

## Research Article

# Trends and Factors Associated with Neonatal Sepsis at Ruhengeri Referral Hospital, Rwanda

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Received: June 08, 2021; Accepted: July 07, 2021;

Published: July 14, 2021

## Abstract

Neonatal sepsis is estimated to cause 26% of all neonatal mortality globally including Africa with 17% neonatal deaths. Early diagnosis and management can considerably decrease the risk of neonatal sepsis, and improve the outcome. This study aimed to determine trends and the risk factors associated with neonatal sepsis at Ruhengeri Referral Hospital from 2018 to 2019. A total of 1220 neonates' medical files were reviewed. Data were recorded and analyzed by using SPSS. Logistic regression analysis was used to estimate factors associated with neonatal sepsis, 5% was considered as significance level. Results showed that the majority of neonates 57.4% were females, 53.9% of neonates had 0-7 days while 46.1% had more than 7 days of birth. The total cases of neonatal sepsis from January to December 2018 were found to be 207 with an average of 17 cases per month whereas there were 165 cases from January to December 2019 with an average of 14 cases per month. Research findings revealed that rupture of membranes (AOR=3.6; 95% CI: (1.34-4.76); p<0.001) and prolonged labour (AOR=1.5; 95% CI: (1.12-2.43); p<0.001) were associated with neonatal sepsis. Vaginal delivery and no history of urinary tract infection were protective factors to neonatal sepsis occurrence. The study also observed that the majority of the neonates had early onset of sepsis (<7 days). Hence, encouraging mothers to use antenatal care services might help identify the risk factors and possible interventions to reduce the risk factors of adverse birth outcomes including neonatal sepsis.

**Keywords:** Neonatal sepsis; Neonatal death; Ruhengeri referral hospital

## Introduction

Sepsis is a dysregulated host response to infection leading to life-threatening organ dysfunction [1]. The Global Burden of Disease (GBD) estimated 1.3 million annual incident cases of neonatal sepsis and other infections (approximately 937 cases per 100 000 live births) and 203000 sepsis-attributable neonatal deaths [2,3].

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 [4,5]. In sub-Saharan Africa alone, an estimated 5.3-8.7 million disability-adjusted life-years have been lost in 2014 due to neonatal sepsis and consecutive long-term morbidity [6]. In sub-Saharan Africa neonatal sepsis is the main newborn killer where more than one third of neonatal deaths [7].

Neonatal sepsis is categorized based on the time of occurrence including early onset diseases (EOD) and late onset diseases (LOD). This differentiation has clinical fact: for instance, EOD is mostly caused by bacteria attracted before and during birth whereas LOD bacteria are attracted afterbirth from health facility or community [8]. Early onset of sepsis remains a common and big issue for neonate, especially intrapartum antimicrobial streptococcus (BGS) commonly found to be an etiological agent, but Escherichia viral or fungal etiology may also manifested at 7 days of life and must be differentiated from bacteria sepsis [9].

In Rwanda, there has been a significant decrease in under-five

mortality, from 196 per 1000 live births in 2000 to 50 per 1000 live birth in 2015, making the country one of the dew in SSA to achieve the MDGs for child mortality. Again, the neonatal mortality rate significantly decreased from 41 per 1000 live births in 1990 to 17 per 1000 live births in 2016 [10]. The main cause of neonatal mortality in Rwanda are prematurity (41%), and neonatal sepsis (10%) [11]. The Rwanda Demographic Health Survey (RDHS 2014-2015) reported that newborn death was 20/1000 live birth [12].

To our knowledge no study have been conducted in Northern Province of Rwanda assessed the risk factors of neonatal sepsis. A report from Ruhengeri hospital showed that 2142 neonates admitted in neonatology in 2016 of them 514 (24%) were reported to have neonatal infections during hospitalization. Therefore, this research sought to assess the trends and factors associated with neonatal sepsis in Rwanda with special focus on Ruhengeri Referral Hospital.

## Materials and Methods

### Study design

This research was a descriptive hospital-based retrospective study. This study has used quantitative approach to determine the trends, and factors associated with neonatal sepsis among hospitalized neonates. This study was conducted among neonates hospitalized in neonatal unit at Ruhengeri Referral Hospital located in Northern Province, Musanze District of Rwanda. Ruhengeri referral hospital serves 413,470 people with 17 health centers. The hospital building comprises the pediatric department with 96 beds among them 36 beds

and 11 incubators and 12 staffs among them 3 health care providers are on daily shift in neonatal unit.

### Target population

The study targeted 1220 individuals composed with neonates and mothers found in neonatal unit from January 2018 to December 2019. All 1220 medical records (neonates' files) from Neonatal units with inclusion criteria were checked during data collection period from January 1, 2018 to December 31, 2019.

A structured checklist was used to retrieve needed information from neonate's medical files. Mainly, the checklist comprised the socio-demographic features, maternal and pregnancy-related factors and neonates-related factors.

### Data analysis and ethical consideration

Data collected was analyzed by using SPSS after being coded, compiled and recorded. Descriptive statistics showing frequency distributions and percentage have been used to represent variables under study. Research findings are presented in tables and graphs. Multivariate analysis was used to determine statistical associations between the dependent and independent variables. A two tailed p-value of less than or equal to 0.05 at 95% confidence interval has been used in order to state the statistical significance.

This study was approved by Mount Kenya University Rwanda Ethical review board. The ethical approval was presented to the Ruhengeri Referral Hospital Administration to obtain permission to carry out the study according to the required rules and regulations of hospital administration. The hospital management's team was informed that findings are to be used for academic purpose and confidentiality was ensured.

## Results

A total of 1220 clients' files have been reviewed in line with the objectives and giving a response rate of 100%.

### Socio-demographic characteristics of the mothers

As presented in table 1, a total of 1220 medical files equals to a total of 1220 mothers aged at least 18 years old have been reviewed in the Neonatal Unit at Ruhengeri Referral Hospital. Findings revealed that 66.2% of mothers were aged between 18 and 35 years, 57.1% were in the second social category, 66.7% were coming from rural areas, most of the mothers (75.3%) had attended primary school, a big part of the mothers (76.0%) were married while the majority of the mothers (73.4%) of the mothers were unemployed.

### Trends of neonatal sepsis at Ruhengeri Referral Hospital

The trends of neonatal sepsis among neonates hospitalized in neonatal unit at Ruhengeri Referral Hospital between 2018 and 2019 are shown in Figure 1.

The total cases of neonatal sepsis from January to December 2018 were found to be 207 cases with an average of 17 cases per month whereas there were 165 cases from January to December 2019 with an average of 14 cases per month. These findings show a decrease in neonatal sepsis cases from 2018 to 2019. Findings in Figure 1 indicate that there was an increase of neonatal sepsis in the February 2018 (from 15 cases to 23 cases) whereas it has decreased in February 2019 (from 18 cases to 13 cases). A high increase of cases was observed

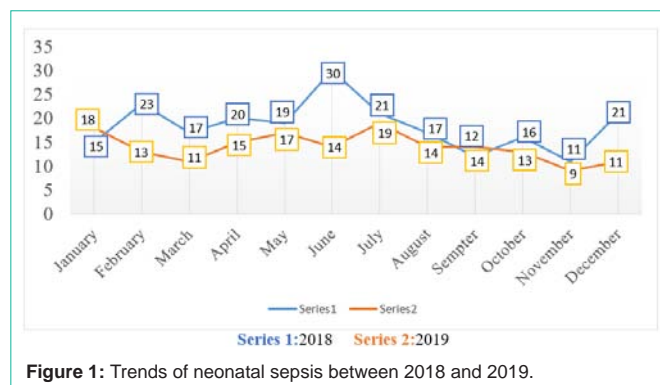


Figure 1: Trends of neonatal sepsis between 2018 and 2019.

Table 1: Socio-demographic characteristics of the mothers.

Variables	Items	Frequency (n)	Percent (%)
Mother's age	18-35 years	808	66.2
	More than 35 years	412	33.8
Social category [Ubudehe]	Category 1	184	15.1
	Category 2	697	57.1
	Category 3	316	25.9
	Category 4	23	1.9
Residence	Rural	814	66.7
	Urban	406	33.3
Education level	Primary education	919	75.3
	Secondary school	173	14.2
	University	128	10.5
Marital status	Single	217	17.8
	Married	927	76
	Divorced	53	4.3
	Widowed	23	1.9
Employment status	Employed	325	26.6
	Unemployed	895	73.4

from May to June 2018 (from 19 cases to 30 cases); while there was a decrease from May to June 2019 (from 17 cases to 14 cases). At the end the year, the number of cases of neonatal sepsis has re-increased for both 2018 and 2019 from 11 cases to 21 cases and from 9 to 11 cases respectively.

Findings show that 30.3% of neonates hospitalized in neonatal unit at Ruhengeri Referral Hospital from 2018 and 2019 had neonatal sepsis.

### Factors associated with sepsis at Ruhengeri Hospital

The findings revealed that neonates aged above 23 days were less likely to have sepsis than neonates aged  $\leq 7$  days (AOR=0.6; 95% CI: [0.25-0.96];  $p=0.043$ ); neonates without congenital malformations were less likely to have neonatal sepsis than those with congenital malformations (AOR=0.3; 95% CI: (0.06-3.43);  $p=0.002$ ). Mother's without diseases history during their pregnancies were less likely to have children with neonatal sepsis than women suffered from any disease during pregnancies (AOR=0.4; 95% CI: (0.25-0.86);  $p=0.002$ ); women with no history of urinary tract infections during pregnancy were less likely to have children with neonatal sepsis than women

**Table 2:** Predictors of neonatal sepsis among hospitalized neonates at RRH.

Characteristics	Items	Crude OR (95% CI)	Adjusted OR (95% CI)	p-value
Mother's age	18-35 years	Ref.	Ref.	Ref.
	More than 35 years	1.3(1.05-1.79)	0.5(0.15–2.24)	0.715
Mother's social category [Ubudehe]	Category 1	Ref.	Ref.	Ref.
	Category 2	3.1(2.22-4.37)	1.9(0.50–4.98)	0.624
	Category 3	1.5(1.07-2.24)	1.3(0.41–3.35)	0.415
	Category 4	2.06(2.72-15.6)	1.1(0.42–2.53)	0.112
Mother's education level	Primary education	Ref.	Ref.	Ref.
	Secondary school	1.7(1.23-2.58)	0.8(0.25–1.44)	0.082
	University	0.9(0.59-1.46)	0.7(0.21–2.14)	0.754
Mother's employment status	Employed	Ref.	Ref.	Ref.
	Unemployed	0.6(0.47-0.85)	0.4(0.15–1.74)	0.463
Neonate's age	0-7 days	Ref.	Ref.	Ref.
	8-15 days	1.4(1.12-1.95)	0.12(0.07–0.93)	0.089
	16-23 days	1.03(0.61-2.5)	0.4(0.07–1.99)	0.067
	Above 23 days	0.7(0.47-1.19)	0.6(0.25–0.96)	0.043
Neonate's gender	Male	Ref.	Ref.	Ref.
	Female	0.7(0.60-0.99)	1.1 (0.31–1.37)	0.226
Congenital malformations	Yes	Ref.	Ref.	Ref.
	No	0.4(0.25-0.73)	0.3(0.06–3.43)	0.002
Diseases during pregnancy	Yes	Ref.	Ref.	Ref.
	No	1.5(1.14-1.87)	0.4(0.25–0.86)	0.002
Urinary tract infections	Yes	Ref.	Ref.	Ref.
	No	0.3(0.27-0.48)	0.2(0.12-0.81)	<0.001
Mode of delivery	C-section	Ref.	Ref.	Ref.
	Vaginal	0.7(0.58-0.96)	0.3(0.013–0.819)	0.025
Birth attended by skilled personnel	Yes	Ref.	Ref.	Ref.
	No	3.02(1.81-5.06)	2.1(1.43-4.35)	<0.001
Rupture of membranes	Yes	3.8(1.24-5.63)	3.6(1.34-4.76)	<0.001
	No	Ref.	Ref.	Ref.
Prolonged labour	Yes	1.9(1.41-2.77)	1.5(1.12-2.43)	<0.001
	No	Ref.	Ref.	Ref.

with history of urinary tract infections (AOR=0.2; 95% CI: (0.12-0.81);  $p<0.001$ ); Neonates born vaginally were less likely to have neonatal sepsis than neonates delivered by C-section (AOR=0.3; 95% CI: (0.013-0.819);  $p=0.025$ ); the odds of having neonatal sepsis was 2.1 times higher among births not attended by a skilled personnel than births attended by skilled personnel (AOR=2.1; 95% CI: (1.43-4.35);  $p<0.001$ ); mothers with rupture of membranes were more likely (AOR=3.6; 95% CI: (1.34-4.76);  $p<0.001$ ) and mothers experienced prolonged labor were 1.5 times more likely delivering children with neonatal sepsis than those who did not experience it (AOR=1.5; 95% CI: (1.12-2.43);  $p<0.001$ ).

## Discussion

The present study assessed factors associated with neonatal sepsis at Ruhengeri Referral Hospital in Rwanda in order to tackle the disease burden and its specific associated problems.

The study has documented the trends and factors associated with neonatal sepsis among 1220 hospitalized neonates in the study area. Neonatal sepsis is the most common diagnosis in neonatal intensive care units [13-15].

Research findings revealed that there was an increase of neonatal sepsis in January 2018 with 23 cases of neonatal sepsis whereas it has decreased in January 2019 with 13 cases of neonatal sepsis. Forthcoming the mid-year (June) 2018 and 2019, the number of neonatal sepsis cases highly increased from 19 cases on May 1, 2018 to 30 cases on June 1, 2018 while there was a decrease in the same months of 2019 (from 17 cases on May 1, 2019 to 14 cases on June 1, 2019). The study findings have shown different findings with the previous findings from Iran and Korea [16,17].

The decrease of the rate of neonatal sepsis found in this study, difference in studies conducted Iran, and Korea may be attributed to

the efforts made by Rwanda Ministry of Health and its partners who availed disease prevention guidelines and tools in all health facilities of Rwanda including Ruhengeri Referral Hospital.

In this study, the prevalence of neonatal sepsis was found to be 30.3% with about 34.7% of these cases with early-onset neonatal sepsis (<7 days), which is to ascertain extent comparable with other studies [18,19].

Many studies conducted around the world display differently the prevalence of neonatal sepsis; however, the prevalence of studies done around Sub Saharan Africa and other developing countries is higher than that of the developed countries [20]. The prevalence in our study is comparable with studies from different sides of the world: 37.6% in North-West Nigeria [21], 39% in New Delhi, India [22], 45.9% in Egypt [23] 38.9% at a tertiary hospital in Mwanza, Tanzania [24] and 31.4% in Dar Es Salam, Tanzania [25].

Similar findings were as well obtained in a study conducted Nigerian Teaching hospitals that reported a neonatal sepsis prevalence of 33.1% [26]. A prevalence of 38.9% was found in a study conducted in Benin City, Nigeria [27], 42% in University of Maiduguri Teaching Hospital [28], 41.2% in Jos University Teaching Hospital [29], and 35.5% in ABUTH University Teaching hospital, Zaria, Nigeria [30]. The reasons for these disparities could be referred to the difference in hospital settings as it has been shown that neonatal sepsis is an issue in resource-poor settings [31].

The current study findings revealed that the odds that a neonate develops sepsis decreased with an increasing in neonatal age. Those findings contrasted with findings from a study conducted in Ghana where the probability that a neonate develops sepsis increased with increasing neonatal age (<7days) [32]. Furthermore, those findings from Ghana were consistent with the study conducted in Ethiopia [7].

In this study, neonates born to mothers who had not got urinary tract infections (UTI) during pregnancy were less likely to have sepsis. This finding is equivalent with the findings of previous studies conducted in Ghana and Ethiopia [7,33]. These findings were consistent with the statement that maternal UTI is often associated with early-onset neonatal sepsis, especially if untreated during the third-trimester pregnancy or labor, and it may be associated with neonatal sepsis following the colonization of the birth canal by the infectious agent [34].

In the line with the present findings, a study conducted in Indonesia, Utomo found cesarean section is risk of developing neonatal sepsis, which is inconsistent with the results of the current study [35]. It is noted that newborns delivered through the normal way (vaginal) have been found less likely to have neonatal sepsis than those born through C-section even if they are exposed to vaginal and fecal bacteria [36,37].

In this study, early rupture of membranes and prolonged labor has found to increase the odds of ascending microorganisms from the birth canal into the amniotic sac and fetal compromise as well as asphyxia, which frequently leads to sepsis in the neonatal period. This finding was consistent with findings from a study conducted by Endale et al. where neonates born to mothers who had premature rupture of membranes during pregnancy were 4.6 times more likely to

have developed sepsis [38] These findings could serve as justification for prophylactic antibiotic therapy for neonates born to mothers with a history of premature rupture of membranes during pregnancy. Furthermore, several other study findings [37,39,40] were found to be inconsistent with the current study findings.

## Conclusion

In this study, the trend of neonatal sepsis at Ruhengeri Referral Hospital has found to vary month per month during the study period. The prevalence of neonatal sepsis was found to be high among the neonates studied. Most important significant maternal and neonatal predictors to neonatal sepsis were found to be neonate's age, diseases during pregnancies, urinary tract infections, delivery mode, who attended the birth, rupture of membranes and prolonged labor. Therefore, encouraging mothers to use antenatal care services might help identify the risk factors and possible interventions to reduce the risk factors of adverse birth outcomes including neonatal sepsis. And also healthcare personnel improving the care they render to mothers and babies could be a key factor in reducing neonatal sepsis. There is a need to effectively plan and implement the neonatal sepsis education and promotion sessions targeting mothers and health care providers.

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