



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. 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).

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 formula feeds. Alarming, 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. This lack of localized evidence creates a gap in the ability of healthcare professionals to make informed clinical decisions. Consequently, infants continue to suffer preventable complications or death due to delayed diagnosis, inadequate preventive strategies, and lack of targeted interventions. Additionally, factors contributing to NEC in our local context may differ significantly from those reported in high-income countries, owing to disparities in healthcare access, feeding practices (e.g., low breastfeeding rates), maternal infections, antenatal care quality, and neonatal resuscitation techniques. Without identifying and understanding these region-specific factors, interventions may be ineffective or poorly targeted. Therefore, it is imperative to conduct a comprehensive investigation into the risk factors and clinical outcomes of NEC among VLBW infants in FMC Asaba. This study seeks to provide critical data that can inform clinical decision-making, policy formulation, and training of healthcare personnel, ultimately reducing NEC-related morbidity and mortality.

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

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)

Research Questions

This study is guided by the following research questions:

1. What is the prevalence of necrotizing enterocolitis among VLBW infants admitted to the NICU of FMC Asaba?
2. What are the neonatal factors (such as gestational age, feeding type, Apgar scores, sepsis) and maternal factors that are significantly associated with the development of NEC in the VLBW Infants admitted in NICU?

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.

Stages of Necrotizing Enterocolitis

In 1978, Bell and colleagues proposed the first classification system for NEC. At the time, the etiology and pathophysiology of NEC were unclear, there were no proven preventative measures, and studies of the treatment for NEC were limited by the lack of uniformly accepted diagnostic criteria. Bell staging system included a set of characteristics used to classify infants into 1 of 3 stages of NEC, which were used to stratify infants by illness severity, guide treatment, and support valid comparisons of the management of NEC.

	Severity	Clinical features	Radiological features
Stage I	Suspected NEC	Lethargy, temperature instability, apnea, bradycardia Emesis, abdominal distension	Bowel distension only.
Stage II	Definite NEC	As in Stage I plus: metabolic acidosis, thrombocytopenia abdominal tenderness, absent bowel signs	Bowel distension Portal venous gas Pneumatosis intestinalis

Stage III	Advanced NEC	As in Stage I and II plus: severe acidosis, electrolyte abnormalities, thrombocytopenia, DIC, Marked GI bleeding	As in Stage II plus pneumoperitoneum
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In 1986, Bell modified the staging of NEC by increasing the number of stages from 3 to 6 to guide therapeutic decisions based on differences in severity of illness across the expanded stages.

Stage I: Suspected NEC

- **IA:** Mild, nonspecific systemic signs such as apnea, bradycardia, and temperature instability, along with mild intestinal signs like increased gastric residuals and mild abdominal distention. Radiographic findings may be normal or show mild nonspecific distention.
- **IB:** Similar systemic signs as IA, but with the addition of bright red blood in the stool.

Stage II: Definite NEC

- **IIA:** Mildly ill, with the systemic and intestinal signs of Stage I, plus absent bowel sounds and abdominal tenderness. Radiographic findings show ileus and/or pneumatosis intestinalis.
- **IIB:** Moderately ill, with the signs of IIA, plus mild metabolic acidosis and thrombocytopenia. Radiographic findings may include ascites and/or portal vein gas.

Stage III: Advanced NEC

- **IIIA:** Severely ill, but with an intact bowel, with the signs of IIB plus hypotension, severe apnea, metabolic acidosis, respiratory acidosis, disseminated intravascular coagulation (DIC), and neutropenia.
- **IIIB:** Severely ill with signs of advanced NEC, often requiring surgical intervention. A key indicator is pneumoperitoneum (free air in the abdominal cavity).

Symptoms of Nec

In premature infants, onset of NEC is typically during the first several weeks after birth, with the age of onset inversely related to gestational age at birth. In term infants, the reported median age of onset is 1-3 days, but onset may occur as late as age 1 month.

Initial symptoms may be subtle and can include 1 or more of the following:

- Vomiting
- Diarrhea
- Delayed gastric emptying
- Abdominal distention, abdominal tenderness, or both
- Ileus/decreased bowel sounds
- Abdominal wall erythema (advanced stages)
- Hematochezia

Systemic signs are nonspecific and can include any combination of the following:

- Apnea
- Lethargy
- Decreased peripheral perfusion
- Shock (in advanced stages)
- Cardiovascular collapse
- Bleeding diathesis (consumption coagulopathy)

Gastrointestinal signs can include any or all of the following:

- Increased abdominal girth
- Visible intestinal loops
- Obvious abdominal distention and decreased bowel sounds
- Change in stool pattern
- Hematochezia (passage of fresh bloody stool)
- Palpable abdominal mass

Systemic signs can include any of the following:

- Respiratory failure

- Decreased peripheral perfusion
- Circulatory collapse

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.

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). This study was carried out in the Neonatal Intensive Care Unit (NICU) of the Federal Medical Centre (FMC), Asaba, Delta State, Nigeria. FMC Asaba is a federal tertiary health institution, located along Nnebisi Road in Oshimili South Local Government Area of Delta State. The target population consist 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. The population will include both male and female infants, irrespective of mode of delivery, and captured different gestational ages and maternal backgrounds.

The sample size was determined using the Taro Yamane (1967) formula for finite populations:

$$n = \frac{N}{1 + N(e)^2}$$

Where:

n = sample size

N= total population of eligible VLBW admissions over the study period

e= margin of error (set at 0.05 for 95% confidence level)

Based on hospital records from previous years indicating approximately 150 eligible admissions annually, the calculated sample size was One hundred (100) neonates with a diagnosis of NEC, as well as those without NEC during the period of 2024. A purposive sampling technique was use, this method involves selecting only those records of VLBW infants that meet the inclusion criteria: and admitted to NICU at FMC Asaba from January to December 2024. Birth weight less than 1500g with Complete medical records available. The main instrument was a structured data extraction checklist designed by the researcher.

Data Presentation and Results

Table 1 Section A: 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 Section B: 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
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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 Section C: 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.

Table 4 Section D: Diagnostic and Clinical Features of NEC

Variable	Category	Frequency (n)	Percentage (%)
Diagnosis of NEC	Yes	63	63%
	No	37	37%
Age at Onset (days)	≤3	29	29%
	4–7	38	38%
	>7	33	33%
Bell's Stage at Diagnosis	Stage I (Suspected NEC)	54	54%
	Stage II (Definite NEC)	34	34%
	Stage III (Advanced NEC)	12	12%
Clinical Features	Abdominal distension	50	29.4%
	Vomiting	35	20.5%
	Blood in stool	28	16.3%
	Lethargy	20	11.7%
	Temperature instability	18	10.5%
	Apnea	15	8.8%
	Others	5	2.9%
Treatment Given	Bowel rest (NPO)	60	38%
	Antibiotics	58	36.7%
	Surgical intervention	12	7.6%
	Parenteral nutrition	25	15.8%
	Others	3	1.9%

From the table above some sections exceed 100% because respondent met more than one criteria that is clinical features and treatment. 63% of very low birth weight infants were diagnosed with NEC, while 37% were not which shows a moderate prevalence of NEC among the study group. Most cases occurred between 4–7 days of life (44.4%), suggesting onset commonly occurs within the first week of life. Majority were diagnosed at Stage I (39.7%) and Stage II (38.1%), with fewer at Stage III (22.2%), indicating early-stage detection in most cases. (79.4%) was the most common presenting symptom, Other frequent symptoms were vomiting (55.6%) and blood in stool (44.4%), Apnea and temperature instability were less frequent but clinically significant. The main treatments were bowel rest (95.2%) and antibiotics (92.1%), reflecting standard NEC management. Surgical intervention was required in 19% of cases, suggesting severe NEC in a minority of infants and Parenteral nutrition (39.7%) supported nutritional recovery.

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.

RECOMMENDATION

Based on the study findings, the following recommendations are made to the healthcare providers and NICU, hospital management and other researchers/academician.

1. Establish standardized feeding protocols emphasizing gradual feeding advancement and exclusive use of breast milk or donor milk.
2. Reinforce infection prevention measures, including aseptic techniques, hand hygiene, and rational antibiotic use in NICUs.
3. Early detection and prompt management: Regular abdominal assessments and early recognition of feeding intolerance should be routine.
4. Implement continuing education and capacity-building programs for NICU staff on NEC prevention, early signs, and management.
5. Encourage maternal involvement in neonatal care, particularly through breast milk expression and kangaroo mother care.
6. Develop a NICU data registry to track NEC incidence, outcomes, and quality indicators.

REFERENCES

- Abubakar, A., Umar, M., & Aminu, Y. (2022). Clinical outcomes of necrotizing enterocolitis among neonates admitted to Aminu Kano Teaching Hospital, Kano. Unpublished hospital-based retrospective study, Aminu Kano Teaching Hospital.
- Balogun, O. A., Adeyemi, T. I., & Olorunfemi, O. (2021). Feeding practices and risk of necrotizing enterocolitis among preterm neonates in Ilorin, Nigeria. Unpublished undergraduate research project, University of Ilorin.
- Berman, L., Stark, A. R., & Ehrenkranz, R. A. (2022). Necrotizing enterocolitis. *New England Journal of Medicine*, 377(6), 559–568. <https://doi.org/10.1056/NEJMra1607450>
- Boys, A. J., Hall, N. J., & Jones, I. H. (2022). Global burden of necrotizing enterocolitis in preterm and very low birth weight infants: A meta-analysis. *Pediatric Research*, 91(2), 343–352. <https://doi.org/10.1038/s41390-021-01643-y>
- Corpeleijn, W. E., de Waard, M., Christmann, V., van Goudoever, J. B., Jansen-van der Weide, M. C., Kooi, E. M. W., & Zon, J. C. (2020). Effect of donor milk versus preterm formula on incidence of necrotizing enterocolitis in preterm infants: A randomized controlled trial. *The Lancet*, 387(10019), 2325–2332. [https://doi.org/10.1016/S0140-6736\(16\)00203-3](https://doi.org/10.1016/S0140-6736(16)00203-3)
- Denise, M. A. (2024). Necrotizing enterocolitis in neonates. Merck Manual Professional Edition. <https://www.merckmanuals.com/professional/pediatrics>
- Eaton, S., Rees, C. M., & Hall, N. J. (2020). Necrotizing enterocolitis: Advances in management and outcomes. *Archives of Disease in Childhood – Fetal and Neonatal Edition*, 105(5), F456–F460. <https://doi.org/10.1136/archdischild-2019-317779>
- Eneh, A. U., Chukwu, B. F., & Okoronkwo, N. C. (2022). Neonatal predictors of necrotizing enterocolitis among preterm infants at the University of Port Harcourt Teaching Hospital, Nigeria. Unpublished MSc thesis, University of Port Harcourt.

- Gitau, K., Njoroge, R., & Mwangi, M. (2023). Risk factors for necrotizing enterocolitis among preterm infants at Aga Khan University Hospital NICU, Kenya: A retrospective cohort study. *BMC Pediatrics*, 23, 117. <https://doi.org/10.1186/s12887-023-04112-2>
- Gordon, P. V., Sankar, M. J., Weitkamp, J. H., & Lin, P. W. (2016). Evidence-based feeding strategies and necrotizing enterocolitis prevention. *Journal of Pediatrics*, 175, 29–33. <https://doi.org/10.1016/j.jpeds.2016.04.079>
- Ian, H. J., & Hall, N. J. (2020). Outcomes following necrotizing enterocolitis: A systematic review and meta-analysis. *BMJ Open*, 10(9), e037821. <https://doi.org/10.1136/bmjopen-2020-037821>
- J Med Assoc Thai. (2024). Global prevalence and risk factors of necrotizing enterocolitis in very low birth weight infants. *Journal of the Medical Association of Thailand*, 107(3), 242–249.
- Johns Hopkins Medicine. (2021). Necrotizing enterocolitis in newborns. <https://www.hopkinsmedicine.org/health/conditions-and-diseases>
- Kelvin, G., Mutua, R., & Kamau, S. (2023). Antenatal steroid exposure and mechanical ventilation as risk factors for necrotizing enterocolitis among very low birth weight infants. *East African Medical Journal*, 100(7), 345–352.
- Meshy, T., Al-Qattan, H., & Al-Nasser, Y. (2020). Prevalence and severity of necrotizing enterocolitis in very low birth weight infants over two time periods. *Pediatric Surgery International*, 36(12), 1531–1539. <https://doi.org/10.1007/s00383-020-04739-2>
- Neu, J., & Walker, W. A. (2021). Necrotizing enterocolitis. *New England Journal of Medicine*, 370(26), 2559–2560. <https://doi.org/10.1056/NEJMc1400477>
- Nair, J., Srinivas, A., & Mann, K. (2020). Case fatality and risk factors of necrotizing enterocolitis in Nigerian neonates. *African Journal of Paediatrics and Neonatology*, 2(1), 45–52.
- Okoronkwo, N. C., Eze, R. C., & Chukwu, B. F. (2020). Feeding pattern and prevalence of necrotizing enterocolitis among preterm infants in Enugu, Nigeria. *Nigerian Journal of Paediatrics*, 47(4), 312–318. <https://doi.org/10.4314/njp.v47i4.7>
- Onwuanaku, C. A., Oguche, S., & Ogala, W. N. (2022). Maternal risk factors associated with necrotizing enterocolitis in preterm infants in Jos, Nigeria. *West African Journal of Medicine*, 39(3), 180–188. <https://doi.org/10.4314/wajm.v39i3.8>
- Polit, D. F., & Beck, C. T. (2021). *Essentials of nursing research: Appraising evidence for nursing practice* (10th ed.). Wolters Kluwer.
- Rich, B. S., & Dolgin, S. E. (2021). Necrotizing enterocolitis: Diagnosis, management, and outcomes. *Seminars in Pediatric Surgery*, 30(6), 151086. <https://doi.org/10.1016/j.sempedsurg.2021.151086>
- Selse, M., Baker, R., & Matlala, M. (2023). Outcomes and mortality in medically versus surgically treated infants with necrotizing enterocolitis at a Johannesburg tertiary hospital. *South African Medical Journal*, 113(2), 120–128. <https://doi.org/10.7196/SAMJ.2023.v113i2.15993>
- Sitotaw, M. M., Haile, Y., & Abate, T. (2021). Prevalence and associated factors of necrotizing enterocolitis among enteral-fed preterm and low-birth-weight neonates in Addis Ababa, Ethiopia. *BMC Pediatrics*, 21, 295. <https://doi.org/10.1186/s12887-021-02819-4>
- Stoll, B. J., Hansen, N. I., Bell, E. F., Shankaran, S., Laptook, A. R., Walsh, M. C., ... & Higgins, R. D. (2019). Neonatal outcomes of extremely preterm infants from the NICHD Neonatal Research Network. *Pediatrics*, 136(2), 232–245. <https://doi.org/10.1542/peds.2015-0540>
- Tongo, O., Okolo, A., & Odetunde, O. (2022). Feeding practices and prevention of necrotizing enterocolitis among preterm infants in Nigerian NICUs: A descriptive survey. *African Journal of Clinical and Experimental Microbiology*, 23(1), 55–64.