Treatment Outcome and Associated Factors of Neonates Admitted in Neonatal Intensive Care Unit of Public Hospitals in Eastern Ethiopia

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Abstract

Background: Neonatal morbidity and mortality are emerging as prominent components of under-five mortality, whereas many of the deaths are easily preventable. Different studies have identified different reasons, which are not conclusive to all set up. Therefore, this study aimed to assess reasons for admission, treatment outcomes and identify the associated factors among neonates admitted to the neonatal intensive care unit in selected public hospitals in Eastern Ethiopia.

Methods: An institution-based cross-sectional study was conducted on 489 neonates admitted to the neonatal intensive care unit in public hospitals in Eastern Ethiopia from April to May 2018**.** Data were collected using a pre-tested face-to-face interview questionnaire and clinical record review. The data were entered into Epi-Data Version-3.1 and analyzed using Statistical Package for the Social Sciences Version-22. Bivariate and multivariate logistic regressions were done to identify factors associated with treatment outcomes. Variables with P-value <0.05 at a 95% confidence interval were considered statistically significant factors.

Results: Three hundred fifteen (64.4%) of the neonates were improved, while the rest were not. Maternal educational level of college and above AOR=0.37; 95% CI: 0.14, 0.98), out-born delivery (AOR=0.43; 95% CI: 0.21, 0.89), low birth weight (AOR=0.43; 95% CI:0.22, 0.83), < 3 days of hospital stay (AOR=0.24; 95% CI:0.14, 0.41), fifth minute Appearance, Pulse, Grimace, Activity and Respiration score < 6 (AOR=0.44;95% CI:0.25, 0.79) and no feeding given per mouth (AOR=0.19; 95% CI:0.11, 0.33) were the factors significantly associated with neonatal treatment outcome.

Conclusion: Sepsis, perinatal asphyxia, and prematurity were the main reasons for admission. The study area health offices, non-governmental organizations, and health care providers should implement intervention strategies by targeting identified factors to improve neonatal outcomes.

Keywords: *Eastern Ethiopia; Neonatal admission; Neonatal morbidity; NICU; Treatment outcome*

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Introduction

The neonatal period, from birth to the first 28 days of life, is the most hazardous period of life because of the various diseases that the neonate faces. The risk of dying is highest during this period of life (Zage and Ater, 2016). Globally, close to three million babies die annually in their neonatal period. Many of them die on their first day or within the first week of life (Afolabi, 2017; Jonathan and Stoltenberg, 2012). In Ethiopia, Neonatal Morality Rate (NMR) was 29 deaths per 1,000 live births, which is higher compared to the target (CSA, 2016).

The risk of death in the neonatal period is six times greater in developing countries than in developed ones. This figure goes up to over eight times in the least developed countries. Close to 70% of early child deaths are due to conditions that could be prevented or treated with access to simple and affordable interventions (WHO, 2016; Ndombo, 2017). In addition to mortality, neonatal morbidity is also becoming a burden to the health care system (Chow, 2015; UNICEF *et al*., 2015).

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A trained health care team with the help of advanced technology should effectively provide specialized care in the neonatal intensive care unit (NICU) to intervene before life-threatening conditions emerge (Chow, 2015). Improving antenatal care (ANC), maternal health, and timely referral of high-risk cases to tertiary care hospitals help to improve neonatal outcomes (Ndombo, 2017; UNICEF *et al*., 2015; Ali *et al*., 2013; Seoud *et al*., 2005; Omoigberale *et al*., 2010).

To prevent early death in children, it is critical to ensure that every pregnant woman and every newborn has access to and receives quality care and life-saving interventions. Additionally, countries need to accelerate progress to reach the Sustainable Development Goal target of a neonatal mortality rate (NMR) of 12 deaths per 1,000 live births by 2030 (UNICEF*, et al*., 2015).

In Ethiopia, prematurity, neonatal sepsis, respiratory distress, meconium aspiration syndrome, asphyxia, hypothermia, low birth weight (LBW), jaundice, hypoglycemia, and hyaline membrane disease have been the main causes of admission to the NICU (Atnafu *et al*., 2016; Kokeb and Desta, 2016; Abdifatah *et al*., 2018). There is a paucity of information on reasons for admission, treatment outcomes, and the associated factors among neonates admitted to the neonatal intensive care unit in public hospitals in Eastern Ethiopia. Therefore, this study aimed to assess treatment outcomes, and identify the associated factors among neonates admitted to the NICU of selected public hospitals in eastern Ethiopia.

Materials and Methods

Study Design, Area, and Period

A hospital-based cross-sectional study was conducted among neonates admitted to the NICUs in public hospitals in eastern Ethiopia from April 1 to May 30, 2018. The study area included Harari Regional State, Dire Dawa City Administration, and East and West Hararge zones of the Oromia Region.

The distance of Harar town from Addis Ababa is 526 km; it has a total population of 245,000; there are 2 public hospitals and 8 health centers. Of these, the 2 public hospitals have NICU. Dire Dawa is found at 515 km from Addis Ababa, to the east; it has a total population of 266,000; there are 2 public hospitals and 15 health centers. Of these, the 2 public hospitals have NICU. The East Hararge Zone, whose center is Harar town, has a total population of 3,587,042; there are 5 public hospitals and 115 health centers. Of these the 4 public hospitals have NICU. The center of West Hararghe Zone is Chiro town, which is 326 km far from Addis Ababa to the east; the zone has a total population of 2,467,364; there are 3 public hospitals and 83 health centers. Of these the 2 public hospitals have NICU. Five hospitals (those with NICU) selected by simple random sampling technique were included in the study. The two were Hiwot Fana Specialized University Hospital and Dilchora Referral Hospital, which are the largest referral hospitals in eastern Ethiopia, with an average NICU admission of 95 neonates per month in each. The remaining hospitals were Garamuleta, Dedar, and Chiro Hospitals, with an average NICU admission of 40 neonates per month in each.

Population

All neonates admitted to the NICU in public hospitals in eastern Ethiopia were the source population. The study population was neonates admitted to the NICUs in the randomly selected public hospitals of eastern Ethiopia during the study period. The neonates who were discharged without treatment and those whose mothers or guardians were not present at all times during the study period were excluded.

Sample Size and Sampling Technique

The sample size was determined by double population proportion using Statcalc of Epi Info statistical software Version 7 considering 95% confidence level, power of 80%, an assumption of the ratio of unexposed (without antenatal care (34)) to exposed (with antenatal care (22)) equivalent to 1:1 (Bogale *et al.,* 2012) and added 5% non-response rate. The final sample size was 491.

There were ten public hospitals in eastern Ethiopia to provide NICU services. Among these, the two referral hospitals of eastern Ethiopia (Hiwot Fana Specialized University Hospital and Dilchora referral Hospital) and three general hospitals were selected using a simple random sampling technique: Garamuleta Hospital, Deder Hospital, Chiro Hospital, Dilchora Referral Hospital, and Hiwot Fana Specialized University Hospital. The final sample size of this study was proportionally allocated based on the estimated

neonatal admission in each selected public hospital. Neonates admitted to the NICU in selected public hospitals during the study period were included in the study until the allocated sample size was obtained.

Methods of Data Collection

Face-to-face interview: Data were collected from each hospital using a structured questionnaire by one neonatal nurse and one pediatric resident practitioner. The questionnaire was used to collect data related to maternal sociodemographic, obstetric characteristics, ANC visit, age at admission, sex, gestational age at birth, Appearance, Pulse, Grimace, Activity, and Respiration (APGAR) score, admission diagnosis, the weight of the neonate, duration of hospital stays, need for ventilator support, neonatal outcome, and cause of mortality.

Clinical record review: Clinical data were collected after a pediatrician or general practitioner conducted a clinical evaluation on admission using a checklist. The pediatrician or general practitioner determined the treatment outcomes of the neonate after he/she had conducted the necessary investigations. Weight was measured using a digital infant weighing scale (Seca) and reading was recorded to the nearest 0.05 kg. Gestational age was assessed using the last menstrual period and when this was not reliable or unknown, the New Ballard Score was used. The axillary temperature of the neonates was measured for 3 minutes by using a digital thermometer at admission.

Data Quality Assurance

The questionnaire was translated from English into the local language (Amharic) and back-translated into English to maintain consistency. A pre-test was done on 5% of the total sample in Jugal Hospital and correction was done on the tool. Additionally, training of data collectors and supervision of data collection was undertaken. Supervisors and investigators closely checked the completeness of data on daily bases. The collected data were double entered into Epi-Data Version 3.

Operational Definition

Reason for Admission: the main reason for admitting the neonate to NICU is the primary diagnosis. Comorbid conditions were to be considered as a secondary diagnosis. The physicians working in NICU depending on the sign and symptoms of the neonate and the laboratory investigations available determined these.

Treatment Outcome: the status of the neonate at discharge (improved, discharged against medical advice, referred, and died).

Data Processing and Analysis

The data were entered into Epi-Data Version 3.1 and then exported and analyzed using Statistical Package for the Social Sciences (SPSS) Version 22.0. The descriptive statistics of each variable (percentages, mean, and standard deviation) were presented using tables and figures. The overall proportion of treatment outcome was calculated as the status of the neonates at discharge as improved, if they improved and did not improve if they were discharged against medical advice before improved, referred, or died. Univariate analysis was used to describe the frequency distribution of each variable. Bivariate analysis was used to estimate the association of treatment outcomes with maternal and newborn characteristics. Stepwise regression (forward selection and backward elimination) was utilized for variable selection using a p-value of 0.20 or less for multivariable analysis. The Hosmer and Lemeshow goodness-of-fit test were used to assess whether the necessary assumptions for the application of multiple logistic regression were fulfilled and a p-value > 0.05 was considered a good fit. A multivariate logistic regression model was built to incorporate both maternal and newborn characteristics selected in the bivariate analyses using stepwise regression. A p-value of <0.05 was used to declare statistical significance.

Ethical Consideration

Ethical clearance was obtained from the Institutional Health Research Ethics Review Committee of the College of Health and Medical Sciences, Haramaya University with ethical clearance number IH- RERC/134/2018 . Then , a support letter was obtained from the college to the respective regional health of- fices . Subsequently , a permission letter was collected from regional and city administration health bureaus, zonal, woreda health offices, and hospital officials to conduct the study . During the data collection , each mother (guardian) of the neonates was informed about

the aim of the study. The benefits and risks of the study were explained to each mother or guardian of the neonates included in the study. Then, informed, voluntary, written, and signed consent was obtained from each participant before the start of the data collection. To ensure confidentiality, names and other identifiers of the patients and health care professionals were not recorded on the data collection tools.

Results

Characteristics of Mothers of Neonates

Overall, 489 study participants were included in the study, with a response rate of 99.6%. The mean age of the mothers of the neonates was 26.44 (±6.04) years. The majority of the study participants were in the age group of 21-30 years (279 (57.1%)) and most of them can't read and write, 198 (40.5%).

More than 90% of the mothers were married and more than half were urban residents, 255 (52.1%). Concerning ANC follow-up, more than two-thirds (378 (77.3%) had attended at least once during the index pregnancy and 180 (36.8%) began at < 24 weeks of gestation (Table-1)

Table 1: Characteristics of mothers of neonates admitted to NICU in public hospitals of eastern Ethiopia, 2018.

Characteristics	Category	Frequency	Percent (%)
Age of mothers (in years)	less than 20	109	22.3
	21-30	279	57.1
	31-40	95	19.4
	≥ 41	6	1.2
Education level	Unable to read and write	198	40.5
	Able to read and write	59	12.1
	Primary Education	111	22.7
	Secondary Education	80	16.4
	College and above	41	8.4
Marital status	Single	28	5.7
	Married	452	92.4
	Divorced	7	1.4
	Widowed	2	.4
Residence of mother	Urban	255	52.1
	Rural	234	47.9
ANC follow-up	Yes	378	77.3
	No	111	22.7
Place of ANC follow up	Public	320	65.4
	Private	58	11.9
Gestational age at the start of ANC follows-up (in weeks)	< 24	180	36.8
	24 -29	149	30.5
	30- 35	37	7.6
	> 35	12	2.5
Number of ANC follow up attended	One	37	7.6
	Two	80	16.4
	Three	145	29.7
	four and above	116	23.7

ANC=Antenatal Care

Obstetric Characteristic

More than half, 283 (57.9%), of the mothers had given birth to more than one child. Ninety percent of the neonates (440) were singleton deliveries, while 380 (77.7%) were delivered at the index hospital. Two hundred ninety-nine (61.1%) births were attended by midwives. Two hundred eighty-eight (58.9%) of the mothers had a labor that lasted 4 to 12 hours. More than two-thirds, 338 (69.1%), of the deliveries were affected by spontaneous vaginal delivery, and three hundred nineteen (65.2%) of the babies were delivered at term (Table 2).

Complications during Pregnancy

Four hundred eight (83.4%) of the mothers had no complications during the pregnancy of the index case. Among those with complications during pregnancy, preeclampsia or eclampsia was the most common (43 (8.8%)) followed by PROM (18 (3.7%)), Ante partum hemorrhage (17(3.5%)) and Chorioamnionitis (8(1.6%)), with some overlapped complication. Four hundred fifty-nine (93.9%) mothers had no medical illness during pregnancy. Nearly half of the mothers, 226 (46.2%), had complication during labor, and the most common complications were prolonged labor (103 (21.1%)), followed by non-reassuring fetal heart-beat (84 (17.2%)), PROM (31 (6.3%)), and cord prolapse, 8 (1.6%)

Table 2**:** Obstetric characteristics of mothers of neonates admitted to NICU in public hospitals of eastern Ethiopia, 2018.

Characteristics	Category	Frequency	Percent
Gravidity	Primigravida	190	38.9
	Multigravida	299	61.1
Parity	Primipara	206	42.1
	Multipara	283	57.9
Birth order of the index neonate	First	198	40.5
	Second	109	22.3
	Third	71	14.5
	Fourth	30	6.1
	Fifth and above	81	16.6
Type of pregnancy	Single	440	90.0
	Twins	46	9.4
	Triple multiple	3	0.6
Place of delivery	At the index hospital	380	77.7
	Another hospital	30	6.1
	Health center	53	10.8
	Private facilities	4	0.8
	Home	22	4.5
Birth attendant	Midwife	299	61.1
	Physician	151	30.9
	Nurse	11	2.2
	Traditional Birth Attendants	23	4.7
	Others*	5	1.0
Duration of labor (in hours)	< 4	43	8.8
	4-12	288	58.9
	Greater than12	158	32.3
Amniotic fluid status during labor	Clear	360	73.6
	Meconium stained	107	21.9
	Bloodstained	22	4.5
Mode of delivery	Spontaneous vaginal delivery	338	69.1
	Cesarean section	122	24.9
	Instrumental delivery	27	5.5
	Breach extraction	2	0.4

* *Health Officer Health Extension Workers, students*

Characteristics of the Neonates

Three hundred six (62.6%) of the admitted neonates were male and more than two-thirds (378 (77.3%)) were admitted within 24 hours of delivery. More than half, 276 (56.4%), of the neonates had a normal birth weight. More than two-thirds, 350 (71.6%), of the neonates were hypothermic upon admission. The 5th minute Apgar score showed that ≤3 scores were recorded for 7 (1.4%) and 4-6 scores were recorded for 126 (25.8%) neonates (Table 3).

Table 3: Characteristics of neonates admitted to NICU in public hospitals of eastern Ethiopia, 2018.

Variable	Category	Frequency	Percent
Sex of the newborn	Male	306	62.6
	Female	183	37.4
Age of neonate on admission (in hours)	≤ 24	378	77.3
	≥24	111	22.7
Birth weight (gram)	< 1000	8	1.6
	1000-1499	33	6.7
	1500-2499	145	29.7
	2500-3999	274	56.0
	≥ 4000	29	5.9
Temperature at admission	< 36.5	350	71.6
	36.5-37.5	92	18.8
	>37.5	47	9.6
APGAR score at 1st minute	≤3	38	7.8
	4-6	168	34.4
	7-10	178	36.4
	Unknown	105	21.5
APGAR score at 5th minutes	≤3	7	1.4
	4-6	126	25.8
	7-10	251	51.3
	Unknown	105	21.5
Initiation of Feeding with	Nothing by mouth	152	31.1
	Exclusively breast feeding	301	61.1
	Formula feeding	36	7.4

APGAR=Appearance, Pulse, Grimace, Activity, and Respiration

Reason for Admission to NICU

The reasons for admission of the neonates were early onset of sepsis, 248 (50.7%), followed by perinatal asphyxia, 180 (36.8%). As care and treatment strategy, antibiotics and intravenous fluids were administered for 448 (98.0%) and 416 (85.1%) neonates, respectively. The mean duration of stay in the NICU was 5 (±3.94) days (Table 4).

Treatment Outcome

Among the admitted neonates, 64.4% (95% CI: 60%–69%) were improved and the rest 35.6 (95% CI: 31%–40%) were not improved. Twenty percent of the neonates died, 10.8% were discharged against medical advice, and 4.7% were referred for better treatment and care. The most common reason for the neonates who were taken against medical advice was unsatisfactory service (27 (5.5%)), followed by service cost, 20 (4.1%). The most prominent reason for the death of the neonates was prematurity (48 (49.0%)), followed by perinatal asphyxia (37 (36.8%)), respiratory distress syndrome (26 (26.5%)) and infection (6 (6.1%)).

Factors Affecting Treatment Outcomes

In the bivariate analysis; maternal level of education, residence, ANC follow-up during the current pregnancy, place of delivery, duration of labor, amniotic fluid status during labor, mode of delivery, complication during pregnancy, obstetric complication, length of hospital stay, gestational age at birth, age of neonate on admission, birth weight, APGAR score at 5th, axillary temperature admission, and initiation of feeding variables were found significant and entered to multivariate analysis.

Table 4: Reason for admission among neonates admitted to NICU in hospitals of eastern Ethiopia, 2018.

Characteristics	Category	Frequency	Percent
Admission diagnosis	Early-onset sepsis	248	50.7
	Perinatal asphyxia	180	36.8
	Prematurity	142	29.0
	Meconium aspiration syndrome	106	21.7
	Respiratory distress syndrome	72	14.7
	late-onset sepsis	52	10.6
	Jaundice	54	11.0
	Congenital malformation	33	6.7
	Anemia	11	2.2
	Others*	16	3.3
Care and treatment	Oxygen	272	55.6
	Kangaroo mother care	72	14.7
	Intravenous fluid	416	85.1
	Antibiotics	435	89.0
	Glucose	312	63.8
	Resuscitation	194	39.7
	Blood transfusion	11	2.2
	Phototherapy	60	12.3
	Others**	9	1.8
Length of hospital stay (in days)	<3	160	32.7
	4-7	229	46.8
	>7	100	20.4

**Underweight, Heart problem, Burn, Trauma, Unknown cause; ** Nutritional supports, Follow-up, Incubation.*

In the multivariate analysis; maternal education level of college/more, out-born neonates, low-birth weight, < 3 days hospital stay, fifth minute Apgar score, and feeding status of nothing by mouth were the associated factors with neonatal outcomes.

The study participants with a maternal educational level of college or above were 63% less likely to improve (AOR = 0.37; 95% CI: 0.14, 0.98) than those who can't read and write. Those who were delivered in other health facilities were 57% less likely to improve (AOR=0.43; 95% CI: 0.21, 0.89) compared to those who were delivered at the index hospital. Also, the neonates who stayed in the hospital for 3 days or less were 76% less likely to improve (AOR=0.24; 95% CI: 0.14, 0.41) when compared to those who stayed 4-7 days in the hospital. The neonates with low birth weight were 57% less likely to improve (AOR=0.43; 95% CI: 0.22, 0.83) when compared to those with normal weight. The neonates with asphyxia were 56% less likely to improve (AOR=0.44; 95% CI: 0.25, 0.79) than those who were not asphyxiated. The neonates with NPO feeding status were 81% less likely to improve (AOR=0.19; 95% CI: 0.11, 0.33) when compared to those neonates exclusively breastfed (Table-5).

Table 5: Factors affecting treatment outcome among neonates admitted to NICU in hospitals of eastern Ethiopia, 2018.

Characteristics	Improved No (%)	Not improved No (%)	COR	AOR
Maternal level of education				
Unable to read & write	119 (60.1)	79 (39.9)	1	
Able to read and write	40 (67.8)	19 (32.2)	1.40 (0.755, 2.587)	1.78 (0.75, 4.23)
Grade 1-8	74 (66.7)	37 (33.3)	1.33 (0.816, 2.160)	0.82 (0.44, 1.55)
Grade 9-12	57 (71.3)	23 (28.8)	1.65 (0.938, 2.885)	1.22 (0.52, 2.84)
College and above	25 (61.0)	16 (39.0)	1.04 (0.521, 2.066)	**0.37 (0.14, 0.98)***
Residence of mother				
Urban	177 (69.4)	78 (30.6)	1	1
Rural	138 (59.0)	96 (41.0)	0.63 (0.436, 0.919)	0.72 (0.39, 1.32)
ANC follow up during current pregnancy				
Yes	252 (66.7)	126 (33.3)	1	1
No	63 (56.8)	48 (43.2)	0.65 (0.426, 1.011)	0.92 (0.49, 1.72)
Place of delivery				
Inborn (in this hospital)	253 (66.6)	127 (33.4)	1	1
Other facility	46 (52.9)	41 (47.1)	0.56 (0.351, 0.903)	**0.43 (0.21, 0.89)***
Home	16 (72.7)	6 (27.3)	1.34 (0.511, 3.504)	1.79 (0.47, 6.84)
Duration of labor (in hours)				
4 -12	177 (61.5)	111 (38.5)	1	1
Less than 4	27 (62.8)	16 (37.2)	1.058 (0.546, 2.052)	1.34 (0.55, 3.27)
More than 12	111 (70.3)	47 (29.7)	1.481 (0.978, 2.244)	1.38 (0.784, 2.44)
Amniotic fluid status during labor				
Clear	224 (62.2)	136 (37.8)	1	1
Meconium stained	78 (72.9)	29 (27.1)	1.633 (1.014, 2.630)	1.68 (0.87, 3.23)
Blood stained	13 (59.1)	9 (40.9)	0.877 (0.365, 2.106)	1.26 (0.42, 3.84)
Mode of delivery				
Spontaneous vaginal delivery	221 (65.4)	117 (34.6)	1	1
Cesarean section	79 (64.8)	43 (35.)	0.973 (0.630, 1.501)	0.99 (0.54, 1.82)
Instrumental deliver	15 (51.7)	14 (48.3)	0.567 (0.265, 1.215)	0.70 (0.24, 2.03)
Complication during pregnancy				
Yes	159 (70.4)	67 (29.6)	1	1
No	156 (59.3)	107 (40.7)	0.614 (0.421, 0.896)	0.65 (0.38, 1.12)
Obstetric complication				
Yes	42 (51.9)	39 (48.1)	1	1
No	273 (66.9)	135 (33.1)	1.878 (1.159, 3.041)	1.76 (0.91,3.41)
Length of hospital stay (days)				
4-7	172 (75.1)	57 (24.9)	1	1
≤3	68 (42.5)	92 (47.5)	0.245 (0.159,0.378)	**0.24 (0.14, 0.41)***
>7	75 (75.0)	25 (25.0)	0.994(0.578, 1.711)	1.10 (0.59, 2.07)
Gestational age at birth				
Term	227 (71.2)	92 (28.8)	1	1
Preterm	82 (51.3)	78 (48.7)	0.426 (0.287, 0.631)	0.84 (0.44, 1.62)
Post term	6 (60.0)	4 (40.0)	0.608 (0.168, 2.204)	0.62 (0.11, 3.50)

Age of neonate on admission(days)				
Less than or equal to one day	251 (66.4)	127 (33.6)	1	1
Greater than one day	64 (57.7)	47 (42.3)	0.689 (0.447, 1.062)	0.70 (0.33, 1.48)
Birth weight (gram)				
2500-3999	211 (71.0)	86 (29.0)	1	1
Less than 2499	77 (47.2)	86 (52.8)	0.365 (0.245, 0.543)	**0.43 (0.22, 0.83)***
≥ 4000 grams	27 (93.1)	2 (6.9)	5.502 (1.280, 23.647)	4.29 (0.86, 21.36)
APGAR score at 5th minutes				
7-10	188 (74.9)	63 (25.1)	1	1
≤ 6	68 (51.1)	65 (48.9)	0.351 (0.225, 0.546)	**0.44 (0.25, 0.79)***
Unknown	59 (56.2)	46 (43.8)	0.430 (0.266, 0.694)	0.54 (0.22, 1.29)
Axillary temperature admission				
36.5 – 37.5	64 (69.6)	28 (30.4)	1	1
<36.5	218 (62.3)	132 (37.7)	0.723 (0.441, 1.184)	0.79 (0.42, 1.52)
>37.5	33 (70.2)	14 (29.8)	1.031 (0.479, 2.220)	0.89 (0.33, 2.39)
Initiation of Feeding with status				
Exclusive breast feed	237 (78.7)	64 (21.3)	1	1
Nothing by mouth	53 (34.9)	99 (65.1)	0.145 (0.094, 0.223)	**0.19 (0.11, 0.33)***
Formula feeding	25 (69.4)	11 (30.6)	0.614 (0.287, 1.314)	0.92 (0.36, 2.33)

**statistically significant at p-value <0.05; APGAR = Appearance, Pulse, Grimace, Activity, and Respiration; ANC=Antenatal Care*

Discussion

In this study, sepsis (61.3%), perinatal asphyxia (36.7%), and prematurity (29%) were the most common reasons for admission. Three hundred fifteen (64.4%) neonates were improved while 98 (20%) died and the rest were discharged against medical advice (10.8%) and 4.7% were referred for better treatment. Maternal level of college or above education, place of delivery (delivery in other facilities), a hospital stay of 3 days or less, being underweight upon admission, Apgar score at 5th minute, and feeding status of NPO were identified to be the factors associated with poor treatment outcome.

The dominance of sepsis as a reason for admission was higher than the findings from Vietnam (Miles *et al.*, 2017), Nepal (Shah *et al*., 2013), Pakistan (Ali *et al.*, 2013), and Ghana (Walana *et al*., 2016). This study finding was comparable to birth asphyxia and prematurity in South Africa (Hoque *et al*., 2011); birth asphyxia and prematurity in Uganda (Hedstrom *et al*., 2014; Abdallah *et al*., 2016) infection and prematurity in northern Ethiopia (Kokeb and Desta, 2016). However, it is different when compared with previous studies report of asphyxia and infection in India and Pakistan (Salve *et al.*, 2015; Ali *et al*., 2013), infection, prematurity, and birth asphyxia in Nepal, Ghana, and Tanzania (Shah *et al*., 2013; Walana *et al*., 2016; Mmbaga *et al.,* 2011), prematurity and infection in South Africa (Hoque *et al.,* 2011), and birth asphyxia in Nigeria (Elizabeth, and Modupe, 2015). It might be due to a difference in the quality of care in that setting. This discrepancy in the prevalence of neonatal infection in developing countries could be explained by low socioeconomic status and the presence of other risks, including prematurity, prolonged labor, and rupture of the membrane (Ekwochi *et al*., 2014). Moreover, the lack of appropriate interventions in the antenatal, intrapartum, and postpartum neonatal care could have contributed to the high prevalence of sepsis in the present study.

In the treatment outcome in our study, 64.4% of the neonates had improved, while 20.0% died. This finding is comparable with studies in Nigeria (Elizabeth and Modupe, 2015; Ekwochi *et al*., 2014), in Nepal (Shah *et al.*, 2013). Furthermore, studies in Ethiopia reported an improvement of 75.1%- 81.8% and 14.3% - 23.2% of deaths among neonates (Kokeb and Desta, 2016; Tekleab *et al*., 2016; Demisse *et al*., 2017). In

contrast, findings from India and Jordan showed that deaths among neonates were between 7.16% and 11.02% (Sridhar *et al*., 2015; Prasad and Singh, 2011; Rohit *et al*., 2015). This difference in findings might be because many of the NICUs included in this study were recently established; as a result, they may not have the necessary facilities to provide standardized care for neonates admitted in their setting.

The neonates with low birth weight were less likely to improve when compared to those with normal birth weight. This finding is similar to other studies conducted in Nigeria, South Africa, Nigeria, and central Ethiopia (Elizabeth and Modupe, 2015; Hoque *et al.,* 2011; Olusanya, 2011; Bogale *et al.,* 2012). This might be because neonates with low birth weights are more likely to face complications like asphyxia, infection, and poor feeding status that can lead to poor neonatal treatment outcome since their lung is not mature, and have less immunity system, and fewer organ growth.

The neonates who stayed in the hospital for less than 3 days were less likely to improve when compared to those who stayed 4-7 days. This finding is similar to another study conducted in central Ethiopia (Bogale *et al*., 2012). This might be because those neonates who stayed more days in the hospital can access the full course of treatment. This study showed that neonates who were not given feeding per Os (mouth) were less likely to be improved than those who were breastfeeding. This finding is similar to the study conducted in Nigeria (Elizabeth and Modupe, 2015). This is because breast milk also helps to prevent infection by helping to build the immune system of the neonate.

The neonates who had an Apgar score of <6 at the fifth minute were less likely to be improved than those who scored more than 7 minutes. This finding is supported by other studies done in Uganda, Ghana, Zambia, and Nigeria (Abdallah *et al*., 2016; Dassah *et al.,* 2014; Hedstrom *et al*., 2014; Liu *et al*., 2013; Elizabeth and Modupe, 2015). Additionally, those neonates who were born out of the index hospital were less likely to be improved when compared to neonates born in the index hospitals. This might be because those neonates born in index hospitals can access early care and treatment when they face any problem then out born.

This study showed that neonates born from mothers who have college/more educational levels were less likely to improve than those who can't read and write. This finding is different from the study done in Nigeria (Elizabeth & Modupe, 2015). This might be due to our study being dominated by those unable to read and write, 40.5%, but those study participants at college/more education levels were 8.4%.

This study included multiple facilities and follow-up of neonates from admission to the outcomes at facility level. In addition, it was carried out without sampling; therefore, the possibility of sampling error was eliminated. However, this study was a hospital-based cross-sectional; hence, the result does not reflect the population-based outcomes of neonates in the study area. In addition, for the diagnosis of respiratory distress syndrome and neonatal infection, chest X-rays and blood cultures were not performed consistently as recommended by experts. Another limitation is that due to the absences of follow up the status of the neonate after discharge was unknown.

Conclusion

Sepsis, asphyxia, and prematurity were the main reasons for neonatal admissions in the NICUs of public hospitals in the eastern part of Ethiopia. Three hundred fifteen (64.4%) neonates were improved while 98 (20%) died and the rest were discharged against medical advice (10.8%) and 4.7% were referred for better treatment. Maternal level education, place of delivery, hospital stay, the weight of the neonate, Apgar score, and feeding status were identified to be the factors associated with neonatal treatment outcome. Based on the findings of the study, study area health facilities, Dire Dawa health office; local and national stakeholders need to design preventive mechanisms for the factors like neonatal sepsis, perinatal asphyxia, and prematurity. Multicenter, prospective studies including major centers providing neonatal care in the regions will provide a better idea.

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Competing interests

The authors declare that there is no conflict of interest

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List of abbreviation

APGAR=Appearance, Pulse, Grimace, Activity, and Respiration; NICU=Neonatal intensive care unit

Authors' contribution

All authors had substantial contributions to the study design and development of the data collection tools. All authors were also involved in data acquisition, analysis, interpretation, and write-up. FA drafted the manuscript and prepared the final version for publication. All authors read and approved the final version of the manuscript.

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