

## Treatment Outcomes and Associated Factors of Preterm Birth of Neonates Admitted in Intensive Care Unit of Dessie Referral Hospital, North Central Ethiopia

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Received date: Oct 25, 2018; Accepted date: May 15, 2019; Published date: May 22, 2019

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### Abstract

**Background:** Globally, preterm birth and its complications have become major public health problems, which account 28% of all neonatal deaths; it is also accompanied by substantial perinatal morbidity.

**Objective:** To assess treatment outcomes and associated factors of preterm birth of neonates admitted in a neonatal intensive care unit of a Dessie Referral Hospital, Ethiopia.

**Methods and materials:** This study employed cross-sectional study design to review medical records of 290 preterm birth neonates retrospectively using simple random sampling technique during the past three years prior to this data collection period (January 2013 to January 2016) admitted in Dessie Referral Hospital. The data were collected using pre-tested and structured checklist and then entered, cleaned and analyzed by using SPSS version 20. Results were presented in the form of tables and narrations. Crude odds ratio and adjusted odds ratio analysis were performed to test the association between poor treatment outcomes of preterm birth neonates and associated factors.

**Results:** Overall survival proportion of neonates at hospital discharge was 62.1%, while the mortality rate was (30.9%). Gestational age (AOR=2.60; CI: 1.24-5.47), Apgar score at 5 minutes (AOR=7.54; CI: 2.150-26.44), sex (AOR=1.88; CI: 1.031- 3.42), types of feeding (AOR=7.09; CI: 3.20- 20.43) and place of delivery (AOR=2.47; CI: 1.33 -4.58) were factors associated with poor treatment outcomes of preterm birth neonates. The commonest medical conditions were hypothermia in 129 (44.5%) followed by respiratory problems in 108 (37.2%) and jaundice in 57 (19.6%) of the patients.

**Conclusion:** Gestational age, APGAR score at 5 minutes, sex, and place of delivery were among the factors associated with poor treatment outcomes of preterm birth neonates admitted in neonatal intensive care unit of Dessie Referral Hospital. The mortality rate of preterm neonates observed in this study was high which indicates that the survival of preterm neonates must be improved.

**Keywords:** Treatment outcome; Neonatal intensive care unit; Preterm birth

### Introduction

Preterm neonatal mortality contributes significantly to the high incidence of death among children under-five years of age and literally preterm birth is meant babies born alive before 37 completed weeks of pregnancy [1]. Around the world, an estimated 15.1 million babies are born preterm of which 1.1 million deaths are attributed to preterm birth complications [2]. The proportion of all childhood deaths due to preterm birth complications is projected to increase to 18% by 2030 and preterm mortality accounts for 28% of global neonatal deaths [3]. Together with South Asia, the sub-Saharan African region accounts for over 80% of all neonatal deaths caused by premature birth complication [4,5].

Most premature babies (>80%) are born between 32 and 37 weeks of gestation (moderate/late preterm) and die needlessly for lack of simple, essential care such as warmth and feeding support [5]. In developed countries, a lot of researches have been done regarding on the survival of preterm neonate as a result continued innovation has been made in neonatal intensive care facilities and obstetric interventions, by which fetal survival is now possible, even at 20-week gestation [1]. The risk of neonatal death due to complications of preterm birth is at least 10 times higher for an African baby than for European baby [3]. In developing countries, including Ethiopia even in the best setup, rescue is hard below 37 weeks of gestation and half of the babies born at 32 weeks die due to lack of feasible, cost-effective care (warmth, breastfeeding support, basic care for infection and breathing difficulties) [6].

In Ethiopia, preterm birth was accounted 12.5% of all deaths of children under five years and one of the main causes of neonatal

mortality, which accounts for 23% of all other causes of neonatal deaths [7,8].

Putative risk factors affecting the treatment outcome of neonates admitted in the neonatal intensive care unit includes maternal age, gestational age of neonate, birth weight, availability of resources, adequate and well-trained personnel [9]. Morbidity, mortality and prolonged Hospital stay of preterm babies result in significant cost to the health sector, parents and the society; furthermore, the morbidity associated with preterm birth often extends to later life, resulting in enormous physical, psychological and economic costs [1]. Ethiopia has been making progress in reducing child mortality rate, furthermore, the country sets goal of national newborn and child survival strategy (2015-2020) to reduce neonatal mortality from 28 to 11/1,000; one of the key guiding principles for implementation of the revised strategy is innovation and the use of evidence-based interventions [10].

Hence, this study had audited mortality and identified factors affecting treatment outcomes of preterm birth neonates admitted into the neonatal intensive care unit (NICU) of Dessie Referral Hospital, Ethiopia.

## Methods and Materials

This study was conducted, at the neonatal intensive care unit of a Dessie referral Hospital which is 401 km from the capital Addis Ababa, from January 1 to May 30, 2015. The Hospital is situated to North East of Addis Ababa. Now, the neonatal intensive care unit (NICU) in the hospital renders service for about 5398 newborn babies in one year and it has 32 beds, 2 incubators, and phototherapy and manned by pediatricians [2], Nursing staff with an average ratio of one nurse to patients [8,11].

Facility-based cross sectional study design was used. The source populations were all preterm neonates admitted into the NICU to Dessie referral Hospital while the study population constituted all preterm neonates admitted to the NICU to Dessie Referral Hospital from 2013 to 2016. Sample size is calculated using a single proportion formula and we have taken a total of 290 study participants. Simple random sampling was employed to select medical records of preterm neonates admitted in the NICU from January (2013-2016) which was identified from registration log book. Neonates with incomplete information were excluded from the study and replaced by a new one selected by simple random sampling from the rest of the neonates in the register to fill the sample. Data regarding neonate's demographic, clinical information and outcome were extracted from admission and discharge book, NICU registration log book and neonate's charts. Maternal socio-demographic factor and obstetric risk factors were obtained from NICU registration book and neonate's chart. Gestational age was calculated based on the last menstruation period reported by the mothers.

Structured checklist was used to review records and the data was collected by 3 BSC nurses and one archive officer after being trained on how to extract the data from the patient chart. Preterm birth treatment outcome is the independent variable while age of mother, address, party of mothers, antepartum hemorrhage, mode of delivery, antenatal care, HIV status, sex, gestational age, birth weight, multiple pregnancy, Apgar score at 5th minute, place of delivery and respiratory support. To ensure data quality, the checklist is prepared in English due to the fact that all registration forms were prepared in English. Pretest was done in the study site and correction has been conducted for items in the checklist that was not clear.

The data were checked for completeness, inconsistencies; then entered, cleaned and analyzed in SPSS version 20. The binary logistic regression model was used to test the association between dependent and independent variables. All variables with P value <0.25 in bivariate analysis were included in the multivariable analysis. Magnitude of association was measured by using an odds ratio at 95% confidence interval. Statistical significance was declared at P<0.05. Lastly, the data are presented with texts and tables.

## Ethical consideration

The study was conducted after an ethical clearance had obtained from institutional ethical review board of Mekelle University, College of Health Sciences. Then, officials at different levels in the hospital were communicated through letters from Dessie Referral Hospital. The responsible bodies at the wards and archive room were told about the purpose of the study. All the selected files and medical records were reviewed in the archive room of hospital to ensure confidentiality.

## Results

The study reviewed 290 medical records of neonate admitted in NICU of Dessie Referral Hospital from January 2013 to January 2016. A total of 5398 neonates were admitted to the NICU of Dessie Referral Hospital, of which 1324 (24%) neonates were preterm babies (748 males and 576 females). Among the study participants, more than eighty percent, 238 (82.1%) of preterm neonates were admitted in the first 24 hours.

## Morbidity and mortality pattern

Of 290 cards of neonates, 180 (62.1%) showed that near to two third was survived at discharge. The three most common medical conditions were hypothermia 129 (44.5%) followed by respiratory problems 108 (37.2%) and jaundice 57 (19.6%) of the patients. The mortality rate was highest in neonates with sepsis 30(46.8%), anemia 28 (46.4) and respiratory problems 108 (42.6%). During the study period, more than two-third 203 (70%) of admitted preterm neonates had received antibiotics, 116 (40%) of getting kangaroo mother care (KMC) and 10% dextrose being the commonest treatment used. Among the investigation done for the preterm neonates; complete blood count of 34 (8%), blood group and Rh factor did for 98 (33.8%) and random blood sugar for 12 (4.1%).

## Demographic and obstetric characteristic preterm neonates' mothers

Among 290 neonate's mothers, 190 (65.5%) of the mothers were urban residents. The mean maternal age was 28 ( $\pm$  5.1) years and 258 (85.2%) of them were found in the age range between 18 and 35 years. Nearly ninety percent of the mothers were delivered by spontaneous vaginal delivery and regarding their ethnicity, almost all of them, 278 (96%) of the mothers were Amhara. Regarding the obstetric characters of the mothers, the majority of 272 (93.8%) the mothers had ANC follow up, 45 (15%) fifty percent of the mothers had a history of antepartum hemorrhage and twenty-five percent of mothers were history of premature rupture of the membrane. Regarding the history of preterm birth, 74 (25.5%) of neonate's mothers were reported having a history of premature rupture of membrane (Table 1).

### Neonatal factors

Sixty-three (21.7%) of the neonates were born at 34 weeks of gestation followed by 57 (19.7%) born at 32 weeks of gestation.

Variables		Frequency (N)	Percentage (%)
Residence	Urban	190	65
	Rural	100	34
Ethnicity	Amhara	278	95.9
	Afar	12	4.1
Age (year)	>35	30	10.3
	18-35	258	85.2
	<35	2	4.4
ANC	Yes	272	93.8
	No	18	6.2
Parity	6 and above	2	0.7
	02-May	81	27.9
	<2	207	71.4
Mode of delivery	SVD	267	92.1
	CS	23	7.9
Delivery happened	Spontaneously	285	98.3
	Medically indicated	5	1.7
Antepartum hemorrhage	Yes	45	15.5
	No	245	84.5
History of preterm birth	Yes	35	19
	No	255	81
History of stillbirth	Yes	8	2.8
	No	282	97.2
premature rupture of membrane	Yes	74	25.5
	No	216	74.5
Gestational diabetes mellitus	Yes	10	3.4
	No	280	96.6
HIV status of mothers	Yes	9	3.1
	No	281	96.9

ANC=Antenatal care, SVD=Spontaneous vaginal delivery, CS=Cesarean section, DRH=Dessie, R=Referral, H=Hospital, HIV=Human Immunodeficiency Virus

**Table 1:** Demographic and obstetric characteristic of preterm neonate's mothers in DRH, 2016.

Regarding their sex, 159 (54.8%) of the study participants were males and 131 (45.2%) of the study participants were females with a male to female ratio of 1.2:1. The study showed that more than half of the preterm neonates 161 (55.5%) had an Apgar score of 4-6 in the first 5 minute. Regarding neonatal feeding, out of the study subject, (146) half of the preterm neonates were supplemented with breastfeeding. Approximately (260) ninety percent of the preterm neonates were singleton babies. Among the study participants (n=290) oxygen was prescribed for 51 (17.6%) of preterm neonates (Table 2).

Variables		Frequency (N)	Percentage (%)
Gestational age	28-31	89	30.7
	32-33	93	32.1
	34-36	108	37.2
Birth weight	<1000 gm	5	1.7
	1-1499 gm	78	26.9
	1500-2499 gm	190	65.5
	>2500	17	5.9
Sex	Male	159	54.8
	Female	131	45.2
APGAR score at 5th minute	0-3	23	7.9
	04-6	161	55.5
	07-10	106	36.6
Place of delivery	Home	84	28.7
	Health center	98	37.5
	Hospital	108	33.8
Multiple pregnancy	Yes	30	89.7
	No	160	10.3
Oxygen administered	Yes	51	82.4
	No	239	17.6
Feeding	Breast feeding	146	50.3
	Mixed	52	17.9
	Other fluid	92	31.7

APGAR=Appearance, Pulse, Grimace, Activity, Respiratory Effort

**Table 2:** Characteristic of preterm neonates admitted in NICU of DRH, 2016.

### Factors associated with of preterm birth neonatal treatment outcome

This study showed that the smaller the gestational age of neonates, the more likely to die (AOR=2.60, 95% CI: (1.24-5.47), p=0.012). This study revealed that male preterm neonates were nearly two times more likely to die than the female preterm neonates (AOR=1.88, 95% CI: (1.031-3.42), p=0.039).

In this study the place where the neonates born was significantly associated with neonatal treatment outcome. Preterm babies who born in Dessie Referral Hospital were almost 2.5 times more likely to die than who born at Dessie Referral Hospital (AOR=2.47 95% CI: (1.33-4.58), p=0.004). According to this study, the preterm neonates who fed other than breast milk was 8 times more likely to die than who

fed breast milk (AOR=8.09, 95% CI: (3.20-20.43), p=0.05). It was also found that the Apgar score in the first 5 minute was statistically significant. The less Apgar score of the preterm neonates in the first 5 minute, the more likely to die (AOR=7.54, 95% CI: (2.150-26.44), p=0.002) (Table 3).

Variables		Survived=180, n (%)	Died=110, N (%)	COR (95% CI )	AOR (95% CI)
Feeding	Breast milk	113(62.8)	33(30)	1	1
	Mixed	39(21.7)	13(11.8)	7.827(4.34-14.11)	
	Other	28(15.6)	64(58.2)	7.83(4.34- 14.11) <sup>†</sup>	8.09 (3.20-20.43) <sup>**</sup>
APGAR score at 5th minute	0-3	7(3.9)	16(14.5)	7.41(2.74- 2.93) <sup>*</sup>	7.54 (2.15-26.44 ) <sup>**</sup>
	04-6	92(51.1)	69(62.7)	2.43(1.41-4.20) <sup>†</sup>	
	07-10	81(45)	25(22.7)	1	1
Gestational age	28-31	42 (23.3)	47(42.7)	4.59(.33-1.06) <sup>*</sup>	2.60 (1.24-5.47 ) <sup>**</sup>
	32-33	56(31.1)	37(33.6)	0.28 (0.16-0.52) <sup>*</sup>	1.71 (0.81-3.60 )
	34-36	82(45.6)	26(23.6)	1	1
Birth weight	<1000gm	3(1.7)	2(1.8)	5.00(0.49-50.83)	
	1-1499gm	24(13.3)	54(49.1)	6.88 (3.58-79.65) <sup>*</sup>	
	1500-2499gm	138(76.7)	52(47.3)	2.83 (0.62-12.79) <sup>†</sup>	
	>2500gm	15(8.3)	2(1.8)	1	
Sex	Male	87(48.3)	72(65.4)	3.02(1.24- 3.30) <sup>*</sup>	1.88 (1.03-3.42) <sup>**</sup>
	Female	93(51.7)	38(34.5)	1	1
Place of delivery	Home birth	28(15.6)	56(50.9)	4.50(2.66-7.60) <sup>*</sup>	2.47 (1.33-4.58 ) <sup>**</sup>
	Health center	67(37.2)	31(28.2)	2.3(.20-6.40)	
	Hospital	85(47.2)	23(20.9)	1	1
Oxygen administration	Yes	26(14.4)	25(22.7)	1	
	No	154(85.6)	85(77.3)	0.57(0.31- 1.06)	
Multiple pregnancy	Yes	13 (7.2)	17 (15.5)	2.35(1.10-2.10) <sup>†</sup>	
	No	167 (92.8)	93 (84.5)	1	

<sup>\*</sup> = Crude odd ration at p<0.25, <sup>\*\*</sup> = statistically significant in adjusted odd ration at p<0.05

COR=Crude odd ration, AOR=Adjusted odd ration

**Table 3:** Factors associated with treatment outcome of preterm birth among neonates admitted in DRH, 2016 (n=290).

## Discussion

Preterm birth is a major cause of death in neonates and lifelong disabilities in the survivors. The world health organization reported that 15 million babies are born prematurely each year, of which 6.7% was dying [7-12]. The present study showed that preterm birth admission constituted 24% of all admissions in the NICU of a Dessie Referral Hospital. This result is nearly comparable to 26% reported by the Tikur Anbesa Specialized Hospital, Ethiopia but less than a study

done in Iraq, while compare compared to study done in Cameron it was higher [13-16]. The incidence rate of preterm birth in the developed countries was ranged from 5% to 10%, whereas in the developing countries, the prevalence has increased with an average 18% [4,5].

The overall survival proportion of admitted preterm neonates in this study was 180 (62.1%), which makes the mortality, 110 (37.9%). This result was nearly similar to reported by the study done in Kenya

(60.6%) and Nigeria (65.9%) [13,14] but less than reported by study done in South East Nigeria Hospital (76%) [17]. This high mortality rate of neonates was probably attributed to home birth, half of the neonates admitted in the NICU were borne in home which is risk for infection, and hypothermia during transportation to the hospital.

This study demonstrated that preterm neonates who born at gestational age of 28-31 weeks were 2.6 times more likely to die as compared to neonates who born 34-36 gestational weeks. This is in agreement with the study done in Tikur Anbesa Specialized Hospital, Ethiopia and Kenya teaching hospital who reported that very preterm neonates were more likely to die compared to late preterm neonates [14,18]. Similar finding from Australia also revealed that one-week gestational age increased the survival rate of neonates greater than 5% [19]. This finding was also strengthened by a meta-analysis study done in East Africa found that the odds of death were over six times higher for babies born moderately preterm compared to those late preterm neonates [20]. Increasing gestational age is associated with better respiratory maturity which enables preterm infants to adapt better to extra-uterine life.

It has long been noted that male infants are at increased risk of death and in this study it was observed that male preterm neonates were 1.9 more likely to die compared to their female counterparts. This finding was consistent with findings of other studies done in different areas; finding from the aforementioned studies in Ethiopia reported similar results [14,21]. It is also consistent with studies done in Australian hospital who reported that being male, increasing the probability of death as compared to their counterpart female, additionally similar finding in Brazil observed that being male was found to be determining factor [13,22]. This could be due to the fact that girl's fetus has a more favorable hormonal milieu leading to accelerated lung maturation compared to the male fetus and furthermore, male fetuses are exposed to higher levels of androgen and Mullerian inhibiting substance, which adversely affect surfactant production [23].

This study also found that preterm babies born at home had a lesser chance of survival at discharge than preterm babies born in the hospital. Babies born at home were 2.5 times more likely to die as compared to babies who born in Dessie Referral Hospital. This finding is in line with those studies carried out in Tikur Anbesa Specialized Hospital and [14]. This finding was also in agreement with a study done in Uganda and Nigeria, where neonates born in hospital had better outcomes than those born outside the hospital [11,24]. This may be explained by the fact that, currently in Ethiopia home birth attended by unskilled persons in unhygienic condition was highly practiced (84%) as a result risk factors are disproportionately affecting out born babies admitted to the NICU [7]. This finding was also supported reports from studied in Ethiopia indicated that health facility delivery was found to reduce neonatal mortality [25]. This highlights the treatment outcome of preterm infant is more favorable with maternal transfer rather than transfer after birth [9].

The other finding of this study also revealed that neonates who had not breast fed were 2.1 times more likely to die as compared to those who had breast milk. This is in agreement with a study done in northwestern, Ethiopia which showed that when children were not exclusively breastfed, the risk of infant death will increase by 69% [26]. Similarly, finding had been reported by the study done in Nigeria majority of the neonates who had breast milk was discharged being survived [27]. WHO reported that non-breastfed infants were 14 times more likely to die from all causes than the infants who had breast

feeding [28]. Breastfeeding has even more pronounced health benefits for preterm infants and significantly decrease neonatal mortality [29].

In this study, it was also shown that neonates who had an Apgar score of less than four were 7.5 times more likely to die as compared to the neonates who had Apgar score 7-10. This is consistent with studies done in Tikur Anbesa specialized hospital reported that preterm neonates with an Apgar score of less than four had a poor treatment outcome [21]. Another study in Kenya showed that increase in Apgar scores was reported to have better survival to hospital discharge in preterm infants [14] and similarly finding had been reported by the study done in Iran [30]. The Apgar score, despite not being an indicator for resuscitation maneuvers, could still be the prognostic marker of mortality secondary to perinatal asphyxia [31]. A study conducted in America with a retrospective analysis stated that the 5-minutes Apgar score remained a valid predictor of neonatal mortality and the Apgar score continues to provide convenient shorthand for reporting the status of the newborn infant and the response to resuscitation [32].

## Conclusions

According to this study, the mortality rate of preterm infants is high compared to the national and subnational figures and it needs urgent intervention. Small gestational age, being male, out born, not having breastfed and lower Apgar score in the first 5 minute were identified as associated factors for the poor treatment outcome of preterm neonates admitted in NICU of Dessie Referral Hospital, Ethiopia. The maternity and NICU wards should work to initiate breastfeeding in the first one hour and every effort should be made to avoid home delivery.

## Acknowledgment

Authors would also like thank to Dessie Referral Hospital and the data collectors for providing valuable data and information.

## Competing Interests

The authors declare that they have no competing interests.

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