Determinants of Maternal and Neonatal Outcomes of Oligohydramnios After 37⁺⁰ Weeks of Gestation in Mekelle Public Hospitals, Northern Ethiopia

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Abstract

Background Oligohydramnios is a state of deficient amniotic fluid defined objectively using ultrasound measurements as single deepest vertical pocket less than 2 centimeters and/or amniotic fluid index less than 5 centimeters. It has been correlated with conditions that threaten both maternal and fetal health. The aim of this study is to assess determinants of adverse maternal and perinatal outcome in women with oligohydramnios after 37⁺⁰ weeks in Ayder Comprehensive Specialized Hospital and Mekelle General Hospital from April 1, 2018 – March 31, 2019.

Methods This was prospective observational study. Total population purposive sampling method was employed to collect data prospectively.

Result During the study period, there were a total of 10,451 deliveries, of which 273 were complicated with oligohydramnios, making the prevalence of term oligohydramnios 2.6%. The composite adverse perinatal and maternal outcomes were 38.1% and 89.4% respectively. Primigravidity, degree of oligohydramnios, presence of intrauterine growth restriction and postterm pregnancy were associated with adverse perinatal outcome. Degree of oligohydramnios and hypertensive disorders of pregnancy were found to be predictor of composite adverse maternal outcome.

Conclusion Appreciation of determinants of composite adverse maternal and neonatal outcome can aid prompt interventions and mobilization of resources for resuscitation and early transfer to neonatal intensive care unit. Knowledge of determinants of maternal outcome can serve as a tool for patient counseling and for anticipation of maternal complications.

Introduction

Oligohydramnios is a state of deficient amniotic fluid defined sonographically as single deepest vertical pocket less than 2 centimeters and/or amniotic fluid index less than 5 centimeters [1]. Studies from different institutions and countries show that the prevalence of oligohydramnios ranges from 1-5% at term but it can go as high as 12-14 % after 41 weeks and as high as 30% in postterm pregnancies [1–6]. The reported prevalence of oligohydramnios at term gestation in the Ethiopian context is 2.3% [7].

Oligohydramnios has always been a topical issue in obstetrics because it is associated with grave perinatal outcome and increased maternal operative interventions. It is associated with adverse perinatal outcomes of poor first minute APGARs, increased risks of thick meconium in labor and risks of meconium aspiration, high admission rates to neonatal intensive care unit (N-ICU) and risks of perinatal deaths. There is an association of oligohydramnios with intrauterine growth restriction (IUGR) and risks of congenital anomalies in the babies.

This condition also puts the mother at risks of procedures and operative interventions of induction and cesarean delivery [3,4,8,9]. Mothers with oligohydramnios are at increased risk of delivering via cesarean

section primarily due to abnormal fetal wellbeing in labor [2,10 - 12]. Studies show high rate of cesarean delivery in both high – income and low – income countries ranging from 42.0 – 83.6% [2–4,7,8,13 - 15].

To the contrary there are studies that show oligohydramnios does not predict maternal and neonatal outcome. According to this studies there is a need for increased pregnancy surveillance if an oligohydramnios is detected. Otherwise, pregnancy interventions including induction or cesarean delivery for the mere presence of oligohydramnios cannot be justified [6,9,16]. In general there is no sufficient evidence to optimize the management of women with oligohydramnios and hence has always been area of controversy.

At Ayder Comprehensive Specialized and Mekelle General Hospitals, there is no continuous fetal monitoring with tracing. Therefore, owing to the perceived uncertainty of the intrapartum follow up and the increased rate of cesarean delivery in labor in those who are induced, there is a trend to lower a threshold to do elective cesarean delivery in cases of oligohydramnios.

There is an observed high prevalence of oligohydramnios and associated maternal and fetal morbidities in our set – up. Yet, no study examined maternal and fetal complications and outcomes associated with oligohydramnios in Mekelle General and Ayder Comprehensive Specialized Hospitals. Only few studies have been conducted on the subject in the Ethiopian context. With this in mind, this study was conducted to see the prevalence of oligohydramnios and examine determinant predictors of composite adverse maternal and neonatal outcomes.

Oligohydramnios poses a dilemma in management specially in set – ups with no continuous fetal monitoring [6]. Due to intrapartum complication and high rate of perinatal morbidity and mortality associated with oligohydramnios, rates of caesarean section are rising, but decision between vaginal delivery and caesarean section should be well balanced so that unnecessary maternal morbidity is prevented and perinatal morbidity and mortality are reduced [6,13].

Context specific appreciation of magnitude of the problem of oligohydramnios and factors related to poor outcome could help stratify management of these mothers and can aid prompt interventions and mobilization of resources for resuscitation and early transfer to NICU. It can also serve as a baseline local data against which mothers and their family could be advised and counseled about the degree of perinatal morbidity and mortality this condition incurs.

Biological importance of Oligohydramnios

Amniotic fluid serves to protect the fetus and umbilical cord from compression. It also has antibacterial properties, serves as a reservoir of water and nutrients and provides the necessary condition for normal development of fetal lung, musculoskeletal and gastrointestinal system, regulates temperature, reduces the impact of uterine contractions on the fetus [8,13]. It enables continued fetal growth in a non-restricted, sterile and thermally controlled environment [17].

Excessive or deficient amniotic fluid volume [AFV] has been used to indicate pregnancies that may be at risk for poor outcome. Such pregnancies have been associated with an increased anomaly rate, as well as increased perinatal morbidity and mortality[18]. Decreased amniotic fluid volume is especially of concern when it occurs in conjunction with structural fetal anomalies, fetal growth restriction, postdates pregnancies, and maternal disease [19,20].

Methods of determining amniotic fluid volume

Different tests have been proposed to determine amniotic fluid volume as mean of evaluation of fetal wellbeing [12]. Amniotic fluid index [AFI] and single deepest pocket [SDP] are the most-used semi-quantitative techniques. AFI is calculated by summing the depth in centimeters of 4 different pockets of fluid not containing cord or fetal extremities in 4 abdominal quadrants using the umbilicus as a reference point and with the transducer perpendicular to the floor [4,21,22].

SDP refers to the vertical dimension of the largest pocket of amniotic fluid [with a horizontal measure of at least 1 cm not containing umbilical cord or fetal extremities and measured at a right angle to the uterine contour and perpendicular to the floor. SDP is the criterion used in the biophysical profile to document adequacy of AFV [18,21].

AFI and SDVP have been validated as an accurate and reproducible techniques for assessment of amniotic fluid volume and are associated with poor perinatal outcome and increased maternal morbidities [9]. However the AFI identifies a significantly greater number of women as having oligohydramnios versus the SDP but without any difference in perinatal outcomes. Compared with SDP, AFI excessively characterizes a greater number of pregnancies as having oligohydramnios leading to more interventions without improvement in perinatal outcome [23].

Complications of Oligohydramnios

Adverse Perinatal Outcome

Oligohydramnios is one of the severe obstetric complications with poor fetal and maternal outcome. It is associated with low Apgar scores and NICU admissions, even in the absence of other 'high-risk' characteristics [14]. Risk of meconium stained liquor can go as high as 40-44%, respiratory distress as high as 13%, NICU admission as high as 15-19%, perinatal death 2.4 – 6.4 % and the composite adverse perinatal outcome can go as high as 15% [7]. Rates of fetal distress in labor can go as high as 30% and as high as 20% of neonates are reported to have low first minute Apgar [24].

Generally the risk of adverse perinatal outcome is increased in oligohydramnios including both gross and corrected perinatal mortality [25]. In one study in 7587 high risk patients Gross and corrected perinatal mortality in association with normal qualitative amniotic fluid volume ranged from 4.65/1000 and 1.97/1000, respectively, to 187.5/1000 and 109.4/1000 in association with decreased qualitative amniotic fluid volume, respectively [25].

In postterm pregnancies, patients with reduced amniotic fluid had a significant increase in meconium-stained amniotic fluid and growth-retarded babies and were more likely to require delivery by caesarean section for fetal distress and ultrasound measurement of amniotic fluid represents an effective discriminatory test in post-term pregnancy [26]. More important, adverse perinatal outcome is significantly more frequent with severely diminished compared with borderline amniotic fluid volume [4,27].

Maternal Outcome

Oligohydramnios also increases maternal risk in terms of labor induction and cesarean section and their attendant risks [11,28]. Studies done among different study groups in United States, Nigeria, Nepal, India and Pakistan show cesarean section rates of 20.2%, 30.8%, 64% and 83.6% respectively [8,9,29,30].

Risk Factors for Oligohydramnios

Majority of cases of oligohydramnios are idiopathic. The commonest and persistent maternal causes and risk factors of oligohydramnios are hypertension, anemia, premature rupture of the membrane (PROM), postdate and postterm pregnancy and abruption [2,8,14]. Chronic abruption can lead to a condition called chronic-abruption-oligohydramnios sequence (CAOS) in early pregnancy [31]. There are also case reports of malaria as a cause of oligohydramnios [32].

There are also mirads of fetal congenital anomalies that cause oligohydramnios. The commonest are congenital anomaly of the kidneys and urinary tracts (CAKUT), potter syndrome, and amniotic band syndrome [11,14]. Therefore, a thorough fetal anatomic survey focusing on the genitourinary tract and an attempt at visualizing free amniotic bands should be performed with ultrasound in cases of oligohydramnios [33]. Management of oligohydramnios also warrants increased antepartum surveillance for early detection of pregnancy complications and fetal scanning growth restriction [34]. Midtrimester oligohydramnios can also lead to the development of fetal pulmonary hypoplasia [35].

Therefore the delivery should be conducted under circumstances that allow appropriate support and intervention on behalf of the fetus [34] and vaginal delivery necessitates continuous intrapartum fetal heart rate monitoring [11].

Research Objectives

General objective

- To assess the magnitude and determinants of composite adverse perinatal and maternal outcomes of oligohydramnios in Mekelle Public Hospitals from April 1, 2018 – March 31, 2019..

Specific Objectives

1. To determine the magnitude of oligohydramnios in Mekelle Public Hospitals from April 1, 2018 – March 31, 2019.
2. To assess the determinants of composite adverse perinatal outcome in mothers with oligohydramnios diagnosed after 37⁺⁰ weeks of gestation in Mekelle Public Hospitals from April 1, 2018 – March 31, 2019.
3. To assess the determinants of composite adverse maternal outcome in mothers with oligohydramnios diagnosed after 37⁺⁰ weeks of gestation in Mekelle Public Hospitals from April 1, 2018 – March 31, 2019.

Research Methods And Materials

Study Setting

The study was conducted at Ayder Comprehensive Specialized and Mekelle General Hospitals. Both are public hospitals with speciality services.

Ayder Comprehensive Specialized Hospital is one of the largest public hospitals in Ethiopia serving as a referral catchment area for more than 8 million people from Tigray, Afar, and Northern Amhara Regional States. It is tertiary hospital giving all types of care. It provides a comprehensive care of which obstetrics and gynecology care service provision is one of the main services. It has two separate Out Patient Departments; one offering services for low risk mothers and the other for high risk mothers. There are 78 in – patient beds in two wards, 4 delivery couches, 1 emergency room, 2 procedure rooms and 1 meeting hall for Obstetrics and Gynecology care services. There is also an OR table reserved only for emergency cesarean delivery in the main OR. During the study period, there were 10 senior Obstetrician and Gynecologists, 34 residents, 40 midwives and 27 nurses providing the care. This hospital hosted 5,163 deliveries during the study period.

In terms of outpatient obstetric services, it has two out – patient clinics in two separate buildings. There is an out – patient clinic separate from the main hospital building but in the same premises, where women are primarily triaged during their first visit. Those who are low risk continue follow up at the low risk clinic. Women who are high risk at the first triage or women who are subsequently diagnosed or develop high risk condition on subsequent contacts are sent to the high risk clinic located in the center of the main building. Those who are high risk are followed separately in a high risk clinic.

Mekelle General Hospital is an affiliate hospital of Ayder Comprehensive Specialized Hospital where Residents and Seniors from ACSH rotate monthly to deliver Obstetric and Gynecology services. It similarly hosted 5,155 deliveries during the study period.

Study Design

This was prospective observational study.

Source population

All pregnant women who seek service at Mekelle town public hospitals.

Study population

All pregnant women who were diagnosed to have oligohydramnios by ultrasound and getting service at Mekelle Hospital and Ayder Comprehensive Specialized Hospital during the study period.

Study Subjects

All pregnant women who fulfilled the inclusion criteria are enrolled in the study .

Eligibility Criteria

Inclusion Criteria

1. Gestational age after 37⁺⁰ weeks of gestation calculated from reliable date or early ultrasound taken before 24⁺⁰ weeks of gestation
2. Singleton gestations
3. AFI < 5 cms and/or SDVP is < 2 centimeters

Exclusion Criteria

1. Women with PROM
2. Mothers who are admitted with the diagnosis of oligohydramnios and corrected after rehydration
3. Women with Intrapartum Fetal Death [IUFD] at presentation

Study variables

Independent variable

- Maternal age, marital status, address, educational status, occupation, gravidity, parity, previous history of abortion, ANC, HIV sero – status, antepartum complications, degree of oligohydramnios, IUGR,

Dependent variables

- Composite adverse maternal and perinatal outcome

Sample size determination

Sample size of the study as calculated using OpenEpi, Version 3, open source calculator: frequency of composite adverse perinatal outcome in women with oligohydramnios at term was taken 9.7 % from

literature review [36]. Statistical power is 80 and two sided significance level is 95% giving sample size of 135.

Table 1: Sample size as calculated from OpenEpi, Version 3

Sample Size for Frequency in a Population		
Population size [for finite population correction factor or fpc][<i>N</i>]:	1000000	
Hypothesized % frequency of outcome factor in the population [<i>p</i>]:	9.7%+/-5	
Confidence limits as % of 100[absolute +/- %] [<i>d</i>]:	5%	
Design effect [for cluster surveys- <i>DEFF</i>]:	1	
Sample Size[<i>n</i>] for Various Confidence Levels		
Confidence	Level [%]	Sample Size
95%		135
80%		58
90%		95
97%		165
99%		233
99.9%		380
99.99%		531
Equation		
Sample size <i>n</i> = [DEFF*Np[1-p]]/ [(d²/Z² _{1-α/2} *[N-1]+p*[1-p])]		

Results from OpenEpi, Version 3, open source calculator–SSPropor

Sampling technique/procedure

The study was conducted at Ayder Comprehensive Specialized Hospital and Mekelle Hospital. This two hospitals are chosen for their case load and speciality services. Total population purposive sampling technique was employed to enroll all mothers who are admitted with oligohydramnios after 37⁺⁰ weeks of gestation to the labor ward for pregnancy termination. Mothers who fulfilled the inclusion criteria were

asked for consent and upon agreeing for the data collection, structured questionnaire was administered.

Results

Socio – demographic and obstetric profile

During the study period a total of 10,451 women gave birth in both institutions of the study area. From a total of 332 sampled women with oligohydramnios, 59 were excluded for reasons including presentation at preterm gestational age, unknown or unreliable last date or absence of early milestones to date the pregnancy. All the remaining 273 women were enrolled giving 100% response rate. This makes the prevalence of oligohydramnios 3.2% across all gestations and 2.6% in those who presented after 37⁺⁰ weeks of gestation with optimally dated pregnancy.

Most of the study participants [n = 244, 89.4%] were in the age group of 20 – 34 years with minimum and maximum age of the study participants being 18 and 45 years. Majority of the study participants [n = 240, 87.9%] reside in the urban setting. Intermis of educational background, [n = 106, 38.8%] attended secondary school, [n = 97, 35.5%], graduated from university or college, and [n = 51, 18.7%] attended elementary school. The remaining participants [n = 19, 7.0%] had no formal education. Sixty-three-point four percent of participants are house wives, while the remaining [n = 66, 24.2%, n = 26, 9.5%, n = 8, 2.9%] are government employees, self-employed and unemployed respectively.

Table 2: Socio – demographic and obstetric variables of pregnant mothers with oligohydramnios after 37⁺⁰ weeks managed at Ayder Comprehensive specialized and Mekelle General Hospitals, from April 1, 2018 – March 31, 2019

Variables		Frequency	Percent [%]
<i>Socio – demographics</i>			
Address	Urban	240	87.9
	Rural	33	12.1%
Age in years	≤ 19	10	3.7%
	20 - 34	244	89.4%
	≥35	19	7.0%
Education	No formal education	19	7.0
	Elementary school	51	18.7
	Secondary school	106	38.8
	College or university	97	35.5
Occupation	Housewife	173	63.4
	Self employed	26	9.5
	Government employees	66	24.2
	Unemployed	8	2.9
Marital status of respondents	Married	270	98.9
	Single	3	1.1
<i>Obstetric Variables</i>			
Gravidity	I	116	42.5
	II – IV	144	52.7
	≥V	13	4.8
Gestational age	Early Term	68	24.9
	Full Term	99	36.3
	Late Term	54	19.8
	Post Term	52	19.0
ANC booking status	Booked	232	85.0
	Not booked	41	15.0
Obstetric and medical problems	Yes	28	10.3
	No	245	89.7

Previous history of abortion	Yes	37	13.6
	No	236	86.4
Possible causes of Oligohydramnios	Idiopathic	130	47.6
	Prolonged pregnancy	102	37.4
	IUGR	20	7.3
	Hypertensive diseases	17	6.2
	APH	2	0.7
	Congenital anomaly	2	0.7
AFI	<2	160	58.6
	$\geq 2 - 5$	113	41.4

Majority of the mothers [n = 232, 85%] were booked for antenatal contact. With regard to obstetric factors and history, 116 women [42.5%] were primigravids, 144 [52.7%] were women with gravida II – IV, and women with gravida 5 and above accounted for only 13% [n = 4.8%]. Most of the study participants [n = 245, 89.7%] had neither obstetric, nor medical problems in the index pregnancy apart from the oligohydramnios, while the remaining 28 women [10.3%] had either obstetric or medical complications. Of these, hypertensive disorders were the most common obstetric complication [n = 17, 6.2%] followed by antepartum hemorrhage complicating two cases [n = 1, 0.4%] and gestational diabetes mellites [n = 1, 0.4%]. Among the medical complications, retroviral infection [n = 9, 3.3%], cardiac [n = 1, 0.4%] and hyperthyroidism [n = 1, 0.4%] were noted in this study.

Concerning the presence of possible cause of oligohydramnios, no plausible cause of oligohydramnios was present in nearly half of the cases. Prolonged pregnancy, hypertensive disorders of pregnancy and severe IUGR were the most common problems identified accounting for 37.4%, 7.3% and 6.2% respectively. More than half of the cases had AFI < 2 [Table 2].

Perinatal outcome

In the present study, the rate of composite adverse perinatal outcome was 38.1% [n = 104]. The frequency of adverse perinatal outcomes in the study participants were, low first minute APGAR [n = 33, 12.1%], low birthweight [n = 54, 19.8%], NICU admission [n = 42, 15.4%], and thick meconium [n = 25, 9.2%]. Death of eleven babies [4%] was recorded in this study.

Table 3: Adverse perinatal outcomes in pregnant mothers with oligohydramnios after 37⁺⁰ weeks managed at Ayder Comprehensive specialized and Mekelle General Hospitals, from April 1, 2018 – March 31, 2019

Variables		Frequency	Percent
1 st minute APGAR Score	<7	33	12.1
	≥7	240	87.9
Birthweight in kilograms	< 2.5	54	19.8
	≥2.5	219	80.2
NICU Admission	Yes	42	15.4
	No	231	84.6
Thick Meconium	Yes	25	9.2
	No	248	90.8
Perinatal death	Yes	11	4.0
	No	262	96.0

There were 11 perinatal deaths in this study. Three died immediately after birth before referral to N – ICU. The remaining 8 died after admission to N – ICU. Forty-two neonates were admitted to N-ICU. The most common reasons for N – ICU admission were, perinatal asphyxia [n = 15, 35.7%,], meconium aspiration syndrome [n = 8, 19.04%], early onset neonatal sepsis [n = 7, 16.7%] [Table 3].

Predictors of Adverse Perinatal Outcome

IUGR [χ^2 [df] =24.630[1], degree of oligohydramnios [χ^2 [df] =7.815[1], gravidity at presentation [χ^2 [df] =, gestational age at delivery [χ^2 [df] = 20.203[4] and causes of oligohydramnios [χ^2 [df] =20.203[4] were found to have an association with composite adverse perinatal outcome. p – value < 0.05 was taken to show statistical significance for all variables [Table 4].

Table 4: Association between socio – demographic and obstetric variables with adverse perinatal outcome in pregnant mothers with oligohydramnios after 37⁺⁰ weeks managed at Ayder Comprehensive specialized and Mekelle General Hospitals, from April 1, 2018 – March 31, 2019

Variable		Composite Adverse Perinatal Outcome		X2[df]	P-value
		Yes	No		
Hemoglobin Level	<11.0	5 [50%]	5 [50%]		0.513*
	≥11	99 [37.6%]	164 [62.4%]		
Mode of delivery	Spontaneous vaginal	15 [38.5]	24 [61.5%]	4.058[4]	0.398
	Operative Vaginal	8 [50%]	8 [50%]		
	Cesarean	74	115		
	Vaginal breech	1 [50%]	1 [50]		
	Induced vaginal	6 [22.2%]	21 [77.8]		
IUGR	Yes	25 [78.1%]	7 [21.9%]	24.630 [1]	<0.001**
	No	79 [32.8%]	162 [67.2%]		
AFI	<2	72 [45.0%]	88 [55.0%]	7.815[1]	0.005**
	2 – 5	32 [28.3%]	81 [71.7%]		
Age of participant	≤19	3 [30.0]	7 [70.0%]	2.903 [2]	0.234
	24 – 34	97 [39.8]	147 [60.2%]		
	≥35	4 [21.1]	15 [78.9%]		
Gravidity at presentation	Primigravid	61 [52.6%]	55 [47.4%]	18.698[2]	<0.001**

	Gravida II – IV	38 [26.4%]	106 [73.6%]		
	≥ Gravida V	5 [38.5%]	8 [61.5%]		
Causes of Oligohydramnios	Prolonged pregnancy	41 39.8%	62 60.2%	20.203[4]	<0.001**
	Hypertensive diseases of pregnancy	11 [73.3%]	4 [26.7%]		
	IUGR	13 [65.0%]	7 [35.0%]		
	Congenital anomaly	3 [50.0%]	3 [50.0%]		
	Idiopathic	36 [27.9%]	93 [72.1%]		
Gestational age	Early term	27 39.7%	41 [60.3%]	14.477[3]	0.002**
	Full term	30 30.3%	69 [69.7%]		
	Late term	16 29.6%	38 [70.4%]		
	Post term	31 59.6%	21 [40.4%]		
HIV serostatus	Positive	4 [3.8%]	8 [4.7%]		1.000*
	Negative	100 [96.2%]	161 [95.3%]		
Hypertensive Disorders of Pregnancy	Yes	13 [12.5%]	91 [87.5%]	13.422 [1]	0.001
	No	3 [1.8%]	166 [98.2%]		

Labor circumstances	Spontaneous labor	26 [43.3%]	34 [56.7%]	7.771 [3]	0.051
	Induced labor	26 [28.0%]	67 [72.0%]		
	Elective CD	37 [40.2%]	55 [59.8%]		
	Emergency CD	15 [53.6%]	13 [46.4%]		
Antepartum complications	Yes	15 [53.6%]	13 [7.7%]	3.169[1]	0.075
	No	89 [36.3%]	156 [92.3%]		
ANC Booking	Booked	92 [85.0%]	140 [82.8%]	1.594[1]	0.207
	Not booked	12 [15.0%]	29 [17.2%]		
Previous history of abortion	Yes	13 [12.5%]	24 [14.2%]	0.159[1]	0.690
	No	91 [87.5%]	145 [85.8%]		

* Fisher's Exact Test was used in this case. ** denotes variables with significant association at P – value < 0.05

In bivariate analysis of ANC booking, presence of antepartum medical or obstetric complication, cause of oligohydramnios, degree of oligohydramnios, gestational age at delivery, gravidity, mode of delivery, IUGR and labor circumstances showed significant association with composite adverse perinatal outcome at P – value < 0.25.

When these variables are computed into multivariable regression, only IUGR, degree of oligohydramnios, gestational age, presence of hypertensive disorders of pregnancy and gravidity were found to be significant predictors of composite adverse perinatal outcome. Accordingly, therefore, the likelihood of

experiencing adverse outcome was 20-fold greater in pregnancies in mothers complicated with IUGR than their counterparts [AOR = 20.375, 95% CI, [2.215-192.885]. This wide confidence interval is related to small sample of IUGR cases. Women who were complicated with hypertensive disorders of pregnancy were more than fourteen times at odds of experiencing composite adverse perinatal outcome than those who had no hypertensive disorders of pregnancy [AOR = 14.550, CI [2.812 - 68.498]. Similarly, women who presented at post term gestation with oligohydramnios are 13 – fold more likely to have a composite adverse perinatal outcome compared to other women who present at full term gestation with oligohydramnios [AOR = 13.334, 95% CI [2.296 – 77.435]. Mothers who are primigravids are 3 times more likely of having an adverse perinatal outcome than mothers who are gravida II – V [AOR = 3.388, 95% CI [1.772 – 6.478]. Women who had AFI < 2 centimeters had the likelihood of composite adverse perinatal outcome is twice that of women with AFI 2 – 5 centimeters [AOR = 2.169, 95% CI, [1.18 – 4.100] [Table 4].

Table 5: Multivariate analysis of factors associated with composite adverse perinatal outcome in pregnant mothers with oligohydramnios after 37⁺⁰ weeks managed at Ayder Comprehensive specialized and Mekelle General Hospital, from April 1, 2018 – March 31, 2019

Variables		Composite adverse perinatal outcome		COR	AOR	P – value
		Yes	No			
ANC Booking	Booked	92	140	1	1	0.112
	Not booked	12	29	0.630 [0.630 - 0.306]	0.474 [0.189- 1.191]	
	No	89	156	1	1	
Hypertensive disorders	Yes	13	91	7.905 [2.195 -28.463]	14.550 [2.812 - 68.498]	0.001
	No	3	166	1	1	
IUGR	Yes	25	7	7.324 [3.037 - 17.660]	20.670 [2.215- 192.885]	0.008
	No	79	162	1	1	
AFI	<2	72	88	2.071 [1.238 - 3.464]	2.028 [1.056 - 3.892]	0.034
	2 – 5	32	81	1	1	
Gestational age at delivery	Early term	27	41	1.515 [0.792 - 2.895]	1.236 [0.561- 2.662]	0.615
	Full Term	30	69	1	1	
	Late Term	16	38	0.968 [0.469 - 1.999]	2.096 [0.390- 12.088]	
	Post term	31	21	3.395 [1.685 - 6.840]	14.483 [2.424 86.520]	
Gravidity	I	61	5	3.094 [1.840 - 5.203]	3.534 [1.824- 6.848]	0.001

	II – IV	38	106	1	1	
	≥ V	5	8	1.743 [0.537 - 5.658]	1.706 [0.368 - 7.896]	0.495
Labor Circumstances	Spontaneous	26	34	1	1	
	Induced	26	67	0.507 [0.256 - 1.004]	0.550 [0.223 - 1.357]	0.195
	Elective CD	37	55	0.880 [0.455 - 1.701]	0.980 [0.373 - 2.577]	0.967
	Emergency CD for those not in labor	15	13	1.509 [0.613 - 3.716]	1.302 [0.371- 4.571]	0.680
Mode of Delivery	Spontaneous vaginal	15	24	1	1	
	Operative vaginal	8	8	1.600 [0.495 - 5.172]	0.556 [0.122- 2.524]	0.447
	Cesarean	74	115	1.030 [0.507 - 2.090]	0.694 [0.253- 1.905]	0.478
	Vaginal breech	1	1	1.600 [0.093 - 27.547]	2.613 [0.090- 75.929]	0.576
	Induced vaginal	6	21	0.457 [0.150 - 1.392]	0.469 [0.111- 1.991]	0.305

Maternal Outcome

Majority of study participants, 190 [69.6%] delivered via cesarean delivery. The most common indication for cesarean delivery was oligohydramnios with unfavorable Bishop [n = 60, 22%], followed by nonreasoning fetal hear rate status [NRFHRS] [n = 43, 15.8%], and oligohydramnios with IUGR [n = 34, 12.5%] [Table 6].

Table 6: Indications for cesarean delivery in pregnant mothers with oligohydramnios after 37^{+0} weeks managed at Ayder Comprehensive specialized and Mekelle General Hospitals, from April 1, 2018 – April 31, 2019

a.	Indication	Frequency	Percent [%]
1.	Oligohydramnios with unfavorable Bishop	60	22.0
2.	Nonreassuring fetal heart rate status [NRFHRS]	43	15.8
3.	Oligohydramnios with IUGR	34	12.5
4.	Failed Induction	18	6.6
5.	Severe Oligohydramnios with previous CD Scar	11	4.0
6.	Oligohydramnios with malpresentations	10	3.7
7.	Fetal Macrosomia	6	2.2
8.	Poor progress of labor with factors precluding augmentation	6	2.2
9.	Placenta Previa	1	0.4

Sixty mothers [22.0%] presented with spontaneous onset of labor. Out of these mothers 25 [41.7%] delivered spontaneously, 25 [41.7%] delivered via cesarean delivery and 8 [13.3%] mothers delivered via operative vaginal delivery and 2 [3.3%] delivered via assisted breech vaginal delivery. Nearly 50% of mothers who were induced ended up in cesarean delivery for different reasons. Elective cesarean delivery constituted approximately for one – third [$n = 92$, 33.7%] of the cases primarily for reasons of oligohydramnios with unfavorable Bishop and oligohydramnios with IUGR. In twenty-eight [10.3%] mothers, cesarean delivery was conducted for indications not including labor [Table 6].

Table 7: Labor circumstances at presentation and final mode of delivery in pregnant mothers with oligohydramnios after 37^{+0} weeks managed at Ayder Comprehensive specialized and Mekelle General Hospitals, from April 1, 2018 – March 31, 2019

		Mode of Delivery				
		Vaginal Delivery				Cesarean Delivery
		Spontaneous	Induced	Operative	Breech	
Labor Circumstances	Spontaneous labor [n = 60]	25	-	8	2	25
	Induced [n = 93]	-	41	7		45
	Emergency CD for indications not in labor [n = 28]	-	-	-	-	28
	Elective CD [n = 92]	-	-	-	-	92
	Total [n = 273]	25	41	15	2	190

Table 7: Cross tabulation of socio – demographic and obstetric variables against mode of delivery in pregnant mothers with oligohydramnios after 37⁺⁰ weeks managed at Ayder Comprehensive specialized and Mekelle General Hospitals, from April 1, 2018 – April 31, 2019

Variables		Mode of Delivery				
		Vaginal Delivery				Cesarean Delivery
		Spontaneous	Induced	Operative	Breech	
Maternal age	≤19	2	0	1	0	7
	20 – 34	34	26	14	2	168
	≥35	3	1	1	0	14
Antepartum obstetric and medical complication	Yes	3	4	2	0	19
	No	36	27	14	2	170
Parity	Primigravid	14	9	15	1	88
	Primipara	11	11	0	1	62
	2 – 4	14	7	1	0	37
	≥5	0	0	0	0	2
IUGR	Yes	3	0	2	0	27
	No	36	27	14	2	162
AFI	<2	18	16	9	0	117
	2 – 5	21	11	7	2	72
Previous history of abortion	Yes	3	3	0	0	31
	No	36	24	16	2	158
Gestational age	Early term	4	4	4	1	55
	Full term	16	8	7	0	68
	Late term	8	9	1	1	35
	Post term	11	6	4	0	31

Two hundred forty-four [89.4%] of the study participants had composite adverse outcome defined as either of labor induction, operative vaginal delivery or cesarean delivery. Of all the socio – demographic and obstetric variables, only degree of oligohydramnios and HIV serostatus were found to be associated with composite adverse maternal outcome.

On bivariate analysis, marital status, HIV serostatus, Hypertensive disorders and degree of oligohydramnios were found to be significant predictors of composite adverse maternal outcome. When these variables are computed into multivariate regression only HIV serostatus [AOR = 5.609, 95% CI

[1.192-26.394], and degree of oligohydramnios [AOR = 2.389, 95% CI, [1.035-5.514], were found to be significant predictors of composite adverse maternal outcome. Accordingly, women who have positive HIV serostatus are five times at odds of having composite adverse maternal outcome and women who have AFI < 2 have more than twice chance of experiencing composite adverse maternal outcome [Table 8].

Table 8: Multivariate analysis of factors associated with composite adverse maternal outcome in pregnant mothers with oligohydramnios after 37⁺ weeks managed at Ayder Comprehensive Specialized and Mekelle General Hospitals, from April 1, 2018 – March 31, 2019.

Variables		Composite adverse maternal outcome		COR	AOR	P – Value
		Yes	No			
Marital Status	Married	242	28	1	1	0.395
	Single	2	1	0.231 [0.020 -2.634]	3.706 [0.403 - 57.95]	
HIV Serostatus	Reactive	235	3	0.332 [0.085 - 1.304]	5.609 [1.192-26.394]	0.029
	Nonreactive	9	26	1	1	
Hypertensive Disorders	Yes	15	1	1.834 [0.233-14.418]	1.967 [0.213-18.163]	0.564
	No	229	28	1	1	
Gestational age	Early Term	65	3	3.569 [.530-2.573]	3.376 [0.890-12.804]	0.074
	Full Term	85	14	1	1	
	Late Term	48	6	1.318 [.287-49.867]	1.265 [0.436-3.673]	
	Post term	46	6	1.263 [1.589-262.509]	1.068 [0.363-3.137]	
AFI	<2	148	12	2.184 [0.999-4.776]	2.389 [1.035-5.514]	0.041
	2 – 5	96	17	1	1	

Odds of experiencing composite adverse maternal outcome nearly doubles, triples and quadraples in women with hypertensive disorders of pregnancy compared to those without, oligohydramnios at early term gestation compared to those at full term and in those who are not married compared with those who are married respectively but these variables did not show an actual significant statistical trend [Table 8].

Discussion

Most of the study participants [$n = 244$, 89.4%] were in the age group of 20–34 years with minimum and maximum age of the study participants being 18 and 45 years. In the present study, the rate of oligohydramnios in those who have reliably dated pregnancy after 37⁺₀ weeks is 2.6%. One hundred four [38.1%] mothers and 244 [89.4%] mothers had composite adverse perinatal and maternal outcome respectively.

The rate of oligohydramnios [2.6%] in the present study is in agreement with other studies done in Ethiopia, India, Nigeria, Israel and USA which reported similar rates [1, 7, 36, 37].

Similar to study done in India, in the present study no plausible causes of oligohydramnios were present in nearly half of the cases [13]. Prolonged pregnancy, hypertensive disorders of pregnancy and severe IUGR were the most common problems identified accounting for 37.4%, 7.3% and 6.2% respectively which is in agreement with the aforementioned study which reported similar rates.

One hundred four [38.1%] mothers and 244 [89.4%] mothers had composite adverse perinatal and maternal outcome respectively. Compared to similar study done in Israel by Ashwal, E. et al, composite adverse outcome was higher in the present study [38.1% Vs 9.7%] [36]. Comparisons cannot be made short of published studies which take composite adverse perinatal outcome as an outcome variable in similar set up.

Similar to an other study done in Ethiopia which reported the effect of oligohydramnios on perinatal outcome in the present study there were slightly higher rates of neonatal morbidities in terms of low birthweight [19.8% Vs 11.5%], and admission to N – ICU [15.4% Vs 11.86%, while there was slightly lower incidence of thick meconium in labor in the present study than the aforementioned study [9.2% Vs 12.88%] [7].

Similar to rates in both developing and developed countries which showed high rates of cesarean delivery ranging from 42.0–83.6%, this study revealed rates of cesarean delivery to be nearly 70% [1–3, 7, 24, 29, 38]. What is more revealing is that, the commonest indication was oligohydramnios with unfavorable Bishop [$n = 60$, 22%]. This correlates well with a study done in India which describes isolated oligohydramnios as the commonest [24%] indication for cesarean delivery for reasons of which they described lack of facilities for intrapartum monitoring and inadequate neonatal care which sounds similar to our set-up. Another study in Ethiopia also reports similar indications [7]. However, the present study did not find an association in between mode of delivery and composite adverse perinatal outcome.

Perinatal adverse outcome in women who present at 42⁺₀ weeks or beyond is twice – seven times higher than that of pregnancies who present at full term [39]. The thirteen times increased risk observed in the present study cannot be explained by only being post term. Thus, post term can be taken as an independent predictor of adverse perinatal outcome in women who present with oligohydramnios. Similarly, IUGR is a marker of adverse outcome by itself [40, 41]. The significantly higher rates of

composite adverse perinatal outcome in the present study reveals IUGR as a significant independent predictor of adverse outcome in women with oligohydramnios.

Conclusion

This study concludes that women with oligohydramnios after 37⁺₀ weeks gestation experience significantly increased morbidities in terms of composite adverse perinatal and maternal outcome.

This study helps to delineate presence of which factors determine a composite adverse perinatal and maternal outcome. It can be concluded that presence of IUGR, being primigravid, degree of oligohydramnios, presence of hypertensive disorders of pregnancy and post term gestation are predictors of experiencing composite adverse perinatal outcome in women with oligohydramnios after 37⁺₀ weeks of gestation. Degree of oligohydramnios and HIV serostatus are significant independent predictors of composite adverse maternal outcome.

Neither labor induction, nor mode of delivery affect perinatal outcome. Thus, decisions to proceed with either vaginal or cesarean delivery can be individualized in relation with the presence or absence of predictors of composite adverse perinatal outcome stated above.

Abbreviations

ACSH	Ayder Comprehensive Specialized Hospital
AFI	Amniotic Fluid Index
ANC	Antenatal Care
AOR	Adjusted Odds Ratio
CAKUT	Congenital Anomaly of the Kidney and Urinary Tract
CAOS	Chronic Abruptio Oligohydramnios Sequence
CD	Cesarean Delivery
COR	Crude Odds Ratio
HIV	Human Immunodeficiency Virus
IUGR	Intrauterine Growth Restriction
MVP	Maximum Vertical Pocket
OR	Odds Ratio
SDP	Single Deepest Pocket
SDVP	Single Deepest Vertical Pocket

Declarations

Ethics approval and consent to participate

The proposal was approved by the research and community service committee of Mekelle University, College of Health Sciences; permissions were obtained from ACSH medical director's office and Mekelle Hospital director's office to undertake the study before start of data collection. Written informed consent was obtained from all mothers who participated in this study. The data was not used for other purpose other than the objective of the study. Names and other identifiers were not used in collecting the data, and confidentiality was maintained by keeping the data collection forms locked in a cabinet and the electronic data files were kept in password protected computer.

Consent for Publication

Not applicable

Availability of data and materials

The datasets used and/or analyzed during the present study can be accessed from the corresponding author up on reasonable request.

Competing Interests

The authors have declared that no competing interest exists.

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Authors' Contributions

HT: conceived research idea, design of the research, supervised, designed questionnaire, data collection, data analysis, manuscript draft and review. HG: co-supervised, designed questionnaire, manuscript review. TG: designed questionnaire, data collection, manuscript draft. AY: data analysis, manuscript draft and review. HE: Data analysis. YB: Design of the research and data analysis. EA: Data collection and manuscript review. All authors have read and approved the manuscript.

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Figures

Conceptual Framework [1,3,7,14]

Figure 1

Conceptual framework

Figure 2

Diagram showing how the two hospitals were chosen for the study

Supplementary Files

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