International Research Journal Of Medicine and Health Sciences

*Vol 5, Issue 1, pp 1-14, Oct 12, 2023, © International Research Journal Publishers, ISSN 2710-2742 (online) www.irjp.org*

# ASSESSMENT OF PREVALENCE AND RISK FACTORS OF NEONATAL SEPSIS AMONG NEONATES ADMITTED IN NEONATOLOGY UNIT AT UNIVERSITY TEACHING HOSPITAL OF BUTARE, RWANDA

**[1*]Igihozo Sylvie, [2]Kayirangwa Ephigenie & [3]Domitillah Ndunge**

[1*]Scholar, Mount Kenya University, Rwanda
[1,2]Mount Kenya University

Accepted, October 2nd, 2023

**ABSTRACT**

**Introduction:** Neonatal sepsis is a major cause of newborn deaths worldwide and one of the main factors that contribute to high neonatal mortality rates. Neonatal sepsis accounts for 5 million newborn deaths, and is mostly diagnosed in underdeveloped countries or in developing countries including Rwanda.

**Objective**: To assess the prevalence and risk factors of neonatal sepsis among neonates admitted in neonatology unit of University Teaching Hospital of Butare.

**Methodology:** A retrospective and quantitative research design was applied in this research, Target population is neonates admitted in Butare teaching hospital from January to December 2022, the sample size calculated was 216 participants, Sampling technique is simple random sampling technique, data collection tools was closed ended questions, data analysis was analysed using statistical package for social science known as SPSS version 23.

**Results:** The study reviewed 216 of neonates and found that 59.3% of them were having sepsis .This sepsis was associated to the UTI/STI during the pregnancy, more than 4times of vaginal examination, Female gender, APGAR score <8 At 5th minute and Birth Weight < 2kg with the following adjusted odd ratios and their confidence interval : AOR 6.087[1.282-28.899], AOR 3.299[1.369-7.952], AOR 2.850[1.328-6.115], AOR : 17.045[2.729-106.468] and AOR : 5.028[1.869-13.526].

**Conclusion**: there is a higher prevalence of neonatal sepsis which associated to the UTI/STI during the pregnancy, more than 4times of vaginal examination, Female gender, APGAR score <8 At 5th minute and Birth Weight < 2kg

**Recommendations**: development of guidelines on management and prevention of neonatal sepsis the most important. In addition to this further research identify other risk factors are encouraged.

**Keywords;** *Prevalence, Risk Factors, Neonatal Sepsis, Neonates, University Teaching Hospital of Butare*

## INTRODUCTION

Sepsis and septic shock remain life-threatening conditions due to dysregulation of host response to infection worldwide. Based on the timing of infection, neonatal sepsis has been

classified as early onset sepsis (EOS –onset in the first 72 hours from birth) and late onset sepsis (LOS – onset occurring after the first3 days from birth) (Thompson et al 2019). This grouping implies differences in the expected mode of transmission and predominant causative microorganisms. EOS is generally caused by vertical transmission from mothers to infants during the intrapartum period, while LOS is caused by postnatal horizontal transmission, mainly from organisms acquired after birth. Epidemiological studies on neonatal sepsis, EOS was 2.6-fold more common than LOS(World Health Organisation, 2020).

World widely the Global Burden of Disease (GBD) Study estimated 1.3million annual incident cases of neonatal sepsis, resulting in 203 000 sepsis-attributable deaths. Neonates are disproportionately affected in low-income and middle-income countries (LMICs) with a high prevalence of infectious diseases and poor access to adequately equipped and staffed healthcare facilities (Fleischmann *et al.*, 2021). An estimated 375 000 neonatal deaths due to sepsis occurred globally in 2018, which represented 15% of all neonatal deaths, according to data from WHO and the Maternal and Child Epidemiology Estimation Group (MCEE) . A recently-updated and expanded systematic review reported an estimated 3.9 million annual neonatal sepsis cases (2824 per 100 000 live births) and 689 922 deaths (18%) worldwide. Higher incidence rates were found in at-risk groups of neonates and in LMICs(World Health Organisation, 2020).

In United State America, the prevalence of culture-proven early-onset sepsis is approximately 0.3-2 per 1000 live births. Of the 7%-13% of neonates who are evaluated for neonatal sepsis, only 3%-8% of those screened will have culture-proven sepsis (Gollehon, 2019). In Europe specifically in Germany, Sepsis is a common and frequently fatal condition in pediatric patients, particularly among neonates and children with comorbidities. In neonates, the incidence of neonatal sepsis was 1,006 cases per 100,000 live births. Case fatality was 3.9%. While 17.7% of very low birth weight infants had neonatal sepsis, only 2.1% of low birth weight and 0.6% of normal birth weight neonates were affected, respectively (Born et al , 2021).

In Asia currently, no standard guidelines exist for maternal Group B Streptococcus (GBS) screening and neonatal Group B Streptococcus disease prevention in China. The overall incidence of neonatal sepsis due to group b streptococcus in neonate was estimated to be 0.31 (95% CI 0.27–0.36) cases per 1000. Sepsis remains a significant cause of neonatal morbidity and mortality in China. A better understanding of neonatal sepsis in China as compared with other industrialized and non-industrialized countries helped to optimize neonatal health care both regionally and globally(Dong *et al.*, 2020). In south Asia, the prevalence of sepsis among the neonates admitted into NICU of the concerned public hospitals in Dhaka was 69.35%. The factors associated to neonatal sepsis were, perinatal asphyxia, presence of infection at umbilical cord, history of bottle feeding of the neonates and preexisting maternal infection were significantly associated with neonatal sepsis. The odds of developing sepsis among the neonates with ≤ 2.5 kg weight at admission was more than three times higher than neonates with admission weight > 2.5kg(Nyma *et al.*, 2020).

In Africa the systematic review conducted in ten countries Sub-Saharan African region showed the highest rates of neonatal mortality of 50% due to neonatal sepsis. In this systematic review the significant risk factors were resuscitation, low birth weight and 1.5–2.5 kg, low APGAR score at the first minute and fifth minute prematurity <37 weeks , no crying at birth , male sex, prolonged labor, premature rupture of membranes, multiple digital vaginal examinations meconium stained, amniotic fluid , intrapartum maternal fever ,foul-smelling vaginal discharge and low socioeconomic status (Bech et al., 2022).

In East Africa, the prevalence of neonatal sepsis was 28.6%. Neonates born of single mothers, mothers with history of UTI, PROM and anemia were at higher risk to develop neonatal sepsis. Pre-maturity , low Apgar score at 5th minutes and history of invasive procedure were the neonatal factors independently associated with neonatal sepsis. In Tanzania the prevalence of Neonatal sepsis was131(49.8%) and there was a significant association between age of the neonates , gestation age , birth weight cannulated and being kept under oxygen with neonatal sepsis(Gollehon, 2019). In Rwanda there is few published results in regard to the prevalence and risk factors of neonatal sepsis, One retrospective study conducted at Ruhengeri referral hospital showed that the prevalence of neonatal sepsis is 16.9 % .This study showed that the rupture of membranes and prolonged labor were associated with neonatal sepsis(Nimukuze and Mukarwego, 2021)

**Problem statement**

Neonatal sepsis is a major cause of newborn deaths worldwide and one of the main factors that contribute to high neonatal mortality rates. Neonatal sepsis accounts for 5 millions newborn deaths, and is mostly diagnosed in underdeveloped countries or in developing countries including Rwanda. Neonatal sepsis is a high-priority public health issue, particularly in the context of developing country, where it constantly emerges as one of the major contributors to neonatal morbidity and mortality. In addition to the substantial percentage of immediate mortality, neonatal sepsis imposes a wide range and varying degrees of long-term disabilities upon the survivors in their future. Previous research revealed that such long-term impairments might be in the form of cognitive disability, learning disabilities, and developmental delays, hearing loss or visual disturbance, resulting in a major socio-economic burden in resource-poor countries and contributing to the global disease burden. The global burden of morbidity was estimated at about 3% of all Disability Adjusted Life Years. It has resulted in an estimated economic burden of up to US$469 billion in this region (DALYs)(Nyma et al., 2020)

In Rwanda neonatal sepsis mortality rate, (per 1,000 live births) was reported at 17.5 % in 2021, according to the World Bank collection of development indicators. Consolidated data on the prevalence of infections in neonatal units, including sepsis, is still few in Rwanda. One study conducted in Northern Province at Ruhengeri hospital showed neonatal sepsis prevalence of 16.9%. In southern province especially at CHUB, this prevalence is not yet assessed and during the clinical practice the primary investigator of this study observed different neonates hospitalized for neonatal sepsis. Therefore, the primary investigator takes the initiative to assess the prevalence of neonatal sepsis and its associated factors in order to establish the preventing measures of neonatal sepsis.

**Specific objectives**

i. To determine the prevalence of neonatal sepsis among neonates admitted in neonatology unit of University Teaching Hospital of Butare.
ii. To identify risk factors of neonatal sepsis among neonates admitted in neonatology unit of University Teaching Hospital of Butare.

**Empirical Literature**

***Prevalence of Neonatal Sepsis***

According to the study conducted in Ethiopia on prevalence of neonatal sepsis and associated factors among neonates in neonatal intensive care unit at selected governmental hospitals in Shashemene town, Oromia regional state, 2017 state that among 244 neonates who were admitted in NICU 190(77.9%) had neonatal sepsis, and from those neonates 123 (64.7%) had early onset neonatal sepsis and 67 (35.3%) had late onset neonatal sepsis.This study also showed that among 244 sampled neonates 22 (9%) of their mothers had history of UTI and

among them, 14 (5.7%) neonates had developed neonatal sepsis, and 17 (7%) of their mothers had history of meconium stained amniotic fluid out of them 10 (4%) developed neonatal sepsis (18). Concerning place of delivery 181 (75%) of neonates were delivered in hospital and, out of them 144 (79.6%) neonates developed neonatal sepsis, furthermore 36 (14.6%) were delivered in health center; from this 27 (11%) of neonates had neonatal sepsis (Getabelew et al., 2018).

The study conducted in Kenya revealed that among 1262 admissions to the newborn unit during 4 years, 23.9% were diagnosed with neonatal sepsis and overall mortality rate of admissions was 24.7%, whereas mortality attributed to sepsis was 18.2% in addition the research showed that there is strong biannual peak in sepsis cases with peaks in July 2012 and July 2014 (19)(Geyt., & Hauck, 2018).

The study conducted in Eastern Africa on Neonatal sepsis and its associated factors: a systematic review and meta-analysis, 2019 said that in total of 26 studies with 11239 participants were used for analysis. The pooled prevalence of neonatal sepsis in East Africa was 29.65% (Home delivery, maternal history of UTI, gestational age (preterm), prolonged labor (and PROM were identified factors of neonatal sepsis (Abate et al., 2020).

According to research conducted in Uganda on prevalence and associated factors of neonatal sepsis revealed that prevalence of neonatal sepsis was 11% (Al-Matary et al., 2019)

According to research conducted in Bangladesh on The prevalence of sepsis among the neonates admitted into NICU of the concerned public hospitals in Dhaka revealed the prevalence was 69.35%. In the multiple logistic regression model, perinatal asphyxia, presence of infection at umbilical cord, history of bottle feeding of the neonates and pre-existing maternal infection (OR were significantly (p-value $< 0.05$ associated with neonatal sepsis. The odds of developing sepsis among the neonates with $\leq 2.5$ kg weight at admission was more than three times higher than neonates with admission weight $> 2.5$ kg (Nyma et al., 2020).

In Rwanda a study conducted in 2018 in Rwandan hospitals showed that a total of 1723 neonates were hospitalized over the two-year, and among them 88.7% were admitted within the first 48 h of life while the remaining were admitted after 48 hours, 58.4% were male, 53.8% had normal birth weight and 36.4% were born premature and the most important is that neonatal sepsis was 23.6% (Nyishime et al., 2018).

***Risk Factors of Neonatal Sepsis***

The study conducted in Ghana on Risk Factors Associated with Neonatal Sepsis: A Case Study at a Specialist Hospital in Ghana found that the following are neonatal risk factors of Neonatal Sepsis: APGAR scores in the first and fifth minutes which is less than 7, resuscitation at birth, duration of stay at the health facility, and neonatal age. Utomo in 2010 found cesarean section delivery as aVariable that was statistically associated with the risk of developing neonatal sepsis(Adatara et al., 2018).

A study conducted in Ethiopia on clinical outcome and risk factors of neonatal sepsis among neonates in FelegeHiwot referral Hospital, Bahir Dar, Amhara Regional State from 225 neonates 169 (75.1%) were admitted with early onset of sepsis. From total 71 (31.6%) were low birth weight, 173 (76.9%) were term (37–42 weeks), 8 (3.6%) were presented with meningitis, 8 (3.6%) had history of birth asphyxia, and 73 (32.4%) neonates were with Apgar score less than six. Most, 203 (90.2%)(Tewabe et al., 2017).

A study conducted on the incidence and risk factors associated with blood culture proven neonatal SEPSIS have found main neonatal risk factors of neonatal sepsis as duration of stay in the facility and neonatal age on admission in their research on incidence and risk factors associated with blood culture proven neonatal sepsis(Yadav et al., 2021).

A study conducted in Indonesia on risk Factors of Neonatal Sepsis revealed that the following as risk factors prematurity, low birth weight, asphyxia, resuscitation during delivery, invasive procedure, congenital anomaly, parenteral nutrition, long hospital stay in neonatal intensive care unit (Utomo, 2020).

A study conducted in India on Risk factors of neonatal sepsis found that in fifteen studies were included from 11,009 records, of which nine were prospective in design. Birth weight and gestational age at delivery were the most frequently reported factors. On meta-analyses, it was found that male sex, 1out born neonates, need for artificial ventilation, gestational age <37 weeks and premature rupture of membranes emerged as risk factors for neonatal sepsis (Murthy et al., 2019).

A study conducted in Kenya on Prevalence and Predictors of Neonatal Sepsis among Neonates Admitted at the Newborn Unit of Kenyatta National Hospital revealed that the prevalence of neonatal sepsis was 28.6%. Neonates born of single mothers, mothers with history of UTI (AOR and anaemia were at higher risk to develop neonatal sepsis. Prematurity (), low Apgar score at $5^{th}$ minutes and history of invasive procedure were the neonatal factors independently associated with neonatal sepsis (Okube & Komen, 2020).

**Theoretical Framework**

Health Belief Model is one of the most important theories of behavior change that has been widely considered in behavioral health sciences and successfully applied in the design of health interventions. The model emphasizes the individual perceptions ( perceived sensitivity, perceived severity, perceived benefits, perceived barriers, guidance for action, and self-efficacy) in determining the likelihood of performing a behavior According to this model, a person's decision and motivation to perform a particular behavior included items such as a person's perception of being at risk (perceived susceptibility) and its seriousness( perceived severity), belief in the perceived action of usefulness to reduce the risk of neonatal sepsis, understanding of health benefits (perceived benefits), person's perception of the difficulties and cost of performing behaviors(perceived barrier), and moderating factors such as demographic and psychosocial variables(awareness) and people's judgments of their capabilities to execute given level of performance( self-efficacy) (Gharouni et al., 2020).

The Health Belief Model is most relevant to the infection control and prevention, because the key to any of these proposed practices being successful is the belief that there is a problem and that acting on this problem will positively affect the outcomes. Mothers generally try to do their best for delivering health neonates and therefore, should be open to carrying out best things and initiating changes that benefit their neonates' health.

## METHODOLOGY

The researcher used a retrospective study using quantitative method that was conducted within a period of two weeks to review the files in order to assess the prevalence and risk factors of neonatal sepsis in neonatal unit at University Teaching Hospital of Butare.

The target population of this study was all neonates admitted in neonatology of CHUB from January 2022 up to December 2022.

The sample size was determined using Cochran Formula below: $n=\mathbf{z^2(pq)/e^2}$

A sample of 216 neonate files was selected among all files of neonates admitted in neonatal unit of CHUB from January 2022 up to December, 2022. Simple random sampling technique was used by using excel which has patient identification number of the neonates admitted in the aforementioned period.

Self-developed questionnaire was used in data collection. Data were collected using predetermined tool and cleaned, coded into excel sheet and then exported into SPSS version 23 for analysis. Descriptive statistics was used to show frequency distribution for categorical

variables and to calculate the mean and standard deviation for continuous variables. Univariate analysis was used to identify all possible factors, to be included in multivariate analysis if their P value is less than 0.25. Multivariate logistic regression analysis was used to determine the independent factors associated with antenatal care consultation while simultaneously controlling for potential confounders. A p-value of <0.05 was considered as statistically significant.

The ethical approval for this study was obtained from the Mount Kenya University Rwanda and CHUB ethical committee. The researcher explained the purpose of the research to the unit manager of neonatology unit and ask the permission to look for neonates' files identification in patient register randomly. In archive the researcher reviewed only the files of neonates selected in patient register of neonatology unit. The researcher maintained protection of human rights during this study. To ensure confidentiality, anonymity of participants was ensured. The results of this study will be for academic purpose only.

## FINDINGS AND DISCUSSIONS

**Prevalence of neonatal sepsis among neonates admitted in neonatology at CHUB**

The prevalence of neonatal sepsis results is presented in Figure 1.

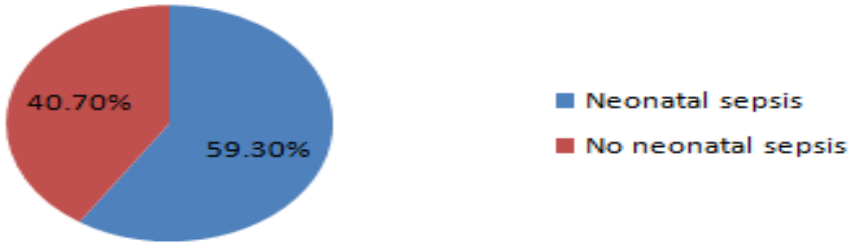


**Figure 1: Neonatal sepsis prevalence**

The prevalence of neonatal sepsis has been found to be 59.3% among the overall participants of the study **N=216.**

**Risk factors of neonatal sepsis among neonates admitted in neonatology unit at CHUB**

**Table 1: Characteristics of the mother and neonatal sepsis**

| Characteristics | | Neonatal sepsis N(%) | No neonatal sepsis N(%) | PValue |
|---|---|---|---|---|
| Mother's age | a.under 18 years | 2(100) | 0(0) | 0.609 |
| | b.18-28 years | 40(61.5) | 25(38.5) | |
| | c..28-35 years | 44(55.7) | 35(44.3) | |
| | d.above 35 years | 41(59.4) | 28(40.6) | |
| Marital status | a.Married | 124(59.6) | 84(40.4) | 0.455 |
| | c.Separated | 0(0) | 2(0) | |
| | d. Single | 4(66.7) | 2(33.3) | |
| Religion | a.Adventist | 27(61.4) | 17(38.6) | 0.379 |
| | b. Muslim | 18(75) | 6(25) | |
| | c. Catholic | 36(54.5) | 30(45.5) | |
| | d.Other | 47(57.3) | 35(42.7) | |
| Residence | a.Urban | 22(46.8) | 25(53.2) | 0.064 |
| | b.Rural | 106(62.7) | 63(37.3) | |
| Maternal education | a. No education | 6(60) | 4(40) | 0.202 |

| | | | | |
|---|---|---|---|---|
| | b. Primary | 76(63.3) | 44(36.7) | |
| | c.Secondary | 19(48.7) | 20(51.3) | |
| | d.university | 27(57.4) | 20(42.6) | |
| Occupation of mother | a. Housewife | 82(67.2) | 40(32.8) | 0.005 |
| | b. Civil servants | 33(55.9) | 26(44.1) | |
| | c.Business | 13(37.1) | 22(62.9) | |
| | d.Student | 0(0) | 0(0) | |

**Source: (Researcher, 2023)**

Through this study, Table 1 show the results depicted that the association between mother's age was not significant where for under 18 year mothers 2(100%), for those between 18 and 28 years 40(61.5%), for those above 35 years 41 (59.4%) their neonates got neonatal sepsis. In the same line the association between neonatal sepsis and marital status ,124(59.6%) of married people and 4(66.7%) of single their neonates got neonatal sepsis. Considering the neonatal sepsis and religious belief Adventist, Muslim catholic and others believers presented to have neonatal sepsis like 27(61.4%), 18(75%), 36(54.5%), 47(57.3%) respectively. Maternal education was found also not to be significant factor for neonatal sepsis where 6(60%), 76(63.3%), 19(48.7%), 27(57.4%) of mothers whom their child affected by neonatal sepsis did no education, primary, secondary and college(university) respectively. Only two variables region of residence and occupation of the mothers whom their child get neonatal sepsis were found to be significant where the 106(62.7%) vs 22(46.8%) were from rural region and urban region while for housewife, civil servants and business women it was found at rate of 82(67.2%),33(55.9%), 13(37.1%) respectively.

**Table 2: Maternal health related factors and neonatal sepsis**

| **Variables** | | **Neonatal sepsis** | **No neonatal sepsis** | **P value** |
|---|---|---|---|---|
| Parity | a.primipara | 31(57.4) | 23(42.6) | 0.752 |
| | b. multipara | 97(59.9) | 65(40.1) | |
| ANC during the pregnancy for this neonate | a. Yes | 128(59.8) | 86(40.2) | 0.165 |
| | b. No | 0(0) | 2(100) | |
| Number of ANC received | a. none | 0(0) | 2(100) | 0.003 |
| | b.once | 10(55.6) | 8(44.4) | |
| | c.two times | 33(80.5) | 8(19.5) | |
| | d. three times | 52(62.7) | 31(37.3) | |
| | e.four times | 33(47.1) | 39(52.9) | |
| Place of delivery | a. Hospital | 128(62.7) | 76(37.3) | <.0001 |
| | b. Health center | 0(0) | 12(100) | |
| Type of delivery | a.Spontaneous | 49(62) | 30(38) | 0.347 |
| | a.Instrumental | 4(100) | 0(100) | |
| | b. C section | 75(56.4) | 58(43.6) | |
| Duration of labor | a.normal | 78(60.9) | 50(39.1) | 0.575 |
| | b.prolonged | 50(56.8) | 38(43.2) | |
| Fever during the time of labor | 1.Yes | 14(100) | 0(0) | 0.001 |
| | 2.No | 114(56.4) | 88(43.6) | |
| the amniotic fluid with foul of smelling | 1.Yes | 33(100) | 0(0) | <.0001 |
| | 2.No | 95(51.9) | 88(48.1) | |

| | | | | |
|---|---|---|---|---|
| | 1.Yes | 6(54.6) | 5(45.4) | 0.03 |
| Eclampsia during the pregnancy | 2.No | 118(57.6) | 87(42.4) | |
| | 1.Yes | 17(73.9) | 6(26.1) | 0.178 |
| Bleeding during the pregnancy | 2.No | 111(57.5) | 82(42.5) | |
| | 1.Yes | 14(70) | 6(30) | 0.003 |
| UTI/STI during the pregnancy | 2.No | 110(56.1) | 86(43.9) | |
| | 1.Yes | 2(100) | 0(0) | 0.515 |
| history of Chorioamnionitis | 2.No | 126(58.9) | 88(41.1) | |
| history of PROM on that | 1.Yes | 42(68.9) | 19(31.1) | 0.091 |
| pregnancy | 2.No | 86(55.5) | 69(44.5) | |
| | 1-4 s | 95(56.9) | 72(43.1) | 0.247 |
| Times of vaginal examination | More than 4 | 33(67.3) | 16(32.7) | |

**Source: (Researcher, 2023)**

Table 2 of maternal health related factors and neonatal sepsis showed that 31(57.4%) of primipara develop neonatal sepsis while 23(42.6%) of them did not develop neonatal sepsis, on multipara party, 97(59.9%) of them develop neonatal sepsis while 65(40.1%) did not develop it. Concerning the use of ANC, 128(59.8%) of the participants develop neonatal sepsis while 86(40.2) did not develop neonatal sepsis. Considering the number of ANC received, 2(100%) they didn't receive any ANC and they didn't develop neonatal sepsis, 10(55.6%) received one ANC and developed neonatal sepsis vs (44.4%)of whom they didn't develop it. for the one who received two times ANC 33(80.5%)developed neonatal sepsis while 8(19.5%) did not develop it. For the one who received three times ANC 52(62.7%)developed neonatal sepsis while 31(37.3%) didn't develop it. In contrast, for the woman who received four times ANC 33(47.1 %) developed neonatal sepsis while 39(52.9%) did not develop it.

Regarding the association of place of delivery and neonatal sepsis, 128(62.7%) of hospital deliveries developed neonatal sepsis while 76(37.3%) didn't develop it in contrast to that, 12(100%) of health center deliveries didn't develop neonatal sepsis. Concerning the type of delivery, spontaneous vaginal delivery was associated with 49(62%) neonatal sepsis vs 30(38%) who didn't develop it. For the instrumental delivery, 4(100%) developed neonatal sepsis while for cesarean section 75(56.4%) developed neonatal sepsis and 58(43.6%) didn't. In the respect to the duration of labor, the woman who had normal length of labor, 78(60.9%) developed neonatal sepsis while remaining 50(39.1%) in contrast the woman who had prolonged labor 50(56.8%) developed neonatal sepsis while 38(43.2%)didn't develop it. Regarding the fever during the time of labor,14(100%) of mothers who have had fever during labor their children received neonatal sepsis ,114(56.4%)the one who didn't have fever during labor developed neonatal sepsis while 88(43.6%) didn't develop both fever and neonatal sepsis. Regarding the association of neonatal sepsis and foul smelling amniotic fluid ,33(100%) of who had foul smelling amniotic fluid developed neonatal sepsis ,95(51.9%) women developed neonatal sepsis without its association with foul smelling amniotic fluid while 88(48.1%)didn't have both. Eclampsia during pregnancy was found to have a significant association with neonatal sepsis, where 6(54.6%)of the women who had eclampsia during pregnancy developed neonatal sepsis while5(45.4%) didn't develop it, for the woman without the history of eclampsia 118(57.6) developed neonatal sepsis while 87(42.4%) didn't develop it.Bleeding during pregnancy was found not to be significant with 111(57.5%) women who developed neonatal sepsis without history of bleeding during pregnancy while 82(42.5%)didn't develop neonatal sepsis.

For the women with positive bleeding during pregnancy 17(73.9%) developed neonatal sepsis while 6(26.1%) didn't develop it. UTI/STI during the pregnancy was found to have a significant association with neonatal sepsis where 14(70%) of women with history of UTI/STI developed neonatal sepsis, 6(30%)didn't developed it while for those women without history of UTI/STI,110(56.1%)developed neonatal sepsis versus 86(43.9%) of who didn't develop it.

Concerning the history of Chorioamnionitis, 2(100%) developed neonatal sepsis but for those without history of Chorioamnionitis 126(58.9%) developed neonatal sepsis while 88(41.1%) didn't develop it. For the woman with history of PROM on that pregnancy, 42(68.9%) developed neonatal sepsis while 19(31.1%) didn't develop it. compared with those without history of PROM on that pregnancy 86(55.5%) developed neonatal sepsis while 69(44.5) %) didn't develop it. Regarding times of vaginal examination 95(56.9%) of women who received less than four times vaginal examination developed neonatal sepsis versus 72(43.1%) who didn't develop neonatal sepsis. The significant number of neonatal sepsis was found to be 33(67.3%) for those of more four times vaginal examination while only 16(32.7%) didn't develop neonatal sepsis.

**Table 3: Neonatal factors and neonatal sepsis**

| Variables | | Neonatal sepsis | No neonatal sepsis | Pvalue |
|---|---|---|---|---|
| Gestational age | a.< 37 weeks | 77(72) | 30(28) | |
| | b. 37 - 40 wks | 51(46.8) | 58(53.2) | <.0001 |
| Gender | Female | 61(72.6) | 23(27.4) | |
| | Male | 67(50.8) | 65(49.2) | .002 |
| APGAR score at 1st minute | APGAR <8 | 38(76) | 12(24) | |
| | APGAR>7 | 90(54.2) | 76(45.8) | .008 |
| APGAR score at 5th minute | APGAR <8 | 24(92.3) | 2(7.7) | |
| | APGAR>7 | 104(54.7) | 86(45.3) | <.0001 |
| Birth Weight at birth | below 2kg | 71(78) | 20(22) | |
| | b.≥ 2kg | 57(45.6) | 68(54.4) | <.0001 |
| Meconium stained | a.Yes | 17(81) | 4(19) | .037 |
| | b.No | 111(43.1) | 84(43.1) | |

**Source: (Researcher, 2023)**

Table 3 of neonatal factors and neonatal sepsis showed that among Gestational age < 37 weeks, 77(72%) of them develop neonatal sepsis while 30(28 %) did not develop neonatal sepsis, regarding to the gender 61(72.6%) of female develop neonatal sepsis while 23(27.4%) of them did not develop neonatal , the number of male who develop neonatal sepsis 67(50.8%) is almost equal to the number who did not develop neonatal sepsis 65(49.2%),concerning, APGAR score at 1st minute less than 8 minutes 38(76%), APGAR score at 5th minute than 8 minutes 24(92.3%), In regard to the Birth Weight at birth less than 2kg 71 (78%) develop neonatal sepsis while 20(22%) did not develop neonatal sepsis, among the birth weight .≥ 2kg , 57(45.6%) of them develop neonatal sepsis while 68(54.4%) did not develop neonal sepsis . In regard to the meconium stained 17(81%) of them develop neonatal sepsis, only 4(19%) did not develop neonatal sepsis.

**Table 4: Multivariate analysis of potential risk factors and neonatal sepsis**

| Characteristics | An | AOR [95% C .I ] | Pvalue |
|---|---|---|---|

| | | | |
|---|---|---|---|
| Residence | a.Urban | .808[.347-1.880] | .621 |
| | b.Rural | Ref | |
| | 1.Yes | 5.520[.630-48.385] | .123 |
| Eclampsia during the pregnancy | 2.No | Ref | |
| | 1.Yes | 1.038[.282-3.816] | .955 |
| Bleeding during the pregnancy | 2.No | Ref | |
| | 1.Yes | 6.087[1.282-28.899] | .023 |
| UTI/STI during the pregnancy | 2.No | Ref | |
| | 1.Yes | 1.299[.587-2.874] | .518 |
| history of PROM on that pregnancy | 2.No | Ref | |
| | 1-4 times | Ref | |
| Times of vaginal examination | More than 4 | 3.299[1.369-7.952] | .008 |
| Gestational age | a.< 37 weeks | 1.154[.448-2.973] | .767 |
| | b. 37 - 40 wks | Ref | |
| Gender | Female | 2.850[1.328-6.115] | .007 |
| | Male | Ref | |
| APGAR score At 1st minute | APGAR <8 | 1.061[.372-3.024] | .912 |
| | APGAR>7 | Ref | |
| APGAR score At 5th minute | APGAR <8 | 17.045[2.729-106.468] | .002 |
| | APGAR>7 | Ref | |
| Birth Weight at birth | a. < 2kg | 5.028[1.869-13.526] | .001 |
| | b.≥ 2kg | Ref | |
| Meconium stained | a.Yes | 3.253[.820-12.902] | .093 |
| | b.No | Ref | |

**Source: (Researcher, 2023)**

Table 4: Multivariate analysis showed that UTI/STI during the pregnancy increase the risk of neonatal sepsis six times compared to the one without UTI : AOR 6.087[1.282-28.899], more than 4times of vaginal examination increase the risk of neonatal sepsis three times compared to the ones with less than 4 times of vaginal examination :AOR 3.299[1.369-7.952],, Female gender increase the risk of neonatal sepsis two times compared to the male gender: AOR 2.850[1.328-6.115] , APGAR score <8 At 5th minute increase the risk of neonatal sepsis 17 times compared to the one with APGAR > 7 8 At 5th minute AOR : 17.045[2.729-106.468] and Birth Weight < 2kg at birth increase the risk of neonatal sepsis five times compared to the ones with the birth weight ≥ 2kg AOR : 5.028[1.869-13.526]

## Discussion of findings

The presented study showed the higher prevalence 59.3 of neonatal sepsis. This is closer the cross-sectional study conducted in South Africa among neonates admitted into the NICUs of Dhaka Medical College Hospital (DMCH) and Dhaka Shishu (Children) Hospital to determine the prevalence and associated risk factors of sepsis among neonates admitted into neonatal intensive care units (NICU) of public hospitals showed the higher prevalence of 69.35%(Nyma et al., 2020).

It is very closer also to other study conducted in Ethiopia on prevalence of neonatal sepsis and associated factors among neonates in neonatal intensive care unit at selected

governmental hospitals in Shashemene town, Oromia regional state, revealed that among 244 neonates who were admitted in NICU 190(77.9%) had neonatal sepsis, and from those neonates 123 (64.7%) had early onset neonatal sepsis and 67 (35.3%) had late onset neonatal sepsis .this similar may justified by the fact that all these were conducted in developing countries where infection prevention is not adequate.

However it is contrary to the study conducted in 2018 in Rwandan hospitals (Rwinkwavu and Kirehe) showed that a total of 1723 neonates were hospitalized over the two-year which showed the prevalence of the neonatal sepsis was 23.6% (Nyishime et al., 2018). It is differing also to the study conducted in Eastern Africa on Neonatal sepsis and its associated factors: a systematic review and meta-analysis, 2019 said thatin total of 26 studies with 11239 participants were used for analysis. The pooled prevalence of neonatal sepsis in East Africa was 29.65% (Home delivery, maternal history of UTI, gestational age (preterm) ,prolonged labor (and PROM were identified factors of neonatal sepsis.(Abate et al., 2020)

This difference while it is the same country may be justified by the fact that the presented study conducted in teaching hospital where different districts hospital transfers the neonates with sepsis while the other one was conducted in district hospital where the majority of the neonates with sepsis are not hospitalized there.

The presented showed that UTI/STI during the pregnancy increase the risk of neonatal sepsis six times compared to the one without UTI. This is in line to another study conducted in Kenya with the aim of determining Prevalence and Predictors of Neonatal Sepsis among Neonates Admitted at the Newborn Unit of Kenyatta National Hospital which revealed that the neonates from mothers with history of UTI) were at higher risk to develop neonatal sepsis(Okube & Komen, 2020).

The presented study showed that APGAR score<8 At 5$^{th}$ minute increase the risk of neonatal sepsis 17 times compared to the one with APGAR > 7 8 At 5$^{th}$ minute .This is very similar to another study conducted in specialist hospital of Ghana which showed that the APGAR scores in the first and fifth minutes which is less than 7 is an independent risk factor of neonatal sepsis s (Adatara.P...,et al., 2019). Similar observations are also shown in the studies conducted in India (1997), Saudi Arabia (1997), Bangladesh (2011) and Washington (1985) which indicated that APGAR score at 5$^{th}$ minute had a strong effect on risk of neonatal sepsis. It is similar also to the study conducted in Nigeria on the Prevalence and factors associated with neonatal sepsis in a tertiary hospital found that the prevalence of neonatal sepsis was 37.6%. *Escherichia coli* was the most commonly isolated organism. Neonates 0–7 days of age were 2.8 times less likely to develop neonatal sepsis than older neonates. Babies born with an Apgar score of <6 within the 1$^{st}$ min were 2.4 times more likely to develop neonatal sepsis than those whose Apgar score was higher (Olorukooba et al., 2020).This is explained by the fact that asphyxia causes an immunological insult and resuscitation procedures following birth asphyxia tend to explore newborns to pathogenic microbes(Murthy et al., 2019).

The presented study showed that the low Birth Weight < 2kg at birth increase the risk of neonatal sepsis five times compared to the ones with the birth weight ≥ 2kg .This similarly to another study conducted Indonesia on risk Factors of Neonatal Sepsis revealed that, low birth weight is an independent risk factors of neonatal sepsis (Utomo, 2020).It is similar also to the study conducted in Ethiopia on clinical outcome and risk factors of neonatal sepsis among neonates in FelegeHiwot referral Hospital, Bahir Dar, Amhara Regional State from 225 neonates 169 (75.1%) were admitted with early onset of sepsis which showed that 71 (31.6%) of neonates who developed neonatal sepsis were low birth weight (Tewabe et al., 2017)

The presented study also showed that more than 4times of vaginal examination increase the risk of neonatal sepsis three times compared to the ones with less than 4 times of vaginal examination but there is no other which identified this factor which due inadequate of infection control precaution during examination. The presented study showed that Female gender increase the risk of neonatal sepsis two times compared to the male gender .This is contrary study conducted in India on Risk factors of neonatal sepsis found that in fifteen studies were included from 11,009 records, of which nine were prospective in design. Birth weight and gestational age at delivery were the most frequently reported factors where on meta-analyses, they found that male sex is an independent risk factor on neonatal sepsis (Murthy et al., 2019). There is no clear explanation for this discrepancy, further research is required to confirm which has the higher probability of developing neonatal sepsis.

## Conclusion

The study conducted in neonatology unit of University teaching Hospital of Butare with the aim of assessing the prevalence and risk factors of neonatal sepsis showed that Neonatal Sepsis prevalence is 59.3% which is about 43% higher compared to the study conducted in Ruhengeri Hospital. The prevalence revealed are associated with having UTI/STI during the pregnancy that increase the risk of neonatal sepsis six times compared to the one without UTI , more than 4times of vaginal examination increase the risk of neonatal sepsis three times compared to the ones with less than 4 times of vaginal examination, Female gender increase the risk of neonatal sepsis two times compared to the male gender, APGAR score <8 At $5^{th}$ minute increase the risk of neonatal sepsis 17 times compared to the one with APGAR > 8 At $5^{th}$ minute and Birth Weight < 2kg at birth increase the risk of neonatal sepsis five times compared to the ones with the birth weight ≥ 2kg

**Recommendations**

Since neonatal sepsis is a preventable cause of neonatal mortality the researcher recommends that preventable measures of neonatal sepsis are adhered to reduce the occurrence of Neonatal Sepsis at University Teaching Hospital of Butare those includes but not limited to the strengthening of Infection and prevention control measures during management of labor and during Neonatal care delivery. This can be achieved through training of medical staff especially midwives, Nurses Obstetrician and Pediatrician about the condition and its management. Neonates who present with signs and symptoms of sepsis need to be early diagnosed and timely initiation of appropriate clinical management which is critically important to reduce Neonatal sepsis complication and mortality. There should also be awareness to general community especially to pregnant mothers, postpartum mothers and other neonatal care takers about the prevention of Neonatal Sepsis. In addition early screening of all suspected cases of Neonatal Sepsis and immediate treatment of all the neonates found to be diagnosed with Sepsis is recommended to prevent mortality from neonatal sepsis,

## REFERENCES


Abate, B. B., Kasie, A. M., Reta, M. A., & Kassaw, M. W. (2020). Neonatal sepsis and its associated factors in East Africa: a systematic review and meta-analysis. *International Journal of Public Health*, *65*(9), 1623–1633. https://doi.org/10.1007/s00038-020-01489-x

Adatara, P., Afaya, A., Salia, S. M., Afaya, R. A., Kuug, A. K., Agbinku, E., & Agyabeng-Fandoh, E. (2018). Risk Factors for Neonatal Sepsis: A Retrospective Case-Control Study among Neonates Who Were Delivered by Caesarean Section at the Trauma and Specialist Hospital, Winneba, Ghana. *BioMed Research International*, *2018*, 1–7. https://doi.org/10.1155/2018/6153501

Al-Matary, A., Heena, H., AlSarheed, A. S., Ouda, W., AlShahrani, D. A., Wani, T. A., Qaraqei, M., Abu-Shaheen, A., Edmond, K., Zaidi, A., Mersha, A., Worku, T., Shibiru, S., Bante, A., Molla, A., Seifu, G., Huka, G., Abraham, E., Teshome, T., … Jana, A. K. (2019). Burden and factors associated with clinical neonatal sepsis in urban Uganda: a community cohort study | BMC Pediatrics | Full Text, (available at https://bmcpediatr.biomedcentral.com/articles/10.1186/s12887-018-1323-4). *PLoS Medicine*, *7*(3), 1–8. https://bmcpediatr.biomedcentral.com/articles/10.1186/s12887-018-1323-4%0Ahttps://doi.org/10.1016/j.jiph.2019.03.007

Bech, C. M., Stensgaard, C. N., Lund, S., Holm-Hansen, C., Brok, J. S., Nygaard, U., & Poulsen, A. (2022). Risk factors for neonatal sepsis in Sub-Saharan Africa: A systematic review with meta-analysis. *BMJ Open*, *12*(9). https://doi.org/10.1136/bmjopen-2021-054491

Fleischmann, C., Reichert, F., Cassini, A., Horner, R., Harder, T., Markwart, R., Tröndle, M., Savova, Y., Kissoon, N., Schlattmann, P., Reinhart, K., Allegranzi, B., & Eckmanns, T. (2021). Global incidence and mortality of neonatal sepsis: A systematic review and meta-analysis. *Archives of Disease in Childhood*, *106*(8), 745–752. https://doi.org/10.1136/archdischild-2020-320217

Getabelew, A., Aman, M., Fantaye, E., & Yeheyis, T. (2018). Prevalence of Neonatal Sepsis and Associated Factors among Neonates in Neonatal Intensive Care Unit at Selected Governmental Hospitals in Shashemene Town, Oromia Regional State, Ethiopia, 2017. *International Journal of Pediatrics*, *2018*, 1–7. https://doi.org/10.1155/2018/7801272

Geyt, J. L., & Hauck, S. (2018). G272 Epidemiological trends of neonatal sepsis in a county referral hospital in central Kenya. *Archives of Disease in Childhood, 101(Suppl 1)*, *101*(Suppl 1), 2016.

Gharouni, K., Ardalan, A., Araban, M., Ebrahimzadeh, F., Bakhtiar, K., Almasian, M., & Bastami, F. (2020). Application of Freire's adult education model in modifying the psychological constructs of health belief model in self-medication behaviors of older adults: A randomized controlled trial. *BMC Public Health*, *20*(1), 1–12. https://doi.org/10.1186/s12889-020-09425-7

Gollehon, N. S. (2019a). Neonatal sepsis. *Medscape*, 384–385.

Gollehon, N. S. (2019b). Neonatal sepsis. *Medscape*, *21*(3), 276–281. https://doi.org/10.36106/ijsr/2409139

Murthy, S., Godinho, M. A., Guddattu, V., Lewis, L. E. S., & Sreekumaran Nair, N. (2019). Risk factors of neonatal sepsis in India: A systematic review and meta-analysis. *PLoS ONE*, *14*(4), 1–26. https://doi.org/10.1371/journal.pone.0215683

Nimukuze, & Mukarwego. (2021). Trends and Factors Associated with Neonatal Sepsis at Ruhengeri Referral Hospital, Rwanda. *Austin Journal of Women's Health*, *8*(3). https://doi.org/10.26420/austinjwomenshealth.2021.1055

Nyishime, M., Borg, R., Ingabire, W., Hedt-Gauthier, B., Nahimana, E., Gupta, N., Hansen, A., Labrecque, M., Nkikabahizi, F., Mutaganzwa, C., Biziyaremye, F., Mukayiranga, C., Mwamini, F., & Magge, H. (2018). A retrospective study of neonatal case management and outcomes in rural Rwanda post implementation of a national neonatal care package for sick and small infants. *BMC Pediatrics*, *18*(1), 1–11. https://doi.org/10.1186/s12887-018-1334-1

Nyma, Z., Rahman, M., Hasan, S. M. M., Roby, N. U., Khanam, F., Alam, M. E., & Ali, M. (2020). Prevalence and Associated Risk Factors of Sepsis among Neonates Admitted into Neonatal Intensive Care Units of Public Hospitals in Dhaka. *Cureus*, *12*(3). https://doi.org/10.7759/cureus.7461

Okube, O. T., & Komen, M. (2020). Prevalence and Predictors of Neonatal Sepsis among Neonates Admitted at the Newborn Unit of Kenyatta National Hospital, Nairobi, Kenya. *Open Journal of Obstetrics and Gynecology*, *10*(09), 1216–1232. https://doi.org/10.4236/ojog.2020.1090114

Olorukooba, A., Ifusemu, W., Ibrahim, M., Jibril, M., Amadu, L., & Lawal, B. (2020). Prevalence and factors associated with neonatal sepsis in a tertiary hospital, North West Nigeria. *Nigerian Medical Journal*, *61*(2), 60. https://doi.org/10.4103/nmj.nmj_31_19

Tewabe, T., Mohammed, S., Tilahun, Y., Melaku, B., Fenta, M., Dagnaw, T., Belachew, A., Molla, A., & Belete, H. (2017). Clinical outcome and risk factors of neonatal sepsis among neonates in Felege Hiwot referral Hospital, Bahir Dar, Amhara Regional State, North West Ethiopia 2016: A retrospective chart review. *BMC Research Notes*, *10*(1), 1–7. https://doi.org/10.1186/s13104-017-2573-1

Utomo, M. T. (2020). Risk Factors of Neonatal Sepsis: A Preliminary Study in Dr. Soetomo Hospital. *Indonesian Journal of Tropical and Infectious Disease*, *1*(1), 23. https://doi.org/10.20473/ijtid.v1i1.3718

WHO. (2020a). Global report on the epidemiology and burden of sepsis: current evidence, identifying gaps and future directions. In *World Health Organization*. http://apps.who.int/bookorders.%0Ahttps://apps.who.int/iris/bitstream/handle/10665/334216/9789240010789-eng.pdf

WHO. (2020b). *Sepsis*. https://www.who.int/news-room/fact-sheets/detail/sepsis

Yadav, N. S., Yadav, P. K., Kasarla, R. R., & Parajuli, P. (2021). Incidence and Risk Factors Associated with Blood Culture Proven Neonatal Sepsis. *Journal of Universal College of Medical Sciences*, *9*(01), 28–32. https://doi.org/10.3126/jucms.v9i01.37963