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Prevalence and immediate adverse birth outcomes following augmentation of labor with oxytocin at Mbarara Regional Referral Hospital, Southwestern Uganda. A cross-sectional study.

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Abstract.

Background:

Augmentation of labor using oxytocin is widely practiced to manage inadequate uterine contractions and prevent prolonged labor. However, its use has been associated with adverse maternal and perinatal outcomes, including uterine hyperstimulation, postpartum hemorrhage, fetal distress, and increased operative deliveries. This study assessed the prevalence and immediate adverse birth outcomes among women undergoing augmentation of labor at a tertiary hospital in Southwestern Uganda.

Methodology:

A hospital-based cross-sectional study was conducted from December 2024 to April 2025 among 210 women who delivered following oxytocin augmentation at Mbarara Regional Referral Hospital. Data were collected using a pre-tested questionnaire and clinical chart review. Immediate adverse birth outcomes were defined as maternal and/or perinatal complications occurring within 24 hours of delivery. Data were analyzed using Stata version 17 to determine prevalence and associated characteristics.

Results:

The prevalence of immediate adverse birth outcomes was 22.4% (95% CI: 17.2–28.6%). Adverse maternal outcomes alone occurred in 11.0% of participants, perinatal outcomes alone in 7.1%, while 4.3% experienced both. The most common maternal outcomes were caesarean section (6.2%) and postpartum hemorrhage (5.2%). Among perinatal outcomes, low Apgar score (<7 at 5 minutes) and neonatal intensive care unit admission were most frequent (8.1% each). Referral status and marital status showed significant associations with adverse outcomes.

Conclusion:

The prevalence of immediate adverse birth outcomes following oxytocin augmentation is high, highlighting a significant obstetric concern. Both maternal and neonatal complications remain common in this setting.

Recommendation:

Strengthening adherence to labor monitoring protocols, particularly the use of the WHO labor care guide, and careful selection and monitoring of women undergoing oxytocin augmentation are essential to reduce adverse birth outcomes.

Keywords: *Oxytocin augmentation, adverse birth outcomes, labor augmentation, Apgar score, Mbarara Regional Referral Hospital.*

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Background.

Augmentation of labor is the stimulation of the uterus to increase the frequency, duration, and force of contractions following the commencement of established labor. 1 Its goal is to decrease the negative effects of protracted labor on both the mother and the fetus by increasing the efficacy of uterine contractions. 2, 3 The use of synthetic oxytocin is widely used in labor when contractions are inadequate; however, it is also associated with adverse birth outcomes. 4 Uterine hyper-stimulation with possible outcomes of uterine rupture and fetal distress can occur, increasing the risk of instrumental vaginal delivery and caesarean sections. 5, 6 Fetal brain injury or intrauterine fetal mortality may result from hypertonic contractions' reduction of oxygen supply to the fetus. 7 With prolonged oxytocin augmentation, the myometrium's oxytocin receptors may become desensitized,

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which could raise the risk of uterine atony and postpartum hemorrhage. 8

Globally, oxytocin augmentation is likely administered to more than half of laboring women; however, this differs greatly between countries and even within each nation. 2 In Africa, the rate of oxytocin for labor augmentation varies from 0.7% to 97.0%, exceeding 30% in most countries. 9 The prevalence of adverse birth outcomes following augmentation of labor with oxytocin is difficult to quantify globally due to varying definitions of 'adverse' and differences in oxytocin usage across regions. 10, 11 The adverse birth outcomes following oxytocin augmentation are associated with several factors and are still a common health problem of reproductive health concern. 12-15 This diversity of oxytocin use for labor augmentation necessitates contextual studies on its associated adverse birth outcomes.

In Uganda, the prevalence of augmentation of labor with oxytocin is 35.1%. 16 The maternal mortality rate and perinatal mortality rate are still high at 189 deaths per 100,000 births and 18 deaths per 1,000 births, respectively. 17 The institutional maternal mortality rate and perinatal mortality rate are even higher at 687 deaths per 100,000 births and 52 deaths per 1,000 births, respectively. 18 Oxytocin augmentation is associated with adverse birth outcomes that subsequently contribute to the above high mortality. This study determined the prevalence and factors associated with immediate adverse birth outcomes following augmentation of labor with oxytocin at a tertiary hospital in southwestern Uganda. The evidence from this study will help to inform practice and to strengthen adherence to protocols on oxytocin use to help prevent immediate adverse birth outcomes associated with it, and to identify which women are more likely to have adverse birth outcomes while on oxytocin augmentation, and to address modifiable factors promptly. This study assessed the prevalence and immediate adverse birth outcomes among women undergoing augmentation of labor at a tertiary hospital in Southwestern Uganda.

Methodology.

Study design, setting, and population.

We conducted a cross-sectional study among women who delivered following the augmentation of labor with oxytocin from December 2024 to April 2025 at MRRH. MRRH is a tertiary hospital in southwestern Uganda, about 260Km from the capital Kampala. It serves more than 3.5 million people19 from 13 districts and neighboring countries of Tanzania, Rwanda, Burundi, and the Democratic Republic of Congo. The obstetrics and gynecology department is run by obstetricians and gynecologists, resident doctors, midwives, and intern doctors, who are involved in routine inpatient clinical care. Women for delivery are admitted to the antenatal ward, and those anticipated to have vaginal delivery are admitted to the labor ward. Their names are written on the monitoring board, and labor progress is monitored using the WHO labor care guide, which is started in the active phase of labor. Women whose labor progress is prolonged due to inadequate uterine contractions, labor augmentation with oxytocin is initiated in consultation with the specialist, and labor monitoring with the labor care guide is done by either a midwife, intern doctor, or resident doctor until vaginal delivery or caesarean delivery if indicated. Vacuum delivery is also done for women with a prolonged second stage of labor if indicated. Each day, the facility manages at least two women for augmentation of labor with oxytocin. 18 MRRH has a 24-hour operating theatre with two operating rooms run by resident doctors and specialists in the obstetrics and anesthesia departments. The hospital also has fully functional intensive care units for both mothers and neonates that handle critical adverse birth outcomes when they occur.

The study was approved by the Mbarara University of Science and Technology Research Ethics Committee under reference **MUST-2024-1782** and the Uganda National Council for Science and Technology (UNCST) under reference **HS5863ES**, and informed consent was obtained from all the study participants.

Eligibility criteria and sampling.

We included all women who delivered following documented augmentation of labor with oxytocin at a gestational age of 26 weeks and 0 days and above at MRRH. Gestational age was calculated from the first day of the woman's last normal menstrual period or first trimester ultrasound scan dating. We excluded women who had a diagnosis of intrauterine fetal death before initiation of augmentation of labor with oxytocin. The sample size was calculated using the Kish-Leslie formula (1965), commonly applied for prevalence and cross-sectional studies.

$$n = \frac{Z^2 p q}{d^2}$$

Where;

n = Total number of participants required.

Z=1.96, the Z score for a normal distribution corresponding to a 95% confidence interval.

p = Estimated proportion of immediate adverse birth outcomes was determined using a prevalence of 14.4% (cesarean section) among women who delivered following augmentation with oxytocin at a tertiary and teaching hospital in Manchester. 20

q= 1-p. Which is 1-0.144 = 0.856

d= Standard error =5%

Applying the formula: **n** = (1.96)2 x 0.144x0.856/ (0.05)2, we obtained 210 participants after adjusting for a 10% non-response rate, and participants were selected consecutively.

Variables.

The dependent variable was an immediate adverse birth outcome following augmentation of labor with oxytocin. An immediate adverse birth outcome was defined as either an adverse maternal outcome and/or an adverse perinatal

outcome occurring up to 24 hours following delivery. The adverse maternal outcomes included uterine rupture, postpartum hemorrhage, instrumental vaginal delivery, and caesarean delivery, while the adverse perinatal outcomes included fresh stillbirth, A/S < 7 at 5 minutes, and admission to the neonatal intensive care unit. 14 The independent variables included obstetrics and medical factors such as gestational age, parity, fetal weight, hypertensive disorders, number of ANC visits and diabetes mellitus, sociodemographic factors such as maternal age, marital status, education level, residence, referral status, and occupation, and intrapartum factors such as labor care guide use, dose of oxytocin, prostaglandin use before initiation, duration of augmentation of labor and time of delivery.

Data collection.

A pre-tested questionnaire in REDCap was administered by trained research assistants who were midwives at the postnatal ward. The research assistants collected data on sociodemographic, obstetric, medical, and intrapartum factors and immediate adverse birth outcomes. Marital status was documented as either married when the woman was in a formal union or cohabiting and single when separated or divorced. Education level was measured as never went to school or the highest level of education attained, being primary, secondary, or tertiary. Residence was considered urban if the participant resided in a town council, municipality, or city and rural if the participant resided in a village. The labor care guide was considered used if the labor care guide had at least two consecutive plots of fetal heart rate and uterine contractions monitoring, and not used if the labor care guide was plotted once for fetal heart rate and uterine contractions monitoring or was missing in the participant's clinical chart. Presence of hypertensive disorders was yes if the patient had been managed for pre-eclampsia/eclampsia, evidenced by documentation in the clinical chart, and no if the patient had not been managed for pre-eclampsia/eclampsia. Referral status was recorded as " yes if the participant was referred from a lower health facility, evidenced by a referral form or documented in the clinical chart, and no if the patient had no documentation of being referred from a lower health facility. Duration of augmentation of labor was calculated from the time of initiation of augmentation to the time of delivery of the baby for vaginal delivery and the time of sanctioning a caesarean section for caesarean delivery. Postpartum hemorrhage was considered present if there was a recorded estimated blood loss of more than 500mls for vaginal delivery and more than 1000ml for caesarean delivery. For the babies who were admitted to the neonatal intensive care unit, their charts were reviewed to identify the reason for admission.

Data management and analysis.

Study data were collected and managed using REDCap electronic data capture tools hosted at Mbarara University of Science and Technology and exported into Stata software version 17 (StataCorp. 2021. Stata: Release 17. Statistical Software. College Station, TX: StataCorp LLC) for cleaning and analysis. The prevalence of immediate adverse birth outcomes following augmentation of labour was obtained by dividing the number of women who had immediate adverse birth outcomes by the total number of participants enrolled in the study, expressed as a percentage. The proportion with its 95% confidence interval was calculated, and the findings were presented on a pie chart. The frequency of each immediate adverse outcome was obtained, and the findings were presented on a bar graph.

Ethical considerations

We obtained scientific clearance from the Obstetrics and Gynaecology department, MRRH/MUST, and the Faculty Research Committee (FRC), Faculty of Medicine, MUST, and administrative clearance from the Hospital Director of MRRH. The ethical approval was obtained from the Research Ethics Committee (REC) of MUST under reference MUST-2024-1782. The study was registered with the Uganda National Council for Science and Technology (UNCST) under reference HS5863ES. Informed written consent was obtained from women to participate in the study before enrolment. Women who declined to participate in the study for one reason or another still received standard care by the clinical team. To ensure privacy, we consented mothers/caretakers to a private area, away from other patients or caretakers. Also reviewed their clinical charts in a private area and entered their data in a database. The database was only accessible by the study PI and research assistants on personal computers and phones, encrypted with password protection and anti-theft protection. We did data analysis from a remote site from the data collection site.

Results.

Of the 210 enrolled participants in this study, with 100% response rate, 47 (22.4%) had immediate adverse birth outcomes (Figure 1).

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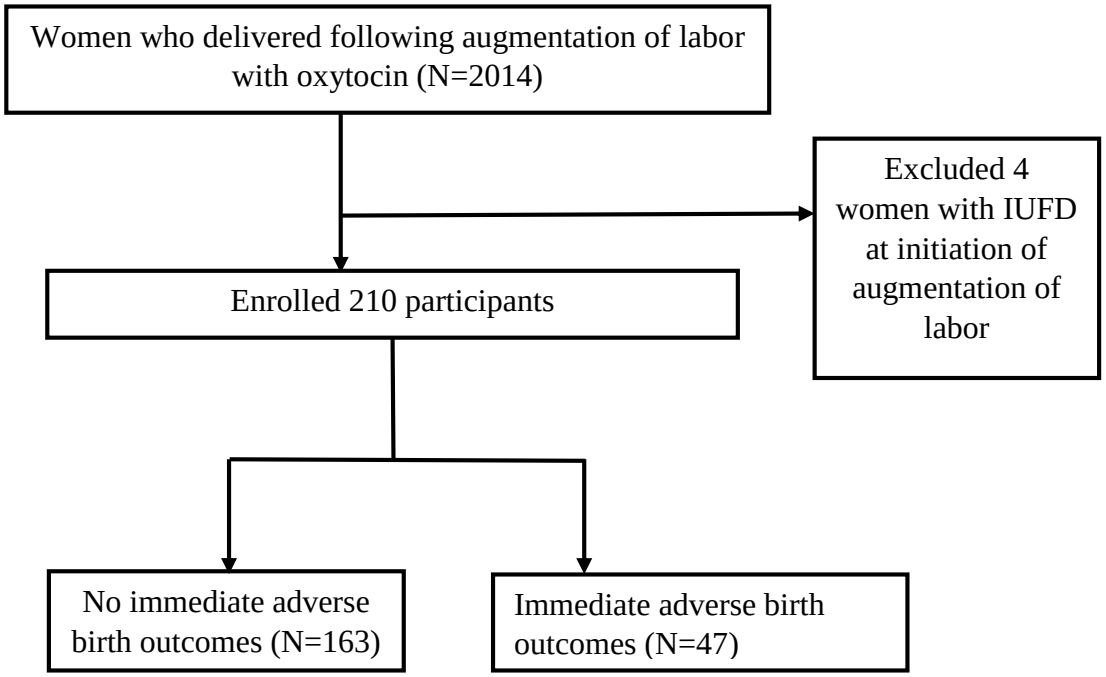
Figure 1: Participant Recruitment Chart



Baseline Sociodemographic and medical characteristics of participants

Table 1: Baseline Sociodemographic and medical characteristics of participants

Variables	Total	Adverse birth outcomes		p-value
	N=210	Yes (N=47)	No (N=163)	
Mean age (SD)	24.7 (4.9)	25.1 (5.1)	24.6 (4.8)	0.566
Age category				0.681
<20 years	33 (15.7)	6 (12.8)	27 (16.6)	
20-34 years	171 (81.4)	39 (83.0)	132 (81.0)	
35+ years	6 (2.9)	2 (4.3)	4 (2.5)	
Residence				0.384
Urban	132 (62.9)	27 (57.4)	105 (64.4)	
Rural	78 (37.1)	20 (42.6)	58 (35.6)	
Highest level of education				0.564
None/Primary	94 (44.8)	24 (51.1)	70 (42.9)	
Secondary	80 (38.1)	15 (31.9)	65 (39.9)	
Tertiary	36 (17.1)	8 (17.0)	28 (17.2)	
Marital status				**0.033***
Unmarried	16 (7.6)	7 (14.9)	9 (5.5)	
Married	194 (92.4)	40 (85.1)	154 (94.5)	
Occupation				0.113
Unemployed	60 (28.6)	14 (29.8)	46 (28.2)	
Informal employment	100 (47.6)	27 (57.4)	73 (44.8)	
Formal employment	50 (23.8)	6 (12.8)	44 (27.0)	
Referral status				**<0.001***
No	110 (52.4)	14 (29.8)	96 (58.9)	
Yes	100 (47.6)	33 (70.2)	67 (41.1)	
Diabetes mellitus				0.349

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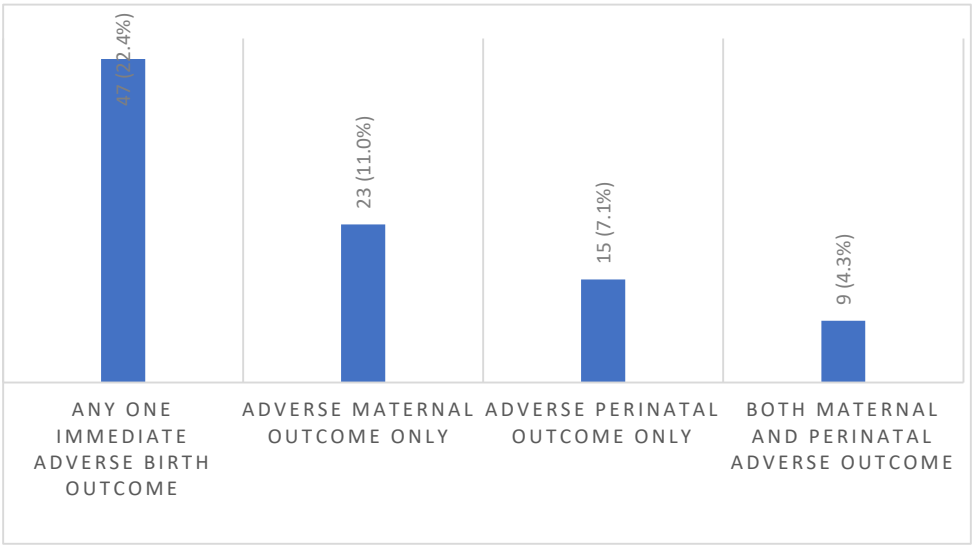
No	207 (98.6)	47 (100.0)	160 (98.2)	
Yes	3 (1.4)	0 (0.0)	3 (1.8)	

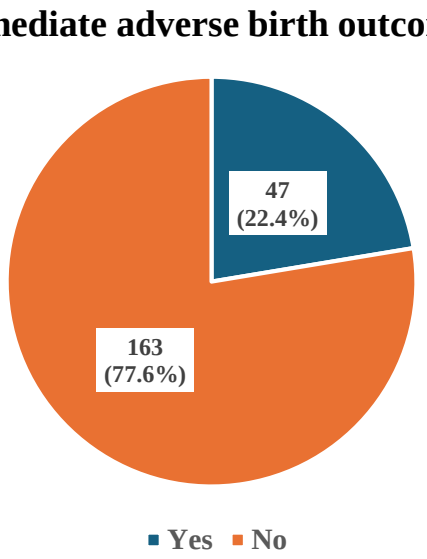
*SD: Standard deviation, *: p-value <0.05.*

The mean age of women was 24.7 years (SD 4.9), with the majority aged 20–34 years (81.4%). Most resided in urban areas (62.9%) and were married (92.4%). Most of these participants' characteristics did not differ among women with immediate adverse birth outcomes and those with no adverse outcomes except for the marital status and referral status. Among the unmarried women, the proportions were higher among those with immediate adverse birth outcomes compared to those without adverse birth outcomes (14.9% vs. 5.5%; p-value = 0.033). Among the referred women, the proportions were higher among those with immediate adverse birth outcomes compared to those without adverse birth outcomes (70.2% vs. 41.1%; p-value < 0.001) (table1).



Prevalence of immediate adverse birth outcomes following augmentation of labor at MRRH.

Figure 2: showing the prevalence of immediate adverse birth outcomes at MRRH.



The prevalence of immediate adverse birth outcomes following augmentation of labour at MRRH is 22.4% (95% CI: 17.2-28.6%) as shown in Figure 1.

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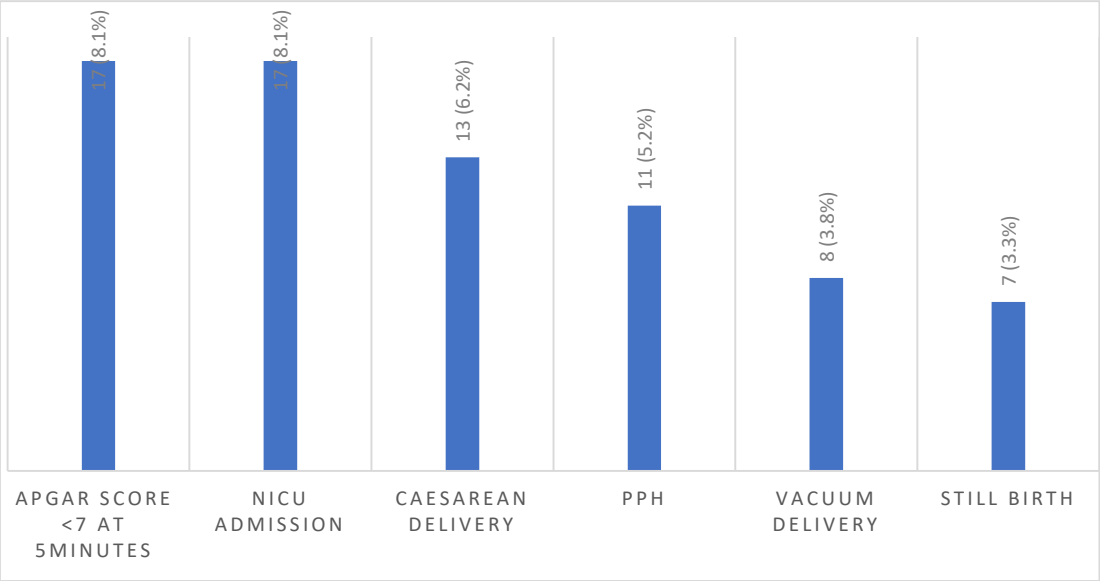
Immediate adverse outcomes following augmentation of labor at MRRH.

Figure 3: Graph showing immediate adverse outcomes following augmentation of labor at MRRH.

Figure 4: Graph showing specific adverse outcomes following augmentation of labor at MRRH



As shown in Figure 3, 47 women developed at least an adverse birth outcome. Of these, adverse maternal outcomes alone occurred in 23 women, while adverse perinatal outcomes alone were present in 15 cases. 9 women had both maternal and perinatal adverse outcomes. The most common adverse maternal outcome was caesarean section (n=13), followed by postpartum hemorrhage (n=11), while the most adverse perinatal outcomes were Apgar score less than 7 at 5minutes and admission to the Neonatal Intensive Care Unit, each accounting for 17 cases as shown in Figure 4.

Discussion of results.

Prevalence of immediate adverse birth outcomes following augmentation of labor with oxytocin at MRRH.

The prevalence of immediate adverse birth outcomes among women following augmentation of labor with oxytocin at Mbarara Referral Hospital is 22.4% (95% CI: 17.2-28.6%). The prevalence in this study is similar to the findings reported at the University of San Francisco, USA. This reported a prevalence of immediate adverse birth outcomes following augmentation of labor with oxytocin at 26% (CHELMOW and LAROS Jr, 1992). This observation could be because the study setting in the University of San Francisco Medical Centre, which is a research and teaching hospital, uses protocols on augmentation of labor with oxytocin similar to the study setting in our case. Oxytocin infusion may induce hyperstimulation of the myometrium, including excessive frequency of contractions. This may harm the fetus as the placental and fetal blood flow may become compromised with consequent fetal hypoxia (Uvnas-Moberg, 2024).

Prolonged oxytocin treatment also leads to oxytocin receptor desensitization, thereby limiting further oxytocin-mediated contraction response and consequently contributing to uterine atony (Grotegut et al., 2011b). It was also noted that a large number of women in our study were primiparous at 56.7%. Primiparous women have an unprimed myometrium and have a higher incidence of inefficient uterine contractions in the first stage of labor than multiparous women (Hidalgo-Lopezosa et al., 2016). They therefore often receive oxytocin for augmentation of labor with subsequent higher adverse birth outcomes (Hidalgo-Lopezosa et al., 2016; Selin et al., 2009). These effects of oxytocin infusion and the majority of our study participants being primiparous could explain why the prevalence of immediate adverse birth outcomes is high among women in our study following augmentation of labor with oxytocin.

The prevalence of immediate adverse birth outcomes in our study was lower than that in studies conducted in Spain at the general hospital of Granollers and at a tertiary hospital in Cordoba, where the prevalence was 87.8% and 50%,

respectively (Espada-Trespalacios et al., 2021a; Hidalgo-Lopezosa et al., 2016). The observed higher prevalence in these studies could have been because their studies measured umbilical artery PH to determine fetal acidemia as one of the adverse birth outcomes following augmentation of labor with oxytocin, which we did not consider in our study.

On the other hand, our prevalence was higher than that reported in a study conducted at a tertiary and teaching hospital in Manchester, where the prevalence of immediate adverse birth outcomes following augmentation of labor was 14.4% (Bugg et al., 2006). This could be because at St. Mary's Hospital, Manchester, only nulliparous women with spontaneous onset of labor at term were studied, and in our study, we considered both multiparous and nulliparous women, whether at term or preterm.

Immediate adverse birth outcomes following augmentation of labor with oxytocin at MRRH

The immediate adverse birth outcomes were - adverse maternal outcomes alone (11.0%), adverse perinatal outcomes alone (7.1%), while nine women (4.3%) got both maternal and perinatal adverse outcomes. The most common adverse maternal outcomes were caesarean section (6.2%), postpartum hemorrhage (5.2%), and vacuum delivery (3.8%), while the most common adverse perinatal outcomes were Apgar score less than 7 at 5 minutes (8.1%), admission to neonatal intensive care unit (8.1%), and still births (3.3%). There were no documented cases of uterine rupture. Apgar score less than 7 at 5 minutes: Lower percentages were found in Denmark at 1.4% (Kjaergaard et al., 2009), the USA at 3.6% (Wojnar et al., 2014), and Spain at 2.5% (Hidalgo-Lopezosa et al., 2016). This could be because in these countries, labor monitoring on oxytocin augmentation is enhanced with cardiotocography that picks up fetal heart rate irregularities earlier for intervention than we regularly do in our setting. Oxytocin infusion may induce hyperstimulation of the myometrium, including excessive frequency of contractions. This may harm the fetus as the placental and fetal blood flow may become compromised with consequent fetal hypoxia and low Apgar score after birth (Uvnas-Moberg, 2024).

Postpartum hemorrhage: A higher percentage was found in Norway at 24% (Bernitz et al., 2014). This could be because at Ostfold Hospital, postpartum hemorrhage was recorded among women who had more than 500mls of blood loss, regardless of the mode of delivery. A lower percentage was found in Manchester at 1.5% (Bugg et al., 2006). This could be because at St. Mary's Hospital, postpartum hemorrhage was recorded in women who had more than 1000mls of blood loss post-delivery. Oxytocin augmentation for a longer duration may cause myometrial oxytocin receptor desensitization and uterine exhaustion, which leads to uterine atony and subsequent postpartum hemorrhage (Phaneuf et al., 1998). Caesarean section: Higher percentages were found in Manchester at 14.4% (Bugg et al., 2006), the USA at 16.0% (Wojnar et al., 2014), and Denmark at 13.4% (Kjaergaard et al., 2009). These higher findings could be because in these European countries, they use electronic labor monitoring, which picks up fetal distress early as an indication for caesarean section. Vacuum delivery: Higher percentages were found in Norway at 29.8% (Bernitz et al., 2014), Denmark at 27.6% (Kjaergaard et al., 2009), and Manchester at 21.7% (Bugg et al., 2006). These could be because in these high-income countries, the vacuum delivery equipment is more readily available for use than in our setting, where the vacuum delivery equipment is sometimes not functional for use. Augmentation of labor with oxytocin is associated with increased risk of instrumental vaginal delivery to shorten the second stage of labor due to fetal distress (Svärdby et al., 2007). Stillbirth: A lower percentage was found in Nepal at 0.2% (Litorp et al., 2021b). These could be because Nepal included only women at term in their study. Term neonates are less likely to die due to birth asphyxia compared to preterm neonates, who we included in our study. Admission to neonatal intensive care unit (NICU): A higher percentage was found in Norway at 12.8% (Bernitz et al., 2014). This could be because at Ostfold Hospital, all neonates transferred to NICU were considered, regardless of the diagnosis, unlike in our study, where we considered only neonates who had birth asphyxia. Lower percentages were found in the USA at 2.1% (Wojnar et al., 2014) and Manchester at 3.7% (Bugg et al., 2006). This could be because in the USA and Manchester, they recorded lower percentages of Apgar scores less than 7 at 5 minutes, and hence had lower NICU admissions.

Conclusion.

The prevalence of immediate adverse birth outcomes following augmentation of labor with oxytocin at Mbarara Regional Referral Hospital is high.

The most common adverse maternal outcomes are caesarean section, postpartum hemorrhage, and vacuum delivery, while the most common adverse perinatal outcomes are Apgar score less than 7 at 5 minutes and stillbirths.

Limitations.

Postpartum hemorrhage was measured based on the clinical team's estimation of blood loss, and this could have underestimated or overestimated this variable. The outcome variable is a composite of both maternal and fetal adverse outcomes, and this could have overestimated the prevalence of adverse birth outcomes in our study.

Recommendation.

Strengthening of labor monitoring should be done using the labor care guide while on augmentation of labor with oxytocin to reduce adverse birth outcomes.

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List of abbreviations.
ANC – Antenatal Care
A/S – Apgar Score
CI – Confidence Interval
DM – Diabetes Mellitus
FRC – Faculty Research Committee
HIV – Human Immunodeficiency Virus
MRRH – Mbarara Regional Referral Hospital
MUST – Mbarara University of Science and Technology
NICU – Neonatal Intensive Care Unit
PPH – Postpartum Hemorrhage
REC – Research Ethics Committee
SD – Standard Deviation
UNCST – Uganda National Council for Science and Technology
WHO – World Health Organization

Informed Consent:
Written informed consent was obtained from all participants before their inclusion in the study. Participants were informed about the purpose of the study, procedures involved, potential risks and benefits, and their right to withdraw at any time without penalty.

Source of funding.
The study was not funded

Conflict of interest.
There is no conflict of interest.

Availability of data.
Data used in this study are available upon request from the corresponding author.

The author's contribution.
DM designed the study, conducted data collection, cleaned and analyzed data, and drafted the manuscript.
OB supervised all stages of the study from conceptualization of the topic to manuscript writing and submission.
RK supervised the study

Author's biography.
Dr. Dickens Mugumya is a student of a Master of Medicine degree of master of medicine in obstetrics and gynaecology at Mbarara University of Science and Technology.
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