Neonatal Mortality and Its Associated Factors among Neonates Admitted to Wollega University Referral Hospital Neonatal Intensive Care Unit, East Wollega, Ethiopia

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Abstract
Ethiopia has a high neonatal mortality rate in spite of dearth of study. Therefore we aimed to assess magnitude and associated factors of neonatal mortality among neonates admitted to neonatal intensive care units of Wollega University Referral Hospital. Accordingly, a facility based cross-sectional study was conducted on 289 by reviewing medical records of neonates admitted to neonatal intensive care unit. The collected data were entered in to Epi data version 3.1 and Stata version 14 used for analysis. Variables with P-value < 0.25 at with 95% confidence interval in binary logistic regression analysis were taken to the multiple logistic regression analysis. Finally, variables with Likewise, variable with P-value < 0.05 at 95% confidence interval in multiple logistic regression analysis were considered as statistically significant. Among 289 neonates admitted to neonatal intensive care unit, 53 (18.34 %) were died. Majority 42(79.25%) of those deaths occurred at ≤ 7 days of birth. Preterm [AOR 4.15, 95% CI (1.67-10.33)], neonates faced birth asphyxia [AOR 3.26, 95% CI (1.33-7.98)], neonates who developed sepsis [AOR 2.29 95% CI (1.01-5.20)] and neonates encountered with jaundice [(AOR 11.08, 95% CI (1.03-119.59)] were more at risk to die. In general, the magnitude of neonatal mortality among neonates admitted to neonatal intensive care unit was high. Gestational age (maturity of new born), birth asphyxia, neonatal sepsis and neonatal jaundice were predictors of neonatal mortality. Neonates admitted to neonatal intensive care unit with sepsis, jaundice, and birth asphyxia demand special attention to reduce neonatal mortality.

Keywords
neonates, mortality, intensive care unit, Wollega university referral hospital

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Introduction
The neonatal period is defined as the first 28 days after birth and it can be further subdivided into the very early (birth to less than 24 hours), early (birth to <7 days), and late neonatal periods (7 days to <28 days).¹ Neonatal mortality rate can also be defined as the number of resident newborns in a specified geographic area dying at less than 28 days of age divided by the number of resident live births for the same geographic area for a specified time period and multiplied by 1000.² Neonatal period is one of the greatest risky periods in human life associated with 3 to 4 million neonatal deaths per year worldwide and 99% of these deaths being in low to middle income countries.³ ⁶

Among the 20 countries with the highest risk of neonatal death worldwide, 15(75%) are in Africa.⁷ Ethiopia is one of these countries experiencing high neonatal mortality rate of 30 per 1000 live births.⁵ ⁸ In spite of hard works done by the government and other partners, inconsiderable decline was attained in the last 15 years.

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and Ethiopia remained with high neonatal mortality rate.\textsuperscript{5} As the prevailing evidence on neonatal mortality was very few to initiate structured intervention, implementation of MDG-4 was unfortunately not effective as planned.\textsuperscript{9,10}

Subsequently, identifying the magnitude and determining the factors associated with neonatal death is an evidence for inventions and a fundamental to tackle the burden of neonatal deaths.\textsuperscript{11,12} However, there was a general shortage of studies on neonatal mortality in the study area.\textsuperscript{11} Therefore, the study aimed to assess the magnitude and associated factors of neonatal mortality among admitted neonate to Neonatal Intensive Care Unit (NICU) of Wollega University Referral Hospital (WURH). The finding of this study can be a baseline data for health professionals working in NICU. Moreover, it can be an input for systematic review to change policy makers and programmers.

**Methods and Materials**

**Study Area and Period**

The study was conducted in Nekemte town at NICU of WURH which is located at a distance of 331 km West of Addis Ababa, in Oromia Regional State. Data were collected from July 1-10, 2019.

**Study Design**

The study was conducted using a cross-sectional study design.

**Source and Study Population**

All medical charts of neonates admitted to WURH neonatal intensive care unit were considered as source of population while medical charts of all neonates admitted to WURH neonatal intensive care unit from July 2017-July, 2019 were considered as study population.

**Inclusion Criteria and Exclusion Criteria**

All selected medical charts of neonates admitted to NICU from July 2017 to July, 2019 with variables of interest were included in the study. All medical charts of neonates with incomplete or with no legible handwriting were excluded from the study.

**Sample Size Determination and Sampling Procedure**

The sample size was calculated using single population proportion formula. The proportion used was 22.8% taken from the study done at Mizan-Tepi Teaching Hospital.\textsuperscript{14} The margin of error 5% with 95% level of confidence was used to calculate the required sample size. Adding 15% for non-response, the final sample size became 312.

By using NICU’s registration book, systematic sampling was used to select study unit for the specific study period. Consequently, all maternal, neonatal & facility related variables were collected.

**Data Collection Instruments and Data Collectors**

Data were collected by using pre-tested, structured check list. Data extraction check lists developed based on instruments applied in different related studies. Four medical interns were recruited to collect data.

**Data Collection Procedure**

Data was extracted by reviewing medical records of newborns using the data extraction checklist. The data extraction checklist contained variables related to socio-demographic characteristics, condition of the baby after birth, neonatal illness, maternal and delivery history.

**Data Processing and Analysis**

EPI data version 3.1 and Stata software version 14 were used for data entry and analysis. After data cleaning, frequencies and percentages were calculated to all variables. Variables with $P$-value of less than 0.25 in binary logistic regression analysis were entered into the multivariable logistic regression analysis. Odds ratio with 95% confidence interval was used to examine associations between dependent & independent variables. Variables with $P$-value $<$ 0.05 were considered statistically significant.

**Data Quality Control Measures**

The quality of the data was assured by using validated and pre-tested data extraction checklist. The validity of the tool was checked by face validity. Data collectors were trained intensively for 1 day on data collection instruments. Furthermore, there was a close supervision throughout the data collection process.

**Operational Definitions**

**Neonatal death:** Death of a neonate that was born alive within the first 28 completed days of life

**Early neonatal death:** The death of neonate that occur during the first 7 days of life
Late neonatal death: Death of a neonate that occur between 7 and 28 completed days of life

Neonatal resuscitation: A rational lifesaving procedure at the time of birth to initiate and maintain breathing and circulation of the neonate.

Ethical Considerations
A permission letter was obtained from Wollega University Institutes of Health Science, and given to WURH.

Result
According to record from NICU, 1297 neonates were admitted in the last 2 years; we have planned to conduct the study on 312 samples, but 289 of neonatal card were reviewed, which give 92.6% response rate.

Magnitude of Neonatal Mortality
Among 289 neonates admitted to neonatal intensive care unit, 53 (18.34 %) were died at 95 CI (14.30-23.26%). Majority 42(79.25%) of the death occur ≤7 days of birth. There was no difference among sexes of died neonates [26(male) versus 27 (female)] (Table 2).

Maternal Related Factors
From the reviewed neonatal cards, 236 (81.66%) of maternal age were in range of 20 to 34 years. Majority 222 (76.82%) of the neonate were from rural residents and 247 (85.47%) of the mothers had antenatal care follow up. Around half 156(53.98%) of women had 2 and above parity, majority 198 (68.51%) of the mothers were gave birth through spontaneous vaginal delivery and 248(85.8%) of the labor lasted less than 24hours.

Only 54 (18.99%) of the women were faced complications during pregnancy and labor. Among complications, obstructed labor was the leading 1 followed by preclampsia, Premature Rupture of Membrane (PROM), Ante Partum Hemorrhage (APH), twin pregnancy and eclampsia (Table 1).

Neonatal Related Factors
From the total neonates admitted to NICU during study period, 229 (79.24%) of neonates were delivered at term and around half of neonates were male. Out of the neonates admitted to NICU, 148(51.21%) of neonates’ birth weight were in normal range (2.5-4 kg). Regarding APGAR score, 178 (61.59%) and 187 (64.71%) of APGAR score at first and fifth minutes were ≥7/10 respectively.

Less than one fourth 59(20.42%) of neonates were resuscitated at birth and 18 (6.23%) of neonates were diagnosed as having congenital anomalies. Around half 130(44.98%) of neonates’ body temperature were in normal range at admission. From the study participants, 53(18.34%) of neonates experienced birth asphyxia and around half 133(46.02%) of neonates diagnosed with neonatal sepsis. Among neonates admitted to NICU, 14(4.84%), 79(27.34%), 6(2.08%), 19(6.57%) and 17(5.88%) were faced hemorrhagic diseases of new born, hypothermia, neonatal jaundice, hypoglycemia and meconium aspiration syndrome respectively (Table 2).

Facility Related Factors
Regarding place of delivery, 193(66.78%) of neonates were delivered in the hospitals followed by health center 76(26.30%). Most 255 (88.24%) of the neonates were stayed in the NICU ≤ 7days after admission (Table 3).

Factors Associated with Neonatal Death
Using multivariable logistic regression, contributing factors of neonatal death were identified. These contributing factors were gestational age, birth asphyxia, neonatal sepsis and neonatal jaundice. Preterm neonates were 4 times more likely die as compared to neonate delivered at term [AOR 4.15, at 95% CI (1.67-10.33)]. Neonates faced birth asphyxia were more likely die as compared to the counterpart [AOR 3.26 at 95% CI (1.33-7.98)].

A neonate who developed neonatal sepsis was 2.3 times more likely die as compared to normal neonates [AOR 2.29 95% CI (1.01-5.20)]. Neonates encountered with neonatal jaundice were eleven times more likely die as compared to their counterpart [(AOR 11.08, 95% CI (1.03-119.59)] (Table 4).

Discussion
Despite numerous innovations and interventions made to improve the survival of newborns, neonatal mortality remains a serious public health concern, particularly in low- and middle-income country.

Therefore, this study aimed to assess the magnitude and factors associated with of neonatal mortality admitted at NICU of WURH.

The magnitude of neonatal mortality among neonates admitted to neonatal intensive care unit was 18.34 % at 95 CI (14.30-23.26%). Majority 42(79.25%)
of the death occur before 7 days of birth. This finding is similar with the studies previously conducted in Ethiopia: Jigjiga- Sheik Hassan Yabare Referral Hospital (20.5%), Amhara reginal state referral hospitals (15.06%), Debre Markos referral hospital (21.3), Eastern part of Ethiopia public hospitals (20.20%) and Mizan-Tepi University Teaching Hospital (22.8%).10,14-17 The similarity of magnitude might be explained by relative similarities in infrastructures, medical equipment and guidelines used in hospitals and also the skill of health professionals working in NICU of Hospitals in Ethiopia.

The magnitude of this study finding is higher than the study done in Libya (10.9%) and Addis Ababa Public hospitals (11.4%).18,19 The discrepancy might be due to study area in terms of infrastructure, and skill of health professionals working in NICU of Libya and Ethiopia may not be similar. In this study, gestational age, birth asphyxia, neonatal sepsis and neonatal jaundice were the identified as determinants. Accordingly, neonates delivered prematurely and admitted to neonatal intensive care unit were 4 times more likely die as compared to neonate delivered at term and admitted to NICU due to different cases. This finding is supported with the studies done in Libya and in Ethiopia, Jigjiga- Sheik Hassan Yabare Referral Hospital, Dessie referral hospitals, Eastern part of Ethiopia public hospitals and Black lion hospital.10,15,20-22 Oxygen deficit at delivery (birth asphyxia) can lead to severe hypoxic ischemic organ damage in newborns followed by a fatal outcome or severe life-long pathologies.

Table 1. Maternal Related Factors among Neonates Admitted to WURH NICU from July, 2017 to July, 2019.

| Variable / Category | Frequency | Percentage |
|---------------------|-----------|------------|
| Maternal age in year |           |            |
| <20                 | 26        | 9.00       |
| 20-34               | 236       | 81.66      |
| ≥35                 | 27        | 9.34       |
| Residence           |           |            |
| Urban               | 67        | 23.18      |
| Rural               | 222       | 76.82      |
| Antenatal care follows up |    |            |
| Yes                 | 247       | 85.47      |
| No                  | 42        | 14.53      |
| Number of antenatal visits |    |            |
| First visit         | 11        | 4.51       |
| Second visit        | 39        | 15.98      |
| Third visit         | 141       | 57.79      |
| Fourth visit        | 53        | 21.72      |
| Parity              |           |            |
| One                 | 133       | 46.02      |
| Two and above       | 156       | 53.98      |
| Duration of labor   |           |            |
| <24 hours           | 248       | 85.81      |
| ≥24 hours           | 41        | 14.19      |
| Duration of rupture of membrane |   |            |
| <8 hours            | 256       | 88.58      |
| ≥8 hours            | 33        | 11.42      |
| Mode of delivery    |           |            |
| Spontaneous vaginal delivery | 198   | 68.51      |
| Instrumental delivery | 21    | 7.27       |
| Cesarean section    | 70        | 24.22      |
| Complications during pregnancy and labor | | |
| Yes                 | 54        | 18.69      |
| No                  | 235       | 81.31      |
| Type of pregnancy and labour complications | | |
| APH                 | 5         | 7.55       |
| Pre-eclampsia       | 7         | 13.21      |
| Eclampsia           | 4         | 7.55       |
| PROM                | 7         | 13.21      |
| Obstructed labour   | 24        | 45.28      |
| Twin pregnancy      | 7         | 13.21      |
Therefore, provisions of quality neonatal care including quality resuscitation, thermal care, and proper feeding are important to reduce adverse outcome of neonates admitted with asphyxia. Furthermore, producing competent health providers through continuous professional development can reduce neonatal mortality.
Table 3. Neonatal Related Factors among Neonates Admitted to WURH NICU from July, 2017 to July, 2019.

| Variable                                   | Category     | Frequency | Percentage |
|---------------------------------------------|--------------|-----------|------------|
| Place of delivery                           | Home         | 20        | 6.92       |
|                                             | Health center| 76        | 26.30      |
|                                             | Hospital     | 193       | 66.78      |
| Duration of stay in NICU                    |              |           |            |
| ≤7 days                                     |              | 255       | 88.24      |
| >7 days                                     |              | 34        | 11.76      |

Table 4. Factors Associated with Neonatal Death among Neonates Admitted to NICU at WURH 2019.

| Variable                                   | Category     | Yes | No | COD/95%CI | AOD/95%CI |
|---------------------------------------------|--------------|-----|----|-----------|-----------|
| Residence                                   | Urban        | 9   | 58 | 1.59 (0.73, 3.46) | 1.13 (0.40, 3.13) |
|                                             | Rural        | 44  | 178| 2.01 (0.95, 4.24) | 1.81 (0.69, 4.71) |
| Antenatal care follow up                    | Yes          | 41  | 206|           |           |
|                                             | No           | 12  | 30 | 1.97 (0.74, 5.21) | 0.69 (0.17, 2.78) |
| Gestational age                             | Pre term     | 28  | 28 | 8.54 (4.35, 16.74) | 4.15 (1.67, 10.33)** |
|                                             | Term         | 24  | 205|           |           |
|                                             | Post term    | 1   | 3  | 2.84 (0.28, 28.46) | 3.87 (0.30, 49.04) |
| Duration of labor                           | <24 hours    | 39  | 209|           |           |
|                                             | ≥24 hours    | 14  | 27 | 2.77 (1.33, 5.76) | 1.55 (0.49, 4.89) |
| Mode of delivery                            | SVD          | 40  | 158|           |           |
|                                             | Instrumental | 7   | 14 | 1.97 (0.74, 5.21) | 0.69 (0.17, 2.78) |
|                                             | C/S          | 6   | 64 | 0.37 (0.14, 0.91) | 0.37 (0.11, 1.26) |
| Complications during pregnancy and labor    | Yes          | 13  | 41 | 1.54 (0.75, 3.14) | 2.07 (0.79, 5.36) |
|                                             | No           | 40  | 195|           |           |
| Resuscitate                                 | Yes          | 20  | 39 | 3.06 (1.59, 5.88) | 1.36 (0.55, 3.33) |
|                                             | No           | 33  | 197|           |           |
| Body temperature at admission               | <36.5°C      | 32  | 81 | 3.88 (1.88, 7.99) | 2.27 (0.91, 5.60) |
|                                             | 36.5-37.5°C  | 12  | 118|           |           |
|                                             | >37.5°C      | 9   | 37 | 2.39 (0.93, 6.12) | 1.75 (0.56, 5.52) |
| Birth asphyxia                              | Yes          | 18  | 35 | 2.95 (1.50, 5.78) | 3.26 (1.33, 7.98)** |
|                                             | No           | 35  | 201|           |           |
| Neonatal sepsis                             | Yes          | 28  | 105| 1.39 (0.76, 2.53) | 2.29 (1.01, 5.20)** |
|                                             | No           | 25  | 131|           |           |
| Neonatal meningitis                         | Yes          | 6   | 15 | 1.88 (0.69, 5.10) | 3.76 (0.99, 14.28) |
|                                             | No           | 47  | 221|           |           |
| Acute respiratory distress syndrome         | Yes          | 5   | 5  | 4.81 (1.34, 17.27) | 3.74 (0.56, 24.79) |
|                                             | No           | 48  | 231|           |           |
| Neonatal jaundice                           | Yes          | 3   | 3  | 4.66 (0.91, 23.76) | 11.08 (1.03, 119.59)** |
|                                             | No           | 50  | 233|           |           |
| Meconium aspiration syndrome                | Yes          | 6   | 11 | 2.61 (0.91, 7.41) | 2.05 (0.58, 7.21) |
|                                             | No           | 47  | 225|           |           |

*P-value of ≤.05. **P-value of <.001.
The bold types implies AOR of significant variables.

The odds of neonatal death were 2 times more likely observed among neonates who had neonatal sepsis as compared to neonate with no sepsis. This finding is in concordance with previous studies conducted in Ethiopia: Eastern part of Ethiopia public hospitals, Dessie referral hospital and Adama hospital medical college. If infection is not treated immediately, it can be complicated to septic shock
and multiple organ dysfunctions in which both are the most common causes of death in the neonatal period. Furthermore, this study found that neonates admitted to the NICU due to neonatal jaundice were at higher risk of death as compared to neonates admitted due to other causes. High level bilirubin in neonate can damage the brain and spinal cord of neonate which can be life threatening and cause neonatal death.

**Conclusion**

In this study, the magnitude of neonatal mortality among neonates admitted to neonatal intensive care unit was high. Gestational age (maturity of new born), birth asphyxia, neonatal sepsis and neonatal jaundice were predictors of neonatal mortality. Therefore, neonates admitted to NICU with birth asphyxia, neonatal sepsis, neonatal jaundice, and prematurity need special consideration and follow up to reduce neonatal mortality. Due to a relative similarity of NICU’s set up in Referral Hospital, relative similarity in skill and qualifications of health professionals working in NICU of Referral Hospital, similar infrastructure pertaining to Referral Hospital in Ethiopia, the finding can be cautiously inferred to different Referral Hospitals in Ethiopia.

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**Authors’ contributions**

All authors participated on conception, study design, acquisition of data, software, analysis and interpretation, a critical review of the document and revision of the manuscript.

**Declaration of Conflicting Interests**

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

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**Ethics approval statement**

A written permission letter was obtained from Wollega University with Ref No.: WU/RD/78/19. Likewise, we got permission from WURH to access data pertaining admitted neonates to NICU. Moreover, no identifiable data were included in dataset and in the manuscript. However, consent to participate was not applicable because of the nature of data.

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**Data sharing and data availability statement**

Data used for this manuscript is available from corresponding author at lalisachewaka@gmail.com on a reasonable request.

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