Magnitude of Neonatal Mortality and associated factors among Neonates at Arba Minch General Hospital

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Abstract

Background: Newborns are the future generations and ensuring their healthy growth and development and all the activities regarding them must be the prime concern of societies. The Ethiopian government has used a combined efforts and interventions in health promotion, nutrition, and non-health sectors at different levels to reduce neonatal mortality but still has high neonatal mortality. The objective of this study was to assess the magnitude of neonatal mortality and associated factors among Neonates admitted in neonatal intensive care unit of Arba Minch general hospital.

Method: A cross sectional study was conducted from January, 01, 2015 to December, 31, 2017 G.C in Arba Minch General Hospital. Simple random sampling technique using computer generated random numbers was used to recruit the predetermined 332 samples. Data were collected using structured checklist and entered, coded, edited and cleaned using Epi-info version 7 and exported to SPSS version 23 for Windows. Crude and Adjusted Odd ratio, 95% CI and P-value were used to assess the strength of association and statistical significance. Variables which have p value ≤ 0.05 were declared as significant.

Result: The magnitude of neonatal mortality was 20.2%. The 5th minute APGAR score less than five (AOR:4.4; 95%CI: 1.98,9.65), Induced labor (AOR:2.7; 95%CI: 1.03,7.37), Duration of labor $\geq$ 18 hour (AOR:2.6; 95%CI: 1.12,6.11), Time of rupture of membrane $\geq$12 hour (AOR:3.9; 95%CI: 1.5,9.87) and Birth order $\geq$ (AOR:19.5; 95%CI: 6.84,55.45) were the independent factors which cause neonatal mortality.

Conclusion: The magnitude of neonatal mortality was high and the fifth minute APGAR score less than 5, Induced labor, Duration of labor more than or equal to 18 hours, Time of rupture of membrane more than or equal to 12 hours before delivery and being fifth or above birth order are the independent factors which cause neonates to die.

Key words

Prevalence; Neonate; Neonatal mortality; Arba Minch General Hospital

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Abbreviations

AHR (Adjusted Hazard Ratio), ANC (Antenatal Care), APGAR (Appearance, Pulse, Grimace, Activity and Respiratory effort), BEMONC (Basic Emergency Maternal and Neonatal Care), CHR (Crude Hazard Ratio), CS (Caesarian section), EBF (Exclusive breast Feeding), NICU (Neonatal Intensive Care Unit), PROM (Premature rupture of membrane), SVD (Spontaneous vaginal delivery).

Summary Box

In the world, from under five children mortality, nearly half of death occurs during this period. Compared to the global neonatal mortality, this is an annual rate of reduction 4.9% vs 2.9% between the year 2000 and 2013. In Sub Saharan Africa (SSA), with an average neonatal mortality rate (NMR) of 41 per 1000 live births, this burden still remains unresolved. The Neonatal Mortality rate was reduced from 37 deaths per 1000 live births in 1990 to 19 by rate of 40% in 2016. In the year 2016, the rate of neonatal mortality in Ethiopia was 29 per 1000 live births.

There is relatively rapid decline in the global mortality of under five children. The extent of the neonatal mortality contributes to determine the overall infant mortality which is directly related to the development status of each country. In addition this study was not conducted before within this study area. It also addresses the prevalence of neonatal mortality and the Socio demographic, Obstetrical and neonatal factors which was not studied before and which contribute for the death of the neonates.

Background

New-borns are the future generations and ensuring their healthy growth and development and all the activities regarding them must be the prime concern of societies. New-born are particularly vulnerable to death. There is relatively rapid decline in the global mortality of under five children [1].

In the world, from under five children mortality, nearly half of death occurs during this period [2,3]. The extent of the neonatal mortality contributes to determine the overall infant mortality which is directly related to the development status of each country [4]. The first week of life is the most hazardous period for neonate with 36% of neonates were died and about 1 million neonatal deaths occur between day 7 and day 27 of life in 2013 [1,5]. The every new-born Action plan launched in June 2014, provides an evoke to accelerate progress through applying effective interventions that can rapidly reduce neonatal mortality [6]. Compared to the global neonatal mortality which is annual rates of reduction 4.9% vs 2.9% between the year 2000 and 2013 [7].

In Sub Saharan Africa (SSA), with an average neonatal mortality rate (NMR) of 41 per 1000 live births, this burden still remains unresolved [8].The Neonatal Mortality rate was reduced from 37 deaths per 1000 live births in 1990 to 19 by rate of 40% in 2016 [9]. The Ethiopian government and other stakeholders involve in the reduction of neonatal mortality such as USAID focus and delivered integrated health service packages of health as evidence-based interventions across a continuum of care at different levels like at the level of the family, community and facility levels by enhancing the availability and accessibility of health services such as maternal health promotion, skilled birth attendance and essential new-born care/treatment in Ethiopia [10] and The Ethiopian government has used a combined efforts and interventions in health promotion, nutrition, and non-health sectors at different levels to reduce neonatal mortality but still has high neonatal mortality [11].

The sustainable development goals (SDGs) are one of the ongoing such commitments which open a new era to intervene the unfinished agenda of the Millennium development goals as well as other emerging social, developmental and global health problems. The sustainable development goal 3 target 3.2 focus on reduction of neonatal mortality rate to 12 per 1000 live births in the year 2030 [12]. Other important renewed intervention was the Every New-born Action Plan (ENAP) which focuses to end preventable stillbirth and new-born death [13]. In addition, the survival status of the neonates was addressed within the study area but the magnitude of mortality was not still known [14]. Therefore, the

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objective of this study was to determine magnitude of neonatal mortality and identify risk factors among neonates admitted in Neonatal Intensive Care unit at Arba Minch General hospital, South Ethiopia.

Methods and Materials
Study setting, period and Design:

Arba Minch General Hospital was selected for this study which is the only hospital among the four hospitals which have neonatal intensive care unit in Gamo Gofa zone. Arba Minch General hospital is situated at Arba Minch town and which is located 468kms far to the south of Addis Ababa, the capital city of Ethiopia and 280 Km from Hawassa, center of southern nation's nationality and people regional state (SNNPR). The study was conducted from January, 01, 2015 to December, 31, 2017 G.C. A cross sectional study was conducted.

Population:

The source populations were all Neonates who have age 28 days and below and who were admitted at Neonatal Intensive Care Unit in Arba Minch General Hospital and the selected Neonates who have age 28 days and below and who were admitted at Neonatal Intensive Care Unit in Arba Minch General Hospital within the study period were the study populations.

Eligibility criteria:

All Neonates age less than 28 days who were admitted to Neonatal Intensive Care Unit in Arba Minch General Hospital within the study period were included and those neonates delivered at home were excluded from the study.

Sampling procedures:

Simple random sampling technique was used to recruit predetermined 332 samples through computer generated random numbers. From the 2012 total Neonate records that were enrolled within the study period, 332 samples were selected and the data were extracted with its necessary information.

Study Variables:

The dependent variable was Neonatal mortality and the Independent variables were categorized into three categories. These are **Socio demographic factors** (Age of Neonate at admission, Sex and Maternal Age), **Neonatal Factors** (5th minute APGAR score, Birth Weight at admission, Delayed initiation of EBF and Complication at Birth) and **Obstetrical Factors** (ANC Follow up, Mode of delivery, Birth order, Gestational age, Premature Rupture of membrane (PROM), Type of Pregnancy (Multiple or Single tone), History of previous pregnancy and Onset of labor.

Data collection instrument and procedures

The source of data was individual patient record documents including registers and monitoring cards and patient admission book. Data were collected by using structured checklist or questionnaire after training was given.

Data Quality Management:

Data quality was assured by caring out careful design of data extraction formats and appropriate modification was made, appropriate recruitment and by giving adequate training and follow-up for data collectors and supervisors. Pre-test was performed to check the consistency of the data collection tool and to check the activity of the data collectors. After pre-testing the questionnaire, cronbatch's Alpha was calculated by using SPSS window version 23 to test internal consistency (reliability) of the item. In addition, content validity was cross checked by another expert (pediatrician) at the University. Intensive supervision was done during the whole period of data collection. A random sample of registration forms were reviewed to conform reliability of data before data collection and the data was checked for completeness and consistency and then it was coded, entered and stored into the computer using the software.

Data Processing and Analysis:

Data were entered, coded, edited and cleaned using Epi-info version 7 and exported to SPSS version 23 for Windows. Then exploratory data analysis was carried out to check the levels of missing values. Bivariate analysis was done to identify associations between dependent and independent variables. Crude Odd Ratio and Adjusted Odd ratio, 95% CI and P-value was used

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to assess the strength of association and statistical significance.

Data clean-up was performed by checking for frequencies, accuracy, outliers, and consistencies and missed values and variables. Frequencies, proportions, and summary statistics were used to describe the study population about relevant variables using tables, charts and graphs. Variables which have p value less than 0.25 were selected as a candidate variable and for all statically significance tests, the cut of value set was P value $\leq$0.05 as this considered statically significant. Since COR did not take into account the effect of the confounding variable(s), multivariate analysis were applied by fitting the logistic regression. The backward stepwise regression method was applied. The data were presented by Tables and graphs.
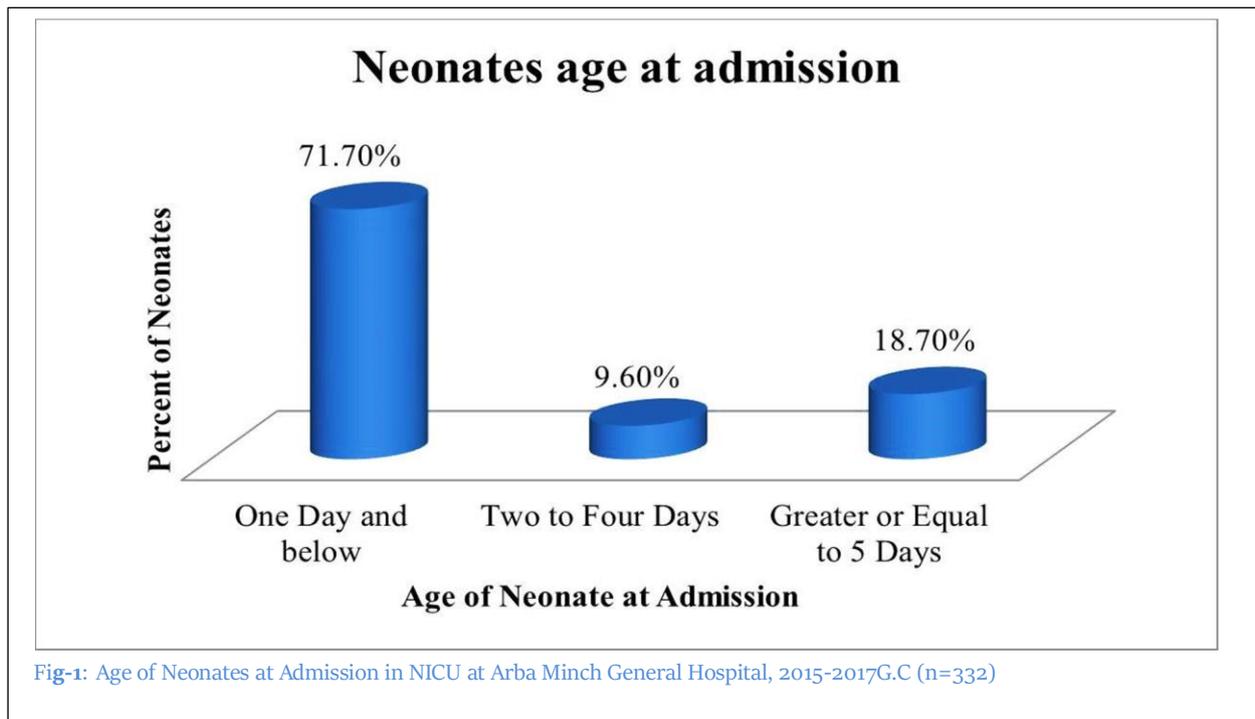
Ethical Considerations:

Ethical clearance was obtained from the Arba Minch university college of medicine and health sciences ethical review board and support letter was obtained accordingly, prior to data collection.

Result

Socio demographic characteristics:

The data were extracted from 332 neonate records from January, 01, 2015 to December, 31, 2017 G.C which yields a response rate of 100%. Among the total reviewed records, 212 (63.9%) were males and the maternal age was lied between 18-42 years in which 279 (84%) were at the age of 18-35 years old. The maximum number of Neonates, 238 (71.7%) were admitted at the age of 1 day and below (**Fig-1**).

Fi**g-1**: Age of Neonates at Admission in NICU at Arba Minch General Hospital, 2015-2017G.C (n=332)

Maternal and Obstetric related Factors:

From the total reviewed records, 13.3%, 16%, 40.7% and 22.9% of the mothers have one, two, three and four ANC visits respectively while the remaining 7.1% have no any ANC visits. Regarding their gravidity, 181 (54.5%) has history of pregnancy before the current neonate.

In considering the gestational age, 194 (58.4%) were delivered before their 37 weeks of gestation. The maximum and minimum duration of labor for this birth was 50 hour and 1 hour respectively which accounts the mean duration of 12.3 (with a standard deviation of 7.5) hours (**Table-1**).

Neonatal Factors:

From the total reviwewed neonate records, for 281 (84.6%) of the Neonates their fifth minute APGAR score

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Table-1: Maternal obstetrical factors of Neonatal mortality for Neonates admitted in NICU at Arba Minch General Hospital, 2015-2017G.C (n=332)

Variables	Category	Frequency(n)	Percent(%)
Onset of Labor	Spontaneous	284	85.5
	Induced	48	14.5
The mode of delivery for this neonate	SVD	248	74.4
	Assisted Vaginal(Instrumental)	21	6.3
	Cesarean section	63	19
Time of rupture of membrane	≥12 hrs	104	31.3
	<12 hrs	228	68.7
Type of pregnancy	Single	301	90.7
	Twin	31	9.3
Birth order	First	147	44.3
	2-4 birth	132	39.8
	≥5 birth	53	16

was measured. The maximum and the minimum fifth minute APGAR score was 10 and 3 respectively. From those measured, 41 (14.6%) have a score of ≤ 5. Two hundered forty (72.3%) of the Neonates were initiated exclusive breast feeding. Among them 208 (62.7%) were initiated with in one hour. Three hundered twenty six (98.2%) of the neonates have complication at birth (**Table-2**).

Magnitude of Neonatal mortality:

From the total of 332 randomly selected neonate records 67 neonates were died at the neonatal intensive care unit of Arba Minch General hospital which yields the magnitude of neonatal mortality 20.2%.

Table 2: Neonatal factors for Neonatal mortality for Neonates who admitted in NICU in Arba Minch general Hospital, 2015-2017G.C (n=332)

Variables	Category	Frequency(n)	Percent(%)
Does the neonate initiate Exclusive breast feeding	Yes	240	72.3
	No	92	27.7
When did the Neonate initiate exclusive breast feeding	With in 1 hour	208	62.7
	After 1 hour	32	9.6
Birth weight of neonate at admission	Less than 1000gm	11	3.3
	1000-2500gm	133	40.1
	≥2500gm	188	56.6
Birth weight at discharge	Less than 1000gm	11	3.3
	1000-2500gm	126	38
	≥2500gm	195	58.7

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Factors associated with Neonatal mortality:

In Multivariable analysis the score of the fifth minute APGAR score, onset of labor, Duration of labor, Duration of Rupture of membrane and birth order were significant factors which enhance neonates to die.

Neonates who have the 5th minute APGAR score less than five were 4.4 times more likely to die as compared to those who have greater or equal to five.

The odd of Neonatal mortality for those whose mothers labor induced have 2.7 times more likely as compared with those of spontaneous labor. Those neonates born from mother with duration of labor greater than or equal to 18 hours have 2.6 times more likely to die than those of the counter parts less than or equal to 12 hours. The likelihood of the neonatal mortality for those born from mothers with the time of rupture of membrane greater than or equal to 12 hour have 3.9 time more likely than those of less than 12

Variables	Category	COR, 95%CI	AOR,95%CI
ANC follow up	Yes	1	
	NO	3.1(1.33,7.44)	
Number of ANC visits	No ANC visits	2.9(1.08,7.8)	
	One ANC visits	0.64(0.23,1.8)	
	Two ANC visits	0.62(0.23,1.64)	
	Three ANC visits	1.1(0.55,2.24)	
	Four ANC Visits	1	
The 5th minute APGAR Score measured	Yes	1	
	No	6.13.2,11.6)	
APGAR score	<5	9.6(0.06,0.21)	4.4(1.98,9.65)
	≥ 5	1	1
Birth weight at admission	<1000gm	4.4(1.26,15.3)	
	1000-2500gm	1.7(0.96,2.9)	
	$\geq$2500gm	1	
EBF initiation	Yes	1	
	No	2.1(1.18,3.64)	
Time of initiation of EBF	Within 1 hour	1	
	After one hour		
Onset of Labor	Spontaneous	1	1
	Induced	1.8(0.9,3.58)	2.7(1.03,7.37)
Duration of Labor	<18 hour	1	1
	$\geq$18 hour	1.1(0.58,1.8)	2.6(1.12,6.11)
Time of ROM	<12 hour	1	1
	$\geq$12 hour	0.32(0.16,0.65)	3.9(1.5,9.87)
Birth order	First	1	1
	2-4 Births	2.9(1.36,6.13)	
	$\geq$5 Births	17.4(7.66,39.64)	19.5(6.84,55.45)

Table 3: Multivariable model for factors of Neonatal Mortality in Arba Minch General Hospital, Southern Ethiopia, 2015-2017G.C(n=332)

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hours. Neonates born as greater than or equal to fifth birth order have 19.5 times more likely to die than those of first birth orders (**Table-3**).

Discussion

This study aims to assess the magnitude of Neonatal mortality and associated factors among neonates admitted in neonatal intensive care unit of Arba Minch General Hospital.

The magnitude of Neonatal mortality in Arba Minch general hospital was 20.2% which was greater than the study conducted in North Gonder Zone which was 4.38, Taleghani Hospital in Iran which was 7.5% and in Bangladesh which was 0.37% [15-17]. This variation might be due to the differences in socioeconomic characteristics, socio demographic characteristics, variation in delivery of health care and variation in accessibility of trained health care professionals.

Neonates who have fifth minute APGAR score less than 5 were 4.4 times more likely to die as compared to those who have greater than five. This finding is similar with a study conducted in Egypt and Cameroon which is 1.3 and 18.56 times more likely to die in Egypt and Cameroon respectively [18,19]. This might be due to the fact that Neonates who have 5th minute APGAR score less than five were severely asphyxiated and also may be associated of complication of labor and pregnancy induced complications.

This study revealed that the onset of labor is one factor which leads neonates to die. The odd of neonatal mortality for those born from mothers with induced labor were 2.7 times more likely to die as compared to those of spontaneous labor. This might be due to that the medications given to induce labor (Oxytocin or prostaglandin) have the tendency to cause abnormal or excessive contraction which reduces the newborns oxygen supply causes fetal distress and lowers the newborns heart rate [20,21].

Mothers whose total duration of labor for that neonate was ≥18 hours have 2.6 times more likely to face Neonatal mortality as compared to the counter

parts whose duration of labor was less than 18 hours. This might be due to the reason that prolonged labor may cause birth asphyxia and chorioamnionitis which may lead the neonate to sepsis and also it may lead to the slow beating of fetus heart and secondary anoxia and increased PH of cord blood [22-24].

This study revealed that Mothers whose rupture of membrane was greater or equal to 12 hour for that neonate was 3.9 times more likely to die as compared to those of less than 12 hours. This is similar with the study conducted in Jimma specialized hospital in which those more than 12 hours have 7.74 times higher hazard of neonatal death [25]. This might be due to as the time of rupture of membrane increase before delivery, the risk for sepsis, asphyxia, pulmonary hyperplasia and preterm labor might be increased [26,27].

Neonates born as fifth and above birth order have 19.5 times more likely to die as compared to those with first birth. Also those Neonates born from mothers who have history of more than 5 births had 12.1 times hazard of death. This is similar with the study conducted in Addis Ababa Tikur Anbesa referral and teaching hospital which revealed that those of fifth of higher birth order had 1.61 times more likely to die than those first order [28]. This might be due to as the birth order increases the maternal age will be increased so if the mothers age has been increased the risk for obstetric complication will be increases and also as the mother's birth order has been increased, there may be a short birth interval which may cause maternal depletion syndrome and resource competition between siblings. The limitation of this study was since it was a secondary chart review; it may lose some variables such as socio-demographic and socioeconomic factors.

Conclusion

The magnitude of neonatal mortality was high and the fifth minute APGAR score, Induced labor, Duration of labor, Time of rupture of membrane and birth order are the independent factors which leads neonates to die.

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Declarations

Ethics approval and consent to participant:

Ethical clearance was obtained from Arba Minch University, College of Medicine and Health Sciences Institutional Ethical Review Board. Support letter was obtained from department of Public health to Arba Minch General Hospital Administration. Furthermore, confidentiality of the study subjects was assured.

Consent for publication

NA

Availability of data and materials

The datasets used and/or analyzed during the current study available from the corresponding author on reasonable request.

Competing Interests

The authors declare that no conflict of Interest

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Not Applicable

Authors Contribution

SD was involved in the conception, design, analysis, interpretation, report and manuscript writing. ZD and AB were involved in the review of the design, analysis, interpretation and report writing. All authors read and approved the final manuscript.

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