

Complications of instrumental vaginal deliveries and associated factors in hospitals of Western Oromia, Ethiopia

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Abstract

Objective: In developing countries like Ethiopia, there is lack of evidence that shows the magnitude and factors affecting complications of instrumental delivery. Most of the research done in Ethiopia was secondary data and lacks variables like socio-demographic factors, availability of cardiotocograph, number of traction, and who conducted delivery (qualification of health workers). So, this study tried to fill the gaps by conducting primary research with secondary data and adding those variables stated above.

Methods: Health facility-based cross-sectional study was conducted from 20 February 20 June 2020 in five public hospitals in East Wollega Zone. Single population proportion formula used to calculate sample size. Systematic random sampling was employed. Interviewer-administered structured questionnaire, checklist, and document review were used to collect data from 282 respondents. Data entered to Epi Data version 3.01 and exported to a statistical package of social sciences version 21 for analysis. Those variables with $p < 0.25$ in the bivariate analyses were a candidate for multivariable logistic regression and multivariable logistic regression was done to identify factors associated with complications of instrumental vaginal delivery using 95% confidence interval and $p < 0.05$.

Results: Complications of instrumental vaginal delivery were 37.2%. Out of all neonates delivered by operative vaginal delivery, 69 (24.5%) developed complications. Vacuum-assisted delivery (adjusted odd ratio = 0.245, 95% confidence interval 0.092–0.658), 120–160 fetal heartbeats per minute (adjusted odd ratio = 0.298, 95% confidence interval 0.114–0.628), birthweight > 4000 g (adjusted odd ratio = 4.09, 95% confidence interval 1.729–9.499) and outlet instrumentation (adjusted odd ratio = 0.139, 95% confidence interval 0.057–0.339) were associated with complications of instrumental vaginal delivery.

Conclusion: Magnitude of complications of instrumental vaginal delivery was high in the study area. So, health professionals should give due attention on instrument selection and application. Instrumental delivery requires a careful assessment of clinical circumstances to identify the indications and contraindications for the application of the instruments.

Keywords

Forceps, vacuum delivery, instrumental vaginal delivery

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Introduction

An instrumental vaginal delivery (IVD) refers to an obstetric procedure in which active measures are taken to accomplish delivery.¹ IVDs are affected by applying direct traction on the fetal skull with vacuum extractor or forceps.^{2,3} Maternal indications for IVD can be prolonged second stage of labor, severe preeclampsia/eclampsia, poor progress of labor because of maternal fatigue or exhaustion, and elective shortening of the second stage of labor. The major fetal indications of IVD include fetal distress or non-reassuring fetal heart rate.^{3,4} Prerequisites for performing IVD are fully dilated cervix, ruptured membranes, cephalic presentation, defined fetal position, fetal head at least at the

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level of ischial spines, empty bladder, adequate maternal pelvis.⁵

In the applications of IVD, the operators' experience matters rather than the instrument. So, to reduce fetal and maternal complications the operator must be familiar with the indications, contraindications, application, and use of the particular instrument.⁶ Previous studies indicated that allowing adequate time during the second stage of labor and application of IVD by experienced health profession when clinically indicated will decrease unnecessary cesarean section.^{7–9} Globally, about 10–20% of all deliveries need some form of assistance or intervention at delivery and 6–12% of these interventions are by IVDs.^{10,11}

Incorrect application of IVD causes serious complications to the mother and the neonates. Maternal complications include vaginal laceration, episiotomy extension, traumatic perineal tear, cervical laceration, hemorrhage (primary PPH), injury to the urinary bladder, anal sphincter, uterine rupture and damage to the pelvic floor.¹²

Fetal minor complications of IVD include soft tissue trauma, cephalohematoma, jaundice, and transient brachial plexus injury. Major fetal complications include hypoxic-ischemic encephalopathy, intracranial and subgaleal hemorrhage, seizures, cranial fracture and permanent brachial plexus injury, admission to the neonatal intensive care unit (NICU) and death. A neonate who is assisted by vacuum deliveries had a greater proportion of NICU admissions compared to spontaneous deliveries (4.2% versus 2.2%) and the mortality rate was higher in the vacuum.¹³

In developing countries like Ethiopia, there is lack of evidence that shows the magnitude and factor related to complication of IVD. Most of the research done in Ethiopia was secondary data and lacks variables like socio-demographic factors, availability of cardiotocograph (CTG), number of traction, who conducted delivery (qualification of health works). So, this study tried to fill the gaps by conducting primary research with secondary data and adding those variables stated above. Therefore, this study aimed to assess complications of IVD and its associated factors among mothers who gave birth in public hospitals of East Wollega zone.

Conceptual framework

The conceptual framework developed after reviewing different literatures^{14–17} (Figure 1).

Methodology

Study area and period

East Wollega is one of the zones in the Oromia Region of Ethiopia. The capital city of East Wollega is Nekemte town, which is 331 km from the capital city of the country (Addis

Ababa). Based on the 2007 Census conducted by the Central Statistics Agency (CSA), this zone has a total population of 1,213,503, of whom 606,379 are men and 607,124 are women; with an area of 12,579.77 square kilometers, East Wollega zone has five public hospitals. These hospitals include Nekemte Specialized Hospital, Wollega University Referral Hospital, Arjo Hospital, Gida general hospital, and Sire Hospital. The study was carried out at all hospitals in East Wollega Zone, Oromia Region in western Ethiopia.¹⁸ Health facility-based cross-sectional study design was conducted from 20 February to 20 June 2020.

Population

Source population. All mothers who gave birth by IVD in public hospitals of East Wollega zone.

Study population. Selected mothers who gave birth by IVD in public hospitals of East Wollega zone during the data collection period.

Inclusion and exclusion criteria

Inclusion criteria. All mothers who gave birth by IVD (forceps or vacuum extraction (VE)) in public hospitals of East Wollega zone during the data collection period.

Exclusion criteria. Mothers who were seriously ill and unable to answer the questions

Mothers who gave twin birth

Sample size determination and sampling procedure

The sample size was determined by using a single population proportion formula. The prevalence of complications of IVD 12.1% was taken from research conducted in Felege Hiwot Specialized Hospital, Northwest Ethiopia.¹⁷ The 10% non-response rate was considered using a 95% confidence interval (CI) and a 4% margin of error. Having all these assumptions, the final sample size was 282.

All public hospitals in East Wollega zones were included in this study. Sample size was allocated for each hospital based on client flow. The last 3-month IVD reports of each hospital prior to data collection were obtained. Total 3-month IVD of those hospitals was 350. IVD report of each hospital was Nekemte specialized hospital 90, Wollega University Referral hospital 60, Gidda General Hospital 120, Sibbu Sire hospital 48, and Arjo hospital 32. Systematic random sampling technique was used with second k th interval to recruit mothers who gave birth by operative vaginal delivery (OVD) at obstetric wards during data collection period in those public hospitals (Figure 2).

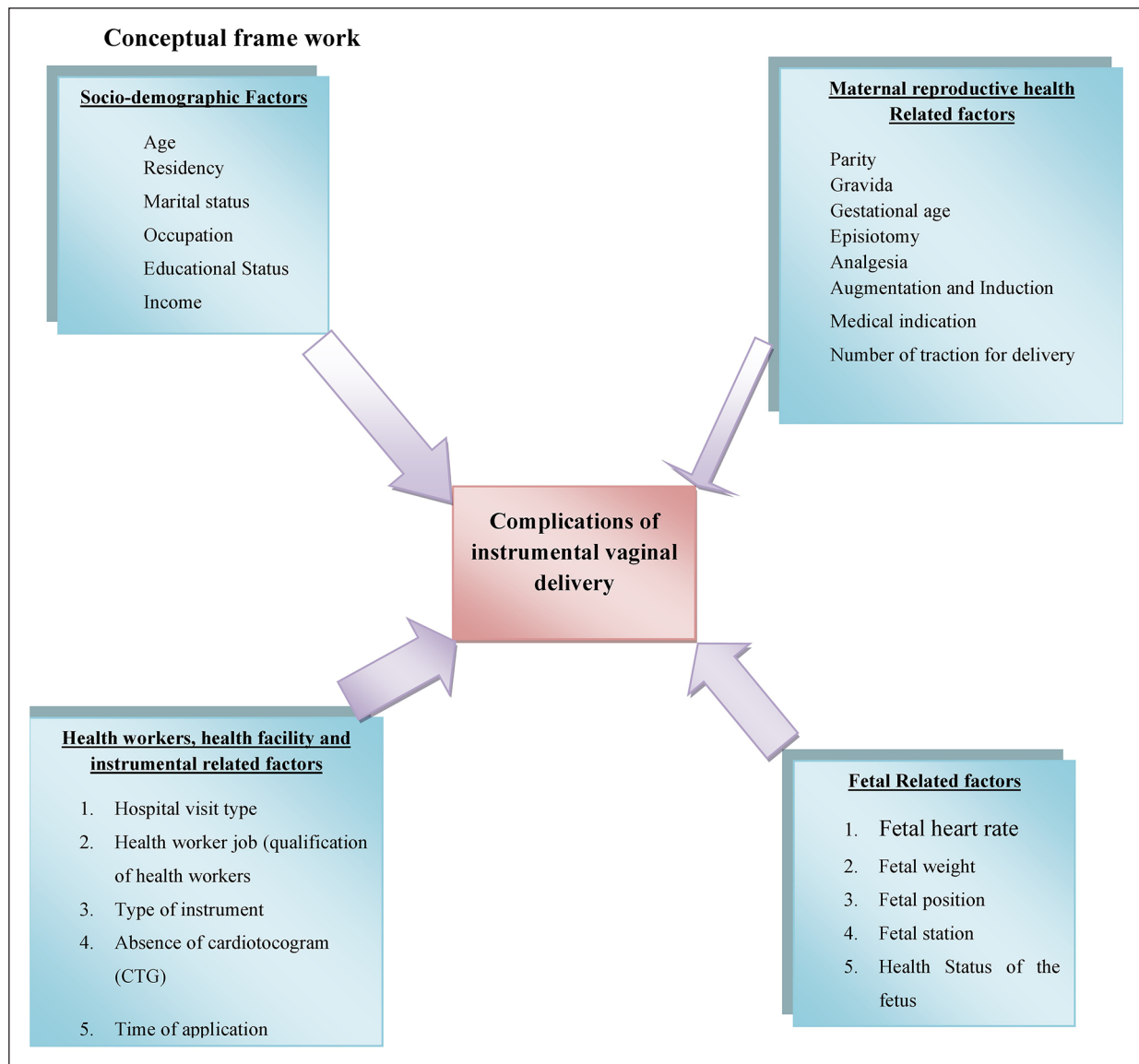


Figure 1. Conceptual framework developed after review of different literatures.

Variables

Dependent variables. Complications of IVD

Independent variables. Socio-demographic factors: Age, Residency, Marital status, Occupation, Educational Status and Income. Maternal factors; Parity, Gravida, Gestational age (GA), Episiotomy, Indication of instrumental, Analgesia, Augmentation and Induction, liquor state, Medical indication, and Number of traction for delivery. Fetal factors: Fetal heart rate, fetal weight, Fetal position, Fetal station, and status of the fetus. Other factors: Types of hospital, health worker job (Qualification), Types of instrument, CTG availability, and Time of application.

Operational definitions

Complications of IVD: When at least one of the following complications are present (maternal complications, like PPH, genital tear, need of blood transfusion, urinary bladder injury, bowel injury, need of major surgery, death, and neonatal complications, like low APGAR score, the need of resuscitation, shoulder dystocia, skull fracture, intracranial hemorrhage (ICH), admission to NICU, and neonatal death).¹⁵

Data collection instrument and procedure

The questionnaire used for this study was adapted and modified from different literatures.^{14,19-21} It consists of

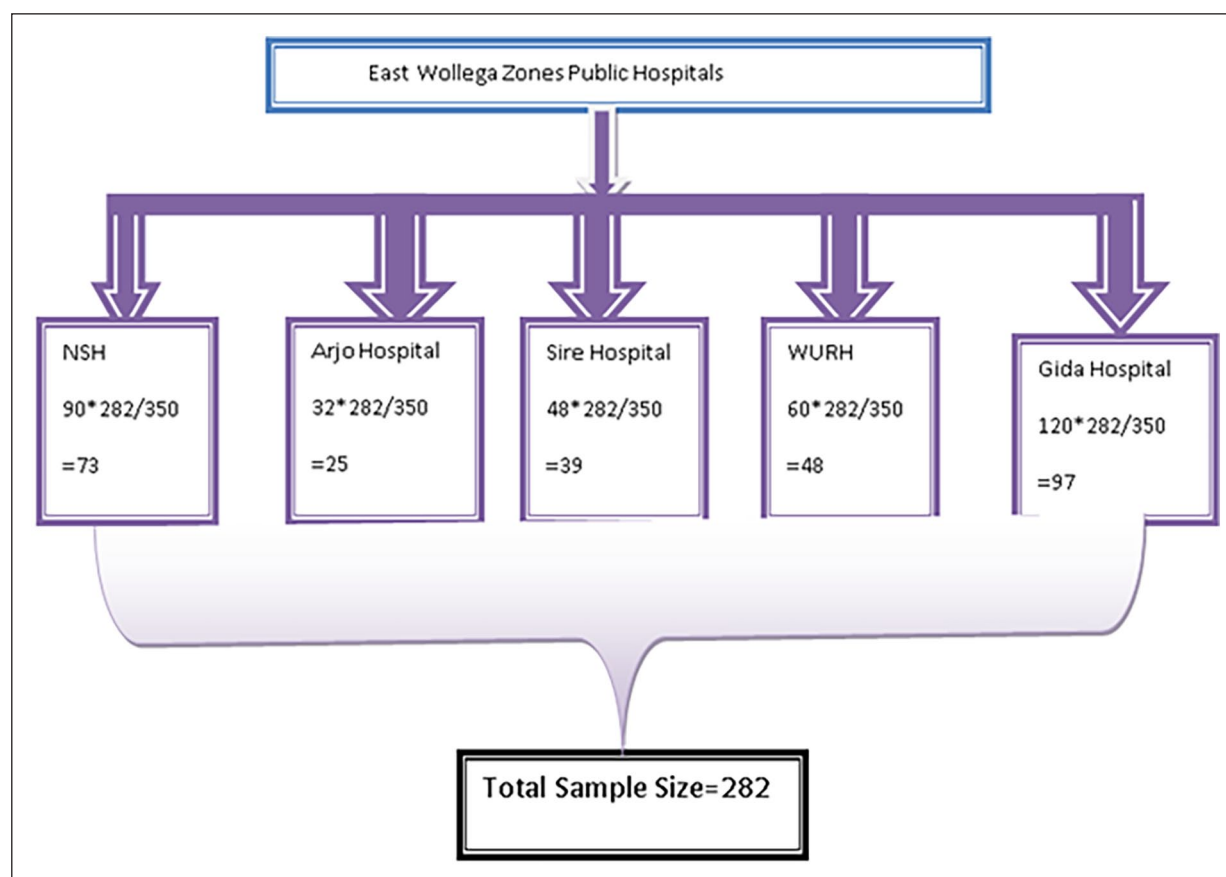


Figure 2. Schematic presentation of sampling technique.

socio-demographic factors associated with complications IVDs, maternal complications, and neonatal complications. The questionnaire was prepared in English and then translated to the working language of the region “Afan Oromo” by a language professional and back-translated to English for consistency. Data were collected from the mothers, chart of the neonates, and document review using interviewer-administered structured questionnaires and checklist. Ten BSc midwives who have data collection experiences and speak “Afan Oromo” fluently were recruited to run the data collection activities. Continuous follow-up and supervision were made by two supervisors and the principal investigator throughout the data collection period.

Statistical analysis

After collection, data were entered into Epi Data 3.1, cleaned and rechecked for its completeness, anomalies, and consistency, and were exported to statistical package of social sciences version 21 (SPSS) versions 21 for analysis. Univariate analyses were conducted for data exploration and descriptive analysis. Bivariate analyses were done to identify candidate variables for multivariable logistic regression analysis at $p < 0.25$. Multivariable logistic regression analysis was done to determine factors associated with complications of IVDs.

The goodness of fit of the model was checked using Hosmer and Lemeshow test at $p > 0.05$. Finally, statistical significance was declared at $p < 0.05$ using adjusted odd ratio (AOR) with 95% CI. The results were presented by tables, graphs, and texts based on the types of data.

Data quality management

Prior to data collection: The questionnaire was translated to the “Afan Oromo” language for the sake of the interview and translated back to English to confirm its consistency. A pre-test was conducted on 5% of the sample at Bako hospital, 1 week prior to the actual data collection time to check the consistency of the questionnaire. Cronbach’s alpha was calculated from pretested data to ensure reliability. Data collectors and supervisors were trained for 2 days on the contents of the questionnaire and data collection procedures. Based on the results, modifications and re-adjustments of the questionnaire were done.

During data collection: Systematic random sampling technique was used to recruit study participants. A signed informed permission was obtained from the respondents, who had a right to refuse at any moment, including during the data collecting period, and who were not under any duress.. Prospective primary data collection were used.

After data collection: The questionnaires were reviewed and checked for completeness by the principal investigator. Epi-data version 3.1 was used to reduce possible errors during data entry. Each and every questionnaire was cross-checked with the entered data to avoid error during data entry.

Ethical consideration

An ethical clearance letter was taken from the Wollega University ethical review board. Permission was obtained from East Wollega zone Health Bureau, Wollega University referral hospital, Nekemte specialized hospital, Arjo, Gidda, and Sire hospitals. Written informed consent was obtained from each mother after the objective of the research, methods of data collection, and confidentiality of the data were described to them by using the consent form attached to each questionnaire. The mothers were also informed that participation in the study was voluntary and that she has the right to withdraw from participation at any time during the interview. The name of the participant was not written on a questionnaire; instead, code was given to maintain the confidentiality of the information of the study participant.

Results

Socio-demographic characteristics

In this study, 282 mothers were participated making response rate 100%. Majority of the respondents 169 (59.9%) were in the age group of 25–34 years. The mean age of the respondents was 26.3 ± 5 standard deviation (SD). Regarding marital status, majority of the respondents 267 (94.7%) were married (see Table 1).

Obstetric-related characteristics

The commonest indication for IVD was prolonged second stage of labor 121 (42.9%) followed by fetal distress 81 (31.5%). The vacuum was the most commonly used type of IVDs in 203 (72%) deliveries and forceps were 79 (28%). The 135 (47.9%) mothers were referred from nearby catchment areas of the hospitals. Two-hundred nine (74.1%) mothers were monitored by CTG, and 194 (68.8%) mothers had an episiotomy.

Ninety-six (36%) of mothers, who underwent IVD had different grades of meconium stained amniotic fluid (MSAF). For 137 (48.9%) mothers, the instrument was applied two times (see Table 2).

ANC: antenatal care; CTG: cardiotocograph; and IVD: instrumental vaginal delivery. Complications of IVDs

The major immediate maternal and neonatal complications due to instrumental vaginal delivery were maternal injury 60 (21.3%) and neonatal injury 69 (24.7%) (Table 3)

Table 1. Socio-demographic characteristics of mothers who gave birth by IVD in public hospitals of East Wollega zone, 2020 (n=282).

Characteristics	Categories	Frequency (%)
Age group	15–24	99 (35.1)
	25–34	169 (59.9)
	35–44	14 (5)
Marital status	Married	267 (94.7)
	Single	12 (4.3)
	Divorced	3 (1.1)
Ethnicity	Oromo	215 (76.2)
	Amhara	49 (17.4)
	Tigre	11 (3.9)
	Gurage	7 (2.5)
Educational status	Cannot read and write	38 (13.5)
	Read and Write	48 (17)
	Primary school (grades 1–8)	58 (20.6)
	Secondary school (grades 9–12)	54 (19.1)
	College and above	84 (29.8)
Religion	Protestant	122 (43.3)
	Orthodox	87 (30.9)
	Muslim	64 (22.7)
	“Wakefata”	9 (3.2)
Wealth quintile	Lowest	100 (35.5)
	Second	14 (5)
	Middle	55 (19.5)
	Fourth	63 (22.3)
	Highest	50 (17.2)
Residence	Urban	183 (64.9)
	Rural	99 (35.1)
Occupation	Housewife	129 (45.7)
	Civil servant	68 (24.1)
	Farmer	34 (12.1)
	Merchant	35 (12.4)
	Others	16 (5.7)

*Students, NGOs, daily labor.

NICU: neonatal intensive care unit Complications of IVD

More than one-third, 105 (37.2%) of the IVD were complicated. Neonatal problems account for 69 of them (24.5 %). Of the total neonatal complications, 46 (67%) were contributed by vacuum-assisted delivery. Neonatal complications that were observed in vacuum-assisted delivery were low APGAR score 32 (45.7%), need resuscitation 9 (12.4%), caput succedaneum 25 (8.9%), and neonatal death 5 (1.8%). Complications developed in forceps-assisted delivery were NICU admission 41 (14.3%), birth trauma 11 (3.9%), and stillbirths 5 (2.1%) (Figure 3).

More than one-fourth of the respondents 60 (21.3%) mothers were developed complications. Majority of these complications were observed in forceps-assisted deliveries 47 (78%) The leading maternal complication was Perineal tear 36 (58.6%). Some of the complications observed in vacuum delivery were cervical tear 24 (39%) and episiotomy extension 12 (14.3%) (Figure 4).

Table 2. Obstetric-related variables among mothers who gave birth by IVD in public hospitals of East Wollega zone, 2020 (n = 282).

Characteristics	Categories	Frequency (%)
Parity	I	150 (53.2)
	II–IV	127 (45)
	V	5 (1.8)
Gravida	1–2	164 (58.2)
	3–4	94 (33.3)
	>5	24 (8.5)
GA	Preterm	50 (17.7)
	Term	229 (81.2)
	Post-term	3 (1.1)
ANC follow-up	Yes	242 (85.8)
	No	40 (14.2)
Number of ANC follow-up	One visit	19 (6.7)
	Two to three visit	183 (64.9)
	Four and above visit	40 (14.2)
Types of labor	Spontaneous	223 (79.1)
	Augmented	38 (13.5)
	Induced	21 (7.4)
Analgesia	Yes	156 (55.3)
	No	126 (44.7)
Type of analgesia	Local	148 (94.9)
	Regional	8 (5.1)
Indication of uses of the instrument	Prolonged second stage	121 (42.9)
	Fetal distress	81 (31.5)
	Maternal exhaustion	48 (17.6)
	Maternal medical condition	24 (8.5)
Types of IVD used	Forceps	79 (28.0)
	Vacuum	203 (72.0)
Visit type	Referred	135 (47.9)
	Direct visit	147 (52.1)
CTG availability	Yes	209 (74.1)
	No	73 (25.9)
The mother had an episiotomy	Yes	194 (68.8)
	No	88 (31.2)
The mother had medical condition	Yes	53 (18.8)
	No	229 (81.2)
Maternal medical condition	Pregnancy induced hypertension	21 (39.6)
	Chronic hypertension	11 (20.7)
	Gestational diabetes	5 (9.3)
	Pre-existing diabetes	9 (17.2)
	Cardiac disease	7 (13.2)
Time of application	On arrival	65 (23.0)
	Followed	217 (77.0)
Status of liquor	Clear	186 (66.0)
	Grade 1 Meconium Stained Amniotic Fluid (G1MSAF)	51 (18.1)
	Grade 2 Meconium Stained Amniotic Fluid (G2MSAF)	36 (12.8)
	Grade 3 Meconium Stained Amniotic Fluid (G3MSAF)	9 (3.2)
Number of traction	Once	87 (30.9)
	Twice	137 (48.9)
	3 times	58 (20.6)
Fetal heartbeat per minute	<120	104 (36.9)
	120–160	144 (51.1)
	>160	65 (12.0)
Fetal position	OA	265 (94.0)
	OT	6 (2.1)
	OP	11 (3.9)
Birthweight in gram	2500–3999	231 (81.9)
	≥4000	51 (18.1)

(Continued)

Table 2. (Continued)

Characteristics	Categories	Frequency (%)
Fetal station	Mid	67 (23.8)
	Low	143 (50.7)
	Outlet	72 (25.5)
Sex of the neonate	Male	156 (55.3)
	Female	126 (44.7)
Delivery conducted by	Midwife	166 (58.9)
	Emergency surgeons	35 (12.4)
	Physician	81 (28.7)

Table 3. Immediate maternal and neonatal complications among mothers who gave birth by IVD in public hospitals of East Wollega zone, 2020.

Characteristics	Category	Frequency (%)
Maternal injury	Yes	60 (21.3)
	No	222 (78.7)
Perineal tears	1st degree	10 (16.6)
	2nd degree	12 (19.4)
	3rd degree	8 (12.9)
	4th degree	6 (9.7)
Cervical or vaginal laceration	Yes	24 (40.0)
	No	36 (60.0)
Traumatic hemorrhage (primary PPH)	Yes	6 (7.2)
	No	54 (92.8)
Need of blood transfusions	Yes	3 (3.6)
	No	59 (96.4)
Episiotomy extension	Yes	12 (14.3)
	No	50 (85.5)
Uterine rupture	Yes	1 (1.2)
	No	61 (98.8)
Need for major surgery (hysterectomy)	Yes	1 (1.2)
	No	61 (98.8)
Neonatal injury	Yes	69 (24.7)
	No	213 (75.3)
APGAR score in the first minute	0–3	15 (5.3)
	4–6	114 (40.3)
	7–10	153 (54.3)
APGAR score in the fifth minute	0–3	13 (4.6)
	4–6	29 (10.3)
	7–10	240 (85.1)
Need of resuscitation	Yes	67 (23.8)
	No	215 (76.2)
NICU admission	Yes	41 (14.5)
	No	241 (85.5)
Birth trauma	Yes	11 (3.9)
	No	271 (96.1)
External ocular injury	Yes	1 (0.4.0)
	No	281 (99.6)
Caput succedaneum	Yes	25 (8.9)
	No	257 (91.1)
Shoulder dystocia	Yes	4 (1.4)
	No	278 (98.6)
Still birth	Yes	10 (3.5)
	No	272 (96.5)
Condition at discharge	Normal	237 (84.0)
	Improved	30 (10.6)
	Died	15 (5.4)

Factors associated with complications of IVD

Those variables with $p < 0.25$ in binary logistic regression were taken to multivariable logistic regression, and $p < 0.05$ was used to identify factors significantly associated with complications of IVD in multivariable logistic regression.

Educational status, types of labor, analgesia, types of IVD used, CTG availability, episiotomy, time of application, the status of liquor, number of traction, fetal heartbeats, birthweight, fetal station and who conducted delivery were identified as candidate variables from bivariate logistic regression analysis and then fitted into the final multivariate logistic regression model to identify independent factors affecting the IVD outcome.

Neonatal birth with > 4000 g weight has shown a strong association with IVD outcome. Neonate birthweight > 4000 gm was 4 times more likely to cause IVD complications when compared with neonate with 2500–3999 gm birthweight (AOR = 4.09, 95% CI 1.729–9.499). Application of IVD when the fetal station is at low pelvis is less likely to cause complications than when the fetal station is at mid pelvis (AOR = 0.139, 95% CI 0.057–0.339). Application of IVD at outlet pelvis is less likely to cause complications than when the fetal station is at mid pelvis (AOR = 0.258, 95% CI 0.095–0.700). Neonates with 120–160 heartbeats per minute were less likely to develop complications when compared with those < 120 beats per minute (AOR = 0.298, 95% CI 0.114–0.628). Furthermore, deliveries assisted by vacuum were less likely to cause complications than those assisted by forceps (AOR = 0.245, 95% CI 0.092–0.658) (see Table 4).

Discussion

This study was conducted in public hospitals of the East Wollega zone to assess the magnitude of complications of IVDs and associated factors among mothers who gave birth by IVD in 2020. The magnitude of complications of IVD in this study was 37.2% (31.9–42.9 with 95% CI). This result is lower than a study conducted at Suhul general hospital, northwest Tigray 45.4%. However, higher than studies conducted at Jimma university medical college 17.3% and Felegehiwot hospitals in Bahirdar 12.1%.^{14,15,17} Reasons for

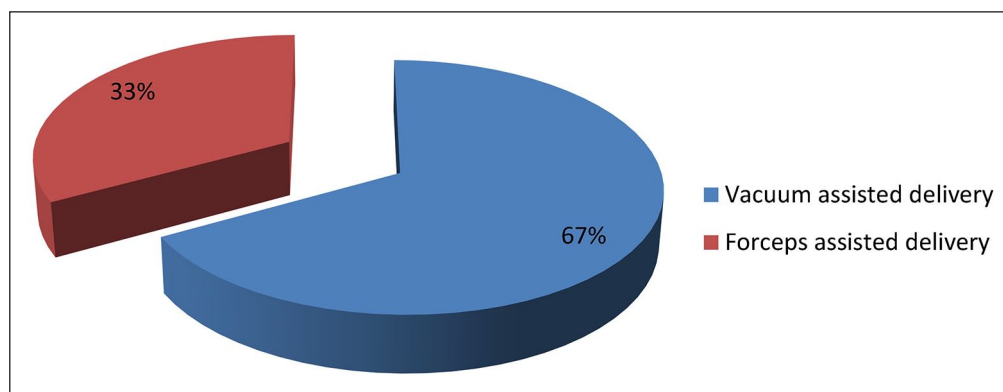


Figure 3. Magnitude of neonatal complications by type of instruments used in public hospitals of East Wollega zone, 2020.

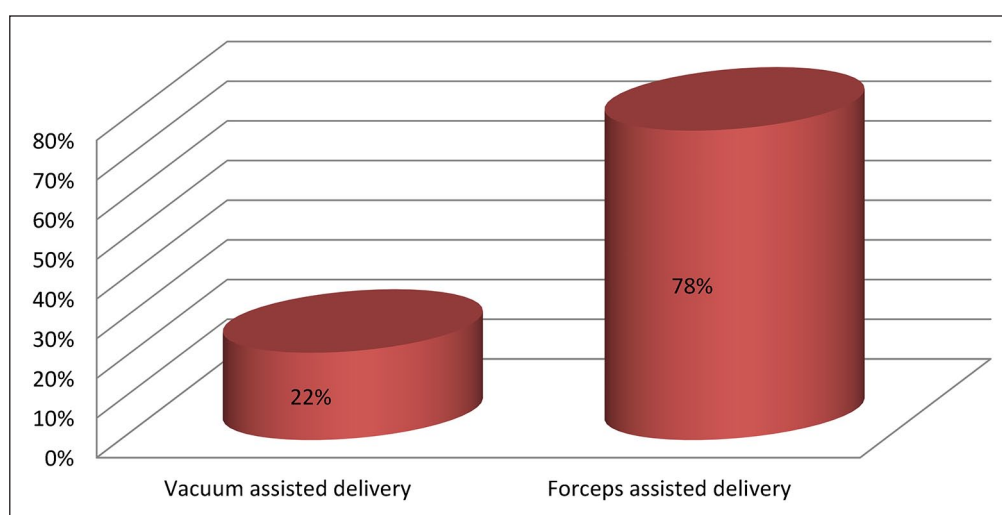


Figure 4. Maternal complications by type of instruments used in public hospital of East Wollega zone, 2020.

this difference could be due to having trained staff, availability of equipment, experienced human resources, and having access to cesarean delivery.

The vacuum was used in 203 (72%) of IVD than forceps which has conformity with the reported trend (76.2%) in a study conducted at Patan Hospital Nepal.¹⁰ In contrast to this, the studies conducted in the United States and Denmark indicated that most of the IVDs were assisted by forceps than vacuum,^{22,23} and the total IVD in Italy was 6.7% during 2005–2015,²¹ which is much lower than this study. The probable reason could be due to high cesarean section facility in Italy.

There is a significant difference in maternal complications between women delivered by vacuum-assisted and those delivered by forceps assisted. Mothers who had vacuum-assisted deliveries were fewer complications than mothers who had forceps-assisted delivery (AOR=0.245, 95% CI 0.092–0.658).

Maternal complications developed by forceps identified by this study include 3° and 4° perineal tear 14 (22.6%), traumatic post-partum hemorrhage 6 (7.2%) and one case of uterine rupture. These findings are in accordance with the

Cochrane database review study that maternal morbidity was less in VE compared to forceps delivery.^{24,25} This may be due to VE is associated with less pain at delivery and less likely to cause serious injury to the mother.

Application of low and outlet instrumentation is less likely to have fetomaternal complications than mid-pelvic (high IVD with station above 2) (AOR=0.139, 95% CI 0.057–0.339) and (AOR = 0.258, 95% CI 0.095–0.700). This result is consistent with the study conducted in Canada.²⁶ Mid-pelvic OVD was associated with significantly higher rates of obstetric trauma, birth asphyxia, ICH due to hypoxia and meconium aspiration syndrome.^{27,28} Prolonged SSOL was the commonest indication for 42.2% of IVD followed by fetal distress (NRFHRP) 28.7% and maternal exhaustion 17.6%. This result is consistent with the findings conducted at Felegehiwot hospital at Bahir Dar, Kannur, India, and Mizan-Tepi University Teaching Hospital, Ethiopia.^{15,26,29}

In contradiction to this result, a study done on trends of instrumental deliveries at a tertiary care teaching hospital in Puducherry in India shows that the indications were the non-reassuring fetal heart with 45.3%. In the study conducted in

Table 4. Bivariate and multivariate logistic regression analyses of factors associated with complications of IVD in public hospitals of East Wollega zone, 2020.

Variables	Complications of IVD		COR (95% CI)	AOR (95% CI)
	Yes	No		
Educational status				
Illiterate	8 (21.1%)	30 (78.9%)	1	1
Read and write	12 (25%)	36 (75%)	1.25 (0.452–3.457)	0.414 (0.105–1.634)
Primary (grades 1–8)	19 (32.8%)	39 (67.2%)	1.827 (0.704–4.740)	1.064 (0.299–3.788)
Secondary (grades 9–12)	27 (50%)	27 (50%)	3.75 (1.458–9.647)*	1.980 (0.561–6.996)
Above 12	39 (46.4%)	45 (53.6%)	3.25 (1.335–7.914)*	1.728 (0.538–5.545)
How labor was started				
Spontaneous	83 (37.2%)	140 (62.8%)	1	1
Augmented	7 (18.4%)	31 (81.6%)	0.381 (0.161–0.904)*	0.200 (0.057–0.700)
Induced	15 (71.4%)	6 (28.6%)	4.217 (1.575–11.291)*	5.412 (0.542–10.988)
Analgesia				
Yes	67 (42.9%)	89 (57.1%)	1	1
No	38 (30.2%)	88 (69.8%)	1.745 (1.062–2.861)*	1.337 (0.595–3.006)
Types of IVD used				
Forceps	50 (63.3%)	29 (36.7%)	1	1
Vacuum	55 (27.1%)	148 (72.9%)	0.216 (0.124–0.374)*	0.245 (0.092–0.658)**
CTG availability				
Yes	69 (33%)	140 (67%)	1	1
No	36 (49.3%)	37 (50.7%)	0.507 (0.295–0.871)*	1.561 (0.590–4.127)
Episiotomy done				
Yes	67 (41.6%)	94 (58.4%)	1	1
No	38 (31.4%)	83 (68.6%)	1.768 (1.026–3.048)*	1.071 (0.489–2.346)
Time of application				
On arrival	31 (47.7%)	34 (52.3%)	1	1
Followed	74 (34.1%)	143 (65.9%)	0.568 (0.324–0.995)*	1.060 (0.444–2.559)
Liquor status				
Clear	62 (33.3%)	124 (66.7%)	1	1
G1MSAF	27 (52.9%)	24 (47.1%)	2.250 (1.200–4.219)*	1.894 (0.731–4.908)
G2MSAF	13 (36.1%)	23 (63.9%)	1.13 (0.537–2.382)	0.644 (0.202–2.047)
G3MSAF	3 (33.3%)	6 (66.7%)	1 (0.242–4.133)	0.407 (0.068–2.423)
Number of traction				
Once	26 (29.9%)	61 (70.1%)	1	
Twice	44 (32.1%)	93 (67.9%)	1.110 (0.620–1.988)	2.208 (0.877–5.559)
3 times	35 (60.3%)	23 (39.7%)	3.570 (1.770–7.177)*	2.968 (1.122–7.850)
FHB per minute				
<120	52 (50%)	52 (50%)	1	1
120–160	38 (26.4%)	106 (73.6%)	0.358 (0.210–0.611)*	0.298 (0.114–0.628)**
>160	15 (44.1%)	19 (55.9%)	0.789 (0.362–1.720)	1.183 (0.372–3.765)
Birthweight in gram				
2500–3999	72 (31.2%)	159 (68.8%)	1	
≥4000	33 (64.7%)	18 (35.3%)	4.049 (2.139–7.665)*	4.09 (1.729–9.499)**
Fetal station				
Mid	46 (68.7%)	21 (31.3%)	1	1
Low	39 (27.3%)	104 (72.7%)	0.171 (0.091–0.323)*	0.139 (0.057–0.339)**
Outlet	20 (27.8%)	52 (72.2%)	0.176 (0.085–0.364)*	0.258 (0.095–0.700)**
Delivery conducted by				
Physician	24 (68.6%)	11 (31.4%)	1	1
Emergency surgeons	36 (44.4%)	45 (55.6%)	0.367 (0.159–0.847)*	0.646 (0.204–2.049)
Midwife	45 (27.1%)	121 (72.9%)	0.170 (0.07–0.376)*	0.382 (0.121–1.208)

AOR: adjusted odd ratio; **CTG**: cardiotocograph; IVD: instrumental vaginal delivery; COR: crude odd ratio; and CI: confidence interval. *Statistically significant at $p < 0.25$ in bivariate, 1 = Reference category; **Statistically significant at $p < 0.05$ in multivariate.

JUMC, a common indication for IVD was also fetal distress with 56.2%.^{30,31} This difference may be due to the number of parity, use of epidural analgesia, and induction and augmentation of labor.

Fetal heartbeat 120–160 beat per minute was significantly associated with complications of IVDs. Having 120–160 fetal heartbeats per minute decreases the risk of developing complications when compared with those with < 120 fetal heartbeats per minute (AOR=0.298, 95% CI 0.114–0.628). Regarding birth outcome, 94.3% of the neonates were alive, 3.5% stillbirth and 1.8% early neonatal death were observed.

The majority of the neonates 231 (81.9%) had birthweight 2500–3999 g and 51 (18.1%) \geq 4000 g, the largest birthweight was 4800 g and 2500 g was the smallest birthweight. Neonatal birthweight has shown a strong association with maternal outcome. Those mothers who gave birth to the neonate with birthweight > 4000 g are more likely to develop maternal complications when compared to those with normal birthweight (AOR=4.09, 95% CI 1.729–9.499). This finding is proven in different literatures; macrosomia attributes for PPH secondary to both uterine atony and perineal lacerations. The risk of shoulder dystocia was also high with macrosomic neonates.^{20,32}

This study revealed that a large number of neonates 129 (45.7%) delivered by IVD was complicated with poor APGAR scores. This finding is nearly the same with APGAR score found from a study at Dilla University referral hospital southern Ethiopia 42%. However, it is lower than the study conducted at Suhul general hospital, Tigray northwest Ethiopia 54%. In contrast, this is greater than the 35% found in a Stockholm, Sweden study. It is also much higher than among neonates delivered by OVD in JUMC in which poor APGAR score accounts 13.2%.^{14,15,24,33} This difference in the level of poor APGAR score may be related to the differences in the status of quality of service in the institutions and differences in the study populations.

In this study, 37.2% of IVD was complicated. Out of this, fetal complications take the lead and account for 69 (24.5%). This study and most other studies showed that there is a significant association between types of instruments used for IVD and neonatal outcomes. From the total complications, vacuum-assisted delivery contributed 67%. Major complications of vacuum-assisted delivery were low APGAR score recorded as commonest fetal complications in 45.7% of all fetal complications. Need for resuscitation in 12.4%, Caput succedaneum in 8.9% and the more serious neonatal complication, three neonatal death occurred in the study period. Major complications of forceps-assisted delivery were 14.3% NICU admission, 3.2% birth trauma, and 2.1% stillbirths were observed.^{22–25,30}

Limitations of the study

Since the study design was cross-sectional, it may not demonstrate direct cause and effect between dependent and independent variables.

Conclusion

The complication of IVD was high in this geographic area. Types of the instrument applied for IVD, birthweight, fetal station, and fetal heartbeats were significantly associated with the complications of IVDs. Since the magnitude of complications of IVD is high in this zone, operators should be aware that forceps and VEs are associated with different benefits and risks. They should choose the instrument most appropriate and safe to prevent complications. The operators should also require a careful assessment of clinical circumstances to identify the indications and contraindications for the application of the instruments. Researchers may use this study and conduct a further detailed research including other variables like body mass index and triangulating with qualitative data.

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Authors' contribution

CS, TH, and MTR designed the project and developed the proposal. CS, TH, MTR, DM, ZD, and SPU did data analysis and interpretation and wrote the article. All authors read and approved the final article.

Availability of data and Materials

Available from the corresponding author on reasonable request.

Declaration of conflicting interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Ethical approval

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Informed consent

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Supplemental material

Supplemental material for this article is available online.

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