PREDICTORS OF MORTALITY AMONG NEONATES HOSPITALIZED WITH NEONATAL SEPSIS AT DURAME GENERAL HOSPITAL, SOUTHERN ETHIOPIA, CASE CONTROL STUDY

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ABSTRACT

BACKGROUND: Neonatal sepsis, resulted from bacterial, viral and fungal invasions of the blood stream is the major cause of neonatal mortality and neurodevelopmental impairment among neonates. It is responsible for more than one third of neonatal deaths in Ethiopia. Assessing and preventing the predictors of mortality in neonatal sepsis helps to reduce the burden of neonatal mortality.

OBJECTIVES: To determine predictor of mortality among neonate admitted with sepsis at durame general hospital, southern Ethiopia, 2020.

METHODS: Institution based case-control study was carried-out using secondary data among a 219 neonates (55 cases and 164controls) in Durame General Hospital (DGH), march 2020. Neonates admitted with sepsis and died were considered as cases and neonates admitted with sepsis and survived (discharged alive) as controls. Cases were selected by taking the deaths of neonates consecutively among those neonates admitted with the diagnosis of neonatal sepsis. The next immediate three corresponding controls were selected by lottery method from the NICU case registration book. Data was collected by using structured pretested checklists from neonates' record and then entered into Epi data version 3.1 and exported to SPSS version 20. Logistic regression was used to identify the predictors of mortality. Statistical significance was declared at $P<0.05$.

RESULTS: A total of 55 cases and 164 controls were included in this study. More than three quarters (81.8%) of cases had early onset sepsis. The multivariable logistic regression analysis showed that predictors of mortality in this study were; poor feeding [AOR = 4.15; 95% CI (1.64, 10.49), p-value=0.003], respiratory distress [AOR = 2.72; 95% CI (1.31,5.61), p-value=0.007], estimated gestational age less than 37 weeks [AOR = 4.64; 95% CI (2.17, 9.91) p-value=<0.001], and convulsion [AOR = 3.13; 95% CI (1.12, 8.76) p-value=0.030].

CONCLUSION: Generally this study concludes that; prematurity, convulsion, poor feeding and respiratory distress are the predictors of sepsis-related neonatal mortality. These factors are preventable and manageable by good antenatal care, intrapartum care, and neonatal care.

KEY WORD: neonatal sepsis, neonatal mortality, durame general hospital, Ethiopia

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ACRONYMS AND ABRIVIATIONS

ANC – Antenatal care

APGAR- Appearance, pulse, grimace, activity, respiration

CBC- complete blood count

DGH- Durame general hospital

EDHS- Ethiopian demographic and health survey

EGA-estimated gestational age

EONS- Early onset neonatal sepsis

HCT- Heamatocrite

HGB- Hemoglobin

HIV- Human immunodeficiency virus

IMNCI- Integrated management of childhood illnesses

LBW-Low body weight

LONS-Late onset neonatal sepsis

MAS- Meconium aspiration syndrome

NICU- neonatal intensive care unit

PNA- perinatal asphyxia

PROM- Premature rupture of membrane

RBC- Red blood cells

RBS- Random blood sugar

SDGs- Sustainable development goals

SNNPR- South nation nationalities and peoples region

SVD- Spontaneous vaginal delivery

VLBW- very low body weight

WBC- white blood cells

WHO- World health organization

Acknowledgment

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CHAPTER 1

1. INTRODUCTION

1.1 BACKGROUND

Neonatal sepsis is defined as a clinical syndrome of bacteremia with systemic signs and symptoms of infection in the first 28 days of life. It can also be resulted from viral and fungal invasions of the blood stream(1). It is considered as a case in the existence of suspected or confirmed infection in the neonate and includes many systemic infections of the newborn like septicemia, meningitis, pneumonia, arthritis etc, but it does not encompass superficial muco-cutaneous infections like thrush(2). Neonatal sepsis is divided into early- and late-onset sepsis, based on timing of infection and presumed mode of transmission. Early-onset sepsis (EOS) is defined by onset in the first week of life, with some studies limiting EOS to infections occurring in the first 72 hours due to maternal intrapartum transmission of invasive organisms. Late-onset sepsis is usually defined as infection occurring after 1 week and is attributed to pathogens acquired postnatally (3).

Neonatal sepsis is a great masquerader that poses diagnostic challenge due to non-specific symptoms and variable laboratory parameters. Due to this lots of other conditions can mimic sepsis leading to both over- and under diagnosis and treatment which is very dangerous. World health organization (WHO) has recognized seven clinical indicators [difficulty feeding, convulsions, movement only while stimulated /lethargy, respiratory rate of >60 breaths in a minute, chest in drawing, or axillary temperature of >38 °C or <36 °C and respiratory distress](4). Another study has additionally incorporated cyanosis and grunting (4). Again the laboratory investigations like the screening tests lack specificity and are not available at many centers in developing countries. Positive blood culture is the gold standard for the diagnosis of neonatal sepsis, but it is positive in 50%–80% at best and negative blood culture does not confirm absence of the disease (5).

Neonatal period starts at birth and includes the first 28 days of life and subdivided in to very early [birth to 24 hours], early [birth to7days] and late [7 to 28 days]. This period is the most risky time for child survival (1)**.** During this period, marked physiologic transitions occur in all organ systems and they learn to respond to many forms of external stimuli, which implies that this period is a highly exposed time as they are completing many of the adjustments required for extra-uterine survival(6). In this period, the immaturity of the immune system, particularly in premature infants, confers distinctive clinical, physical and outcome

characteristics to infections compared with other age groups. In addition inherent factors like poorly developed and immature skin barrier, mucosal defense mechanisms and blood brain barrier contribute to the increased susceptibility of the neonates to infection(6). As a result neonates are more vulnerable to a broad range of pathogens, including those of generally low virulence such asListeria, par echoviruses or Candida(7).

Neonatal mortality is the death of neonates that happens within the first 28th day of life. It is also divided into early neonatal mortality which is before the seventh day of life and late neonatal mortality which is occurring thereafter(8). Sepsis is a major cause of neonatal mortality and neurodevelopmental impairment among neonates. Neonatal sepsis results in death and major disability for 39% of those affected even with timely antibiotic treatment(9).Globally, it is estimated that more than 1.4 million neonatal deaths annually are the consequence of invasive infections (10). Infection-specific mortality vary by geographic region and neonatal risk factors like gestational age and body weight (11). It contributes to nearly 30-50 % of neonatal deaths in developing countries (12). For resource-limited settings like Ethiopia, it is recommended that initiation of treatment for sepsis should be prompted by clinical signs of possible serious bacterial infection(13). As a result, identification of the risk factors that can predict mortality may contribute for risk based diagnosis and better interventions of neonatal sepsis that help to reduce the burden of neonatal mortality resulting from these risks.

1.2 STATMENT OF THE PROBLEM

Globally, approximately 7000 newborns die every day. In 2016, around 2.6 million deaths occurred during neonatal Period (14). Near one-third of these is due to neonatal sepsis. It is the 3rd (following preterm birth complications (35 %) and intra-partum related complications (24 %)) most common cause of neonatal death with 0.401 million deaths in 2015 (15). It is estimated that 2202 neonates per 100 000 live births develop neonatal sepsis with mortality of 11–19%, which translates to an annual incidence of 3million cases globally(16). Neonatal sepsis is responsible for 1.6 times the global number of childhood mortality due to malaria, and over four times the number of childhood deaths caused by HIV(17). This shows neonatal sepsis is still among the leading causes of neonatal mortality and morbidity throughout the globe.

In spite of recent advances in neonatal care, the impact of neonatal sepsis remains marked in developing countries(18). An estimated 6·9 million newborns are reported to have a possible serious bacterial infection (PSBI) every year in sub-Saharan Africa, south Asia, and Latin America (19). In sub Saharan Africa, neonatal sepsis is responsible for seventeen percent of all neonatal death as compared to only six percent in developed countries(20). Numerous factors contribute to this infections and consequent mortality. These include immediate causes such as lack of antenatal care, home deliveries, prematurity, low body weight, and delays in recognition of danger signs(11).

It is tragic that millions of newborn die every year specially when their deaths are so easily preventable. It is estimated that about 75% of neonatal deaths could be avoided with simple, low cost tools that already exist such as antibiotics for pneumonia and sepsis, sterile blades to cut the umbilical cords using knit caps and kangaroo care to keep babies warm(1). To improve the survival of neonates, efforts should be targeted to decrease neonatal sepsis specially in sub-Saharan Africa and South Asia (the two regions with high neonatal mortality) (21). To achieve sustainable development goal (SDG), reducing newborn and under five mortality as low as12/1000 and 25/1000 respectively, is one of the global strategies of WHO in African countries by 2030(22). This could be achieved through better prevention and management of preterm births and severe infections as the key(23).

In the era of millennium development goal (MDG) (2000–15) slower progress was observed in reduction of neonatal mortality relative to under five mortality(24). Therefore, in a post-MDG (2015) development agenda, it is important to focus on specific causes of death in this age group and preventable causes in particular to establish strategies to reduce infant

mortality in developing counties like Ethiopia. While cause-specific mortality varies between settings, yet availability of such information is very limited in our countries context.

In Ethiopia, about 89,000 babies die every year in the first four weeks of life. This accounts for 44% of all deaths in children younger than five years of age. The risk of death is highest in the first 24 hours of life when more than half of deaths occur and about three- quarters of all neonatal deaths occur within the first week of life(25). In 2019 Ethiopian mini demographic health survey (EDHS) reported neonatal mortality rate (NMR) as 30/1000 live births, which is almost similar with 2016 report which was 29/1000 live births with no reduction (26). One third of these deaths is highly attributed to neonatal sepsis which is among the leading cause of neonatal death in Ethiopia, (27). A recent community based study in rural part of Ethiopia also reported sepsis as the leading cause of neonate death [32.5% of the all neonate death](28).

According to 2016 EDHS result there were a great regional variation in neonatal mortality and SNNPR were among high mortality areas with 35 losses per 1000 live births(25). In the Durame general hospital according to HMIS repot of the hospital about two third of the NICU admissions have neonatal sepsis. Furthermore, there are study gaps on determining risk factors for cause-specific neonatal deaths especially sepsis related mortalities in neonatal intensive care unit in our countries context in general and in the study area in particular. Even though, several studies have conducted on neonatal sepsis they mainly focus on epidemiology and didn't addressed outcome of the disease and are mostly cross-sectional which is not preferable for causal inference. Despite of this many studies have confirmed sepsis as the major cause of neonatal death(29,30). This study focuses on determining of predictors of sepsis-related neonatal deaths using methods of multiple logistic regression models. It will investigate the major risk factors of sepsis related death which will help to guide health professionals and health policy makers to identify indicators for monitoring strategies and applying appropriate preventive measures to decrease infant mortality.

CHAPTER 2

2. LITERETURE REVIEW

2.1MAGNITUDE OF SEPSIS RELATED MORTALITY

Even through sepsis related mortality seriously affected low-income country, it is a major public health problem throughout the world. Sepsis related mortality ranged from 11% in the USA to 19% in India(16). According to study conducted in Thailand there were 50 deaths among 285 cases admitted with blood culture positive sepsis(31). Another study in Vietnam showed the case fatality rate of 46% among confirmed cases of late onset neonatal sepsis (32). Similarly, a study conducted in Kathmandu in Nepal showed that the NICU prevalence rate of neonatal sepsis was 47.7% with high rate of associated morality(71.43% of the total mortalities)(33). Another study conducted in south Asia revealed that, the pooled incidence of culture positive sepsis in hospital based reports were 15.8 per 1000 live births and one-third of neonates died from this condition (34). The finding reported from a study in Korea also showed the overall mortality among early onset sepsis cases as 37.8%. The death rate was the highest (47.1%) during the first 3 days after infection, (23.5%) after 4–7 days, and (29.4%) after 8–14 days(35).

According to systematic review conducted using studies from developing countries, the overall mortality due to sepsis for admitted neonate ranges from 14.6 to 36.0%(36). A study in southeastern Mexico reported overall mortality rate of 9.5% among sepsis cases(18). Similar finding (sepsis Case fatality of 9.6) was also reported in India(37). However, other studies in India reported higher mortality rates of 45.9%(38) and 30%in neonates with sepsis(39). A recent study from the Nigeria also supported this reports (mortality rate of 38.24% in outborns with neonatal sepsis)(5).

According to systematic review conducted to show burden of neonatal sepsis in under resource setting infections were responsible for 8% to 80% of all neonatal deaths and as many as 42% of deaths in the first week of life in developing countries(11). The study conducted at Brazil reported 13% death among the neonates with late onset sepsis (24). Another study from Nigeria also reported death rates of 32.2% among newborn infants with sepsis (40). A study in Egypt found that mortality rate among sepsis cases (sepsis fatality rate) was about 25%(41). Similarly, a research done in Tanzania indicated that overall death rate in NICU were higher in neonates with sepsis (24.3%) than those without (p=0.003)(42). Consistent finding is also reported from Sudan (sepsis mortality rate of 24.1%). Study

conducted at Arsi in Ethiopia found the prevalence of clinical neonatal sepsis in NICU to be 34%(43). However according to the findings of study conducted in Shashemene the overall prevalence was 77.9%(12). Similarly, study conducted at Gondar supported this finding of high prevalence (63.69%).According to the finding of kersa health and demographic surveillance, bacterial sepsis of the newborn is responsible for 31.2 % of the deaths in neonatal period(29). Another study in Gondar showed that mortality rate among neonates with sepsis as 8.84%(44).

2.2 SOCIO-DEMOGRAPHIC PREDICTORS OF MORTALITY IN NEONATES WITH NEONATAL SEPSIS

Different studies have confirmed male sex as predictor of mortality in neonates with septicemia (5,37). However, a study from India reported significant association of female gender with poor outcome(45). The risk of neonatal mortality among offspring of women who had a partner co-resident was 18 times lower as compared with offspring of mothers without a partner co-resident in the household (42). According to Systematic Review conducted in Developing Countries age of the neonate at presentation was significant predictor of mortality in newborn infants with sepsis (36).

Similar finding was also reported in South India in which age at admission and duration of hospital stay were the independent risk factors of mortality in newborns with neonatal sepsis. Also the study showed that death due to respiratory distress syndrome was common in male neonates(37). Other study in Thailand confirmed that, early onset septicemia ($P<0.001$) had significant association with fatality(31). In Ethiopia study conducted at Jimma medical center revealed that Male gender, neonatal age at admission ≤7days, urban residency of the family and maternal age >35years were independent predictors of in hospital mortality(46).

2.3 MATERNAL AND NEONATAL PREDICTORS OF MORTALITY IN NEONATAL SEPSIS

According to the finding of a study conducted in France, weight at the onset of sepsis was significant predictors of mortality among neonatal with sepsis(47). In another study in southeastern Mexico a marked difference in the mortality rate was reported between early- and late-onset sepsis. This study also found neonatal factors like prematurity, low body weight, low Apgar score, perinatal asphyxia and the requirement of any invasive medical or surgical procedure as significant predictors of mortality in newborns with sepsis(18). Similarly, the findings of a study in Srinagarind hospital in Thailand confirmed that low

Apgar scores in 1and 5 minute, VLBW and prematurity were all significantly associated with fatality. Additionally in the study Laboratory results like hyperglycemia and thrombocytopenia, clinical features like lethargy, apnea, poor feeding, hypothermia, and jaundice were significant contributors to fatality(31). In another study in Turkey low body weight, mechanical ventilation and parental nutrition were found to be significant risk factors of mortality(48).

According to Systematic Review conducted in Developing Countries neonatal factors, like prematurity and low birth-weight were most frequently associated with mortality (36). Similarly, the finding of a study in Korea revealed that there were significant differences in terms of gestational age and body weight between the death and survival groups of neonates. Additionally, decreased activity in the early phase of infection, and neutropenia were identified as predictors of poor outcomes in the study (35). Again in a study in India, body weight ≤1.5 kg, shock and lethargy were proved to be independent predictors of mortality(49). Study at Kathmandu in Nepal attested Congenital anomaly, LBW, birth asphyxia and preterm birth as predictors of mortality among the neonates with sepsis(33). According to a study conducted in central India preterm with weight <1500 g on admission and admission with clinical features such as hypothermia , respiratory distress , apnea, cyanosis , prolonged capillary refill time and convulsion were the significant neonatal risk factors for mortality of neonates with sepsis(50).

Maternal factors like place of delivery was identified as predictors of mortality in the neonates with sepsis(40). Similarly place of delivery, place of antenatal care and neonatal related factors like respiratory distress, poor cry and convulsion were reported as predictors of mortality by a study in Nigeria(51). Other factors like length of hospital stay was also reported as the independent risk factors of mortality in out born with neonatal sepsis(5). Another study which was conducted in Iraq showed that there were significant relation of mortality to respiratory distress syndrome, hypoxic ischemic encephalopathy, preterm delivery, low birth weight, vomiting, apnea, sclerema, cyanosis and tachypnea (52). In addition, the death rate was higher in neonates with maternal history of prolonged rupture of membrane ≥24 hours (61.5%) compared to (39.4%) in neonates with maternal history of rupture membrane of < 24 hours before labor. The clinical sign like signs of dehydration (82.8%) and prolonged capillary refilling time also predicted the high chance of mortality**.** Other factors such as babies with previous hospitalization, babies that have been delivered at home and history of acute suffering especially with respiratory distress also showed

significant association with mortality(53). In Indonesia the body weight and prematurity were significantly associated with mortality with neonatal sepsis(54).

According to a study in Khartoum in Sudan the deaths were highly associated with early onset sepsis, prematurity and LBW. Another study in Nigeria demonstrated that EGA less than 32 weeks (odds ratio [OR], 5.5), respiratory distress (OR, 3.4), abdominal distension (OR, 2.7), poor skin color (OR, 3.3), and hypoglycemia (OR, 5.2) had significant contributions to the occurrence of death among babies with culture-proven septicemia(40).

In Ethiopia studies showing neonatal sepsis related mortality and its predictors is very scarce. According to study which was conducted in Bahirdar, respiratory distress syndrome and meconium aspiration syndrome were the determinant factors for poor outcome of neonatal sepsis(3). In another study conducted in Addis Ababa, sepsis related mortality within 7-28 days was 1.8 times more likely to occur as compared to dying within first week of life. Also in the study neonatal hypothermia was identified as determinant factor of mortality (55). Similar result were again reported in a study done at Jimma medical center in which convulsion and hypothermia on admission and laboratory results like low red blood cell count and thrombocytosis were significant predictors of mortality(46). Another study in at tikur ambassa specialized hospital revealed that neonatal sepsis is responsible for death of 74.1% of premature neonates(56). The findings of a study using data from kersa health and demographic surveillance confirmed that, birth asphyxia, prematurity and respiratory distress were major determinants of neonatal death (29).

2.4 CONCEPTUAL FRAMEWORK

This conceptual framework was developed after systematic and careful review of different literatures which are related to neonatal sepsis(1,6,21,57). It shows the possible relation of sepsis related neonatal death with different independent variables. There was a stated association on sepsis related neonatal death with maternal factors, socio-demographic characteristics and neonatal factors

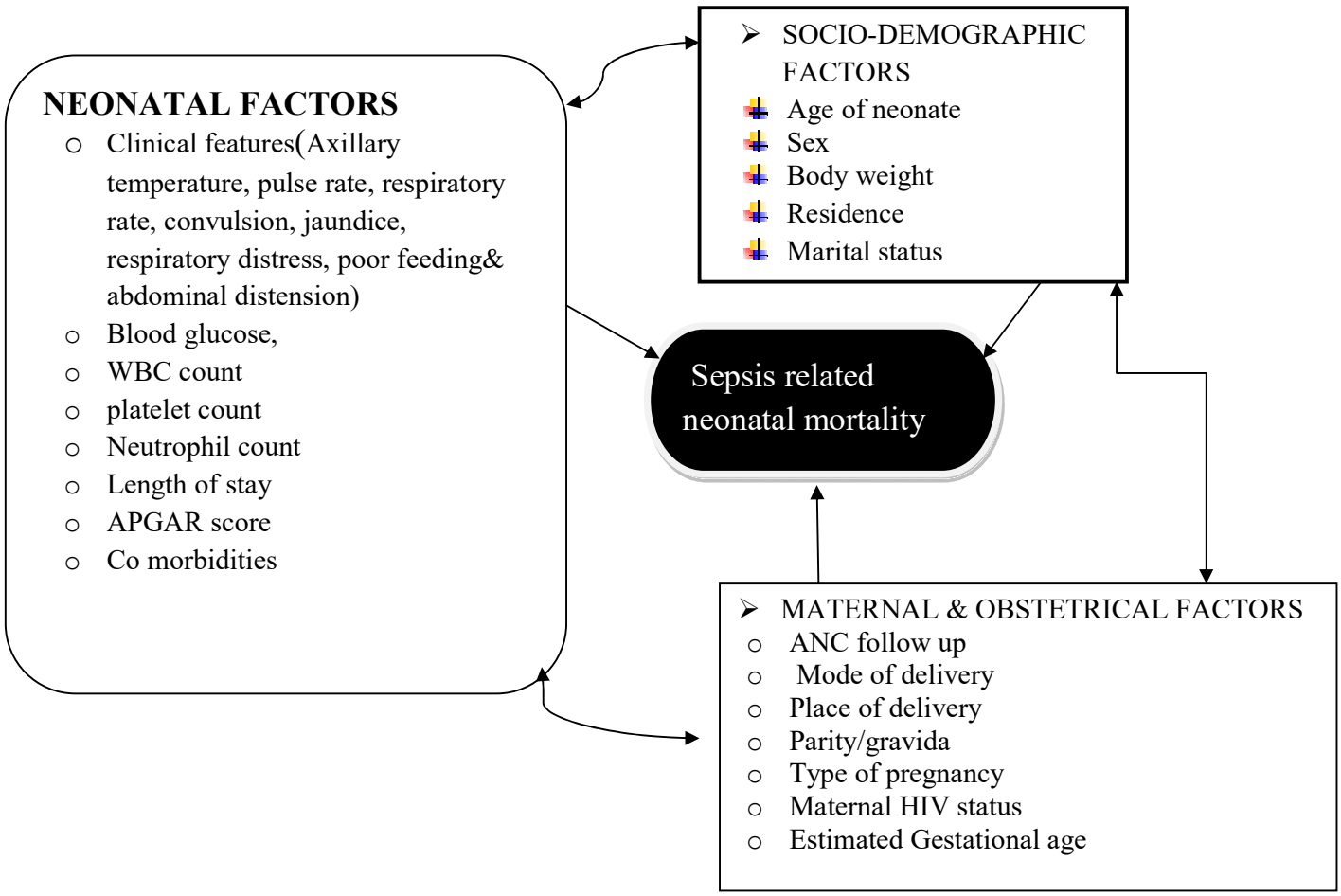

Figure 1: Conceptual framework to assess predictor of mortality among neonate admitted with sepsis at DGH, Durame, Southern Ethiopia, 2020

2.5 SIGNIFICANCE OF THE STUDY

Assessing predictors of mortality among neonates with sepsis helps to reduce the burden of neonatal mortality. **T**hus, the findings of this study will be used as inputs for clinicians, decision makers and program planners at national, regional as well as local levels to formulate strategies to achieve sustainable development goal (SDG) targets for neonates. In addition, it helps health professionals for earlier screening and treatment, by giving health education to mothers before and after delivery and creates awareness to the community about different danger signs for the neonates. It will also have a valuable input for the development of the profession particularly for risk based care of newborns and young infants. Besides, it will serve as a baseline data for further research.

CHAPTER 3

3. OBJECTIVES

3.1 General Objective

To identify predictor of mortality among neonates admitted with neonatal sepsis at durame general hospital, Kembata tambaro zone, southern Ethiopia, 2020.

CHAPTER 4

4. METHODS AND MATERIALS

4.1 STUDY AREA AND PERIOD

This study was conducted in Durame General Hospital (DGH), which is one of the four hospitals in Kembata tambaro zone situated in SNNPR, Kembata tambaro Zone, in Durame town. It is located 352 kilometers from Addis Ababa, the capital. The hospital is providing services for approximately 1.5 million people in its catchment area. The pediatrics department has six units that include outpatient and follow up units, ETAT (Pediatrics emergency triage, assessment and treatment unit), neonatal intensive care unit (NICU), surgical unit, nutritional rehabilitation unit and medical unit. The NICU is rendering service under critical newborn care unit, septic ward, kangaroo mother care (KMC) and mother side and receives 50 to 90 neonates monthly. Currently One pediatrician, five general practitioners and 8 trained and neonatology specialty nurses are providing service in the unit. Investigational modalities including electrocardiography (ECG), ultrasound, x-ray and basic hematologic and chemistry tests are readily available. The study was conducted from March 8 to 30, 2020.

4.2 STUDY DESIGN

Institution based unmatched case-control study was conducted among neonates admitted in NICU.

4.3 POPULATION

4.3.1 Source Population

All neonates admitted to Neonatal Intensive Care Unit (NICU) with the diagnosis of either early onset or late onset neonatal sepsis in the hospital.

4.3.1 Study Population

All sampled neonates who fulfill the inclusion criteria among the newborns admitted due to neonatal sepsis in the study period.

Definition of cases and controls:

Cases: Neonates who were diagnosed as neonatal sepsis by attending physician and died (registered as sepsis related death by attending physician) were assigned as the case group. In this study hematological criteria along with the established IMNCI (Integrated Management of Neonatal and Childhood Illness) clinical features of neonatal sepsis were used to diagnose

neonatal sepsis. Neonates in the presence of one or more of the established IMNCI clinical features [either of fever (>38°C) or hypothermia (<36°C), fast breathing (>60 breath per minute), severe chest indrawing, poor feeding, movement only when stimulated, convulsion, lethargic or unconscious] along with two of the hematological criteria; total leukocyte count (<5000 or >12000 cells/m3, absolute Neutrophil count (<1500 cells/mm^3 or >7500cells/mm^3), erythrocyte sedimentation rate (ESR) (>15/1 h) and platelet count (<150 or >440cells/mm^3) were considered as having neonatal sepsis.

Controls: Newborn admitted with diagnosis of neonatal sepsis who discharged alive (improved) were assigned as the control group

4.4 Inclusion and exclusion criteria

4.4.1 Inclusion criteria

All neonates with features of sepsis (diagnosed as either LONS or EONS) admitted at neonatal unit of Durame general hospital during the study period.

4.4.2 Exclusion criteria

- A neonate with incomplete records and records or chart not available at the time of data collection.
- Those neonates who were transferred to other hospitals or referred before the outcomes can be assessed.
- Neonates left the hospital against medical advises (withdrawn treatment) were excluded from analysis

4.5 SAMPLE SIZE DETERMINATION AND SAMPLING PROCEDURES

4.5.1 SAMPLE SIZE CALCULATION

The sample size was determined by using Epi info version 7 stat calc program by considering the following assumptions:

- power 80%, 95 confidence interval and the ratio of case to contro1:3
- Significant predictors obtained from previous studies [Respiratory distress, hypoglycemia, estimated gestational age less than 32wks, poor skin color and abdominal distention (40) were used to calculate the largest sample size.
- Accordingly, abdominal distension gave the maximum sample size among the predictor variables and is used to calculate the sample size for the study.

Percent of controls who are exposed were 44.1%, odds ratio of 2.7% and 10% for incomplete records. This yields the sample size of 219(55 cases and 164 controls) as shown in the table below.

Table 1: predictor variable used to compute sample size using Epi info software version 7 with the total sample size, january 2020.

Sr. no	Predictor variable	% of control exposed	OR	Total sample size
1	Hypoglycemia	35.1	5.2	79
2	Estimated gestational age<32 wks	9.9	5.5	104
3	Respiratory distress	30.6	3.4	132
4	Poor skin color	22.5	3.3	148
5	Abdominal distention	44.1	2.7	199
After adding 10 % for incomplete records				219

4.5.2 SAMPLING PROCEDURES

Cases were selected by taking the deaths of neonates consecutively among those newborn infants admitted with the diagnosis of neonatal sepsis in the neonatal intensive care unit of the hospital until the sample size is achieved. This retrospective sampling covering a period of one year extended from January 1st to December 31, 2019. The next immediate three corresponding controls were selected by lottery method from the NICU case registration book.

4.6 STUDY VARIABLES

4.6.1 Dependent variable

- Sepsis-related neonatal death.

4.6.2 Independent variables

SOCIO-DEMOGRAPHIC FACTORS

- Age of neonate
- Sex
- Body weight
- Maternal residence
- Marital status

MATERNAL AND OBSTETRICAL FACTORS

- ANC follow up
- Mode of delivery
- Place of delivery
- Estimated gestational age
- Type of pregnancy (Multiple or single tone)
- Parity
- Maternal HIV status

NEONATAL FACTORS

- Temperature
- Pulse rate
- Respiratory rate
- Poor feeding
- APGAR score
- Jaundice
- Respiratory distress
- Skin color
- Abdominal distention
- convulsion
- Blood glucose
- WBC count
- platelet count
- Neutrophil count
- co morbidities
- Length of stay

4.7 DATA COLLECTION INSTRUMENT, PROCEDURES, AND QUALITY MANAGEMENT

The data collection procedure: the list of sampled neonatal septicemia patients medical record numbers were retrieved from neonatal intensive care unit case registration book. The patients' medical records (charts) were then collected from the hospital registry and checked for inclusion criteria. The medical records of eligible patients were reviewed and information transferred in to the data collection form (check list) by the data collectors.

The available data on the patient chart and NICU case registration book is observed and appropriate data extraction checklist is prepared in English. The check list was adapted from national neonatal registration book and previous related studies (27,57). Data were collected by two data collectors who have experience on data collection (one BSc nurses and one specialty in neonatology nurse) and one supervisor (general practitioner) using the structured checklist.

The data collectors were trained for two day on objectives of the study, selection of study participants (card), how to keep confidentiality of information, the contents of the questionnaire and how to fill the data collection format by the principal investigator. Intensive supervision was maintained during the whole period of data collection. The pre-test were performed on 5% random sample of registration form by principal investigator to conform the reliability of the data before the actual data collection. Proper coding and categorization of data were maintained for the quality of the data to be analyzed. Double data entry was used to ensure validity and compared with the original data.

4.8 DATA PROCESSING AND ANALYSIS

Data was checked for completeness and consistencies and then it was cleaned, coded and entered in to Epi data version 3.1 and it was exported to SPSS windows version 20 for analysis. Multi-colinearity was checked using variance inflation factor and value of VIF <10 were used as cutoff point to determine correlation between independent variables. The value of VIF was less than 4. Descriptive statistical techniques were used to obtain summary values for cases and controls separately. Bivariate analysis was performed to identify the crude association between dependent and independent variables. Then variables that show association in the bivariate model ($p<0.25$) were entered and analyzed in a multivariable logistic regression model by using backward stepwise method to identify the predictors of sepsis-related neonatal mortality. Model fitness were evaluated through inspection of

Hosmer–Lemeshow statistic test and provided (P = 0.514), which implies that the model's estimates fit the data at an acceptable level. Odds ratio (OR) was used to assess the strength and direction of association between factors associated with the occurrence of neonatal mortality. Statistical significance was declared at P<0.05. Finally, the result was presented in the form of texts, graphs and tables.

4.9 OPERATIONAL DEFINITIONS AND MEASUREMENT OF VARIABLES

Early onset neonatal sepsis (EONS): sepsis diagnosed within the first 7 days of life.

Late onset neonatal sepsis (LONS): sepsis diagnosed between 7 and 28 days of age.

Low APGAR SCORE: A neonate with an Apgar score of less than 7

Multiparty: Recorded parity of ≥2.

Respiratory distress: neonate having any of these signs; gasping, grunting, severe chest in drawing, nasal flaring or tacky/bradypnea or apnea.

Poor skin color: neonate having any of these signs; cyanotic, pale, grey, mottled, jaundiced, and erythematous including umbilical flare.

Normal white blood cell count: white blood cell count between 5-12x 103 cell/mm^3.

Normal platelet count: platelet count between 150-450 x 103 cell /mm3.

Normal blood glucose: blood glucose between 40mg/dl and 180mg/dl.

Hypoglycemia: A measure of low blood glucose (<40 mg/dl) that was diagnosed and recorded on charts by professionals on admission

Absolute Neutrophil count: Absolute Neutrophil count (<1500 cells/ µl or>7500 Cells/µl),

4.10 ETHICAL CONSIDERATION

Ethical clearance was obtained from JU institute of health science research committee. Then permission was obtained from clinical director and subsequent department and unit heads of the hospital. Following this, searching and obtaining of the selected samples' medical record was processed with the assigned persons. Finally, Care was taken from disclosing patients' records. Since, the study was done through reviewing of medical records, the individual patients may not be subjected to harm as much as the confidentiality is kept. To keep the confidentiality all collected data was coded and locked in a separate room before entered into the computer and names will not be included in the data collection format. After entered to the computer the data was locked by password, and the data was not disclosed to any person other than principal investigator.

4.11 RESULT DISSEMINATION PLAN

The result of the study will be submitted and presented to Jimma University institute of health, Department of epidemiology. The study result will also be submitted to DGH and the finding will be presented in locally or internationally held seminars, workshops, conferences and meetings and it will be published in internationally or nationally recognized journals.

CHAPTER 5

5. RESULT

5.1. DESCRIPTIVE STATISTICS RESULTS

5.1.1. Socio-demographic characteristics of the respondents

A total of 219 neonates (55 cases and 164 controls) who were admitted in NICU were included in this study. According to this study, the mean age of the study participants were 5.35(S.D ±4.77) days and majority of them 45(81.8%) of cases and 106(64.6%) controls) were in the age group of less than seven days (EONS). Most of the participants were from rural areas (61.8% of cases and 53.0% of controls) and more than half 28(50.9% of cases and 91(55.5%) of controls were males. Concerning marital status of the mothers, 53(96.4%) of cases and 160(97.6%) controls were married. Regarding body weight of the neonates majority of the cases 36(65.5%) had body weight of less than 2.5kg whereas majority of the controls 102(62.2%) were in the category of greater than 2.5kg. (**Table** 2)

Table 3: Socio demographic characteristics of the study participants in Durame general hospital, Kembata tambaro zone, southern region, Ethiopia, 2020

Variable	Responses	Case	Control	Total
Sex	Male	28(50.9)	91(55.5)	119(54.3)
	Female	27(49.1)	73(44.5)	100(45.7)
Residence of the mother	Urban	21(38.2)	77(47.0)	98(44.7)
	Rural	34(61.8)	87(53.0)	121(55.3)
Marital status of the mother	Single	2(3.6)	4(2.4)	6(2.7)
	Married	53(96.4)	160(97.6)	213(97.3)
Age	≤7 days	45(81.8)	106(64.6)	151(68.9)
	>7days	10(18.2)	58(35.4)	68(31.1)
Body weight	<2.5kg	36(65.5)	62(37.8)	98(44.7)
	≥2.5kg	19(34.5)	102(62.2)	121(55.3)
Total		55	164	219

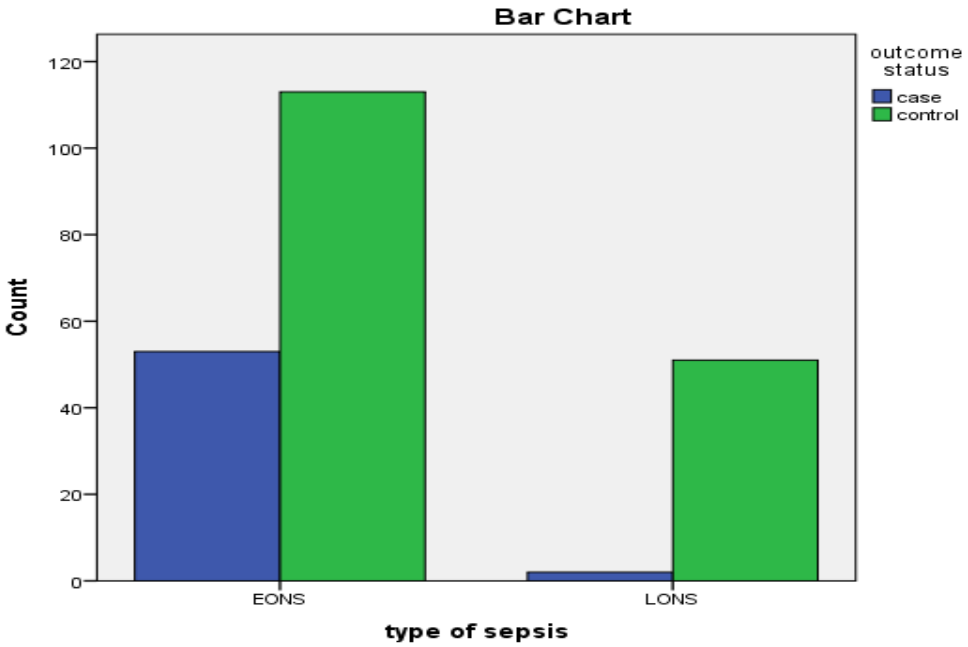

Figure 2: Distribution of types of sepsis among the cases and controls at hospital, durame general hospital, southern Ethiopia, 2020

In this study most of the neonates 45(81.8%) of cases and about two third of controls 106 (64.6%) were admitted with the diagnosis of EONS (at the first week of their life) as shown on figure 2 above.

5.1.2. Descriptive statistics of maternal factors for mortality in neonatal sepsis

This study revealed that, most of mothers 52(94.5%) of cases and 156(95.1%) of controls had ever got ANC service during their pregnancy of the current neonate. The proportion of mothers who got ANC service less than three times is higher in cases 10(18.2%) than in controls 21(12.8%). Similarly the proportion of women who had multiple birth (twin birth and above) was higher in cases 3(5.5%) compared to controls 6(3.7%). Majority of women had given birth at health facility 51(92.7%) of cases and 150 (91.5%) of controls. Also in this study 22(40%) of the mothers among the cases and nearly three fourth among the controls 118(72.0%) were in the gestational age group of 37-42 completed weeks (term) whereas the proportion of mothers with gestational age <37 completed weeks was higher in cases 33(60%) than controls 46(28%). Regarding mode of delivery, majority 120(73.2) of controls and one third 37(67.3) of cases had spontaneous vaginal delivery. Women who had more than one birth (Miltipareous) were more 34(61.8%) among cases than controls 79(48.2%).

Table 4: Maternal characteristics of neonates for the study of predictors of mortality in neonatal sepsis in Durame general hospital, Kembata tambaro zone, southern region, Ethiopia, 2020

Variable	Responses	Case	Control	Total
		Count (%)	Count (%)	
Parity of the mother	Primipareous	21(38.2)	85(51.8)	106(48.4)
	Miltipareous	34(61.8)	79(48.2)	113(51.6)
Mode of delivery	svd	37(67.3)	120(73.2)	157(71.7)
	c/s	13(23.6)	35(21.3)	48(21.9)
	instrumental delivery	5(9.1)	9(5.5)	14(6.4)
Does the mother have ANC in recent birth	Yes	52(94.5)	156(95.1)	208(95.0)
	No	3(5.5)	8(4.9)	11(5.0)
N^{o} of ANC visit	1 to 3 visit	10(18.2)	21(12.8)	31(14.2)
	>3 visit	42(76.4)	135(82.3)	177(80.8)
Type of pregnancy	Single	52 (94.5)	158 (96.3)	210 (95.9)
	Multiple	3(5.5)	6(3.7)	9(4.1)
Place of delivery	Health facility	51(92.7)	150 (91.5)	201(91.8)
	Home delivery	4 (7.3)	14 (8.5)	18(8.2)
Maternal HIV status	Positive	1 (1.8)	2 (1.2)	3(1.4)
	Negative	51(92.7)	154 (93.9)	205 (93.6)
	Unknown	3(5.5)	8 (4.9)	11 (5)
Estimated gestational age in weeks	<37weeks	33(60.0)	46(28.0)	79(36.1)
	>=37weeks	22(40.0)	118(72.0)	140(63.9)
Total		55	164	219

5.1.3. Descriptive statistics of neonatal factors for mortality in neonatal sepsis

In this study the proportion of neonates with first and fifth minute APGAR score <7 (low APGAR score) was 27(49.1%) and 16(29.1%) in cases which was higher than controls 45(27.4%) and 17(10.4%) respectively. Among clinical features, most neonates 46(83.6%) of cases and 106(64.6%) of the controls had poor feeding at presentation. More than half of the cases 30(54.5% were presented with hypothermic appearance of their body temperature whereas most of the controls 81(49.4%) were presented with normal body temperature. Other clinical features recorded during admission where respiratory distress in 29(52.7%) and 57(34.8%), bradypnea in 13(23.6) and 11(6.7%), bradycardia in 8(14.5%) and 16(9.8%), abdominal distention 7(12.7%) and 13(7.9%), poor skin color in 9 (16.4%) and 19(11.6%) and convulsion 11(20.0%) and 14(8.5%) of cases and controls respectively. Regarding associated co morbidities perinatal asphyxia is more common among the cases 12(54.5%) and controls 16(38.1%) than the others. Other co morbidities recorded were meconium aspiration syndrome in 7(33.3%) and 16(37.2), congenital abnormality in 1(4.8%) and 4(9.3%) and others (anemia, skin infections, hyaline membrane disease, necrotizing enter colitis, birth injury) in 8(38.1%) and 15(34.9) of case and controls respectively. Among the sampled neonates 20(36.4%) of cases and 47(28.7%) of the controls have leukocytosis which was higher among cases than controls. Similarly, 16(29.1%) of cases and 36(22.0%)of controls have elevated Neutrophil count. Other hematological findings recorded were leucopenia, thrombocytopenia hypoglycemia and thrombocytosis in 7(12.7%) and 12(7.3), 12(21.8%) and 64(39.0%), 6(10.9%) and 11(6.7%) and 8(14.5%) and11 (6.7%), of cases and controls respectively as shown on (table 4).

Table 5: Description of neonatal characteristics for the study of predictors of mortality in neonatal sepsis in Durame general hospital, Kembata tambaro zone southern Ethiopia 2020.

Variable	Responses	Case Count (%)	Control Count (%)	Total
Axillary temperature	Normal body temperature	17(30.9)	81(49.4)	98(44.7)
	Hypothermia	30(54.5)	55(33.5)	85(38.8)
	Fever	8(14.5)	28(17.1)	36(16.4)
Respiratory rate	Normal RR	33(60.0)	120(73.2)	153(69.9)
	Bradypnea	13(23.6)	11(6.7)	24(11.0)
	Tachypnea	9(16.4)	33(20.1)	42(19.2)
Pulse rate	Normal PR	42(76.4)	135(82.3)	177(80.8)
	Bradycardia	8(14.5)	16(9.8)	24(11.0)
	Tachycardia	5(7.3)	13(7.9)	18(8.2)
Respiratory distress	Yes	29(52.7)	57(34.8)	86(39.3)
	No	26(47.3)	107(65.2)	133(60.7)
Poor feeding	Yes	46(83.6)	106(64.6)	152(69.4)
	No	9(16.4)	58(35.4)	67(30.6)
Abdominal distention	Yes	7(12.7)	13(7.9)	20(9.1)
	No	48(87.3)	151(92.1)	199(90.9)
Skin color	Poor	9(16.4)	19(11.6)	28(12.8)
	Good	46(83.6%	145(88.4)	191(87.2)
Have jaundice	Yes	8(14.5)	18(11.0)	26(11.9)

	No	47(85.5)	146(89.0)	193(88.1)
Have convulsion	Yes	11(20.0)	14(8.5)	25(11.4)
	No	44(80.0)	150(91.5)	194(88.6)
Fist minute APGAR score	Low APGAR score	27(49.1)	45(27.4)	72(32.9)
	High APGAR score	28(50.9)	119(72.6)	147(67.1)
APGAR5 score category	Low APGAR5 score	16(29.1)	17(10.4)	33(15.1)
	High APGAR5 score	39(70.9)	147(89.6)	186(84.9)
Co morbid disease	Yes	22(40.0)	42(25.6)	64(29.2)
	No	33(60.0)	122(74.4)	155(70.8)
Meconium aspiration syndrome	Yes	7(33.3)	16(37.2)	23(35.9)
	No	14(66.7)	27(62.8)	41(64.1)
Congenital abnormality	Yes	1(4.8)	4(9.3)	5(7.8)
	No	20(95.2)	39(90.7)	59(92.2)
Perinatal asphyxia	Yes	12(54.5)	16(38.1)	28(43.8)
	No	10(45.5)	26(61.9)	36(56.2)
Other co morbidity	Yes	8(38.1)	15(34.9)	23(35.9)
	No	13(61.9)	28(65.1)	41(64.1)
WBC count	Normal WBC count	28(50.9)	105(64.0)	133(60.7)
	Leucopenia	7(12.7)	12(7.3)	19(8.7)7%
	Leukocytosis	20(36.4)	47(28.7)	67(30.6)

Platelet count	Normal platelet count	35(63.6)	89(54.3)	124(56.6)
	Thrombocytopenia	12(21.8)	64(39.0)	76(34.7)
	Thrombocytosis	8(14.5)	11(6.7)	19(8.7)
Neutrophil count	Normal Neutrophil count	37(67.3)	123(75.0)	160(73.1)
	Neutropenia	2(3.6)	5(3.0)	7(3.2)
	Elevated Neutrophil count	16(29.1)	36(22.0)	52(23.7)
Blood glucose	Normal blood glucose	45(81.8)	144(87.8)	189(86.3)
	Hypoglycemia	6(10.9)	11(6.7)	17(7.8)
	Hyperglycemia	4(7.3)	9(5.5)	13(5.9)
Total		55	164	219

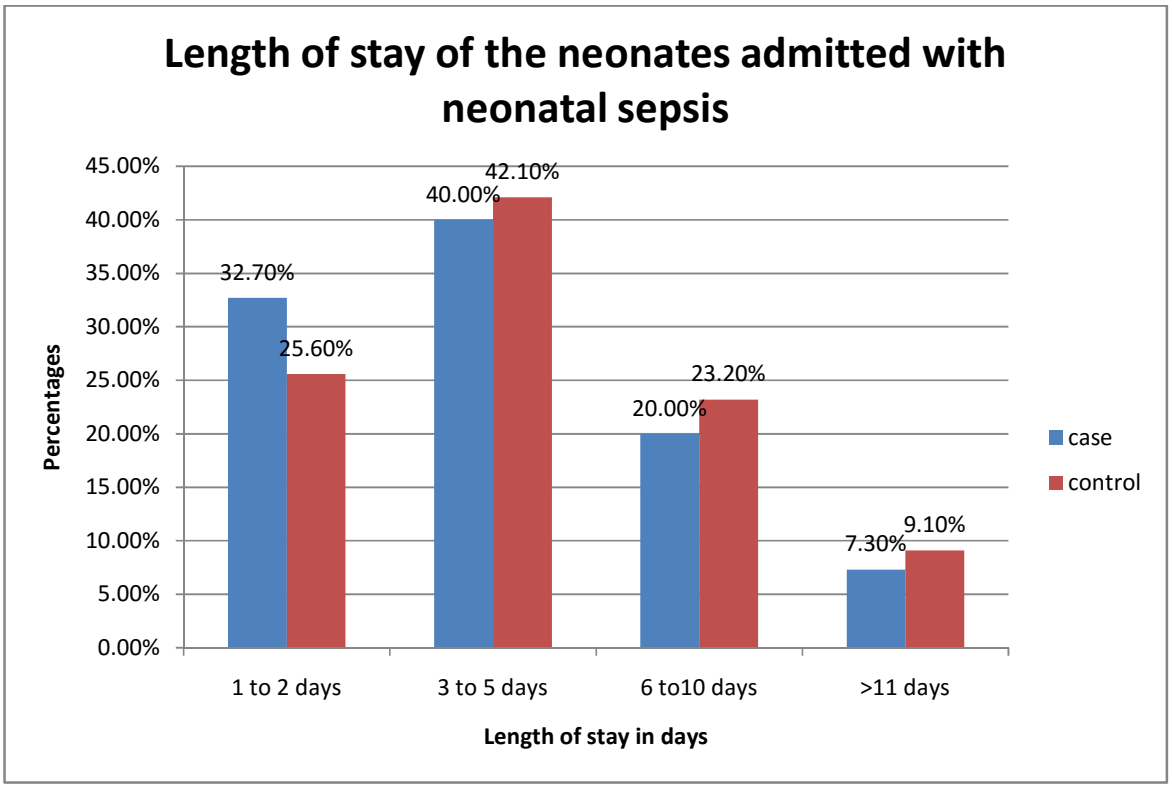

Figure 3; Distribution of the neonates by their length of stay at hospital, durame general hospital, southern Ethiopia, 2020

In this study majority (40.0%) of cases and (42.1%) controls were stayed 3 to 5 days in the hospital as shown on the bar graph at figure 3 above.

5.2 BIVIATE LOGISTIC REGRSION ANALYSIS RESULTS

In bivariate analysis of the whole data 14 variables were statistically significantly associated with sepsis related neonatal death at p-value of 0.25 (Table 5). However, sex of the neonates, residence of the mother, marital status, mode and place of delivery, type of pregnancy, ANC visit, maternal HIV status, pulse rate, jaundice, abdominal distension, blood glucose level, Neutrophil count and Length of stay were not statistically significantly associated with risk of sepsis related death.

Table 6: Bi-variable logistic regression analyses of sepsis-related neonatal mortality among neonate admitted in NICU at durame General hospital, southern Ethiopia, 2020

Variables	**Responses**	**Case Count (%)**	**Control Count (%)**	**COR(95%CI)**	**P-value**
1. Neonate age	≤7 days	45(81.8)	106(64.6)	2.46 (1.16, 5.25)	0.020
	>7days	10(18.2)	58(35.4)	1	
2. Parity	Primipareous	21(38.2)	85(51.8)	1	
	Miltipareous	34(61.8)	79(48.2)	1.74(0.93, 3.25)	0.081
3. Respiratory distress	Yes	29(52.7)	57(34.8)	2.09(1.13, 3.89)	0.019
	No	26(47.3)	107(65.2)	1	
4. Poor feeding	Yes	46(83.6)	106(64.6)	2.79(1.27, 6.12)	0.010
	No	9(16.4)	58(35.4)	1	
5. Axillary temperature	Normal body T^{o}	17(30.9)	81(49.4)	1	
	Hypothermia	30(54.5)	55(33.5)	2.59(1.31, 5.16)	0.006
	Fever	8(14.5)	28(17.1)	1.36(0.53, 3.49)	0.522
6. Respiratory rate	Normal RR	33(60)	120(73.2)	1	
	Bradypnea	13(23.6)	11(6.7)	4.29(1.76, 10.47)	0.001
	Tachypnea	9(16.4)	33(20.1)	0.99(0.43, 2.28)	0.984
7. Convulsion	Yes	11(20.0)	14(8.5)	2.68(1.14, 6.32)	0.024
	No	44(80.0)	150(91.5)	1	
8. Body	<2500g	32(58.2)	66(40.2)	3.12 (1.65, 5.90)	<0.001

weight	≥2500g	23(41.8)	98(59.8)	1	
9. Gestational age	<37	33(60)	46(28)	3.85(2.03, 7.28)	<0.001
	≥37	22(40)	118(72)		
10. APGAR1	Low APGAR1 score	27(49.1)	45(27.4)	2.55(1.36, 4.79)	0.004
	High APGAR1 score	28(50.9)	119(72.6)	1	
11. APGAR5	Low APGAR5 score	16(29.1)	17(10.4)	3.55(1.65, 7.65)	0.001
	High APGAR5 score	39(70.9)	147(89.6)	1	
12. Co morbidity	Yes	22(40)	42(25.6)	1.94(1.01, 3.68)	0.044
	No	33(60)	122(74.4)	1	
13.Platelet count	Normal platelet count	35(63.6)	89(54.7)	1	1
	Thrombocytopenia	12(21.8)	64(39)	0.48(0.23, 0.98)	0.047
	Thrombocytosis	8(14.5)	11(6.3)	1.85(0.68, 4.98)	0.224
14. WBC count	Normal	28(50.9)	105(64)	1	
	Leucopenia	7(12.7)	12(7.3)	2.18(0.78, 6.07)	0.133
	Leukocytosis	20(36.3)	47(28.7)	1.59(0.82, 3.12)	0.171

5.3 PREDICTORS OF SEPSIS RELATED NEONATAL MORTALITY

All variables which had shown statistically significant association during the bivariate analysis, such as age of the neonates, parity of the mother, poor feeding, hypothermia, convulsion,, body weight, estimated gestational age, APGAR score at first and fifth minute, co morbidities, respiratory distress, thrombocytopenia, thrombocytosis, leucopenia and leukocytosis were collectively entered in the multivariable analysis. In multivariable logistic regression analysis four variables were found to be predictors for the occurrence of death after controlling possible confounders.

The multivariable logistic regression result showed that a clinical presentation like poor feeding was significantly associated with sepsis related neonatal mortality. The odds of sepsis-related mortality among neonates who had a history of poor feeding were about four times higher than those neonate who did not have history of poor feeding [AOR= 4.15; 95%CI (1.64, 10.49), p-value=0.003].

History of respiratory distress also showed a statistical significant association with sepsis-related neonatal mortality. This study showed that, neonates who had respiratory distress had 2.7 times higher odds of sepsis related mortality compared to those neonates who did not have a respiratory distress[AOR =**2**.72; 95% CI(1.31, 5.61), p-value=0.007].

The finding of this study showed that convulsion had significant association with risk of sepsis-related neonatal mortality. The odds of sepsis-related mortality among the neonates with history of convulsion was three times higher than those neonates who did not have history of convulsion [AOR =3.13; 95% CI (1.12, 8.76), p-value=0.030].

This study also showed that newborn infants delivered before 37 completed weeks of gestation (preterm babies) were at risk for sepsis- related neonatal mortality. Neonates who delivered before 37 completed weeks of gestation (preterm babies) had 4.64 times higher odds of mortality compared to neonates who born after 37 completed weeks of gestation [AOR=4.64; 95%CI(2.17, 9.91), p-value<0.001]. As shown on the **table 6** below.

Table 7:Multivariable logistic regression analyses of sepsis-related neonatal mortalities among neonate admitted in NICU at durame General hospital, southern Ethiopia, 2020.

Variables		**AOR**	95%CI	**P-value**
Respiratory distress	Yes	**2**.72	1.31, 5.61	0.007
	No	1		
Poor feeding	Yes	4.15	1.64, 10.49	0.003
	No	1		
Estimated gestational age	<37 weeks	4.64	2.17, 9.91	<0.001
	≥37 weeks	1		
Convulsion	Yes	3.13	1.12, 8.76	0.030
	No	1		

CHAPTER 6

6.1 DISCUSTION

This study attempted to look for determinants of sepsis-related mortality by incorporating as many risk factors as possible. The findings of multivariate logistic regression analysis of this study identified history of respiratory distress, poor feeding, estimated gestational age less than 37 weeks (prematurity) and convulsion as determinants of mortality in neonatal with sepsis.

This study observed statistically significantly association of clinical presentation like respiratory distress with the risk of sepsis-related mortality. Specifically neonates with the history of respiratory distress had approximately three times higher odds of sepsis-related mortality compared with those neonates who did not have this clinical manifestation. This finding is supported by previous studies conducted at Duhok city in Iraq and Nigeria(40,51,52)**.** This might be due to the fact that Babies with respiratory distress don't have a protein called surfactant that keeps small air sacs in the lungs from collapsing which increase the risk of neonatal mortality.

In this study, majority ((83.6%) of the cases had History of poor feeding at presentation with four times higher odds of sepsis-related death compared to neonates who were feeding adequately. This finding is in line with the previous finding reported in Thailand, which showed that neonatal death is 7.8 times more likely in patients with clinical sign of poor feeding compared with the well feeding ones [(AOR =7.807),P<0.001] [(31)]. A study conducted in India also revealed feeding as protective factor of mortality in babies with neonatal septicemia [AOR=0.131; CI(0.027-0.636)], P value=0.012](39). This might be explained by the fact that in the newborn period poor feeding or inadequate caloric intake is likely to produce hypoglycaemia. Endotoxaemia and sepsis has been shown to produce hypoglycaemia by an inhibition of gluconeogenesis, lactic acidosis and increased glucose requirements. In addition breast milk is source of vitamin A and antibodies that helps to fight infections. Thus, the risk of death might be elevated in this group of neonates.

Estimated gestational age less than 37 weeks (prematurity) had shown a significant association with the risk of sepsis-related neonatal mortality with the likelihood of death of 4.6 times higher among neonates born before 37 completed weeks of gestation compared to those neonates born thereafter. This result is consistent with studies conducted in Indonesia, Thailand, Duhok city in Iraq, in central India, south-eastern Mexico and a systematic review conducted in developing country (5,18,31,36,52,54). This might be explained by the fact that

premature infants are at increased risk for developing complications of septicemia because of deficiencies in humoral and cellular immunity.

Convulsion was significantly associated with the risk of sepsis-related mortality. Particularly the odds of sepsis-related mortality were about three times higher among the neonates with the history of Convulsion compared to those neonates who does not have this clinical sign. This result is in agreement with previous reports that associate this factor with poor prognosis and death in the neonate with infection(5,51,58). Neonatal convulsion increases structural brain lesion that include hemorrhage (intracerebral, subarachnoid, and intraventricular) and infarctions of the brain which affects the overall physiological and hemodynamic stability. Another possible reason for increases in acute outcome like mortality is an acute neonatal encephalopathy (includes classic hypoxic-ischemic encephalopathy).

Low body weight is well established neonatal risk factors in lots of study reports from different countries (5,18,36,52,54). Unfortunately, this study did not observe an association between low body weight and risk of sepsis –related neonatal death. Few other studies, conducted in Bangladesh, Nigeria and India also observed that low body weight had an insignificant effect on the risk of sepsis related neonatal mortality (39,40,51,58). Smaller sample size might influence the result along with health service related factors and study design. Residence, parity, ANC service utilization, mode of delivery, body temperature, respiratory rate, perinatal asphyxia, age, APGAR score and hematological findings were not found to be predictors of sepsis-related death in this study. This is in contrary to the findings of studies on risk factors of sepsis-related death in different parts of the world indicated that these factors had an influence on sepsis-related death(34,51,59–61). The reasons for these differences may range from the background of the participants, quality of care, access to health facilities and health professionals.

6.2 LIMITATION OF THE STUDY

This study was limited by the fact that it is a retrospective review of neonatal records and laboratory reports. As such, data collection was restricted to information previously recorded and this may be incomplete for some of the relevant variables under review. This study also lacks data on microorganisms including culture findings, drug resistance, and sensitivity pattern. Additionally, since the study was conducted on only admitted neonates in a single hospital excluding those that were referred to other hospitals, thus the results might lack generalizability to the total population of sepsis cases.

CHAPTER 7
7. CONCLUSION AND RECOMMENDATIONS

7.1 CONCLUSION

Generally, the findings of this study noted that in septicemic neonates admitted in neonatal intensive care units (NICU), respiratory distress, poor feeding, estimated gestational age less than 37 completed weeks (prematurity) and convulsion were significantly associated with sepsis-related neonatal mortality.

7.2. RECOMMENDATIONS

According to the findings from this study, the following recommendations have been suggested to different stakeholders;

7.2.1. For health workers

There is a need to closely monitor preterm babies, for features of sepsis and to commence adequate therapeutic supports in addition to appropriate antibiotic therapies for them.

Early detection and appropriate management of patients' presentation like respiratory distress, poor feeding and convulsion is necessary to reduce sepsis related neonatal mortality.

Blood glucose needs to be frequently monitored in infants admitted with sepsis especially in those with history of poor feeding to allow prompt management of possible hypoglycemia.

7.2.2. For mothers

Since risk factors like prematurity are preventable by proper antenatal checkups, all pregnant mothers should follow antenatal care service according to Federal Ministry of Health (FMOH) schedules.

7.2.3. For Ministry of health and health service organizations

Government should increase the political priority given to sepsis by improving awareness of the growing medical and economic burden of neonatal sepsis.

Primary care organizations should increase their support towards maternal education and incorporate routine neonatal sepsis screening into the care of neonates considering the identified predictors of mortality.

Health facilities should equip their NICUs' with adequate and appropriate ventilation supports to help neonates with respiratory distress.

7.2.4. For researchers

Researchers who are interested to conduct study on sepsis- related neonatal mortality should have to include neonates in the community which may increase external a validity of the study. It is better if prospective studies done by incorporating more detailed maternal, obstetric and service quality related factors in our country.

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ANNEXES I

DATA COLLECTION CHECKLIST

Structured checklist to determine predictors of sepsis related neonatal mortality at Durame general hospital, SNNPR, Kembata tambaro zone.

ID number _____

1. Case 2. Control

PARTI:-SOCIO-DEMOGRAPHIC FACTORS

Nº	**Question**	**Possible answer**	
1	Birth Weight(g)	_____	
2	Residence	1.urban 2.rural	
3	Neonate age in days	_____	
4	Sex	1.male 2.female	
5	Marital status	1. Single 2. Married 3. other	

PART II:-OBSTETRIC AND MATERNAL FACTORS

Nº	Question	Possible answer	
1.	Parity	1. Primipareous 2. Multipareous	
2.	Mode of delivery	1. SVD 2. C/S 3. Instrumental delivery	
3.	Does mother have ANC for recent pregnancy?	1. yes 2. no	If no skip to Q. nº 6
4.	If yes for Q. nº 4, how many times	_____times	
5.	Type of pregnancy	1. single 2. multiple	
6.	Maternal HIV status	1.positive 2.negative 3. unknown	
7.	Place of delivery	1. Home delivery 2. Health facility	
8.	Estimated gestational age(weeks)	1. < 37 2. 37-42 3. Above 42	

PART III:-Neonate related factors

Sr. nº		Question	Possible answer	
1.		APGAR SCORE	first minute___ 5th minute_____	
2.		Types of sepsis	1.EONS 2.LONS	
3.		Have co morbid disease?	Yes No	If no go to Q5
4.	Co morbidities	Congenital abnormality	Yes No	
		Perinatal asphyxia(PNA)	1.yes 2. no	
		Meconium aspiration syndrome(MAS)	1.yes 2. no	
		Others	_____	
5.	Clinical Features	Axillary temperature	1.<36 2.36-38 3.≥38	
		Respiratory rate	1.<30 2.30-60 3.>60	
		Pulse rate	_____ beat / minute	
		Respiratory distress	1.yes 2. no	
		poor feeding	1.yes 2. no	
		abdominal distention	1.yes 2. no	
		skin color	1.good(pink) 2. poor	
		Jaundice	1.yes 2. no	
		Convulsion	1.yes 2. no	
6.	Length of stay (days)			
7.	Complete blood count(CBC)	Total WBC/mm^3		
		ANC/mm^3		

		Platelet count/mm^3		
8.	Blood glucose	Random blood sugar	_____mg/dl	