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Prevalence, Risk Factors, and Causes of Neonatal Sepsis: Insights from Hospitals in Tripoli-Libya

Sana Masud[1*], Isra Abudhair[1]

[1] Department of Public Health, Faulty of Medical Technology, University of Tripoli, Tripoli, Libya

إنتشار عوامل الخطر وأسباب الإنتان الوليدي: رؤى من مستشفيات طرا بلس-ليبيا

سناء مسعود[1*]، إسراء أبو ظهير[1]
[1] قسم الصحة العامة، كلية التقنية الطبية، جامعة طرابلس، طرابلس، ليبيا

*Corresponding author s.masud@uot.edu.ly *المؤلف المراسل
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Abstract
Around the world, sepsis is the single largest cause of neonatal deaths, and about 36% of neonatal mortality caused by infection. This study aimed to determine the prevalence, causes, and risk factors of neonatal sepsis in Tripoli's hospitals, Libya. In this observational descriptive study, the researchers relied on the information in hospital's files of three big hospitals and two specialized private hospitals, the information collected according to a form prepared by the researchers and checked by neonatologists. The overall prevalence of neonatal sepsis (NS) was 37.5%. Low gestational age, mode of delivery, duration of stay in hospitals, type of feeding, resuscitation, and maternal infections (Urinary Tract Infection (UTI) and Chorioamnionitis as well as prolonged rupture of the membrane (PROM)) were the most important risk factors associated with neonatal sepsis. Mortality from neonatal sepsis can be avoided and the proper implementation of preventive and curative measures against neonatal sepsis can reduce the mortality rate.

Keywords: Neonatal Sepsis; Prevalence; Neonatal Deaths; Tripoli City; Hospital Infection.

الملخص
في جميع أنحاء العالم، يُعد الإنتان أكبر سبب لوفيات الأطفال حديثي الولادة، حيث إن حوالي 36% من وفيات الأطفال حديثي الولادة ناجمة عن العدوى. هدفت هذه الدراسة إلى تحديد مدى انتشار وأسباب وعوامل الخطر للإنتان الوليدي في مستشفيات طرابلس، ليبيا. اعتمد الباحثون في هذه الدراسة الوصفية الرصدية على المعلومات الموجودة في ملفات المستشفيات لثلاثة مستشفيات كبيرة ومستشفيين خاصين متخصصين، وتم جمع المعلومات وفق استمارة أعدها الباحثون ودققها أطباء حديثو الولادة. بلغ معدل الانتشار الإجمالي للإنتان الوليدي 37.5%. كان انخفاض عمر الحمل، وطريقة الولادة، ومدة الإقامة في المستشفيات، ونوع التغذية، والإنعاش، والتهابات الأمهات (مثل عدوى المسالك البولية، والتهاب المشيمة والسلى وكذلك تمزق الغشاء لفترة طويلة) من أهم عوامل الخطر المرتبطة بالإنتان الوليدي. يمكن تجنب الوفيات الناجمة عن الإنتان الوليدي، حيث إن التنفيذ السليم للتدابير الوقائية والعلاجية ضد الإنتان الوليدي يمكن أن يقلل من معدل الوفيات.

الكلمات المفتاحية: الإنتان الوليدي، معدلات الانتشار، وفيات حديثي الولادة، مدينة طرابلس، عدوى مستشفيات.

Introduction:

Mortality and morbidity in the neonatal onset are usually associated with neonatal sepsis (Odabasi & Bulbul, 2020; Shane, Sánchez, & Stoll, 2017). More than 2.5 million newborns die around the world annually, where neonatal sepsis represents two-thirds of this account (Odabasi & Bulbul, 2020; Shane et al., 2017; Almudeer, Alibrahim, & Gosadi, 2020). Globally, the prevalence of Early-Onset Sepsis (EOS) ranges from 1 to 5 per 1000 live births (Odabasi & Bulbul, 2020). Neonatal Sepsis (NS) is the

major cause of mortality and morbidity in the neonatal period (Odabasi & Bulbul, 2020; Shane et al., 2017). According to data collected by the World Health Organization (WHO) in 2018, neonatal sepsis is responsible for 18 to 30% of neonatal mortality (Shane et al., 2017). Moreover, NS is one of the most common causes of neonatal hospitalization in developing countries (Yismaw et al., 2019). NS is considered the third cause of neonatal death after prematurity and intrapartum-related complications (Odabasi & Bulbul, 2020).

Infants with clinical features such as fever, apnea, reduced sucking and movement, bradycardia/tachycardia, vomiting, and infected umbilical cord are diagnosed as neonatal sepsis-infected newborns (Shah et al., 2006). Multiple organ failure, septic shock, and death are complications associated with neonatal sepsis. It is necessary for clinicians to know the signs and symptoms of NS to diagnose it early (Yismaw et al., 2019). Low birth weight (LBW) (Odabasi & Bulbul, 2020; Shane et al., 2017; Almudeer et al., 2020; Yismaw et al., 2019; Murthy et al., 2019; Adatara et al., 2019; Noah, Doya, & Jouni, 2022; Sahu et al., 2022), premature birth (i.e., low gestational age) (Odabasi & Bulbul, 2020; Almudeer et al., 2020; Yismaw et al., 2019; Noah et al., 2022; Sahu et al., 2022), fetal distress, multiple pregnancies, resuscitation of the baby (Odabasi & Bulbul, 2020; Murthy et al., 2019; Shah et al., 2006), low APGAR scores (Odabasi & Bulbul, 2020; Shane et al., 2017; Yismaw et al., 2019; Murthy et al., 2019; Shah et al., 2006; Noah et al., 2022), birth asphyxia (Shane et al., 2017; Murthy et al., 2019; Yismaw et al., 2019), pre-existing maternal infection (Shane et al., 2017), male sex (Murthy et al., 2019; Shah et al., 2006), congenital dermatologic abnormality (Yismaw et al., 2019; Sahu et al., 2022), and prematurity of the fetal immune system (Yismaw et al., 2019), as well as other factors like some cord care unhealthy practices (Odabasi & Bulbul, 2020; Murthy et al., 2019), antenatal care received, type of delivery (Shane et al., 2017; Murthy et al., 2019; Noah et al., 2022), duration of stay in the facility (Murthy et al., 2019; Sahu et al., 2022), newborn mixed feeding, delivery settings (Murthy et al., 2019), use of resuscitation tools, and medical and nursing staff (Murthy et al., 2019) are contributing to the prevalence of neonatal sepsis throughout the world, causing morbidity and mortality among neonates (Murthy et al., 2019). The maternal risk factors include Premature Rupture of Membranes (PROM) (Odabasi & Bulbul, 2020; Shane et al., 2017; Yismaw et al., 2019; Murthy et al., 2019; Noah et al., 2022; Sahu et al., 2022), Chorioamnionitis (Odabasi & Bulbul, 2020; Yismaw et al., 2019), maternal group B streptococcal (GBS) colonization, delivery earlier than 37 weeks of gestation (Odabasi & Bulbul, 2020), intrapartum maternal fever (>38°C) (Odabasi & Bulbul, 2020; Yismaw et al., 2019), poor prenatal care (Odabasi & Bulbul, 2020; Murthy et al., 2019; Yismaw et al., 2019), foul-smelling liquor (Noah et al., 2022), meconium-stained amniotic fluid (MSAF) (Murthy et al., 2019; Noah et al., 2022), maternal age >30-35 (Murthy et al., 2019; Shah et al., 2006), foul-smelling vaginal discharge (Yismaw et al., 2019), and UTI (Yismaw et al., 2019; Sahu et al., 2022).

In developing countries, ENS risk factors also include poor antenatal healthcare services, a high rate of home birth (Odabasi & Bulbul, 2020; Shah et al., 2006), unhygienic birth, poor sanitation during labor, and delay in identifying conditions that pose a risk of infection to the mother or infant (Odabasi & Bulbul, 2020). NS and death frequency differ between populations. It should be mentioned that epidemiological data showed 99% of newborn deaths occurred in developing countries, while only 1% occurred in developed countries (Odabasi & Bulbul, 2020). The incidence of NS in the United States ranges between 1 to 4 illnesses per 1000 live births (Hammoud et al., 2017). Globally, it ranges from 1 to 5 per 1000 live births (Odabasi & Bulbul, 2020). In low- and middle-income countries, NS is responsible for approximately 8% of neonates' deaths and is a predominant cause of neonatal long-term morbidity and mortality (Yismaw et al., 2019). In India, the case mortality of sepsis ranges between 25% to 65% among neonates (Murthy et al., 2019). In Africa, sepsis accounts for 28% of neonatal mortality, and the early detection and treatment of cases can prevent about 84% of neonatal mortality (Shane et al., 2017). Early identification of the risk factors and early diagnosis of neonatal sepsis help physicians in determining the causes to provide prevention of further complications, aiming to reduce morbidity and mortality (Yismaw et al., 2019; Shah et al., 2006). Therefore, this study highlights the neonatal infection's risk factors to develop sound prevention programs.

The aim of this study is to detect the prevalence of neonatal sepsis to reduce the increase in infections and to protect the infant's life. A study conducted by Shah et al. (2006) studied the maternal and neonatal risk factors for neonatal sepsis in Nepal, using a prospective case-control study conducted on neonates up to 7 days of life with a diagnosis of neonatal sepsis. The most important result showed that the overall mortality was 11%, and factors that carried a significant risk for the development of neonatal sepsis were PROM, MSAF, foul-smelling liquor, LBW, prematurity, and low Apgar score at birth. Another study titled "Prevalence and factors associated with neonatal sepsis among neonates in Temeke and Mwananyamala Hospitals in Dar es Salaam, Tanzania" used a hospital-based cross-sectional study conducted during August-September 2015. A standardized questionnaire was used to obtain demographic, obstetric, and clinical information, and the diagnosis of neonatal sepsis was done

clinically. Their results showed that a total of 220 neonates were recruited, 69 (31.4%) had sepsis, and the risk factors associated with neonatal sepsis were maternal age >35 years and resuscitation at birth. Neonatal sepsis among neonates in Dar es Salaam is associated with maternal and health services-related factors (Jabiri et al., 2016). In 2017, Yismaw et al. performed a study that aimed to determine the proportion and risk factors of neonatal sepsis at the University of Gondar Comprehensive Specialized Hospital, North West Ethiopia. It was an institution-based cross-sectional study, and a total of 423 neonates admitted to the neonatal intensive care unit with their index mothers were included in the study. Their result showed that the proportion of neonatal sepsis was 11.7%, and the factors significantly associated with neonatal sepsis (neonatal-related factors) were congenital anomaly and low Apgar score, and the maternal factors were foul-smelling vaginal discharge, PROM, and intrapartum fever (Yismaw et al., 2019).

Another study in the same year of 2017 aimed to investigate the incidence and the pattern of causative organisms of culture-proven early-onset sepsis (EOS) in Arab states. Five neonatal care units participated in this 2-year prospective study in Kuwait, the United Arab Emirates, and Saudi Arabia. Data were collected prospectively using a standardized data collection form. Their result showed that out of 67,474 live births, 102 cases of EOS occurred, and the overall incidence of EOS was 1.5 per 1000 live births. The most common causative organism of EOS was group B Streptococcus (GBS; 60.0%), followed by Escherichia coli (13%) (Hammoud et al., 2017).

Another study performed by Christensen et al. (2018) titled "Association Between Mode of Delivery and Risk of Infection in Early Childhood" was a cohort study collected from the Danish National Patient Registry, based on the Odense Child Cohort, following infants from gestation until a mean age of 3.5 years. Their result showed that a total of 1,921 children were born by vaginal delivery, 283 by elective cesarean section, and 227 by acute cesarean section. The incidence rate for hospitalizations due to infection in children born by elective cesarean section was higher compared with children born by vaginal delivery, with a ratio reaching 1.45 (95% CI = 1.16-1.80, p = 0.001). In 2019, Adatara et al. performed a study titled "Risk Factors Associated with Neonatal Sepsis: A Case Study at a Specialist Hospital in Ghana." Their study was an unmatched retrospective case-control study conducted among 900 neonates. Their result showed that a total of 103 neonates who had sepsis (cases) and 797 neonates who had no sepsis (controls) were enrolled, and the factors that predicted the occurrence of sepsis among neonates were parity, mode of delivery, bleeding disorder, PROM, APGAR score in the first and fifth minute, resuscitation at birth, duration of stay in the facility, and neonatal age on admission (Adatara et al., 2019).

Ali et al. (2020) conducted a study titled "Epidemiology and risk factors associated with early-onset neonatal sepsis in the south of KSA." The researchers used a retrospective review of the medical records of mothers and their neonates who were diagnosed with EOS, and the number of neonates diagnosed with EOS was 126. The incidence of EOS was 4.44 per 1,000 live births during the study period, and their most important risk factors were gestational age and LBW (Almudeer et al., 2020).

A study conducted in 2022 by Noah, Doya, and Jouni aimed to determine the prevalence of early neonatal infections and risk factors associated with neonatal intensive care. They used an observational descriptive study that included 197 neonates out of 700 neonates who were referred to the neonatal intensive care unit at Tishreen University Hospital in Lattakia-Syria over 1 year. Their result was that 197 neonates (28.14%) had early neonatal sepsis, and the most prevalent risk factors for early neonatal infection were cesarean section, followed by maternal infections, male newborn sex, LBW, prematurity, maternal age greater than 30 years and less than 20 years, early rupture of membranes, the need for resuscitation, and meconium amniotic fluid (Noah et al., 2022).

In 2022, a study performed by Sahu et al. aimed to identify the potential risk factors responsible for the poor outcome in neonatal sepsis. A case-control was conducted retrospectively with neonates admitted to the Neonatal Intensive Care Unit in India, and maternal and neonatal details were collected from the medical files. The result showed that a total of 613 neonates were found to have positive culture sepsis out of 4690 neonates. Extreme LBW, extreme preterm, and pregnancy-induced hypertension were the major potential risk factors of NS (Sahu et al., 2022).

Another study conducted in Eastern Ethiopia in 2022, titled "Neonatal Sepsis and Associated Factors Among Neonates Admitted to Neonatal Intensive Care Unit in General Hospitals," used a hospital-based cross-sectional study with a retrospective document review conducted among newborns hospitalized in neonatal intensive care units. The charts of 356 newborns who were hospitalized were reviewed, and the data were collected using a pretested checklist. The overall prevalence of neonatal sepsis was 45.8%, and their result showed that the factors associated with neonatal sepsis were PROM, mode of delivery, low APGAR score, pre-lacteal feeding, and mechanical ventilation (Roble, Ayehubizu, & Olad, 2022).

Another study in 2023, performed by Salama and Tharwat, aimed to identify maternal and neonatal risk factors linked to neonatal sepsis in Egypt. They used a hospital-based retrospective case-control study carried out during the period from June 2020 to May 2021. The study included 522 neonates aged <28 days who were delivered in the study hospital and admitted to the neonatal intensive care unit. Their result showed that a total of 174 cases and 348 controls were included in the study, and maternal age, parity, route of delivery, PROM, prematurity, birth weight, neonatal gender, and age were significantly associated with the risk of sepsis (Salama & Tharwat, 2023).

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Methodology:

Study Design, Period, and Place;

In this study, the researchers depended on information from hospital's files of three big hospitals that provide obstetric and pediatric care in Tripoli (University hospital, Al-Jalla hospital, and Al-Khadra hospital), in addition to two specialized private clinics. The information collected according to a form prepared by the researchers, using observational descriptive study. The data were collected using a pretested checklist, prepared by researchers in which they depended on searching for information in this field on internet in addition to some previous studies. As well as, this checklist pretested by some expert in gynecology and neonatology. This research conducted among newborns hospitalized in neonatal intensive care units in 2023, the data were collected from 3rd to 31th of January - 2024.

Study Population;

The study population represented in children who were recently born in the above-mentioned hospitals. 160 cases were observed, including infected and non-infected cases. 60 cases were infected, 6 infected children were died and one case excluded because of incomplete information. Therefore, the size of the samples subject to the statistical analysis was 53 cases.

Data Analysis;

After completing coding, the answers and entering the study data by using Statistical Package for Social Science (SPSS version 24), each of the risk factors that may have contributed to the infection process in children was studied and analyzed, in order to find out the most contributing factors in the neonatal

infection. Frequency distribution tables for these factors were found and contribution percentage of each alternative was determined using a chi-square test.

Result and Discussion

Since the study was about infection among neonates and the reasons for transmitting it to the neonate, the samples were sorted and it was found that 60 cases were infected with prevalence rate equal to 37.5% of the sorted files. After examination, it was found that 6 infected infants were died with death rate was 3.75%. The samples subject to the study is 53 cases distributed among hospitals. The study revealed that, the prevalence rate of neonatal sepsis is about 37.5%. This finding is in line with previous studies conducted by Jabiri et al. (2016)**,** it was 31.4%, and in line with the study done in Syria by Noah, Doya, and Jouni which was 28.14%, as well as another study conducted by (Roble, Ayehubizu and Olad. 2022), it was 45.8%. Additionally, our result is contra to a study done by (Yismaw et. al., 2019) which was 11.7%, and was 11.4% in a study conducted by (Adatara et. al., 2019). This might be due to difference in study setting and health system set up.

Neonatal Risk Factors;

Gestational age

To find out whether the gestational age is a risk factor in the NS, the relative frequency of gestational age of neonates was found in the research. The percentages for each gestational age category were calculated, 52.8% of newborns were preterm, 43.4% term, and 3.8 % post-term.

Table (1): The infant's gestational age.

Gestational age	Frequency	Percent %	Chi-Square Test	P-value
Preterm	28	52.8	21.547	0.000
Term	23	43.4		
Post-term	2	3.8		
Total	53	100.0		

Through table (1), we found that (p-value=0.000) for Chi-square test was less than 0.05. Therefore, there is a significant importance to the difference in proportions for each of the gestational age alternatives. 52.8% of infected neonates were preterm. This means that, gestational age is a risk factor for neonatal sepsis. Low gestational age (GA) is the strongest predictor of EOS risk within the total birth population (Mukhopadhyay & Puopolo, 2012). (The present study is in line with previous studies conducted by Shah et al. (2006), Jabiri et al. (2016), Almudeer, Alibrahim, and Gosadi (2020), and Noah, Doya, and Jouni (2022) as well as. Salama and Tharwat (2023), they found preterm infants significantly higher risk for EOS compared with term infants conducted by (Roble, Ayehubizu, & Olad, 2022). It may be explained by premature babies may require some invasive procedures, such as; endotracheal intubation and prolonged intravenous infusion, those establish a portal for entry putting them at risk of hospital-acquired infection (Hammoud et al., 2017; Sahu et al., 2022) The incidence of EOS in babies born at 34- 36 weeks' gestation is 2- to 3- fold higher than with those born at 37- 40 weeks (Mukhopadhyay & Puopolo, 2012).

Gender

To find out if gender is a risk factor in the infection, the relative frequency of neonates' gender was found in the research, the result noted that p-value for a Chi-square test was 0.891, it was greater than 0.05. Therefore, there is no relative importance to the differences in proportions for each gender alternatives. Hence our study found no significant relation between gender and the risk of neonatal sepsis. This result agrees with Almudeer, Alibrahim and Gosadi and Roble, Ayehubizu and Olad, but differs from previous studies by Noah, Doya, and Jouni and Salama and Tharwat, who found that male neonate sex important risk factor for NS. This could be because males' neonates are more likely to be born preterm and with a lower BW, and are more sensitive to adverse perinatal and postnatal environmental conditions, both of them increase the risk of NS (Murthy et al*.,* 2019).

Birth weigh

To find out if birth weight is a risk factor in the NS in newborns, the relative frequency of birth weight was found in the research, the results were as in Table (2).

Table (2): The infant's birth weight.

BW	Frequency	Percent %	Chi-Square Test	P-value
<2.5	20	37.7	0.074	3.189
≥2.5	33	62.3		
Total	53	100.0		

Table (2) indicated that p-value was more than 0.05, it was 0.074. This means, there is no relative importance to the differences in birth weight options. Therefore, birth weight is considered a non-risk factor for NS, which is in consistency with (Yismaw et. al., 2019 and Adatara et. al., 2019) results but in contrast to Shah et al. (2006)**,** Noah, Doya, and Jouni (2022)**, and** Salama and Tharwat (2023)**, who** found that BW was **s**tatistically associated to newborn sepsis, and the risk of developing sepsis 3-10 times higher in premature-low-BW babies than full-term normal-BW infants (Odabasi & Bulbul, 2020; Hammoud et al., 2017; Yismaw et al., 2019; Sahu et al., 2022).

Apgar score at 1st five- minutes.

Table (3) illustrates the infant's Apgar score at 1st five minutes.

Table (3): The infant's Apgar score at 1st five minutes.

Apgar score at 1st five minutes	Frequency	Percent %	Chi-Square Test	P-value
>7	26	49.1	0.019	0.891
<7	27	50.9		
Total	53	100.0		

From Table (3), we noted that p-value=0.891, it was greater than 0.05. Therefore, there is no relative importance to the differences in proportions for each Apgar score alternatives, Hence, Apgar score at 1st five minute is considered a non-risk factor for NS in newborns. This result agrees with Salama**)** and Tharwat (2023), but differs from previous studies by Shah et. Al (2006)., Yismaw et. al. (2019), and Adatara et. al(2019), which can be explained by "any newborn with APGAR score of less than 7 at birth must undergo infections from resuscitation equipment during emergency procedures" (Shane et al., 2017).

Type of delivery

To find out if the type of delivery is a risk factor in the neonatal sepsis, the relative frequency of types of deliveries were found in the research. The percentages for each type of deliveries were calculated, 84.9% of deliveries were Caesarean section, 13.2% Normal delivery, and 1.9% Instrumental. The results were as in Table (4).

Table (4): The types of deliveries.

Mode of delivery	Frequency	Percent %	Chi-Square Test	P-value
Normal delivery	7	13.2	64.453	0.000
Caesarean section	45	84.9		
Instrumental	1	1.9		
Total	53	100.0		

Through Table (4), the p-value=0.000, it was smaller than 0.05. Thus, there is a relative importance to the difference in rates for each alternative of the type of delivery, which means, type of delivery is a risk factor for neonatal sepsis. 84.9% of deliveries were caesarean section. Previous research done by Shah et. al(2006)., Jabiri et. al (2016)., and Roble, Ayehubizu and Olad (2022) found that neonates were delivered vaginally were more likely to develop NS than those delivered though CS. In contrast to previous researches, we found that caesarian delivery was a strong predictor of NS, which in consistency with Adatara et. al (2019). and Noah, Doya, and Jouni (2022). CS has recently gained interest as a potential risk factor for infection. This could be explained by the infant was delivered by elective CS have a high risk of frequency of neonatal intensive care unit's admissions, morbidity, and mortality than infants delivered vaginally (Christensen et al., 2018).

Duration of stay in hospital

To find out if the duration of stay in hospital is a risk factor in the NS, the relative frequency of duration of stay in hospital was found in the research. The results were as in Table (5).

Table (5): The infant's duration of stay in hospital.

Duration of stay in hospital	Frequency	Percentage %	Chi-Square Test	P-value
For 2 days or less	14	26.4	15.604	0.001
3-10 days	24	45.3		
11-17 days	11	20.8		
From 18 days and over	4	7.5		
Total	53	100.0		

Through Table (5), we noted that (p-value=0.001) for a Chi-square test was smaller than 0.05. Therefore, there is a relative importance to the difference in rates for each alternative of the duration of stay in hospital. Hence, our study revealed that the duration of stay in hospital from 3-10 days is significantly associated with neonatal sepsis, but this is inconsistent with Yismaw et. al(2019). On the other hand, our results agreement with Adatara et. al (2019). It is expected that the immunological immaturity that could happen in preterm infants whose prolonged stays in hospital and need for invasive procedures place them at increased risk for hospital-acquired infections (Sahu et al., 2022).

Type of feeding

To find out the answer, statistical analysis showed whether the type of feeding is a risk factor for NS, the percentages for each type of feeding were calculated and it was found that 45.7% was from Formulas, 17.0% from Breast-milk, and 28.3% form Both. The results were as in Table (6)

Table (6): The infant's type of feeding.

Type of feeding	Frequency	Percent %	Chi-Square Test	P-value
Breast-milk	9	17.0	11.925	0.003
Formulas	29	54.7		
Both	15	28.3		
Total	53	100.0		

The result in Table (6) showed that, p-value equal to 0.003, this is smaller than 0.05, this means a relative importance to the difference in rates for each alternative of the type of feeding, which indicates that the type of feeding is a risk factor in NS. The feeding of 45.7% infected neonates was from Formulas. This is in agreement with Roble, Ayehubizu and Olad. It is possible that prelacteal feeding and the used bottles were contaminated with infectious pathogens, which promoting entry into the circulatory system, resulting in NS (2). But our result is in contra with Yismaw et. al (2019).

Order of birth

Table (7) illustrates the infant's order of birth.

Table (7): The infant's order of birth.

Order of birth	Frequency	Percent %	Chi-Square Test	P-value
1.00	3	5.7	4.667	0.198
2.00	6	11.3		
6.00	2	3.8		
9.00	1	1.9		
Total	12	22.6		
Missing	41	77.4		
Total	53	100.0		

Table (7) defined that, p-value was greater than 0.05, it was 0.198. Therefore, there is no relative importance to the differences in proportions for each order of birth options. Therefore, order of birth was observed not to be a significant risk factor of NS. This finding is congruent with (Yismaw et. al. 2019 and Adatara et. al., 2019).

Resuscitation

Frequency of resuscitation was found in the research, is resuscitation considered a risk factor affecting the NS in neonates? To find out if resuscitation is a risk factor in the infection process in newborns, the relative frequency of resuscitation was found in the research, the results were as in Table (8) and Figure (1).

Table (8): The infant's resuscitation.

Resuscitation	Frequency	Percent %	%	Chi-Square Test	P-value
Yes	15	28.3	75	5.000	0.025
No	5	9.4	25		
Total	20	37.7	100		
Missing	33	62.3			
Total	53	100.0			

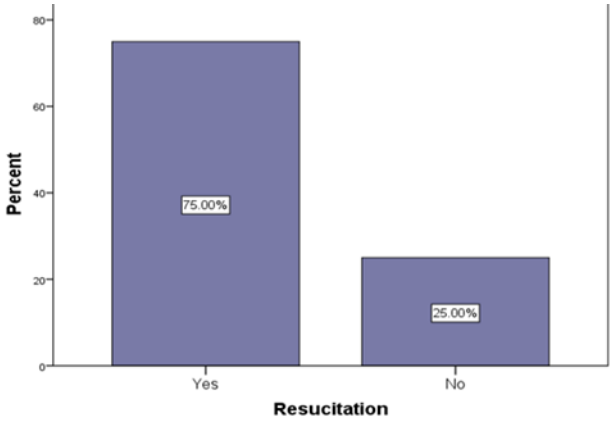

Figure (1): The infant's resuscitation.

The result noted that p-value=0.025, it was smaller than 0.05. Thence, there is a significant importance of resuscitation in NS. In our study, 28.3% of neonates were received resuscitation so resuscitation at birth was found in this study to be statistically associated with the risk of developing NS. This finding is in contra with Shah et. al (2006). and Sahu et. al (2022). Similar study reported by Jabiri et. al (2016), Adatara et. al (2019), and Noah, Doya, and Jouni (2022). This could be due to poor practices and non-adherence to guidelines by health professionals during resuscitation. This may predispose the neonate with a greater risk of developing sepsis. The risk of EOS increases by multiple pregnancies and resuscitation of the baby (Odabasi & Bulbul, 2020).

Maternal Risk Factors;

Maternal infections

To find out if the maternal infections are a risk factor for NS, the relative frequency of maternal infections of neonates' mothers were found in the research. The maternal infections were present in 83.0% of the mothers and absent in 17.0%.

Table (9): The maternal infection.

Maternal infection	Frequency	Percent %	Chi-Square Test	P-value
Present	44	83.0	23.113	0.000
Absent	9	17.0		
Total	53	100.0		

Through Table (9), we noted that p-value=0.000 for a Chi-Square test, it was smaller than 0.05. Thus, there is a significant importance, that means maternal infection is a considerable risk factor in the NS of newborns. To determine which categories (types) of maternal infections had the greatest impact on NS, the percentages for each maternal infection category were calculated and shown in Table (10). The most frequent types of maternal infections were; Chorioamnionitis, PROM, and UTI.

Table (10): The types of maternal infections.

Maternal infection	Frequency	Percent %	Chi-Square Test	P-value
Absent	7	13.2	36.170	0.323
Hypertension/pregnancy-induced	1	1.9		
Type-3	1	1.9		
UTI	3	5.7		
C-reactive protein	2	3.8		
WBCs	1	1.9		
Offensive vaginal discharge	2	3.8		
C-reactive protein & WBCs	5	9.4		
Chorioamnionitis & C-reactive protein	1	1.9		
Chorioamnionitis, C-reactive protein, Fever & UTI	3	5.7		
UTI, Chorioamnionitis & C-reactive protein	1	1.9		
PROM, C-reactive protein & Offensive vaginal discharge	1	1.9		

C-reactive protein & UTI	1	1.9		
UTI & C-reactive protein	1	1.9		
Type-3, C-reactive protein & Offensive vaginal discharge	1	1.9		
Age & Fever	1	1.9		
Chorioamnionitis & Fever	2	3.8		
C-reactive protein, WBCs, UTI & Antepartum hemorrhage	1	1.9		
C-reactive protein, WBCs, UTI, APH & Offensive vaginal discharge	1	1.9		
UTI, Chorioamnionitis & PROM	1	1.9		
C-reactive protein, WBCs, Fever & PROM	1	1.9		
Fever, PROM & STDs	1	1.9		
C-reactive protein, WBCs &UTI	3	5.7		
Chorioamnionitis, UTI, Fever & WBCs	1	1.9		
Fever, C-reactive protein & Offensive vaginal discharge	1	1.9		
RTI & Hypertension/pregnancy-induced	1	1.9		
RTI, UTI & WBCs	1	1.9		
Chorioamnionitis & WBCs	1	1.9		
PROM, APH & Offensive vaginal discharge	1	1.9		
Chorioamnionitis & RTI	1	1.9		
UTI & PROM	1	1.9		
Chorioamnionitis & UTI	1	1.9		
UTI, C-reactive protein & Offensive vaginal discharge	1	1.9		
Multi-gravida & C-reactive protein	1	1.9		
Total	53	100.0		

In our study, Chorioamnionitis was a predisposing risk factor for neonatal sepsis. It is associated with 2- to 3-fold increased risk of EOS in live birth studies of very LBW infants as well as term infants (Mukhopadhyay & Puopolo, 2012). The incidence of birthing sepsis increases basically when there is maternal chorioamnionitis (Hammoud et al., 2017). The current study finding also showed that PROM was significantly associated with the risk of neonatal sepsis which is in agreement with other studies by (Shah et. al., 2006; Yismaw et. al., 2019; Adatara et. al.,20219). Most studies associate PROM as a significant risk factor for early-onset of neonatal sepsis (Yismaw et al., 2019; Noah et al., 2022). Because of the risk of ascending infection, prolonged leaking and PROM is considered as a main risk factor for sepsis (2020) and Sahu et al. (2022). But our results are inconsistent with following reference (Almudeer, Alibrahim, and Gosadi, 2020).

Conclusion

Early and late neonatal septicemia is widespread problem in the infant period that causes high morbidity and mortality rate. The study found both maternal and neonatal factors as possible independent risk factors to have a strong association with the risk of neonatal sepsis. The most contributing factors in neonatal sepsis are; Low gestational age, mode of delivery, duration of stay in hospitals, type of feeding, resuscitation, and maternal infections (Urinary tract infection and Chorioamnionitis as well as prolonged rupture of the membrane). Mortality from neonatal sepsis can be avoided by the early diagnosis, timely supportive management, and proper implementation of preventive and curative measures.

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