Prevalence and Causes of Neonatal Mortality Among Neonates Admitted in Neonatal Intensive Care Unit at Sultan Hassan Yabare Referral Hospital, East Ethiopia 2019

Mohamed Omar Osman*, Abdikani Mawlid Nur, Tahir Yousuf Nour, Mahamed Hussen Hashi, Abdilahi Absidselam Osman

Department of Public Health, Jigjiga University, Jigjiga, Ethiopia

Email address:
Mahamadwehliye@gmail.com (M. O. Osman), Wehliye@jju.edu.et (M. O. Osman)

*Corresponding author

To cite this article:
Mohamed Omar Osman, Abdikani Mawlid Nur, Tahir Yousuf Nour, Mahamed Hussen Hashi, Abdilahi Absidselam Osman. Prevalence and Causes of Neonatal Mortality Among Neonates Admitted in Neonatal Intensive Care Unit at Sultan Hassan Yabare Referral Hospital, East Ethiopia 2019. Science Journal of Clinical Medicine. Vol. 9, No. 1, 2020, pp. 11-17. doi: 10.11648/j.sjcm.20200901.13

Received: December 22, 2019; Accepted: January 15, 2020; Published: January 31, 2020

Abstract: Despite the fact that progresses in reducing child mortality, neonatal survival remains an urgent concern it estimated that the reduction in neonatal mortality was comparatively low; Ethiopia continues to have one of the highest rates of neonatal deaths in Africa with the rate of 29 deaths per 1000 live births. Thus, updated information about the prevalence and causes of neonatal mortality is very decisive for policies consequently improve services and lead to better health for newborns by training health care providers. Therefore, the objective of this study was to assess neonatal death and its possible causes among Neonates Admitted in Neonatal Intensive Care Unit at Sultan Hassan Yabare Referral Hospital, East Ethiopia. An institution based Retrospective cross-sectional study design was conducted in NICU at Sultan Hassan Yabare Referral Hospital from August 1 to August 30, 2019. Data was collected using structured questionnaire adapted from other related literatures. Then the Collected data were cleaned, coded and entered into Epidata 3.1 and exported, to SPSS version 23.0 for cleaning and analyses, data were presented, by using simple frequency tables, percentages and graphs. Prevalence of neonatal mortality on neonates admitted to the NICU at Sultan Hassan Yabare Referral Hospital was 20.5% (95% CI: 16.47-25.53). The current study sepsis (29.5%), multi organ failure and premature related (11.5%) followed respiratory failure and hypoglycemia (7.7%) and low birth weight as well as congenital anomalies and hypothermia (6.4%) were the main causes of neonatal mortality. This study revealed that neonatal mortality is still high in NICU at Sultan Hassan Yabare Referral Hospital. Sepsis, multi organ failure, premature related, respiratory failure and hypoglycemia accounted among major causes. Therefore, effective management of neonatal illness, neonatal infection prevention and interventions on maternal health with training of caregivers in neonatal resuscitation plus improved of newborns care were recommended to reduce neonatal mortality and improve neonatal survival.

Keywords: Prevalence, Causes, Neonatal Mortality, NICU, SHYRH, Jigjiga, Ethiopia

1. Introduction

The neonatal period, which is globally accepted as beginning at birth and ending at 28 completed days of life, is acknowledged as the most critical time in an infant's life [1].

Childhood mortality is often used as broad indicator of the social development or a specific indicator of health situations of a country. yet, child health programs were set low attention, especially neonatal health [2].

Though being newborn is not a disease, large numbers of children die soon after birth: many of them in the first four weeks of life (neonatal deaths), and most of those during the first week.

Neonatal death has been defined by the World Health Organization (WHO) as “deaths among live births during the first 28 completed days of life” which can be further subdivided into early neonatal deaths (deaths between 0 and 7 completed days of birth) and late neonatal deaths (deaths after 7 days to 28 completed days of birth) [3, 4].

In many societies, neonatal deaths and stillbirths are not
perceived as a problem, mainly because they are very common. Among these societies have adapted to this circumstance by not recognizing the birth as complete, and by not naming the child, until the newborn infant has survived the initial period [5].

Neonatal deaths resulted from poor maternal health, insufficient care during pregnancy, inappropriate management of complications during pregnancy and delivery, low hygiene during delivery and the first critical hours after birth, and lack of newborn care [5].

A number of issues such as women’s status in society, their nutritional status at the time of conception, early childbearing, closely spaced pregnancies and unsafe practices, are deeply entrenched in the cultural fabric of societies and relate in ways that are not always clearly understood [5].

During the early neonatal period (0-7 days), the major causes of death are asphyxia, infection, complications of prematurity, and birth defects; infections cause most late neonatal deaths (8-28 days) [6].

Infections are the major cause of mortality and morbidity in infants under 3 months of age in developing countries [6].

Good quality care for the neonate is critical to decreasing infant mortality in developing countries, two-thirds of which occurs during the first 28 days of life [6].

Addressing stillbirths and neonatal mortality requires interventions across the continuum of care (preconception, antenatal, intrapartum, instantaneous postnatal period, and after) and interventions across the health system (family and community level, outreach, and clinical care or facility level). Most of these interventions are included in the Lives Saved Tool, developed to model the impact of the interventions at changed coverage levels [7].

There are parts of existing sets of recommended intervention packages for addressing maternal and neonatal outcomes. Every Newborn Series presents Lives Saved Tool modeling with estimates of lives saved for maternal and neonatal deaths and stillbirths, showing high gains and triple return on investment, with the potential to avert 3 million deaths per year, particularly with facility-based care around birth and care of small and sick newborns [8].

In spite of progress over the past two decades, in 2018 alone worldwide, an estimated 6.2 million children and young adolescents under age 15 died, mostly from preventable causes. The neonatal mortality rate was estimated at 18 deaths per 1,000 live births. Worldwide, an estimated 2.5 million newborns died in the first month of life in 2018 – roughly 7,000 every day [9].

The global number of neonatal deaths declined from 5.0 (4.9, 5.2) million in 1990 to 2.5 (2.4, 2.7) million 2018 – 7,000 deaths every day in 2018 compared with 14,000 in 1990 [9].

On current trends, more than 60 countries will miss the SDG target of dropping neonatal mortality to at least as low as 12 deaths per 1000 live births by 2030. About half of them will not reach the target by 2050 [10].

Disparities in child survival exist across regions and countries: in sub-Saharan Africa among newborns in sub-Saharan Africa, about 1 child in 36 dies in the first month, while in the world’s high-income countries the ratio is 1 in 333 [11].

The most of neonate’s deaths occurred in Southern Asia (39 per cent), followed by sub-Saharan Africa (38 per cent). At the country level, half of all neonatal deaths are concentrated in five countries five countries accounted for half of all neonatal deaths: India, Pakistan, Nigeria, the Democratic Republic of the Congo and Ethiopia [11].

According to the 2016 EDHS results show that the neonatal mortality rate (NMR) is 29, deaths per 1,000 live births, which has revealed considerable fall from the 2011 EDHS report which is 37/1000 live births [12].

Application of essential strategies together with appropriate administration of essential therapies would effectively reduce causes which my potentially precipitate neonatal death. Despite these benefits, guidelines cannot be applied in most middle- or low-income countries due to lack of resources. Early identification of the causes contributing neonatal death would facilitate early clinical diagnosis and treatment aiming to reduce morbidity and mortality. A few studies on causes of neonatal death have been reported in Ethiopia and in this region. This study was therefore, carried out to find out the Prevalence and Causes of Neonatal Mortality among Neonates Admitted in Neonatal Intensive Care Unit at Sultan Hassan Yabare Referral Hospital, East Ethiopia 2019

2. Methods and Materials

2.1. Study Design and Period

An institution based Retrospective cross-sectional study design was conducted in NICU at Sultan Hassan Yabare Referral Hospital from August 1 to August 30, 2019.

2.2. Study Area

The study was conducted in Sultan Hassan Yabare Referral Hospital, Jigjiga East Ethiopia. Jigjiga town is located 626 km east from Addis Ababa, capital city of Ethiopia.

As of 2015 EFY Jigjiga city administration has a total population of 426,122 out of which 85,650 are in reproductive age group (15-49 years). The city has 30 Kebeles (smallest administration units) out of which 20 are urban and 10 are rural, most of the people are of Somali ethnicity (97%) and Muslim (98%) [13].

Sultan Hassan Yabare Referral Hospital (SHYRH) was inaugurated in January, 2017. SHYRH is the largest and modern hospital, providing state-of-the-art, and comprehensive service under one roof in eastern Ethiopia, the hospital has a total of 342 beds, a 13 bed Intensive Care Unit, Operation Theatre with the state of art facilities, emergency service, with Intensive Care Unit, Pharmacy and Clinical Lab facilities are available. Annually, nearly 2000 neonates receive care each year.

2.3. Source and Study Population

2.3.1. Source Population

The source population for the study was all neonates’
cards who were admitted and treated in the Sultan Hassan Yabare Referral Hospital during the last two years (from July 1, 2017 to June 30, 2019).

2.3.2. Study Population
All neonates’ card with age equal to or less than 28 days who were included to the sample and admitted to the NICUs of Sultan Hassan Yabare Referral hospital within the specified period.

2.4. Inclusion and Exclusion Criteria
All neonates’ card with age equal to or less than 28 days who were admitted to the NICUs of Sultan Hassan Yabare Referral hospital were included from the study while Medical records of neonates with incomplete patient chart information were excluded from the study.

2.5. Sample Size Determination and Sampling Procedure
The sample size was calculated with single population proportion formula and by taking into consideration: prevalence (P) of neonatal mortality 43.8% [2], confidence level (CL) 95%, margin of error (d) 5.5%, non-response rate and by using systematic random sampling technique a total of 397 neonatal charts were selected for study. Study Subjects were selected using systematic random sampling method (every Kth) after calculating the “Kth” value by dividing the total number of neonatal admitted within the two years to the required sample size. The first card (subject) was selected randomly or by lottery method with replacement by the next card for those cards which were contains incomplete information and then continues every kth value in similar pattern until the required numbers of samples were collected.

2.6. Data Collection Techniques and Tools
Data was collected using structured questionnaire adapted from other literatures. Then questionnaire was prepared in English language. Prior to actual data collection, data collectors were recruited based on their related professional background and training was given to data collectors on the data collection techniques in order to drill data collectors with the tool. Then Study tool was pre-tested on 5% of hospital NICU patient files.

2.7. Study Variables

2.7.1. Dependent Variable
Neonatal mortality was the dependent variable

2.7.2. Independent Variable
The independent variables included sex of the patient, age at admission, and gestational age, feeding, birth weight, and maternal age, and parity, place of birth, antenatal care (ANC) follow-up, maternal HIV status, mode of delivery, address, and mode of delivery.

2.8. Data Processing and Analysis
The Collected data were cleaned, coded and entered into Epidata 3.1 and exported to SPSS for windows version 23.0 for cleaning and analyses, data were summarized by using simple frequency tables, percentages and graphs.

2.9. Ethical Consideration
Ethical approval was acquired from the institutional review board of the Sultan Hassan Yabare Referral Hospital before conducting the research. Patient consent was not required for retrospective chart review study, as the institution reserves the right to possess the medical record of patients.

2.10. Abbreviations and Acronyms
EDHS: Ethiopia Demographic and Health Survey
NICU: Neonatal intensive care unit
NMR: Neonatal mortality rate
SDG: Sustainable Development Goals
SPSS: Statistical Package for Social science
WHO: World health organization
SHYRH: Sultan Hassan Yabare Referral Hospital

3. Results

3.1. Socio-Demographic Characteristics of Neonates and Neonates of Mothers
Out of 397 selected patient recordings 385 neonatal charts were studied. 12 (3.02%) were excluded the study due to incompleteness which made the respondent rate 96.9%. From all 243 (63.1%) were from urban residence and 314 (81.6%) were aged 0-7 days.

Regarding sex of the neonate more than half 202 (52.5%) were female neonates. Around one third 124 (32.2%) of the neonate’s birth weight were less than 2500gms and 131 (34.0%) were preterm neonates and among all neonate’s 64 (16.6%) of them were Twins.

About maternal parity of the mothers one third 118 (30.6%) were delivered their first child (Table 1).

Concerning maternal age, the mean (+SD) age of the mothers was 29.07 + 6.565. 27 years range from 17 to 44 years.

Table 1. Demographic characteristics of neonates and neonates of mothers who gave birth to neonates admitted to the NICU at Sultan Hassan Yabare Referral Hospital, East Ethiopia from July 1, 2017 to June 30, 2019.

| Variables                  | Category    | Frequency | Percent |
|----------------------------|-------------|-----------|---------|
| Residence                  | Urban       | 243       | 63.1    |
|                            | Rural       | 142       | 36.9    |
| age of the neonate          | 0-7 days    | 314       | 81.6    |
|                            | 8-28 days   | 71        | 18.4    |
| Sex of the neonate          | Male        | 183       | 47.5    |
|                            | Female      | 202       | 52.5    |
| Birth weight                | <2500gms    | 124       | 32.2    |
|                            | 2500-4000gms| 243       | 63.1    |
|                            | >4000gms    | 18        | 4.7     |
| Birth weight                | Preterm     | 131       | 34.0    |
| Gestational age             | Term        | 236       | 61.3    |
|                            | Post term   | 18        | 4.7     |
| Birth type                  | Singleton   | 321       | 83.4    |
|                            | Twins       | 64        | 16.6    |
Mohamed Omar Osman et al.: Prevalence and Causes of Neonatal Mortality Among Neonates Admitted in Neonatal Intensive Care Unit at Sultan Hassan Yabare Referral Hospital, East Ethiopia 2019

3.2. Prevalence of Neonatal Mortality

This study the overall prevalence of neonatal mortality on neonates admitted to the NICU was 20.5% (Table 2).

Table 2. Prevalence of neonatal mortality on neonates admitted to the NICU at Sultan Hassan Yabare Referral Hospital, East Ethiopia from July 1, 2017 to June 30, 2019.

| Variables | Category | Frequency | Percent |
|-----------|----------|-----------|---------|
| Parity    | Primipara | 118       | 30.6    |
|           | Multipara | 267       | 69.4    |

3.3. Clinical Characteristics of Neonates and Neonates of Mothers

Concerning antenatal care almost half of the mothers 190 (49.4%) utilized antenatal care during their pregnancy and about these 84 (44%) had only one antenatal care visit during their pregnancy. Regarding initiation of breast feeding more than two third 294 (76.4%) started breast feeding within one hour and from these 317 (82.3%) neonates were on exclusive breastfeeding. About 198 (51.4%) of the neonates had neonatal fever and 11 (2.9%) of the mothers had HIV/AIDS. About Mode of delivery 306 (79.5%) delivered virginal followed by 73 (19%) delivered by cesarean section and 86 (22.3%) had Complication during labor. Among these 39 (10.1%) were Malpresentation deliveries. Concerning to the Maternal TT immunization 157 (40.8%) of the neonate’s mother had only one tetanus toxoid immunization (Table 3).

Table 3. Clinical characteristics of neonates and neonates of mothers who gave birth to neonates admitted to the NICU at Sultan Hassan Yabare Referral Hospital, East Ethiopia from July 1, 2017 to June 30, 2019.

| Variables               | Category             | Frequency | Percent |
|------------------------|----------------------|-----------|---------|
| Antenatal visits       | Yes                  | 190       | 49.4    |
|                        | No                   | 195       | 49.6    |
| Number of visits       | One                  | 84        | 44.0    |
|                        | Two+                 | 107       | 56.0    |
| History of neonatal    | Yes                  | 198       | 51.4    |
| fever                  | No                   | 187       | 48.6    |
| Breastfeeding          | within 1hr           | 294       | 76.4    |
|                        | after 1hr            | 91        | 23.6    |
| Type of breastfeeding  | Exclusive breast feeding | 317   | 82.3    |
|                        | partial/bottle feeding| 68       | 17.7    |
| HIV                    | Reactive             | 11        | 2.9     |
|                        | Non-reactive         | 374       | 97.1    |
| Mode of delivery       | Vaginal              | 306       | 79.5    |
|                        | Cesarean section     | 73        | 19.0    |
|                        | Instrumental         | 6         | 1.6     |
| Complication           | Yes                  | 86        | 22.3    |
| during labor           | No                   | 299       | 77.7    |
| Maternal TT immunization | None or One          | 157       | 40.8    |
|                        | Two+                 | 228       | 59.2    |

Figure 1. Birth place of neonates admitted to the NICU at Sultan Hassan Yabare Referral Hospital, East Ethiopia from July 1, 2017 to June 30, 2019.

3.4. Causes of Neonatal Mortality

The major causes of death among neonates admitted in NICU were reported to be neonatal sepsis (29.5%), multi organ failure and premature related each account (11.5%) followed respiratory failure and hypoglycemia accounts which caused (7.7%) of all deaths. low birth weight and congenital anomalies and hypothermia were reported each to
be caused (6.4%) of neonatal deaths while birth asphyxia and birth trauma both caused (5.1%) of the neonatal deaths. The least cause of death in this study was 2.6% are due to other different causes (Figure 2).

Figure 2. Causes of neonatal mortality among neonates admitted to the NICU at Sultan Yabare Referral Hospital, East Ethiopia from July 1, 2017 to June 30, 2019.

4. Discussion

Prevalence of neonatal mortality on neonates admitted to the NICU at Sultan Yabare Referral Hospital was 20.5% (95% CI: 16.47-25.53). This finding was higher than the prevalence reported in Jigjiga Karamara General Hospital [14, Bahir Dar [15], and north Gondar [2] as well as Jimma zone Ethiopia [16]. This also is significantly higher than the national level of mortality rate which was 29 per 1000 live births (EDHS 2016) [12]. The variations may be due to methodological differences among studies and number and pattern of study participants, that this study was done on the neonate admitted to NICU that were in critical condition that may add to the likelihood of death.

On the contrary, the current finding is slightly close to other studies conducted in Gondar University Hospital reported to be (23.1%) [17], and Mizan Tepi University Teaching Hospital which was (22.8%) [18]. The similarity between these findings might be due to health service utilization and study settings.

The cause of mortality identified in this study reaffirms the conclusions of earlier studies from Ethiopia and elsewhere. [19-22].

The major cause of neonatal mortality in the current study was sepsis (29.5%). This result is more or less similar with the studies conducted in Jimma Zone (34.3%), Mizan Tepi (30%) and rural Ghana (40.3%) [16, 18, 23]. Infection in developing countries is high as compared to the developed world, which could be explained by low socioeconomic status and the presence of other predisposing factors including prematurity, LBW, prolonged labor, and rupture of membrane [24]. Therefore, these inconsistency results in the prevalence of sepsis could be explained by the variation of diagnostic criteria employed for sepsis and sample size difference or the irregular conditions over time.

This study discovered that (11.5%) of neonatal deaths caused by prematurity. The similar causes of neonatal mortalities were reported in numerous studies conducted in Northern Ethiopia (34%), Jimma, Southwest Ethiopia (7.4%), and urban Pakistan (26%) Iran (26.5%) [22, 25-27].

Another cause of neonatal death in this study was Multi organ failure (11.5%) This finding was agreed with those of Wilkinson et al demonstrating that multiple organ system failure (MOSF) were the most common causes of neonatal mortality in these studies [28-30].

As this study displayed (7.7%) of neonatal mortality originated from Respiratory failure and hypoglycemia. This agreed by study performed in Jimma University Medical Center that Respiratory failure and hypoglycemia were among of the causes of neonatal mortality [25].

Findings in this study showed that (6.4%) of neonatal mortality the caused by Low birth weight and congenital anomalies and hypothermia. Contrary to this finding causes of neonatal mortality were reported in several studies conducted in other centers and countries [31-34]. The difference may be due to the method of assigning the likely
causes of deaths or discrepancy in the distribution of trained human resources, quality of health care provided by the centers and socioeconomic status, as well as geographical locations.

Limitations of the Study
Since the study was retrospective survey, secondary data was collected and then analyzed. In such cases, documents may not be very demonstrative for the wider population or this may inevitably be intricate by incomplete data due to missed information in the record.

5. Conclusion and Recommendations
This study revealed that the Prevalence of neonatal mortality is unacceptably high in the study area compared to the results of different studies in this country and outside.
The causes of neonatal mortality at this center are similar to those reported from other areas. The Majority of neonates in this hospital die from preventable conditions, including infections, prematurity, multi organ failure, along with respiratory failure and hypoglycemia. Hence, they could be prevented through effective neonatal infection prevention and interventions antenatal care, supervised delivery and training of caregivers in neonatal resuscitation, and improved care of newborns having respiratory problems would improve neonatal survival.

Furthermore, studies applying strong designs like prospectively should be conducted to discover more maternal, neonatal and care related characteristics.

Acknowledgements
We would like to extend our gratitude Sultan Hassan Yabare Referral Hospital research center for providing the ethical clearance to conduct the study in the facility.
We would also like express our gratitude and sincerity to the data collectors for their modest cooperation and diligent work.

References
[1] Wardlaw, T., et al., UNICEF Report: enormous progress in child survival but greater focus on newborns urgently needed. Reproductive health, 2014. 11 (1): p. 82.
[2] Kebede, B., et al., Prevalence and associated factors of neonatal mortality in North Gondar Zone, Northwest Ethiopia. Ethiopian Journal of Health Development, 2012. 26 (2): p. 66-71.
[3] Guevera, Y., World Health Organization: Neonatal and perinatal mortality: country, regional and global estimates. 2006.
[4] UNICEF, Levels and trends in child mortality (Report 2014). New York, NY: UNICEF. World Health Organization, World Bank, & United Nations, 2014.
[5] Organization, W. H., Neonatal and perinatal mortality: country, regional and global estimates. 2006.
[6] Lucas, A. O., B. J. Stoll, and J. R. Bale, improving birth outcomes: meeting the challenge in the developing world. 2003: National Academies Press.
[7] Walker, N., Y. Tam, and I. K. Friberg, Overview of the Lives Saved Tool (LiST). BMC Public Health, 2013. 13 Suppl 3: p. S1.
[8] Bhutta Z A, et al., Can Available Interventions End Preventable Deaths in Mothers, Newborn Babies, and Stillbirths, and at What Cost? The Lancet, 2014. 384 (9940): p. 347–70.
[9] Lucia Hug, et al., Levels and trends in child mortality. Report 2019. Estimates developed by the UN Inter-agency Group for Child Mortality Estimation. 2019.
[10] Organization, W. H., Global Health Observatory (GHO) data: Neonatal Mortality. 2016.
[11] Hug, L., D. Sharrow, and D. You, Levels & trends in child mortality: report 2017. Estimates developed by the UN Inter-agency Group for Child Mortality Estimation. 2017.
[12] CSA, C. S. A., Ethiopian Demographic and Health Survey 2016 2016, The DHS Program ICF Rockville, Maryland, USA Central Statistical Agency. p. 123-125.
[13] CSA, Population and Housing Census of Ethiopia, C. S. Agency, Editor. 2015: Addis Ababa.
[14] Farah, A. E., A. H. Abbas, and A. T. Ahmed, Trends of admission and predictors of neonatal mortality: A hospital based retrospective cohort study in Somali region of Ethiopia. PloS one, 2018. 13 (9): p. e0203314.
[15] Tewabe, T., et al., Neonatal mortality in the case of Felege Hiwot referral hospital, Bahir Dar, Amhara Regional State, North West Ethiopia 2016: a one-year retrospective chart review. Italian journal of pediatrics, 2018. 44 (1): p. 57.
[16] Debelew, G. T., M. F. Afework, and A. W. Yalaw, Determinants and causes of neonatal mortality in Jimma Zone, Southwest Ethiopia: a multilevel analysis of prospective follow up study. PLoS one, 2014. 9 (9): p. e107184.
[17] Kokeb, M. and T. Desta, Institution Based Prospective Cross-Sectional Study on Patterns of Neonatal Morbidity at Gonder University Hospital Neonatal Unit, North-West Ethiopia. Ethiop J Health Sci, 2016. 26 (1): p. 73-9.
[18] Mekonnen, T., et al., Assessment of Neonatal Death and Causes among Admitted Neonates in Neonatal Intensive Care Unit of Mizan Tepi University Teaching Hospital, Bench Maji Zone, South-West Ethiopia, 2018. Clinics Mother Child Health, 2018. 15 (305): p. 2.
[19] Adetola, A. O., et al., Neonatal mortality in an urban population in Ibadan, Nigeria. Pediatrics & Neonatology, 2011. 52 (5): p. 243-250.
[20] Matendo, R. M., et al., Challenge of reducing perinatal mortality in rural Congo: findings of a prospective, population-based study. Journal of health, population, and nutrition, 2011. 29 (5): p. 532.
[21] Sahle-Mariam, Y. and Y. Berhane, Neonatal mortality among hospital delivered babies in Addis Ababa, Ethiopia. Ethiopian Journal of Health Development, 1997. 11: p. 275-282.
[22] Mengesha, H. G. and B. W. Sahle, Cause of neonatal deaths in Northern Ethiopia: a prospective cohort study. BMC public health, 2017. 17 (1): p. 62.
[23] Edmond, K. M., et al., Etiology of stillbirths and neonatal deaths in rural Ghana: implications for health programming in developing countries. Paediatric and perinatal epidemiology, 2008. 22 (5): p. 430-437.

[24] Demisse, A. G., et al., Patterns of admission and factors associated with neonatal mortality among neonates admitted to the neonatal intensive care unit of University of Gondar Hospital, Northwest Ethiopia. Pediatric health, medicine and therapeutics, 2017. 8: p. 57.

[25] Seid, S. S., et al., Causes and factors associated with neonatal mortality in Neonatal Intensive Care Unit (NICU) of Jimma University Medical Center, Jimma, South West Ethiopia. 2019. 10: p. 39.

[26] Jehan, I., et al., Neonatal mortality, risk factors and causes: a prospective population-based cohort study in urban Pakistan. Bulletin of the world Health Organization, 2009. 87: p. 130-138.

[27] Zeinalzadeh, A. H., R. Khodaei, and M. Heidarzadeh, Causes of Neonatal Mortality in the Neonatal Intensive Care Unit of Taleghani Hospital. Iranian Journal of Neonatology IJN, 2017. 8 (3): p. 58-61.

[28] Wilkinson, J. D., et al., Outcome of pediatric patients with multiple organ system failure. Crit Care Med, 1986. 14 (4): p. 271-4.

[29] Wilkinson, J. D., et al., Mortality associated with multiple organ system failure and sepsis in pediatric intensive care unit. J Pediatr, 1987. 111 (3): p. 324-8.

[30] Hamshary, A., et al., Prevalence of multiple organ dysfunction in the pediatric intensive care unit: Pediatric Risk of Mortality III versus Pediatric Logistic Organ Dysfunction scores for mortality prediction. Rev Bras Ter Intensiva, 2017. 29 (2): p. 206-212.

[31] Chowdhury, H. R., et al., Causes of neonatal deaths in a rural subdistrict of Bangladesh: implications for intervention. Journal of health, population, and nutrition, 2010. 28 (4): p. 375.

[32] Mmbaga, B. T., et al., Cause-specific neonatal mortality in a neonatal care unit in Northern Tanzania: a registry-based cohort study. BMC pediatrics, 2012. 12 (1): p. 116.

[33] Baiden, F., et al., Trend and causes of neonatal mortality in the Kassena–Nankana district of northern Ghana, 1995–2002. Tropical medicine & international health, 2006. 11 (4): p. 532-539.

[34] Rai, S. K., et al., Causes of and contributors to infant mortality in a rural community of North India: evidence from verbal and social autopsy. BMJ open, 2017. 7 (8): p. e012856.