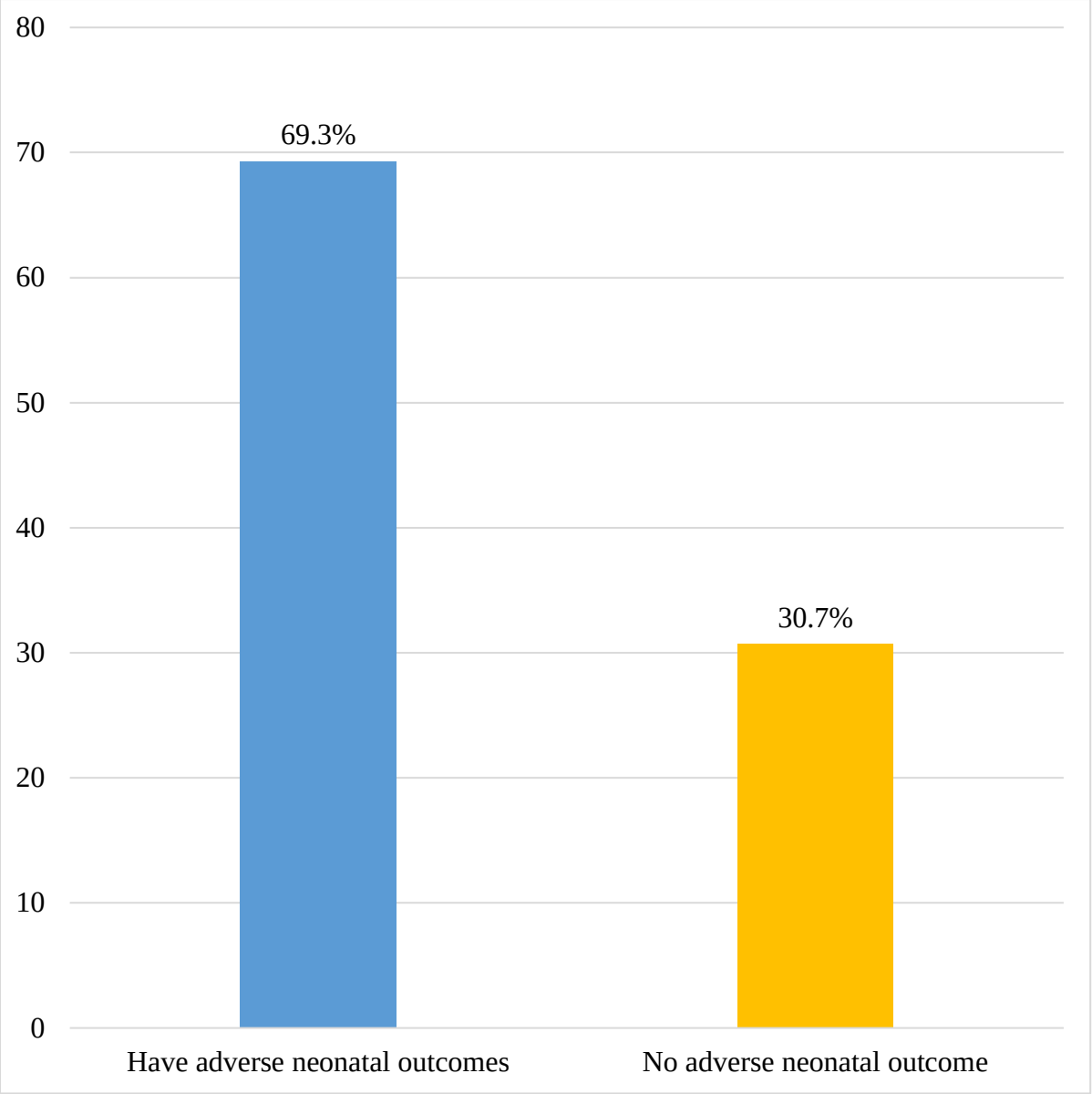


Figure 1: Incidence ofearly adverse outcomes among neonates born to mothers with diabetes mellitus delivering at Ishaka Adventist Hospital and Comboni Hospital.

Results show that the incidence of adverse neonatal outcomes among mothers with diabetes mellitus delivering at Ishaka Adventist Hospital and Comboni Hospitalwas 69.3%.

4. Description early adverse neonatal outcomes among mothers with diabetes mellitus delivering at Ishaka Adventist Hospital and Comboni Hospital.

Table 2: Description early adverse neonatal outcomes among mothers with diabetes mellitusdelivering at Ishaka Adventist Hospital and Comboni Hospital.

Adverse neonatal outcomes	Frequency	Percent
NICU admission		
Yes	41	27.3
No	109	72.7
Early Neonatal Death		
Yes	21	14.0
No	129	86.0
Hypoglycemia		
Yes	38	25.3
No	112	74.7
APGAR		
< 3	11	7.3
4-6	42	28.0
≥ 7	97	64.7
Respiratory Distress		
Yes	31	20.7
No	119	79.3
Birth injuries		
Yes	11	7.3
No	139	92.7
Birth weight		
Macrosomia	68	45.3
Low birth weight	3	2.0
Normal	79	52.7

Results from table 4 show that the most common neonatal adverse outcome was Macrosomia representing an incidence of 45.3%, followed by NICU admission 27.3%, Hypoglycemia

25.3%, Respiratory distress20.7%, early neonatal death 14.0%, low APGAR 7.3%, birth injuries 7.3% and low birth weight 2.0%.

5. Factors associated with early adverse neonatal outcome among mothers with diabetes delivering at Ishaka Adventist Hospital and Comboni Hospital.

The 3rd objective of the study was achieved by conducting bivariate logistic regression analysis of the socio-demographic factors, and obstetric factors, at 95% CI with p≤0.05 as level of significance. Factors that turned up with p≤0.2 were taken to multivariate analysis at 95% CI with p≤0.05 as level of significance.

Table 3: Bivariate analysis of socio-demographic factors associated with early adverse neonatal outcome among mothers with diabetes

	Early adverse neonatal outcome			
Variables	**Yes (104)**	**No (46)**	**cOR(95%CI)**	**P-value**
Age				
21-34 years	70	28	1.78(0.52-6.10)	0.355
> 34 years	27	13	1.48(0.39-5.58)	0.560
≤ 20 years	7	5	1.00	
Occupation				
Unemployed	96	36	**3.33(1.22-9.11)**	**0.019***
Employed	8	10	1.00	
Marital status				
Single	14	8	0.72(0.28-1.87)	0.501
Others	5	3	0.69(0.16-3.03)	0.619
Married	85	35	1.00	
Monthly Income				
< 150000	55	39	**0.20(0.08-0.49)**	**0.001*****
≥ 150000	49	7	1.00	
Education level				

Uneducated	5	6	0.29(0.06-1.32)	0.207
Primary	35	19	0.61(0.19-1.95)	0.408
Secondary	49	16	1.02(0.32-3.25)	0.972
tertiary/university	15	5	1.00	
Residence				
Urban	63	18	**2.39(1.17-4.87)**	**0.016***
Rural	41	28	1.00	

*p<0.05. **p<0.01. ***p<0.001

Results from bivariate analysis of socio-demographic factors show in table 6 found that occupation, income level and residence had values with p≤ 0.2 thus were further analyzed with multi-variate logistic regression analysis.

Table 4: Bivariate analysis of Obstetric Characteristics associated with early adverse neonatal outcome among mothers with diabetes

	Early adverse neonatal outcome			
	Yes (104)	**No (46)**	**cOR(95%CI)**	**P-value**
ANC visits				
< 4	21	13	**1.64(0.79-6.43)**	**0.078***
≥ 4	83	33	1.00	
Gravidity				
Primigravida	22	12	0.77(0.31-1.87)	0.56
2-4	39	16	1.02(0.46-2.27)	0.96
≥ 5	43	18	1.00	
Body Mass Index				
≥ 30	23	6	1.64(0.36-1.63)	0.356
25-29	39	22	0.76(0.36-1.63)	0.479
18.5-24.9	42	18	1.00	
Gestational age				
< 37 weeks	28	5	**3.021(1.08-8.42)**	**0.034***
≥ 37 weeks	76	41	1.00	
History of previous neonatal adverse outcomes				
Yes	23	6	1.89(0.71-5.02)	0.200
No	81	40	1.00	
Treatment				

On treatment	62	16	**2.77(1.34-5.69)**	**0.006**
Notontreatment	42	30	1.00	
Exercise				
Yes	25	20	**2.43(1.16-5.08)**	**0.018***
No	79	26	1.00	

*p<0.05. **p<0.01. ***p<0.001

Results from bivariate analysis of socio-demographic factors show in table 6 found that ANC visits, gestational age, treatment, and exercise had values with p≤ 0.2 thus were further analyzed with multi-variate logistic regression analysis.

Table 5: Multivariate analysis of factors associated with early adverse neonatal outcome among mothers with diabetes

Variables	aOR(95%CI)	P-value
Occupation		
Unemployed	**5.94 (1.70-20.67)**	**0.005****
Employed	1.00	
Monthly income		
< 150000	**0.18 (0.06-0.57)**	**0.004****
≥ 150000	1.00	
Residence		
Urban	0.99 (0.38-2.57)	0.983
Rural	1.00	
ANC visits		
< 4 visits	**1.63 (1.24-16.49)**	**0.035***
≥ 4 visits	.	
Gestationalage		
< 37 weeks	**3.57 (1.06-12.03)**	**0.040***
≥ 37 weeks	1.00	
Treatment		
On treatment	**1.93(1.05-4.36)**	**0.016***
Not on treatment	1.00	
Exercise		
Yes	1.68(0.72-3.94)	0.231
No	1.00	

*p<0.05. **p<0.01. ***p<0.001

At multivariate stage, occupation, income, gestational age, ANC visits and treatment were significant factors associated with early adverse neonatal outcome among mothers with diabetes delivering at Ishaka Adventist Hospital and Comboni Hospital.

Specifically, neonates born to women who earned ≥ 150000 Uganda shillings monthly (p=0.004) were 0.18 times less likely to develop early adverse neonatal outcome. While neonates born to unemployed women (p=0.005) were 5.94times more likely to early adverse neonatal outcome. Those neonates born to women who delivered prematurely that is at gestational age < 37 weeks (p=0.040) were 3.57times more likely to early adverse neonatal outcome. Likewise, neonates born to women who attended < 4 ANC visits(p=0.035) and those on treatment (p=0.016) were 1.63 times and 1.93times more likely to develop early adverse neonatal outcome respectively.

Discussion

This study found that the incidence of hypoglycemia among neonates born to mothers with diabetes was 25.3%. This finding is line with a study by (Alemu et al., 2017) who showed that neonatal hypoglycemia is a common metabolic disease that affects around 8-30% of neonates born to diabetes mothers due to a failure to maintain glucose homeostasis.

In support of this high rates of hypoglycemia among neonates born to mothers with diabetes mellitus is a study done by a population-based cohort study conducted in Pomerania, Germany by (Domanski et al., 2018) which showed that neonates born of a mother with diabetes mellitus increased the odds of hypoglycemia by 11.71.

This study found that the incidence of respiratory distress among neonates born to mothers with diabetes was 20.7%. This comparable to results in a study done by (Mortier et al., 2017) where 20% of women with gestational diabetes had respiratory distress syndrome.

This study found that the incidence of early neonatal deathamong neonates born to mothers with diabetes was 14.0%. In support of this finding, a study done by (Opara et al., 2010) showed that neonates born to diabetic mothers have unusual traits, such as large size and a significant morbidity risk as a result the neonatal death rate is five times higher.

This study found that the incidence of low APGARamong neonates born to mothers with diabetes was 7.3%. This low compared to results in a descriptive study conducted among 75 women with diabetes mellitus in Dharan, Nepal by (Das, 2017) who found that 11.33% neonates had poor APGAR score <7 of which 10.66% had GDM and 4% had overt diabetes.

This study found that the incidence of low birth weight among neonates born to mothers with diabetes was 2.0%. This low

compared with results in an observational, prospective study conducted at the neonatology department of Pakistan Institute of Medical Sciences [PIMS], showed the low-birth-weight babies among neonates born of diabetic mothers were 23% (Article, 2010).

Conclusions

1. The incidenceof early adverse outcomes amongneonatesborn to mothers with diabetes mellitus delivering in Ishaka Adventist Hospital and Comboni Hospital, Bushenyi, Uganda. was high compared to a 5.3% pooled incidence
2. The most frequent early adverse outcome in neonates born to moms with diabetes mellitus was macrosomia, which had a high incidence in generalRespiratory distress, hypoglycemia, and early newborn death were some other early adverse outcomes with high rates. Low APGAR, NICU admission, and birth injuries moderately high rates. Lastly, the incidence of low birth weight was low.
3. The risk of having early adverse neonatal outcomes increased significantly with being unemployed, delivering at gestational age< 37 weeks, having < 4 ANC visits and being on treatment. However, earning ≥ 150000 Ugandan shilling was protective of adverse neonatal outcomes**.**

5.3 Recommendations

1. Ministry of Health and health experts should increase sensitization of motherswithdiabetesmellitus especially by highlighting how they can benefit from ANC visits.
2. There is need to offer Continuous Glucose Monitoring (CGM) to all pregnant women with diabetes mellitus to help them meet their pregnancy glucose targets and improve neonatal outcomes

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