

The Prevalence of Vacuum-Assisted Vaginal Delivery and Its Associated Short-Term Maternal and Foetal Outcomes at a Tertiary Hospital in the Copperbelt Province, Zambia

Emmanuel Chongwe^{1,2}, Imukusi Mutanekelwa², Jonathan Gwasupika³, Ruth L. Mfunne², Ephraim Chikwanda³, Bright Mukanga², Maisa Kasanga⁴, Steward Mudenda⁵, Morgan Mweene⁶, Sebastian Chinkoyo⁷, Mabvuto Zulu^{7*}, Victor Daka^{2*#}

¹Marybegg Health Services, Solwezi, Zambia

²Public Health Department, Michael Chilufya Sata School of Medicine, Copperbelt University, Ndola, Zambia

³Clinical Sciences Department, Tropical Diseases Research Centre, Ndola, Zambia

⁴Department of Pathology and Microbiology, University Teaching Hospitals, Lusaka, Zambia

⁵Department of Pharmacy, School of Health Sciences, University of Zambia, Lusaka, Zambia

⁶Ndola Teaching Hospital, Ndola, Zambia

⁷Clinical Sciences Department, Michael Chilufya Sata School of Medicine, Copperbelt University, Ndola, Zambia

Email: *dakavictorm@gmail.com

How to cite this paper: Chongwe, E., Mutanekelwa, I., Gwasupika, J., Mfunne, R.L., Chikwanda, E., Mukanga, B., Kasanga, M., Mudenda, S., Mweene, M., Chinkoyo, S., Zulu, M. and Daka, V. (2025) The Prevalence of Vacuum-Assisted Vaginal Delivery and Its Associated Short-Term Maternal and Foetal Outcomes at a Tertiary Hospital in the Copperbelt Province, Zambia. *Open Journal of Obstetrics and Gynecology*, 15, 30-43.

<https://doi.org/10.4236/ojog.2025.151004>

Received: November 28, 2024

Accepted: January 5, 2025

Published: January 8, 2025

Abstract

Background: The maternal and neonatal morbidity caused by prolonged labour, maternal exhaustion and other factors push clinicians to speed up the delivery process by employing equipment such as vacuum suction or forceps to save the newborn. The purpose of this study was to determine the prevalence of vacuum-assisted vaginal delivery (VAVD) and its associated short-term maternal and neonatal outcomes at Ndola Teaching Hospital. **Methods:** A retrospective cross-sectional descriptive study through the analysis of routine data for women with singleton-term pregnancies who delivered by vacuum compared with spontaneous vaginal delivery was done at a tertiary hospital for the years 2020 and 2021. Chi-square and Logistic regression were used to investigate factors of vacuum delivery and to adjust for potential confounders. **Results:** Results showed that VAVD was mostly performed in women who had delayed second stage of labour (25.4%), maternal exhaustion (16.0%), foetal distress in the second stage of labour (12.3%). The overall VAVD prevalence was 3.7% (581/15591). Logistic regression showed that multiparous

*Authors contributed equally.

#Corresponding author.



women were noted to be 87.5% (aOR 0.125; 95% CI 0.025 - 0.629; $p = 0.012$) less likely to undergo VAVD compared to nulliparous women. Registrars were almost 6 times (aOR 5.650; 95% CI 1.458 - 22.222, $p = 0.012$) more likely to conduct VAVD compared to midwives. Episiotomy was 3 times (aOR 3.390; 95% CI 1.185 - 9.524; $p < 0.0005$) more likely to be performed during VAVD compared to Spontaneous Vaginal Delivery. Newborns delivered via VAVD were 96.6% (aOR 0.034; 95% CI 0.007 - 0.173; $p < 0.0005$) less likely to be admitted to neonatal intensive care unit (NICU) compared to neonates delivered via spontaneous vaginal delivery. **Conclusion:** The findings indicate the underutilisation of VAVD at NTH based on the low prevalence of 3.7%. VAVD outcomes were affected by multiparity, skill level and Episiotomy procedure, in addition, VAVD influenced admission to the NICU. Hence, there is a need to increase skills in VAVD among first-line healthcare workers such as midwives and intern doctors.

Keywords

Operative Vaginal Delivery, Vacuum-Assisted Vaginal Delivery, Maternal, Neonatal Outcomes, Zambia

1. Introduction

An operative vaginal delivery is one in which forceps or vacuum extraction are used in the second stage of labour during a vaginal birth and can be done with or without any maternal pushing [1]. The global prevalence of operative vaginal delivery varies widely depending on the setting and shows a prevalence of about 3% to 11% [2]. However, studies in various countries show that the utilisation of assisted vaginal delivery in low-middle-income countries (LMIC) was low compared to high-income countries [3]. Similarly, the prevalence of vacuum delivery varies, for instance, in Ethiopia was 3.8% [4], Saudi Arabia 21.1% [5]. Literature from developed countries indicates rates of Instrumental Vaginal Delivery (IVD) ranging from 10% - 15% in the United Kingdom and only 4.5% per cent in the United States [6] [7]. This rate has decreased by half in the previous 20 years [3]. In other studies, scholars have shown that increased rates of caesarean section have led to a reduction in the number of vacuum and forceps deliveries [3].

A prolonged second stage of labour and associated consequences, such as asphyxia, haemorrhage, uterine rupture, obstetric fistula, and infection, is the major causes of maternal and neonatal morbidity and death [8]. One of the evidence-based interventions for reducing the second stage of labour and thereby preventing complications is vacuum extraction [9]. Vacuum-assisted delivery has inherent hazards, but when utilised appropriately, it seldom causes long-term problems for the mother or baby [10]. Postpartum haemorrhage, perineal, cervical and vaginal lacerations, urinary tract infections, and pelvic floor injuries are among the immediate and short-term maternal consequences of vacuum-assisted vaginal

delivery [11]. Additionally, shoulder dystocia, subdural haemorrhage, facial nerve palsy, subconjunctival haemorrhage, retinal haemorrhage, intracranial haemorrhage, scalp laceration, and cervical damage are among the reported neonatal complications that follow a vacuum-assisted vaginal delivery [11]. Despite that vacuum-assisted vaginal delivery is a common procedure performed in tertiary government hospitals in Zambia including Ndola Teaching Hospital (NTH) [12]. There is a paucity of data on the actual prevalence and both maternal and neonatal outcomes of VAVD at NTH which is crucial to designing interventions for maternal and neonatal health. With this background, this study was conducted to determine the prevalence of VAVD and evaluate the maternal and neonatal factors and complications associated with vacuum-assisted vaginal deliveries at the government tertiary hospital in Ndola, Zambia.

2. Materials and Methods

2.1. Study Site

This study was carried out at NTH, a tertiary referral hospital in Ndola in the Copperbelt Province of northern Zambia. Ndola is a major urban town in Zambia and is the provincial capital of the Copperbelt Province. NTH has a bed capacity of 851 and 97 cots [13]. The Maternal Child Health (MCH) services at Ndola Teaching Hospital range from sexual reproductive health, labour ward, obstetric operating theatre, neonatal care and postnatal care services. The hospital attends to referrals from the northern part of Zambia, even though it mainly provides coverage to a district population of about 556,000 people [14].

2.2. Study Design

This was a retrospective cross-sectional study that was done through the analysis of routine data. This study design was chosen as it enabled the simultaneous exploration of the exposure status (VAVD) and its short-term maternal and neonatal effects as the outcome and ultimately determines any associations between the exposure and outcomes. In addition, the study design was ideal to reveal the prevalence of VAVD at NTH and was necessary as there was no follow-up involved.

2.3. Target Population

All women who delivered through vacuum-assisted vagina delivery (VAVD) or Spontaneous Vaginal Delivery (SVD) and their infants who were within were the target population. All women who had vacuum delivery at NTH within the study period were included in the study. Excluded from the study were women who delivered outside NTH or did not deliver via vacuum.

2.4. Study Sample Size Determination

This study was a complete enumeration of all women who delivered via VAVD at the NTH labour ward between 1st January 2020 and 31st December 2021.

2.5. Data Collection

Data was accessed in the months of July and August 2022. Data were collected using a dedicated data collection tool covering socio demographic variables and indications for VAVD. Specific indications for VAVD were verified including prolonged second stage labour, maternal exhaustion, medical contraindications to prolonged pushing such as cardiac disease and foetal malposition. Socio-demographic details such as file numbers, year of admission, age, parity, diagnosis on admissions, the skill level of the attending health worker, adverse outcomes such as episiotomy done or not, postpartum haemorrhage (PPH), Apgar score, admission to Neonatal Intensive Care Unit (NICU) were obtained from the delivery registers. Using the file numbers for the selected women of both VAVD and SVD, their corresponding neonate's case notes were crosschecked in the neonate's medical files from the NICU. The duration of admission to NICU and outcome at delivery (alive or stillbirth) were noted. Indications for VAVD were classified as maternal or foetal.

Maternal outcomes included the proportion of women with perineal tears, episiotomy performed on them and those with postpartum haemorrhage. Neonatal outcomes included stillbirth, severe perinatal outcomes, low Apgar score at 5-min, admission into NICU, and perinatal death. Severe perinatal outcomes were defined as the presence of any of the following: perinatal death, severe birth injury, 5-min Apgar score < 4, and/or convulsions [15]. Severe birth injury was defined as the presence of any of the following: subgaleal hematoma or brachial plexus injury [15].

2.6. Statistical Analysis

Data were entered into Microsoft Excel (Microsoft, Redmond, WA, USA), cleaned and transferred to SPSS version 25.0 (IBM, Armonk, NY, USA) for statistical analyses. The dependent variable was categorical, and binary (*i.e.*, VAVD), while other variables included demographics, obstetric factors, and maternal and neonatal outcomes. We defined VAVD as a vaginal delivery involving the use of a vacuum device to assist in the extraction of the foetus during the second stage of labour. Cross tabulation was done and the chi-square test of independence was used to test for association between the dependent and predictor variables. The chi-square was used for the majority of the analysis unless when the expected value assumption was violated then Fisher's exact test was employed.

Binary logistic regression was then used to test the association between VAVD and various predictor variables and also control for third-variable effects such as confounders. All variables with a p-value < 0.05 in the univariable regression model were included in the multivariate model. Finally, multivariate binary logistic regression was performed in SPSS using the default standard regression analysis (*i.e.*, the "enter" method). For all analyses, a 2-tailed p-value < 0.05 was regarded as statistical significance. We conducted a complete case analysis where missing variables were excluded from the analysis via listwise deletion.

2.7. Ethical Considerations

Ethical approval was obtained from the ethics review committee at the Tropical

Diseases Research Centre (TDRC) in Ndola (IRB Registration Number 00002911). Authority to conduct the study was sought from the National Health Research Authority (NHRA) in Lusaka permission to conduct the study was obtained from NTH management. There was no direct risk to participants as this was routine data that was used from the delivery registers and medical records hence no consent was obtained from any participant. No personal identifiers were collected and all study data was restricted to the study investigators and kept in a secure cabinet at the study office at TDRC.

3. Results

All available records for women who were delivered by VAVD at NTH in 2020 and 2021 were reviewed giving a case retrieval rate of 89.5% (520/581). After adding a randomly selected comparison group of those who delivered via SVD (467), the total number of women included in this study came to 987. Most participants (456/978, 46.6%) were below 25 years and most were nulliparous (416/986, 42.2%). The chi-square test of independence showed that all three demographic and obstetric characteristics were significantly associated with VAVD. Most VAVDs were conducted by registrars and midwives (421/520, 80.9%) see **Table 1**.

Table 1. Demographic and obstetric characteristics of women with VAVD and clinician's skill level who performed VAVD.

Characteristics	Totals	Delivery Type		p value
	n (%)	VAVD	SVD	
Year of admission, n = 987				
2020	616 (100)	370 (60.1)	246 (39.9)	0.000
2021	371 (100)	150 (40.4)	221 (59.36)	
Age (years), n = 978				
<25	456 (100)	269 (59.0)	187 (41.0)	0.001
25 - 34	373 (100)	184 (49.3)	189 (50.7)	
≥35	149 (100)	64 (43.0)	85 (57.0)	
Parity, n = 986				
Nullipara	416 (100)	263 (63.2)	153 (36.8)	0.000
Primipara	199 (100)	114 (57.3)	85 (42.7)	
Multipara (with 2 - 4)	312 (100)	119 (38.1)	193 (61.9)	
Grand multipara (with 5 - 9)	59 (100)	24 (40.7)	35 (59.3)	
Skill level, n = 986				
Midwife	593 (100)	208 (35.1)	385 (64.9)	0.000
Intern Doctor	122 (100)	84 (68.9)	38 (31.1)	
Registrar	255 (100)	213 (83.5)	42 (16.5)	
Consultant	16 (100)	15 (93.8)	1 (6.3)	

3.1. Prevalence and Indications for VAVD

The overall prevalence of VAVD was 3.7% (581/15591) with 95% CI: 5.4% - 6.2%. The 2020 prevalence of VAVD was 4.5% (95% CI: 4.1% - 5.0%), however, this reduced to 2.9% (95% CI: 2.6% - 3.3%) in 2021, see **Table 2**.

Table 2. Prevalence of VAVD in 2020 and 2021.

Delivery Type	Year		Subtotal
	n (%)	n (%)	
	2020	2021	
SVD	5164 (65.9)	5027 (64.8)	10191
VAVD	353 (4.5)	228 (2.9)	581
C/Section	2061 (26.3)	2241 (28.9)	4302
Not specified	259 (3.3)	258 (3.3)	517
Total Deliveries	7836 (100)	7754	15591

Clinicians at NTH conduct VAVD in various maternal and foetal conditions and the top three reasons were delayed 2nd stage of labour (132/520, 25.4%), maternal exhaustion (83/520, 16.0%) and foetal distress (NRFHR) in the second stage of labour (64/520, 12.3%). Less common reasons included previous caesarian section (11.7%), high parity (6.7%), underage (5.4%) and cardiovascular disease (5.0%). Contained in the “other” section in **Figure 1** was VAVD that was performed in the following conditions; asthma in pregnancy, psychosis in pregnancy, elderly prime, epilepsy, postdates, intra-uterine fetal death and twin pregnancy. Reasons for conducting VAVD in the later diagnoses were not clearly stated in the patient’s files and they accounted for (17.5%, 91/520).

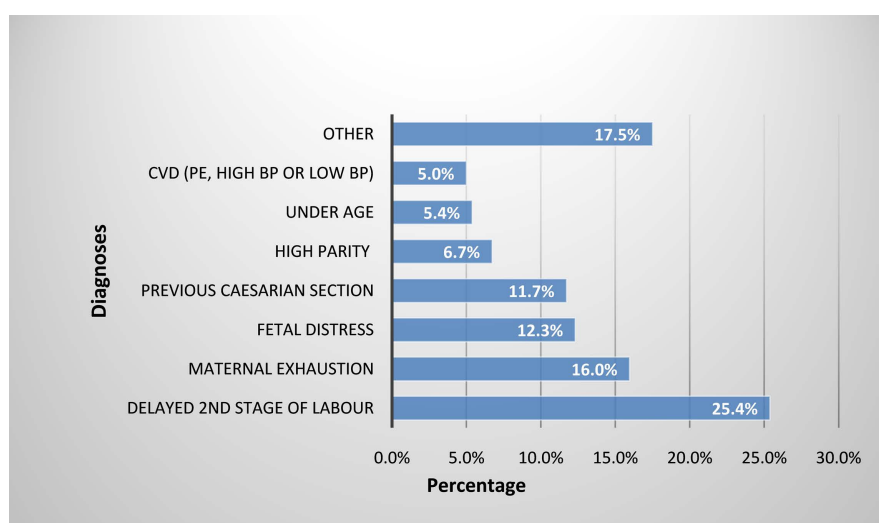


Figure 1. Diagnoses for women who had VAVD at NTH in the years 2020 and 2021.

3.2. Maternal Outcomes after VAVD

Table 3 shows that Episiotomies were mostly done (314/492, 63.8%) together with VAVD compared to SVD. Similarly, perineal tears were seen more (226/412, 54.9%) in women who underwent VAVD compared to SVD. A few (8/985, 0.8%) instances of PPH were noted in the study group.

Table 3. Maternal outcomes after VAVD done at NTH in 2020 and 2021.

Characteristics	Totals, n (%)*	Delivery Type		p-value
		VAVD	SVD	
Episiotomy, n = 987				
No	495 (100)	206 (41.6)	289 (58.4)	0.000
Yes	492 (100)	314 (63.8)	178 (36.2)	
Perineal Tear, n = 987				
No	575 (100)	294 (51.1)	281 (48.9)	0.248
Yes	412 (100)	226 (54.9)	186 (45.1)	
PPH, n = 985				
No	977 (100)	512 (52.4)	465 (47.6)	0.292**
Yes	8 (100)	6 (75.0)	2 (25.0)	

*Row per cent; **Chi-square test was invalid, Fisher's exact test used.

3.3. Neonatal Outcomes after VAVD

Most babies born to the women in the study group were male (544/984, 55.3%) and most (306/517, 59.2%) underwent VAVD compared to females. More than three quarters (788/987, 80.0%) of the babies weighed between 2.5 - 3.9 Kg and almost all (862/983, 87.7%) had good APGAR scores 7 - 10. Among babies in admitted to NICU, above half (267/464, 57.5%) delivered via SVD compared to VAVD. The majority (342/412, 83.0%) were admitted to NICU for less than 8 days duration. No neonatal deaths were reported with SVD unlike 2 with VAVD. VAVD was significantly associated with the child's gender, birth weight, APGAR score, admission to NICU and days spent in NICU, see **Table 4**.

Table 4. Neonatal outcomes after VAVD done at NTH in 2020 and 2021.

Characteristics	Totals, n (%) *	Delivery Type		p-value
		VAVD	SVD	
Child's gender, n = 984				
Female	440 (100)	211 (48.0)	229 (52.0)	0.010
Male	544 (100)	306 (56.3)	238 (43.8)	

Continued

Birth weight, n = 987				
<1.5 Kg	12 (100)	3 (25.0)	9 (75.0)	
1.5 - 2.4 Kg	134 (100)	23 (17.2)	111 (82.8)	<0.01
2.5 - 3.9 Kg	788 (100)	471 (59.8)	317 (40.2)	
≥4.0 Kg	53 (100)	23 (43.4)	30 (56.6)	
APGAR score, n = 983				
7 - 10	862 (100)	445 (51.6)	417 (48.4)	
4 - 6	102 (100)	57 (55.9)	45 (44.1)	0.001
<4	19 (100)	18 (94.7)	1 (5.3)	
Admission to NICU, n = 987				
No	523 (100)	323 (61.8)	200 (38.2)	<0.01
Yes	464 (100)	197 (42.5)	267 (57.5)	
Days spent admitted to NICU, n = 417				
1 day	156 (100)	56 (35.9)	100 (64.1)	
2 to 7 days	186 (100)	74 (39.8)	112 (60.2)	0.044
8 to 28 days	56 (100)	19 (32.8)	39 (37.2)	
>28 days	17 (100)	1 (5.9)	16 (94.1)	
Outcome, n =439				
Dead	2 (100)	2 (100)	0 (0)	0.151**
Alive	437 (100)	169 (38.7)	268 (61.3)	

*Row per cent; **Chi-square test was invalid, Fisher's exact test used.

The multivariate binary logistic regression was used to control for confounders and model the relationship between VAVD and the selected predictor variables, see **Table 5**. The binary logistic regression model significantly predicted the odds of childbirth via VAVD well ($\chi^2 = 1204.288$, $p < 0.0005$) and accounted for 95.0% (based on Nagelkere r^2) of the variations in vaginal deliveries via vacuum. The analysis showed that the odds of vaginal delivery via vacuum for multiparous women were reduced by 87.5% (aOR 0.125; 95% CI: 0.025 - 0.629) compared to nulliparous women. However, compared to midwives, registrars were almost 6 times more likely to perform VAVD (aOR 5.650; 95% CI: 1.458 - 22.222, $p = 0.012$). Furthermore, episiotomies were 3 times more likely to be performed along with VAVD (aOR 3.390; 95% CI: 1.185 - 9.524; $p < 0.0005$). Regarding children delivered by VAVD, 96.6% were less likely to be admitted to NICU (aOR 0.034; 95% CI: 0.007 - 0.173; $p < 0.0005$).

Table 5. Variables associated with VAVD after multivariate binary logistic Regression.

Parameter	Multivariate analysis	
	aOR (95% CI)	p-value
Parity, n = 986		
Nullipara	1	0.776
Primipara	0.794 (0.161 - 3.906)	
Multipara (with 2 - 4)	0.125 (0.025 - 0.629)	0.012
Grand multipara (with 5 - 9)	0.190 (0.018 - 2.041)	0.170
Skill level, n = 986		
Midwife	1	
Intern Doctor	0.635 (0.200 - 2.024)	0.443
Registrar	5.650 (1.458 - 22.222)	0.012
Consultant	0.000 (0.000 -)	0.993
Episiotomy, n = 987		
No	1	
Yes	3.390 (1.185 - 9.524)	0.023
Admission to NICU, n = 987		
No	1	
Yes	0.034 (0.007 - 0.173)	<0.01

4. Discussion

The study aimed to determine the prevalence of VAVD and evaluate the maternal and neonatal factors and complications associated with vacuum-assisted vaginal deliveries at the NTH in Ndola, Zambia. The study found that the prevalence of VAVD at NTH decreased from 4.5% in 2020 to 2.9% in 2021, with an overall prevalence of 3.7% for both years. Comparisons with other delivery modes like caesarean sections, where WHO recognizes rates not exceeding 10% - 15% are well established. However, VAVD rates comparison can only be made among geographic settings due to the lack of international standards to determine acceptable VAVD rates. VAVD rates from this study align with those in Sub-Saharan Africa and other low- and middle-income countries (LMICs) such as Ethiopia (3.8%) [4], but they are lower than those seen in high-income countries like Saudi Arabia (21.1%) [5] and France (29.7%) [16]. These differences could be attributed to differences in cultures, health systems and awareness about the benefits of VAVD where indicated.

The study noted a 1.6% reduction in VAVD prevalence in 2021 and the reasons for the low utilisation of VAVD were not explored because the retrospective

nature of this study precluded such information and this is a limitation. However, we speculate that the reduced rate of VAVD prevalence seen mainly during the period 2020 and 2021 could have been driven by the anxieties brought about by the COVID-19 pandemic and therefore low health seeking behaviours being seen [17].

In-depth interviews with clinicians using a qualitative inquiry could provide more insights. However, other studies from different regions have indicated that reasons for low VAVD rates vary, including lack of equipment, in-service training for healthcare workers, and limited hands-on experience [3].

The current study revealed that multiparous women were less likely to undergo VAVD by up to 87.5% compared to nulliparous women. Hence Clinicians and midwives should be equipped with the necessary skills to perform assisted deliveries among primiparous women to minimise potential neonatal and maternal morbidities. Studies have shown that primiparous women undergoing instrumental delivery were nearly four times more likely to develop complications compared to multiparous women which could explain the difference seen in our study [18]. However, a Sub-Saharan study contradicted this finding, indicating that parity was not significantly associated with VAVD, possibly due to differences in coding for parity, study setting and methods used in the studies [4].

Unlike other short-term maternal outcomes, skill level and episiotomy were significantly associations with VAVD after chi-square. Registrars were almost six times more likely to perform VAVD compared to midwives, indicating a need for improved midwifery skills in this area. As part of task shift and sharing, the trains midwives in performing VAVD to better service the primary healthcare levels, however, in a tertiary level hospital like NTH, VAVD is performed by both mostly medical officers and sometimes senior midwives. The study's findings align with an Ethiopian study, demonstrating that general practitioners and emergency surgical officers were 6 and 42 times more likely than midwives, respectively, to perform operative vaginal deliveries [4].

Episiotomies were performed more frequently along with VAVD to prevent uncontrolled perineal tears in this study. While some studies suggest that episiotomies reduce complications [18]-[20], others argue they may increase perineal trauma, infection, and postpartum haemorrhage [21]. The use of prophylactic antibiotics to reduce infection at the episiotomy site remains controversial [22] [23].

Neonates born via VAVD had 15% lower NICU admission rates compared to those born via spontaneous vaginal delivery (SVD) where 57.5% were admitted. The low VAVD prevalence (3.7%) and high SVD prevalence (65.4%) also entail reduced and increased chances of complications needing NICU admission respectively. The study's findings were consistent with a retrospective cohort study in Oman, which found that instrumental delivery was not associated with NICU admission [24]. However, they differed from a retrospective case-control study in Portugal, where a higher proportion of NICU admissions (4.2%) occurred with VAVD [11], possibly due to variations in VAVD rates due to increased numbers

of specialised staff.

The study's work aligns with international and local public health goals outlined in the Sustainable Development Goal (SDG) 3.1/3.2 and the Ministry of Health Legacy goal number 1 in Zambia. These goals aim to reduce maternal and newborn mortality by 2030, ensuring a healthier population and improved socioeconomic status to realise Zambia's Vision 2030 [25]-[27].

5. Strengths and Limitations

A major strength of the study is the presentation of valuable regional VAVD data over two years from a major referral hospital in Zambia. The study's strength lies in providing data from a significant hospital catering to the northern region of Zambia. A high case retrieval rate (of 89.5%) reduced selection bias, but missing data from patient files posed a limitation, common in retrospective studies and this was handled during data analysis.

6. Conclusion

Our findings showed that VAVD was mostly performed due to delayed second stage of labour, maternal exhaustion, neonatal distress and other reasons. Despite VAVD being an important strategy to reduce preventable intrapartum adverse maternal and neonatal outcomes, this study has shown it is underutilised at NTH based on the low prevalence of 3.7%. Short-term maternal outcomes were affected by multiparity with 2 to 4 children, skill level (Registrar) and Episiotomy procedure while Neonatal outcomes were affected by admission to the Neonatal Intensive Care Unit.

Author Contributions

Conceptualisation: Emmanuel Chongwe, Imukusi Mutanekelwa, Mabvuto Zulu, Victor Daka;

Data curation: Emmanuel Chongwe, Jonathan Gwasupika, Steward Mudenda, Bright Mukanga;

Formal analysis: Steward Mudenda, Imukusi Mutanekelwa, Ruth L. Mfuno;

Investigation: Emmanuel Chongwe;

Methodology: Imukusi Mutanekelwa, Victor Daka;

Project administration: Emmanuel Chongwe, Jonathan Gwasupika, Bright Mukanga;

Supervision: Mabvuto Zulu, Victor Daka, Ruth L. Mfuno;

Writing Original draft: Emmanuel Chongwe, Bright Mukanga, Victor Daka;

Writing review & editing: Emmanuel Chongwe, Imukusi Mutanekelwa, Mabvuto Zulu, Jonathan Gwasupika, Bright Mukanga, Steward Mudenda, Ruth L. Mfuno, Victor Daka.

Funding

This work was not supported by any funding.

Conflicts of Interest

The authors declare no conflict of interest

References

- [1] Yeomans, E.R. (2010) Operative Vaginal Delivery. *Obstetrics & Gynecology*, **115**, 645-653. <https://doi.org/10.1097/aog.0b013e3181cfbefd>
- [2] Hubena, Z., Workneh, A. and Siraneh, Y. (2018) Prevalence and Outcome of Operative Vaginal Delivery among Mothers Who Gave Birth at Jimma University Medical Center, Southwest Ethiopia. *Journal of Pregnancy*, **2018**, 1-12. <https://doi.org/10.1155/2018/7423475>
- [3] Bailey, P., van Roosmalen, J., Mola, G., Evans, C., de Bernis, L. and Dao, B. (2017) Assisted Vaginal Delivery in Low and Middle Income Countries: An Overview. *International Journal of Obstetrics & Gynaecology*, **124**, 1335-1344. <https://doi.org/10.1111/1471-0528.14477>
- [4] Harrison, M.S., Teshome, B., Liyew, T., Kirub, E., Jimenez-Zambrano, A., Muldrow, M., et al. (2020) Prevalence of and Characteristics Associated with Operative Vaginal Birth at Mizan-Tepi University Teaching Hospital. *International Health*, **13**, 199-204. <https://doi.org/10.1093/inthealth/ihaa024>
- [5] Abbas, R.A., Qadi, Y.H., Bukhari, R. and Shams, T. (2021) Maternal and Neonatal Complications Resulting from Vacuum-Assisted and Normal Vaginal Deliveries. *Cureus*, **13**, e14962. <https://doi.org/10.7759/cureus.14962>
- [6] Orazulike, N., Alegbeleye, J., Nyengidiki, T. and Uzoigwe, S. (2018) A 10-Year Review of Instrumental Vaginal Delivery at the University of Port Harcourt Teaching Hospital, Port Harcourt, Nigeria. *Tropical Journal of Obstetrics and Gynaecology*, **35**, 118-122. https://doi.org/10.4103/tjog.tjog_26_18
- [7] Abebaw, Y. and Kebede, E. (2021) Trends in Operative Delivery in Tikur Anbessa Specialized Hospital, Addis Ababa, Ethiopia: A 5 Years' Retrospective Review. *Ethiopian Journal of Health Sciences*, **31**, 1199-1206. <https://doi.org/10.4314/ejhs.v31i6.15>
- [8] Goordyal, D., Anderson, J., Alazmani, A. and Culmer, P. (2020) An Engineering Perspective of Vacuum Assisted Delivery Devices in Obstetrics: A Review. *Proceedings of the Institution of Mechanical Engineers, Part H: Journal of Engineering in Medicine*, **235**, 3-16. <https://doi.org/10.1177/0954411920956467>
- [9] Moldenhauer, J.S. (2021) Operative Vaginal Delivery. <https://www.msmanuals.com/professional/gynecology-and-obstetrics/abnormalities-and-complications-of-labor-and-delivery/operative-vaginal-delivery>
- [10] McQuivey, R. and Block, J. (2017) Vacuum-Assisted Cesarean Section. *International Journal of Women's Health*, **9**, 151-155. <https://doi.org/10.2147/ijwh.s129814>
- [11] Ferraz, A., Nunes, F., Resende, C., Almeida, M.C. and Taborda, A. (2019) Complicaciones neonatales a corto plazo de los partos por ventosa. Estudio caso-control. *Anales de Pediatría*, **91**, 378-385. <https://doi.org/10.1016/j.anpedi.2018.11.016>
- [12] Nkhata, E., Mulenga, D., Tembo, M. and Siziya, S. (2016) The Prevalence and Indication for Caesarean Section at Ndola Central Hospital, Ndola, Zambia. *Asian Pacific Journal of Health Sciences*, **3**, 315-320. <https://doi.org/10.21276/apjhs.2016.3.3.47>
- [13] Mutanekelwa, I., Siziya, S., Daka, V., Kabelenga, E., Mfunne, R.L., Chileshe, M., et al. (2021) Prevalence and Correlates of Voluntary Medical Male Circumcision Adverse Events among Adult Males in the Copperbelt Province of Zambia: A Cross-Sectional

- Study. *PLOS ONE*, **16**, e0256955. <https://doi.org/10.1371/journal.pone.0256955>
- [14] Statistics Agency (2020) Zambia Demographic and Health Survey 2018. Government Printers.
- [15] ACOG (2020) Operative Vaginal Birth. <https://www.acog.org/clinical/clinical-guidance/practice-bulletin/articles/2020/04/operative-vaginal-birth>
- [16] Bourgon, N., Mottet, N., Bourtembourg, A., Pugin, A., Ramanah, R. and Riethmuller, D. (2018) Lésions obstétricales du sphincter de l'anus et ventouse obstétricale chez des primipares à terme. *Gynécologie Obstétrique Fertilité & Sénologie*, **46**, 686-691. <https://doi.org/10.1016/j.gofs.2018.09.006>
- [17] Chileshe, M., Mulenga, D., Mfuno, R.L., Nyirenda, T.H., Mwanza, J., Mukanga, B., Mudenda, S. and Daka, V. (2020) Increased Number of Brought-in-Dead Cases with COVID-19: Is It due to Poor Health-Seeking Behaviour among the Zambian Population? *Pan African Medical Journal*, **37**, Article 136. <https://doi.org/10.11604/pamj.2020.37.136.25967>
- [18] Biru, S., Addisu, D., Kassa, S. and Animen, S. (2019) Maternal Complication Related to Instrumental Delivery at Felege Hiwot Specialized Hospital, Northwest Ethiopia: A Retrospective Cross-Sectional Study. *BMC Research Notes*, **12**, Article No. 482. <https://doi.org/10.1186/s13104-019-4530-7>
- [19] Lund, N.S., Persson, L.K.G., Jangö, H., Gommesen, D. and Westergaard, H.B. (2016) Episiotomy in Vacuum-Assisted Delivery Affects the Risk of Obstetric Anal Sphincter Injury: A Systematic Review and Meta-Analysis. *European Journal of Obstetrics & Gynecology and Reproductive Biology*, **207**, 193-199. <https://doi.org/10.1016/j.ejogrb.2016.10.013>
- [20] Bergendahl, S., Ankarcrona, V., Leijonhufvud, Å., Hesselman, S., Karlström, S., Kopp Kallner, H., et al. (2019) Lateral Episiotomy versus No Episiotomy to Reduce Obstetric Anal Sphincter Injury in Vacuum-Assisted Delivery in Nulliparous Women: Study Protocol on a Randomized Controlled Trial. *BMJ Open*, **9**, e025050. <https://doi.org/10.1136/bmjopen-2018-025050>
- [21] Sagi-Dain, L. and Sagi, S. (2015) Morbidity Associated with Episiotomy in Vacuum Delivery: A Systematic Review and Meta-Analysis. *BJOG: An International Journal of Obstetrics & Gynaecology*, **122**, 1073-1081. <https://doi.org/10.1111/1471-0528.13439>
- [22] Musarandega, R., Nyakura, M., Machezano, R., Pattinson, R. and Munjanja, S.P. (2021) Causes of Maternal Mortality in Sub-Saharan Africa: A Systematic Review of Studies Published from 2015 to 2020. *Journal of Global Health*, **11**, Article 04048. <https://doi.org/10.7189/jogh.11.04048>
- [23] Liabsuetrakul, T., Choobun, T., Peeyanantarassri, K. and Islam, Q.M. (2020) Antibiotic Prophylaxis for Operative Vaginal Delivery. *Cochrane Database of Systematic Reviews*, **2020**, 1-36. <https://doi.org/10.1002/14651858.cd004455.pub5>
- [24] Al Riyami, N., Al Salmiyah, M., Khan, D. and Al Riyami, I. (2021) Maternal and Neonatal Outcomes of Operative Vaginal Deliveries at a Single Tertiary Center. *Oman Medical Journal*, **36**, e263-e263. <https://doi.org/10.5001/omj.2021.61>
- [25] Miyoshi, Y., Matsubara, K., Takata, N. and Oka, Y. (2019) Baby Survival in Zambia: Stillbirth and Neonatal Death in a Local Hospital Setting. *BMC Pregnancy and Childbirth*, **19**, Article No. 90. <https://doi.org/10.1186/s12884-019-2231-9>
- [26] Mangu, C.D., Rumisha, S.F., Lyimo, E.P., Mremi, I.R., Massawe, I.S., Bwana, V.M., et al. (2020) Trends, Patterns and Cause-Specific Neonatal Mortality in Tanzania: A Hospital-Based Retrospective Survey. *International Health*, **13**, 334-343.

<https://doi.org/10.1093/inthealth/ihaa070>

- [27] Mgawadere, F., Unkels, R., Kazembe, A. and van den Broek, N. (2017) Factors Associated with Maternal Mortality in Malawi: Application of the Three Delays Model. *BMC Pregnancy and Childbirth*, **17**, 1-9.

<https://doi.org/10.1186/s12884-017-1406-5>