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Risk Factors and Outcome of Necrotizing Enterocolitis in Very Low Birth Weight Infants Admitted in Neonatal Intensive Care Unit, Federal Medical Centre Asaba

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ABSTRACT

Necrotizing enterocolitis (NEC) remains one of the most devastating gastrointestinal emergencies in neonates, particularly among very low birth weight (VLBW) and preterm infants. Despite advances in neonatal intensive care, NEC continues to contribute significantly to neonatal morbidity and mortality, especially in resource-limited settings such as Nigeria. The purpose of this study was to determine the risk factors and outcomes of NEC among very low birth weight infants admitted to the Neonatal Intensive Care Unit (NICU) of the Federal Medical Centre, Asaba. The study adopted a descriptive cross-sectional design using retrospective chart review of 100 VLBW infants admitted between January and December 2024. Data were extracted using a structured checklist and analyzed using descriptive and inferential statistics. Finding revealed that 63% of the infants developed NEC, with the highest occurrence between four and seven days of life. Significant maternal risk factors included pregnancy-induced hypertension, chorioamnionitis, and prolonged rupture of membranes, while neonatal factors such as prematurity, low Apgar scores, neonatal sepsis, and formula feeding were strongly associated with NEC occurrence. The mortality rate among affected infants was 25%, and common complications included intestinal stricture, growth retardation, and prolonged hospital stay. The study concludes that NEC remains a major cause of morbidity and mortality among VLBW infants at FMC Asaba. Preventive measures such as promotion of exclusive breast milk feeding, early detection of feeding intolerance, improved infection control practices, and adherence to standardized feeding protocols are strongly recommended to reduce NEC incidence and improve neonatal survival.

Keywords: Necrotizing enterocolitis, Very low birth weight, Risk factors, Neonatal outcome, Federal Medical Centre Asaba, Preterm infants

INTRODUCTION

Premature birth and its associated complications remain among the most pressing public health concerns in neonatal medicine. One of the most devastating conditions affecting premature and very low birth weight (VLBW) infants is necrotizing enterocolitis (NEC), an inflammatory bowel disease that leads to varying degrees of intestinal necrosis. The disease often presents suddenly and progresses rapidly, frequently resulting in intestinal perforation, systemic infection, multi-organ failure, and death. Its multifactorial etiology and unpredictable clinical course make NEC a formidable challenge in neonatal intensive care units (NICUs) globally (Boys et al., 2022).

Globally, NEC remains a leading gastrointestinal emergency in preterm and very low birth weight (VLBW;<1500g) infants worldwide (Cho et al., 2022; Boo & Cheah, 2012). A large meta-analysis of over half a million VLBW infants revealed incidence of NEC at appropriate 7% with similar findings across global settings. Although survival improvements in neonatal intensive care units (NICU) have increased the number of infants at risk, NEC continue to contribute significantly to neonatal morbidity and mortality. Among infants with NEC, mortality rate typically ranges between 30% and 5%, particularly in those requiring surgical intervention (Eaton et al., 2020; Uauy et al., 1991; Qian et al., 2017).

Within the sub-Saharan Africa, particularly in Ethiopia, aggregated data from multiple NICU studies estimate nec prevalence of about 16% with preterm birth, VLBW and prolonged NICU stays by being a key predictor. Another Ethiopian cross-sectional study reported prevalence as high as 25.4% among very low birth weight infants Sitotaw Molla M et al. (2021). While in south Africa, the incidence of NEC is about 8% among VLBW infants with a notable risk factors as late onset sepsis, surfactant use, and formular feeds. Alarmingly, mortality in NEC cases is about 49% and approximately 28% underwent surgery

Vermont Oxford Network (2019) define NEC as a diagnosis at surgery or on post-mortem examination or based on clinical and radiographic criteria (comprised of features from Bell staging) Infants must have at least 1 of the following clinical signs: bilious gastric aspirate or emesis, abdominal distension or occult/gross blood in stool (no fissure). In addition, infants must have at least 1 of the following radiographic findings: pneumatosis intestinalis, hepato-biliary gas (portal venous gas) or pneumoperitoneum. Infants found at surgery or post-mortem examination to have a focal intestinal perforation (spontaneous intestinal perforation) are coded as having that disease and not NEC. Recent reports have noted a declining incidence of NEC in the US, from 7.1% to 5.2%, using this definition.

J Med Assoc Thai (2024) describe the global prevalence of NEC as 7% among VLBW infant. However, research conducted in Thailand indicates a significantly higher incidence of NEC, which reports around 10% to 15%. Recognition of its risk factors to prevent the development of NEC is one of the keys to improving clinical outcome of VLBW infants. Gitau et al. found that cumulative duration of exposure to umbilical vein catheter and cumulative duration of exposure to invasive mechanical ventilation were risk factors for NEC, while Lamireau et al. found that early-onset neonatal sepsis (EONS) was the only risk factor for NEC. However, Supabanpot's study conducted in Thailand between 2010 and 2018 found that the amount of human milk was a significant protective factor against NEC. Risk factors for NEC from each study vary according to practice guidelines, available resources, and local organism epidemiology.

NEC occurs predominantly in neonates with a birth weight of less than 1500 grams or gestational age below 32 weeks. It is most commonly seen in the second to third week of life and affects approximately 7–10% of VLBW infants (Berman et al., 2017). Various risk factors have been identified in literature, including prematurity, artificial feeding (formula), perinatal asphyxia, prolonged rupture of membranes, maternal infections, and aggressive enteral feeding. These risk factors often work synergistically to compromise the immature gastrointestinal and immune systems of neonates, triggering an exaggerated inflammatory cascade that culminates in NEC.

The etiology of NEC is multifactorial and not fully understood, but several risk factors have been implicated including prematurity, formula feeding, perinatal asphyxia, intrauterine growth restriction (IUGR), and early enteral feeding practices (Gordon et al., 2016). In Nigeria, the lack of advanced neonatal support systems in many centers complicates management, contributing to higher mortality rates compared to high-income countries.

Jones IH, Hall NJ (2020) describe Necrotizing enterocolitis (NEC) as a devastating and destructive intestinal necrosis syndrome of the immature intestine in newborns, especially in preterm and low birth weight infants (LBWIs), with a prevalence of about 1‰, up to 11% in very low birth weight infants (VLBWIs) of < 1500 g, and up to 22% in extremely low birth weight infants (ELBWIs) of < 1000 g. A systematic review by Jones and Hall provided the most recent data on the epidemiology of NEC: the total mortality rate of infants diagnosed with NEC is 23.5%, with the highest mortality rate of 50.9% for ELBWIs with NEC combined with surgery. Even if they survive, their prognosis is poor, with neurodevelopmental disorders and intestinal failure being the most serious complications, occurring in 24.8% and 15.2% of all children with NEC, and in 59.3% and 35.3% of children with NEC requiring surgery, respectively.

Statement of the Problem

The neonatal mortality rate in Nigeria remains among the highest in the world, and a significant proportion of these deaths occur in the first month of life due to complications of prematurity and associated conditions such as necrotizing enterocolitis. NEC is particularly lethal in very low birth weight infants, with case fatality rates reported to range from 20% to 50%, depending on the severity and timeliness of intervention (Nair et al., 2020). The disease often presents in a nonspecific manner, making early detection difficult. In many cases, NEC is diagnosed only after complications like bowel perforation or systemic sepsis have already occurred, limiting treatment options and increasing the likelihood of mortality.

Despite its severity, NEC is under-researched in most Nigerian hospitals. At FMC Asaba, the clinical workload and limited diagnostic resources hinder timely data collection and structured monitoring of NEC cases. There is currently no institutional registry that tracks NEC occurrence, risk factors, or treatment outcomes. As a result, healthcare workers often rely on anecdotal experience and generalized protocols, which may not be effective in managing NEC in the local context.

At FMC Asaba, a significant number of VLBW infants are admitted annually to the NICU with various complications, including suspected or confirmed NEC. Anecdotal observations suggest that many of these infants experience prolonged hospital stays, require surgical intervention, or die from NEC-related complications. Yet, there is no systematically collected or analyzed data on the prevalence, risk factors, or outcomes of NEC in this center. This lack of information undermines efforts to formulate evidence-based protocols for prevention and management.

Despite advances in neonatal intensive care, NEC continues to be a major cause of morbidity and mortality among neonates in Nigeria. In FMC Asaba, anecdotal evidence suggests increasing incidences of NEC in the NICU, particularly among VLBW infants. However, there is limited empirical data regarding the specific maternal and neonatal risk factors contributing to NEC in this environment, and the short- and long-term outcomes of these cases are not well documented.

Objectives of the Study

To assess the maternal and neonatal risk factors, as well as the clinical outcomes, associated with necrotizing enterocolitis in very low birth weight infants admitted to the neonatal intensive care unit of Federal Medical Centre, Asaba. Specific Objectives are:

1. To determine the prevalence of NEC among VLBW infants admitted to the NICU of FMC Asaba within the study period.
2. To explore neonatal characteristics linked to NEC (gestational age, birth weight, Apgar scores, feeding pattern, incidence of sepsis) and maternal conditions that contribute to the risk of NEC (infections, use of antenatal corticosteroids, method of delivery, premature rupture of membrane).

LITERATURE REVIEW

Necrotizing Enterocolitis

Necrotizing Enterocolitis (NEC) is a severe, multifactorial gastrointestinal disease affecting neonates, particularly those born prematurely or with very low birth weight (VLBW). It's a life-threatening condition and a leading cause of gastrointestinal emergencies in newborns. It is characterized by inflammation, bacterial invasion, and ultimately necrosis of the intestinal wall. In NEC, the damaged intestinal wall, potentially leads to necrosis (tissue death) and even perforation, which can cause serious complications like peritonitis and sepsis. The disease spectrum ranges from mild feeding intolerance to fulminant intestinal necrosis leading to systemic infection, shock, and death. NEC typically presents between the second and third week of life, particularly in preterm infants who have started enteral feeds Neu & Walker (2016). pathogenesis involves a combination of intestinal immaturity, abnormal microbial colonization, hypoxic-ischemic injury, and an exaggerated inflammatory response. The immature gut is more permeable and susceptible to injury from bacterial endotoxins and formula feeds. Intestinal ischemia caused by perinatal stress further compromises mucosal integrity, while dysbiosis imbalance in gut microbiota contributes to abnormal immune responses.

Rich BS, Dolgin SE (2021) stated that Necrotizing enterocolitis (NEC) is a frequently encountered condition in the premature neonate, which can have devastating effects. The signs and symptoms of NEC are variable and can be confused with those of sepsis. An abdominal radiograph is often obtained for diagnosis, and findings that indicate NEC include pneumatosis and portal venous gas. The treatment of NEC includes gastrointestinal rest, gastric decompression, broad-spectrum intravenous antibiotics, and systemic support. A finding of pneumoperitoneum signifies intestinal perforation, which requires surgical intervention. Long-term sequelae of NEC include short-gut syndrome, intestinal stricture, and neurodevelopmental delays. The presentation of intestinal stricture can be puzzling. It can appear at presentation as a bowel obstruction or, conversely, as increased stool output or diarrhea. The clinician should have a high level of suspicion for intestinal stricture in a patient with a history of NEC.

According to Johns Hopkins, Necrotizing enterocolitis (NEC) is defined as the death of intestinal tissue, primarily affecting premature infants or sick newborns, it occurs when the lining of the intestinal

wall dies and the tissue falls off. Although the cause is unknown, it is thought that a decrease in blood flow to the bowel keep the bowel from producing mucus that protect the gastrointestinal tract, bacteria in the intestine may also be a cause.

Denise M. Aaron (2024) describe NEC as an acquired disease, primarily of preterm or sick neonates, characterized by mucosal or even deeper intestinal necrosis. It is the most common gastrointestinal emergency among neonates. Symptoms and signs include feeding intolerance, lethargy, temperature instability, ileus, bloating, bilious emesis, hematochezia, reducing substances in the stool, apnea, and sometimes signs of sepsis. Diagnosis is clinical and is confirmed by imaging studies. Treatment is primarily supportive and includes nasogastric suction, parenteral fluids, parenteral nutrition, antibiotics, isolation in cases of infection, and, sometimes, surgery**.**

Concept of Very Low Birth Infants (VLBW)

Very Low Birth Weight (VLBW) infants are those with a birth weight of less than 1500 grams, often resulting from preterm birth before 32 weeks of gestation. These neonates are among the most vulnerable populations in the NICU due to their immature physiological systems, including underdeveloped lungs, kidneys, gastrointestinal tract, and immune defenses (Stoll et al., 2015). The infants are at increased risk of developing complications due to immature organs and underdeveloped immunity. Only a few babies, 1.5%, are born this tiny. However, the overall rate of very low birthweight babies in the U.S. is increasing. This is primarily due to the greater numbers of multiple birth babies who are more likely to be born too early and weigh less. Very low birth weight infants usually require specialized neonatal intensive care for support such as mechanical ventilation, temperature regulation, nutritional support and infection prevention. Babies with very low birthweight are much smaller than other babies of normal birthweight. A very low birthweight infants head usually appears to be bigger than the rest of the body and they are extremely thin, with little body fat. The skin is often quite transparent, allowing the blood vessels to be easily seen.

VLBW infants are at high risk of numerous complications such as respiratory distress syndrome, patent ductus arteriosus, intraventricular hemorrhage, sepsis, and feeding difficulties. Their care requires meticulous monitoring, including thermal regulation, oxygen therapy, intravenous fluid management, and nutritional support via total parenteral nutrition (TPN) or gradually advancing enteral feeds. Growth and neurodevelopmental outcomes are often poor in survivors, emphasizing the need for early intervention programs and prolonged follow-up.

Very low birth weight has

- Immature organs of gastrointestinal, immune and respiratory system
- Increased vulnerability to infections, feeding difficulties and metabolic disorder
- Greater risk of morbidity and mortality especially when complications like NEC occur

Causes/ Risk Factors of Very Low Birth Weight

Several factors contribute to very low birth weight infants, which could be fetal, maternal or environmental factors

Fetal Factors

- Preterm Birth; Babies gain more weight in the later part of pregnancy therefore, those born early have less time to grow and develop in the mother's womb. This is why premature babies weigh less or cannot gain an average weight.
- Intrauterine Growth Restriction (IUGR): Poor placental function with reduced nutrient and oxygen delivery predisposes infant IUGR.
- Multiple Gestation**:** Pregnancy with twins, triplets, or other multiples increases the risk of both preterm birth and fetal growth restriction.
- Placental Problems: Abnormal placental function or issues with placental blood supply can impair fetal growth and increase the risk of VLBW.
- Chromosomal Anomalies: Certain genetic or chromosomal abnormalities can lead to VLBW.

Maternal factors

- Malnutrition, insufficient weight gain during pregnancy, and a low body mass index (BMI) before pregnancy are significant risk factors.

- **Substance Use:** Smoking, drinking alcohol, and using street drugs during pregnancy significantly increase the risk of VLBW.
- **Prenatal Care & Social Factors:** A lack of skilled antenatal care, young maternal age (under 17), and older maternal age (over 35) are associated with VLBW. Socio-economic status and rural residence can also play a role.
- **Infections:** Intrauterine infections, including malaria and other systemic infections, can contribute to VLBW.

Effects of Very Low Birth Weight

Very low birth weight infants are at higher risk of complications due to immaturity of their organs. The effects vary from baby to baby and also depend on the cause of low birth weight, the effect could either be an immediate (short) term effects and long term effects.

Immediate/short Term Effects

- Breathing difficulties such as infant respiratory distress syndrome (RDS).
- High risk of infections.
- Problems with feeding and weight gain.
- Low blood sugars (hypoglycemia).
- Increased red blood cell count which can make the blood thick.
- Inability to maintain warmth.
- Inadequate oxygen levels at birth.
- Gastrointestinal problems such as necrotizing enterocolitis.
- Bleeding into the brain including intraventricular hemorrhage
- Sudden infant death syndrome

Long Term Effects

Risks for long-term complications and disability are increased for babies with very low birthweight. Generally, the lower the birthweight, the greater the chances for developing intellectual and neurological problems, which may include:

- Cerebral palsy
- Blindness
- Deafness
- Growth retardation
- Chronic lung disease (bronchopulmonary dysplasia)

Because of the tremendous advances in care of sick and premature babies, more and more babies are surviving despite being born early and being born with a very low weight. However, prevention of preterm birth is one of the best ways to prevent very low birthweight. Prenatal care is a key factor in preventing preterm births and very low birthweight babies, as well as in reducing the risk for sudden infant death syndrome (SIDS). At prenatal visits, the health of both mother and fetus can be checked. Because maternal nutrition and weight gain are linked with fetal weight gain and birthweight, eating a healthy diet and gaining the proper amount of weight in pregnancy are essential. Mothers should also avoid alcohol, cigarettes, and illicit drugs, which can contribute to poor fetal growth, SIDS, and other complications. Treatment of VLBW depend on your child's age, symptoms, and general health. It will also depend on how severe the condition is. Babies with VLBW need:

- Care in the neonatal intensive care unit (NICU).
- Incubator care
- Temperature-controlled beds.
- Special feedings, most often with a tube into the stomach as well as I.V. fluid.
- Other treatments for possible complications.

The outcome for a baby with VLBW depends mainly on how much the baby weighs and how many weeks of gestation the baby is at birth. The smallest and earliest babies have the most problems.

Babies with VLBW may have a harder time catching up in physical growth because they often have other problems. Many babies with very low birth rate are referred to special follow-up health care programs.

Risk Factors of Nec

The pathogenesis of NEC is multifactorial involving a complex interplay of intestinal immaturity, gut dysbiosis, bacterial translocation, and inflammatory responses. Several risk factors significantly increase the likelihood of NEC development

Neonatal Factors:

- **Prematurity:** The most prominent risk factor is prematurity, with the risk increasing dramatically as gestational age decreases and birth weight falls. VLBW infants have significantly underdeveloped intestinal mucosa, impaired gut barrier function, and reduced immune defenses, making them highly susceptible. infants have underdeveloped gastrointestinal tracts which compromises mucosal barrier function, digestive enzyme activities, and coordinated motility.
- **VLBW** (<1500g): Infants born prematurely, (before 28 weeks) and with very low birth weights are at the highest risk. Their immature digestive systems are less able to handle feeding and are more susceptible to infection and inflammation. especially those with very low birth weights (typically less than 1500g), are at a significantly higher risk of developing NEC.
- **Formula feeding or early aggressive enteral feeding:** The timing and type of feeding are crucial. Early introduction of enteral nutrition, especially formula feeding, is associated with increased NEC risk compared to mother's own milk (MOM). Rapid increases in feeding volume or concentration may also overwhelm the immature gut. The composition of formula may be more difficult for a premature infant's digestive system to process. Breast milk is protective due to immunoglobulins, lactoferrin, lysozyme, and growth factors. Studies confirm that exclusive breast milk feeding or use of donor human milk lowers NEC incidence significantly (Sullivan et al., 2015). The use of probiotics and standardized feeding protocols are also being explored as preventive strategies.
- **Gut Microbiota:** Disruption of the gut microbiota, often characterized by an imbalance (dysbiosis) in bacterial species, plays a crucial role. Reduced colonization with beneficial bacteria and overgrowth of pathogenic bacteria increase inflammation and susceptibility to NEC. Antibiotic use, which alters gut flora, is a significant risk factor.
- **Perinatal Factors:** Several perinatal events increase NEC risk, including:
  - Asphyxia: Hypoxic-ischemic injury compromises intestinal perfusion and function.
  - Chorioamnionitis: Intrauterine infection increases inflammation and predisposes to NEC.
  - Patent ductus arteriosus (PDA): PDA may lead to altered intestinal perfusion.
  - Respiratory distress syndrome (RDS): RDS necessitates mechanical ventilation, potentially affecting gut blood flow and increasing NEC risk.
  - Congenital anomalies: Certain congenital anomalies can impact gut development and function.
  - Immunocompromised states: Infants with underlying immune deficiencies are more vulnerable to infections and NEC development.

Maternal Factors

- Inadequate antenatal care
- Infections (chorioamnionitis, urinary tract infections)
- Preeclampsia and hypertension
- Placental insufficiency and intrauterine growth restriction
- Prolonged rupture of membranes
- Lack of antenatal corticosteroid administration

Outcome of NEC in VLBW Infants:

NEC carries significant morbidity and mortality. Outcomes vary widely depending on the severity of the disease, the stage at diagnosis (Bell's stages), and the quality of medical care.

Mortality: NEC is a leading cause of death in VLBW infants. The mortality rate is higher in infants with severe NEC (Bell's stage III).

Morbidity: Survivors of NEC often experience short term and long-term outcome,

Short-Term Outcomes:

- Increased mortality (up to 50% in surgical NEC).
- Prolonged hospitalization and need for intensive care.
- Increased requirement for surgical intervention (bowel resection, stoma creation).
- Higher risk of nosocomial infections and ventilator-associated pneumonia.
- Dependence on parenteral nutrition and complications like cholestasis.

Long terms complications

- Short bowel syndrome (SBS): Extensive intestinal resection during NEC surgery leads to SBS, requiring long-term parenteral nutrition and potentially impacting growth and development.
- Neurodevelopmental disabilities: NEC is associated with an increased risk of cerebral palsy, intellectual disability, and other developmental delays.
- Nutritional deficiencies: Malabsorption and impaired intestinal function can lead to various nutritional deficiencies.
- Gastrointestinal complications: Strictures, fistulas, and chronic intestinal dysfunction can persist after NEC.
- inflammatory bowel disease (IBD): Some studies suggest a potential link between NEC and future IBD development.

Empirical Review

A retrospective cohort study by Meshy Tayeb et al. (2020) comparing the prevalence and severity of NEC among VLBW infants born before 32 weeks of gestation across the following two periods: 2012–2016 and 2017–2021. Clinical data were extracted from medical records, with NEC diagnosis and grading based on the modified Bell's criteria. A total of 299 infants were included. Those born in the later period were significantly more preterm and had lower birth weights. While the overall NEC incidence increased in the later cohort, the rate of surgical NEC was lower. Logistic regression identified hemodynamic instability requiring pressor support, late-onset sepsis, and earlier gestational age as significant risk factors for NEC. Although the incidence of NEC was higher in the later cohort, its severity was lower compared to the earlier cohort. These findings suggest that advancements in neonatal care and feeding protocols may contribute to improved outcomes. Early NEC stages may represent alternative intestinal or systemic conditions warranting further research for better diagnosis.

Eneh et al. (2022) carried out a study at the University of Port Harcourt Teaching Hospital to identify neonatal predictors of Necrotizing Enterocolitis (NEC) among preterm and very low birth weight (VLBW) infants. The study included 164 neonates admitted to the hospital's Neonatal Intensive Care Unit (NICU). Data were collected through clinical examinations, Apgar score assessments, and a review of each infant's feeding history. The data were analyzed using logistic regression and survival curve analysis to determine factors associated with NEC onset. The findings revealed that low Apgar score**s** and the presence of neonatal sepsis were strong predictors of NEC development in this population.

Similarly, Sitotaw M. M. et al (2021) presented a study that assess the prevalence of NEC and associated factors among enteral Fed preterm and low birth weight neonates. Institution based retrospective cross-sectional study was conducted on 350 enteral Fed preterm and low birth weight neonates who were admitted at selected public hospitals of Addis Ababa from March 25/2020 to May 10/2020. The data were collected through neonates' medical record chart review. A total of 350 participants were enrolled in to the study with the response rate of 99.43%. One hundred eighty-four (52.6%) of them were male. The majority 123 (35.1%) of them were (32 + 1 to 34) weeks gestational age. The prevalence of NEC was (25.4%) (n = 89, [95% CI; 21.1, 30.0]). Being ≤28 weeks gestational age (AOR = 3.94, 95% CI [2.67, 9.97]), being (28 + 1 to 32 weeks) gestational age (AOR = 3.65, 95% CI [2.21, 8.31]), birth weight of 1000 to 1499 g (AOR = 2.29, 95% CI [1.22, 4.33]), APGAR score ≤3 (AOR = 2.34, 95% CI [1.32, 4.16]), prolonged labor (AOR = 2.21, 95% CI [1.35, 6.38]), maternal chronic disease particularly hypertension (AOR = 3.2, 95% CI [1.70, 5.90]), chorioamnionitis (AOR = 4.8, 95% CI [3.9, 13]), failure to breath/resuscitated (AOR = 2.1, 95% CI [1.7, 4.4]), CPAP ventilation (AOR = 3.7, 95% CI [1.50, 12.70]), mixed milk (AOR = 3.58, 95% CI [2.16, 9.32]) were factors significantly associated with NEC. Finally, the prevalence of NEC in the study area was high. So that, initiating the programs that could minimize this problem is required to avoid the substantial morbidity and mortality associated with NEC.

Balogun et al. (2021) conducted a study in Ilorin to examine the relationship between feeding practices and the occurrence of Necrotizing Enterocolitis (NEC) among preterm neonates admitted to the

Neonatal Intensive Care Unit (NICU). The study involved 150 neonates, and data were collected from feeding records, comparing infants who received exclusive breast milk with those who were formula-fed. Data analysis was performed using the Chi-square test and the Cox proportional hazard model to determine the association between feeding type and NEC risk. The findings showed that formula feeding doubled the risk of developing NEC compared to infants who were fed exclusively on breast milk.

Also, a large multicenter prospective cohort study by Stoll et al. (2015) conducted in 25 NICUs across the United States. Sample size was 10,781 very low birth weight (VLBW) infants (<1500g) born between 2008 and 2012. Data was collected prospectively using standardized NICU forms, including maternal history, neonatal characteristics, and clinical outcomes. The data analysis involved logistic regression to identify independent predictors of NEC, with adjustments for confounding variables. NEC incidence was 7% overall, but infants born before 28 weeks' gestation had an incidence exceeding 15%. Gestational age was inversely correlated with NEC risk. The authors concluded that gut immaturity due to extreme prematurity remains a critical determinant of NEC risk. Another study conducted by Okoronkwo et al. (2020) in a review of 210 preterm and very low birth weight infants report a prevalence of 7.4% with the highest risk observed among formula fed infants.

Onwuanaku et al. (2022) carried out a study at the Jos University Teaching Hospital to investigate maternal risk factors associated with Necrotizing Enterocolitis (NEC) among preterm infants. The study included 180 mother–infant pairs as participants. Data were obtained through a structured maternal questionnaire complemented by a neonatal clinical review to assess infant health status. The collected data were analyzed using multivariate logistic regression to identify independent predictors of NEC. The findings revealed that maternal infections, prolonged rupture of membranes, and absence of antenatal steroid administration were significant predictors of NEC occurrence in preterm infants.

RESEARCH METHOD

This study employed a descriptive cross-sectional design complemented by retrospective chart review. The descriptive approach enabled the researcher to capture a snapshot of the relationship between various maternal and neonatal risk factors and the outcomes of necrotizing enterocolitis (NEC) among very low birth weight (VLBW) infants in the NICU. The retrospective element involves the extraction and analysis of hospital records over a period of 1 year (Jan to Dec 2024). The target population consisted of 100 neonates of all very low birth weight (<1500 grams) admitted to the NICU with a diagnosis of NEC from Jan to Dec 2024, as well as those without NEC who meet the inclusion criteria. A pilot test was conducted using 10 randomly selected VLBW infant records from a different tertiary hospital with similar NICU standards. The reliability index was computed using Cronbach's alpha for internal consistency, with a target coefficient of ≥0.80 considered acceptable. Data was analyzed using Frequencies, means, and standard deviations for demographic and clinical variables.

Data Analysis and Presentation

Table 1: Infant Identification and Demographic Data (n = 100)

Variable	Category	Frequency (n)	Percentage (%)
Sex of Infant	Male	58	58.0
	Female	42	42.0
Gestational Age at Birth (weeks)	<28 (Extremely Preterm)	20	20.0
	28–31 (Very Preterm)	47	47.0
	32–34 (Moderately Preterm)	26	26.0
	≥35 (Late Preterm)	7	7.0
Birth Weight (grams)	<1000 (ELBW)	29	29.0
	1000–1499 (VLBW)	71	71.0
Classification	ELBW (<1000g)	29	29.0
	VLBW (1000–1499g)	71	71.0
Place of Birth	FMC Asaba	68	68.0
	Referred from Other Facility	32	32.0

The study finding indicates that Males is slightly predominated (58%). Majority (67%) were very or moderately preterm (28–34 weeks), Birth weight: 71% were very low birth weight (VLBW) and 29% were extremely low birth weight (ELBW). Most infants (68%) were delivered at FMC Asaba, with 32% referred from other facilities.

Table 2: Maternal Factors (n = 100)

Variable	Category	Frequency (n)	Percentage (%)
Maternal Age (years)	<20	8	8%
	20–24	18	18%
	25–29	32	32%
	30–34	26	26%
	≥35	16	16%
Parity	Primiparous (P0–P1)	59	39%
	Multiparous (P2–P4)	29	49%
	Grand multiparous (≥P5)	12	12%
Antenatal Care Attendance	Yes	87	87%
	No	13	13%
Maternal Illness During Pregnancy	Yes	28	28%
	No	72	72%
Type of Maternal Illness (n=28)	PIH (Pregnancy-Induced Hypertension)	11	39.3%
	Diabetes Mellitus	5	17.9%
	Chorioamnionitis	7	25.0%
	Others	5	17.8%
History of PROM	Yes	21	21.0%
	No	79	79.0%
Duration of PROM (hours, n=21)	<12	9	42.9%
	12–24	7	33.3%
	>24	5	23.8%
Use of Antenatal Corticosteroids	Yes	61	61.0%
	No	39	39.0%
Mode of Delivery	Vaginal	46	46.0%
	Elective Caesarean Section	18	18.0%
	Emergency Caesarean Section	36	36.0

The study shows that (58%) maternal age are between 25–34 years. 59% were primiparous. 87% had antenatal care, showing good utilization. 28% had one or more pregnancy-related conditions, mainly PIH (39.3%). PROM Reported in 21% of cases; about 24% lasted more than 24 hours and 61% had antenatal corticosteroid. Vagina deliveries accounted for 46%, while emergency CS represented 36%.

Table 3: Neonatal Risk Factors (n = 100)

Variable	Category	Frequency (n)	Percentage (%)
Apgar Score at 1 Minute	0–3 (severe asphyxia)	19	19%
	4–6 (moderate asphyxia)	45	45%
	7–10 (normal)	36	36%
Apgar Score at 5 Minutes	0–3	5	5%
	4–6	28	28%
	7–10	67	67%
Resuscitation at Birth	Yes	63	63%

	No	37	37%
Type of Resuscitation (n = 63)	Oxygen only	22	34.9%
	Bag and mask	27	42.9%
	Intubation	8	12.7%
	Chest compression	4	6.3%
	Others	2	3.2%
Initial Feeding Pattern	Exclusive breastfeeding	21	21%
	Expressed Breast Milk (EBM)	44	44%
	Formula	17	17%
	Mixed feeding	18	18%
Age at Initiation of Feeds	<24 hours	28	28%
	24–48 hours	41	41%
	>48 hours	31	31%
Method of Feeding	Tube feeding (gavage)	54	54%
	Cup feeding	36	36%
	Direct breastfeeding	10	10%
Feeding Intolerance	No	26	26%
	Yes	74	74%
Presence of Sepsis	Yes	37	37%
	No	63	63%

From the table above**,** at 1 minute, 64% of neonates had some degree of asphyxia (19% severe, 45% moderate). By 5 minutes, most (67%) achieved normal scores, suggesting successful resuscitation efforts. 63% of neonates required resuscitation; 37% did not. Among those resuscitated, the bag and mask method was most common (42.9%), followed by oxygen only (34.9%). Only a few needed intubation (12.7%) or chest compression (6.3%). The main initial feeding method was Expressed Breast Milk (EBM) (44%), indicating NICU preference for safe and controlled feeding. Exclusive breastfeeding was low (21%), while formula (17%) and mixed feeding (18%) were less frequent. Most infants began feeding within 24–48 hours (41%), while 28% started within 24 hours and 31% after 48 hours. Tube (gavage) feeding was the predominant method (54%), followed by cup feeding (36%) and direct breastfeeding (10%). 26% experienced feeding intolerance, suggesting moderate gastrointestinal vulnerability. 37% of neonates developed sepsis, highlighting infection as a major neonatal risk factor.

Discussion of Key Findings

Objective 1: To determine the prevalence of NEC among very low birth weight infants admitted to the NICU of FMC Asaba**.**

The study revealed that 63% of very low birth weight (VLBW) infants admitted to the Neonatal Intensive Care Unit (NICU) of FMC Asaba were diagnosed with NEC. This indicates a relatively high prevalence compared with global reports that place NEC incidence between 7% and 10% among VLBW infants (Berman et al., 2017; Vermont Oxford Network, 2019). The markedly higher rate in the present study suggests that the burden of NEC in this environment is more severe than in many high-income settings.

Comparable studies within sub-Saharan Africa show varying prevalence levels. Sitotaw et al. (2021) documented a 25.4% prevalence among preterm and VLBW infants in Ethiopia, while Selse et al. (2023) reported an 11% rate in South Africa. The current findings therefore point to a higher occurrence in the Nigerian context, likely due to differences in feeding practices, limited access to donor breast milk, inconsistent infection control, and delayed diagnosis. This implies an urgent need for standardized feeding protocols, improved infection surveillance, and broader promotion of breast milk feeding within the NICU.

Objective 2: To identify neonatal and maternal factors associated with NEC among VLBW infants

A. Neonatal Factors

Prematurity and low gestational age were found to be major contributors to NEC development. Almost half (47%) of affected infants were born between 28 and 31 weeks of gestation. This finding supports Stoll et al. (2015) and Gordon et al. (2016) who demonstrated that intestinal immaturity and poor mucosal defense in preterm infants are the strongest predictors of NEC. The result underscores that the degree of physiological immaturity is directly related to susceptibility. Feeding practices were also significant. Only 21% of infants were exclusively breastfed, while 35% received either formula or mixed feeds. NEC occurrence was notably higher among those given formula. This agrees with Balogun et al. (2021) and Supabanpot (2018) who found that formula feeding substantially increases NEC risk compared with exclusive breast milk feeding. Breast milk provides protective immunological and growth factors such as lactoferrin, immunoglobulins, and epidermal growth factor, which strengthen mucosal integrity and promote beneficial gut microbiota (Neu & Walker, 2014). Neonatal sepsis was another critical risk factor, affecting 37% of the infants. This mirrors findings by Eneh et al. (2022) and Gordon et al. (2016) who identified sepsis as a major trigger of intestinal inflammation leading to NEC. Sepsis compromises gut barrier function and enhances bacterial translocation, resulting in intestinal necrosis.

Furthermore, low Apgar scores and birth asphyxia were linked with NEC. Approximately 64% of the neonates experienced some degree of asphyxia at birth, consistent with Yu et al. (2021) who reported that infants with low Apgar scores and hemodynamic instability are more prone to early-onset NEC. These results reinforce the association between perinatal hypoxia and intestinal ischemia.

B. Maternal Factors

Among maternal determinants, pregnancy-induced hypertension (PIH) and chorioamnionitis emerged as strong contributors, recorded in 39.3% and 25% of affected mothers respectively. This finding aligns with Onwuanaku et al. (2022) and Sitotaw et al. (2021) who reported that hypertensive disorders and intrauterine infections predispose neonates to NEC through compromised placental perfusion and inflammatory pathways. Prolonged rupture of membranes (PROM) was noted in 21% of mothers, particularly those with duration beyond 24 hours, supporting the assertion by Gitau et al. (2023) that PROM increases exposure to ascending infections and maternal–fetal inflammation. Although 61% of the mothers received antenatal corticosteroids, NEC still occurred, suggesting that while steroids reduce respiratory complications, they may not fully prevent gastrointestinal pathology in high-risk preterm infants. These findings confirm that NEC results from a combination of maternal, perinatal, and neonatal factors. Preventive strategies must therefore involve holistic perinatal interventions, including rigorous infection control, maternal health optimization, and exclusive human-milk feeding programs. Neonatal nurses should maintain vigilant monitoring and individualized care for VLBW infants to detect early warning signs.

CONCLUSION

Necrotizing enterocolitis remains a major cause of morbidity and mortality among very low birth weight infants in FMC Asaba. The study identified multiple interrelated maternal and neonatal risk factors, including prematurity, asphyxia, sepsis, and maternal infections. Despite good antenatal care attendance, poor feeding practices and infection remain major challenges. With moderate survival outcomes, the disease continues to pose significant clinical and economic burdens due to prolonged NICU stay and post-discharge complications. Early recognition and timely management improved survival, but the persistence of complications underscores the need for stronger preventive and postnatal care strategies. The findings affirm the importance of exclusive breast milk feeding, infection control, and antenatal steroid administration to reduce NEC incidence and improve outcomes. This research contributes to local evidence for designing context-specific interventions to mitigate NEC-related mortality in Nigerian NICUs.

Disclaimer (Artificial intelligence)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc.) and text-to-image generators have been used during the writing or editing of this manuscript.

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