



# Patterns and Determinants of Neonatal Morbidity and Mortality at the EHFA Foundation Teaching Medical Centre, Bangourain: A Retrospective Study

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## Abstract

The neonatal period, defined as the first 28 days of life, is the most vulnerable time for a child's survival. According to the World Health Organization, nearly 2.3 million neonatal deaths occur annually, accounting for almost 47% of all under-five deaths globally. Despite global advances in maternal and child health, neonatal morbidity and mortality continue to pose serious public health concerns in sub-Saharan Africa, with Cameroon ranking among the countries with the highest neonatal mortality rates. This retrospective study aimed to determine the patterns and determinants of neonatal morbidity and mortality at the EHFA Foundation Teaching Medical Centre, Bangourain. A hospital based retrospective study was conducted and involved the collection of data from hospital record files and patient medical report books for a period of 1 month from 2024 to 2025 using a data extraction form. Authorization was obtained from the Regional Delegate of Health for the West Region and institutional authorization was obtained from the Director of the hospital. Data was analyzed using SPSS version 21 and statistical significance was considered if p value was less than 0.05. The study involved 122 participants, mostly rural-based mothers aged 20 - 34 years with primary education (58.2%) and working as farmers (51.6%). Neonatal morbidity and mortality affected 23 newborns, with the most common complications being premature birth (27.3%) and sepsis (22.7%). Significant associations were found with maternal education ( $p = 0.009$ ), occupation ( $p = 0.05$ ), residence ( $p = 0.05$ ), parity ( $p = 0.018$ ), and fetal conditions ( $p = 0.0001$ ). No significant associations were found with maternal

medical conditions ( $p = 0.59$ ), gestation type ( $p = 0.998$ ), access to healthcare ( $p = 0.28$ ), or environmental factors ( $p = 0.906$ ). Neonatal death was highest among babies of primiparous mothers (73.9%). Female newborns had higher complications, but the association with sex was not significant ( $p = 0.46$ ). It can therefore be recommended that Interventions should prioritize maternal education, improved rural healthcare access, and support for first-time mothers to reduce neonatal mortality.

## Subject Areas

Neuroscience, Pediatrics

## Keywords

Retrospective Study, Patterns, Determinants, Neonatal Morbidity, Mortality, EHFAF Bangourain

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## 1. Introduction

Neonatal morbidity and mortality remain major global public health challenges, particularly in low- and middle-income countries where health system limitations and socioeconomic inequities persist [1]. The neonatal period, defined as the first 28 days of life, is the most critical phase for survival, during which infants are highly vulnerable to illness and death [2]. Although substantial progress has been made in reducing under-five mortality worldwide, the decline in neonatal deaths has been markedly slower. Currently, neonatal deaths account for approximately 47% of all under-five deaths globally, with an estimated 2.3 million deaths each year [3].

The principal causes of neonatal morbidity include complications of preterm birth, sepsis, pneumonia, meningitis, birth asphyxia, and congenital anomalies [4]. These conditions contribute significantly not only to mortality but also to long-term disability among survivors [5]. Mortality patterns vary across regions and are strongly influenced by factors such as access to skilled birth attendants, neonatal intensive care, maternal education, and overall health system capacity. Sub-Saharan Africa bears one of the highest neonatal mortality burdens globally, reflecting severe resource constraints and entrenched systemic inequities [6].

Determinants of neonatal outcomes are multifactorial, encompassing maternal, fetal, healthcare, and socioeconomic factors. Maternal characteristics such as antenatal care attendance, nutritional status, birth spacing, and maternal age are closely associated with neonatal survival [7]. Delivery-related factors, including place and mode of birth as well as the availability of skilled attendants, further influence outcomes [8]. Broader structural determinants—such as poverty, low literacy, inadequate sanitation, and poor transportation infrastructure—compound risks, while shortages of trained personnel and limited neonatal resuscitation capacity highlight systemic weaknesses within healthcare systems [9].

In Cameroon, the neonatal mortality rate is estimated at 25 deaths per 1000 live births, which remains above the global average [10]. Key contributing factors include poor maternal health, limited antenatal care coverage, low rates of skilled birth attendance, high prevalence of home deliveries, and weak health infrastructure, particularly in rural areas [11]. Although government initiatives such as free antenatal consultations, integrated maternal and child health programs, and community-based interventions have been introduced, progress remains uneven due to funding limitations, weak policy implementation, and persistent systemic inefficiencies [12].

Reducing neonatal morbidity and mortality in Cameroon requires context-specific, evidence-based interventions. Priority actions include expanding access to skilled birth attendants, strengthening neonatal intensive care capacity, enhancing health information systems, and improving community-level awareness of neonatal danger signs [13]. Collaborative efforts with organizations such as UNICEF and WHO have improved immunization coverage and newborn care training, yet further work is needed to address cultural barriers and health system inequities [14]. Understanding the local determinants of neonatal outcomes, including within institutions such as the EHFAF Teaching Medical Centre in Bangourain, is crucial for designing sustainable strategies to reduce preventable neonatal deaths and accelerate progress toward Sustainable Development Goal 3.2 [15].

## 2. Methodology

This retrospective study was conducted at the EHFA Foundation Teaching Medical Centre, Bangourain, West Region of Cameroon, a facility operated by the Essential Health for All Foundation (EHFAF) that integrates healthcare delivery with professional training through its educational arm, the Essential Health Higher Institute (EHHI). Hospital registers and patient medical records covering neonatal admissions from 1 January 2024 to 31 July 2025 were reviewed using a structured data extraction tool. The study population comprised 122 neonates, determined using the standard single-proportion sample size formula:

$$n = \frac{Z^2 * p * (1 - p)}{d^2} * DE$$

where  $Z = 1.96$  for a 95% confidence interval,  $p = 0.47$  (estimated prevalence of neonatal morbidity/mortality),  $d = 0.05$  (margin of error), and  $DE = 1.0$  (design effect for a simple cross-sectional design). Due to the limited number of eligible cases during the study period, convenience sampling was applied; this approach was justified as it allowed the inclusion of all available records within the specified timeframe, ensuring maximal data capture given the retrospective nature of the study. Dependent variables included neonatal morbidity and mortality, while independent variables encompassed maternal age, education, parity, gestational age, birth weight, APGAR score, antenatal care attendance, mode of delivery, and newborn sex. Socioeconomic status, access to healthcare, and cultural factors were considered as control variables. Data extraction employed a validated tool captur-

ing socio-demographic characteristics and neonatal outcomes, with prior institutional authorization and strict confidentiality maintained. Data were analyzed using SPSS version 21. Descriptive statistics were presented in tables and charts, while inferential associations were initially tested using Pearson's Chi-square test. For comparisons where several expected counts were  $<5$ , Fisher's exact test was applied to ensure validity. Statistical significance was set at  $p \leq 0.05$ . Ethical clearance was obtained from relevant institutional and regional authorities, with strict measures to ensure privacy and confidentiality throughout the study.

### 3. Results

#### 3.1. Socio-Demographic Characteristics of Research Participants

**Table 1** below presents the socio-demographic characteristics of the study respondents. The study included 122 participants comprising mothers and their newborns. The majority of the children were between 24 hours and 7 days old ( $n = 72$ ; 59.0%), followed by those aged 0 - 24 hours ( $n = 33$ ; 27.0%) and 8 - 28 days ( $n = 17$ ; 13.9%). Most of the newborns were female ( $n = 81$ ; 66.4%), while males constituted a smaller proportion ( $n = 41$ ; 33.6%). The mothers were predominantly in the 20 - 34 years age group ( $n = 72$ ; 59.0%), with fewer aged 35 - 40 years ( $n = 28$ ; 23.0%), 14 - 19 years ( $n = 15$ ; 12.3%), and above 40 years ( $n = 7$ ; 5.7%). A majority had attained only primary education ( $n = 71$ ; 58.2%), with fewer having secondary ( $n = 42$ ; 34.4%) or tertiary education ( $n = 9$ ; 7.4%). Occupation-wise, over half were farmers ( $n = 63$ ; 51.6%), followed by traders ( $n = 20$ ; 16.4%), others ( $n = 23$ ; 18.9%), students ( $n = 11$ ; 9.0%), and teachers ( $n = 5$ ; 4.1%). Most of the respondents were Muslims ( $n = 95$ ; 77.9%), while Christians ( $n = 20$ ; 16.4%) and others ( $n = 7$ ; 5.7%) formed the minority. In terms of residence, a large proportion lived in rural areas ( $n = 106$ ; 86.9%) compared to urban dwellers ( $n = 16$ ; 13.1%). Marital status revealed that most were married ( $n = 75$ ; 61.5%), followed by single mothers ( $n = 39$ ; 32.0%), divorced ( $n = 7$ ; 5.7%), and widowed ( $n = 1$ ; 0.8%). Overall, the typical participant in this study was a rural-based, married Muslim woman aged between 20 and 34 years, with primary-level education, working as a farmer, and caring for a newborn female aged between 24 hours and 7 days.

**Table 1.** Distribution of respondents according to their socio-demographics.

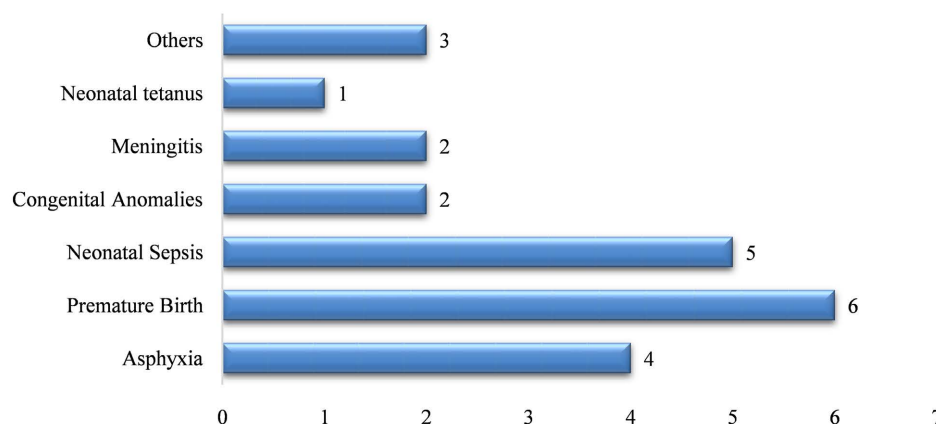
Variable	Characteristic	Frequency (n)	Percentage (%)
Age of the child	0 - 24 hrs	33	27.0
	24 hrs - 7 days	72	59.0
	8 days - 28 days	17	13.9
	<b>Total</b>	<b>122</b>	<b>100</b>
Sex of the child	Male	41	33.6
	Female	81	66.4
	<b>Total</b>	<b>122</b>	<b>100</b>

**Continued**

	Above 40 yrs	7	5.7
	35 - 40 yrs	28	23.0
Age of the mother	20 - 34 yrs	72	59.0
	14 - 19 yrs	15	12.3
	<b>Total</b>	<b>122</b>	<b>100</b>
Level of education of the mother	Primary	71	58.2
	Secondary	42	34.4
	Tertiary	9	7.4
	<b>Total</b>	<b>122</b>	<b>100</b>
Occupation	Student	11	9.0
	Farmer	63	51.6
	Trader	20	16.4
	Teacher	5	4.1
	Others	23	18.9
	<b>Total</b>	<b>122</b>	<b>100</b>
Religion	Christian	20	16.4
	Muslim	95	77.9
	Others	7	5.7
	<b>Total</b>	<b>122</b>	<b>100</b>
Residence	Urban	16	13.1
	Rural	106	86.9
	<b>Total</b>	<b>122</b>	<b>100</b>
Marital status	Married	75	61.5
	Single	39	32.0
	Divorced	7	5.7
	Widowed	1	.8
	<b>Total</b>	<b>122</b>	<b>100</b>

**3.2. Patterns of Neonatal Morbidity and Mortality**

**Figure 1** presents the patterns of neonatal morbidity and mortality among the study population, with a total of 23 cases reported. The most common condition was premature birth, accounting for 6 cases, which represents 26.1% of all reported neonatal complications. This was followed by neonatal sepsis with 5 cases (21.7%), and asphyxia with 4 cases (17.4%). Congenital anomalies and meningitis were each reported in 2 cases, making up 8.7% respectively. Other conditions also accounted for 3 cases (13.0%), while neonatal tetanus was the least frequent, with just 1 case (4.3%).



**Figure 1.** Bar chart showing patterns of neonatal morbidity and mortality among the study population.

### 3.3. Association between Various Socio-Demographic Variables and Neonatal Morbidity and Mortality

**Table 2** presents the relationship between various socio-demographic variables and neonatal morbidity and mortality, using chi-square tests to determine statistical significance. A total of 23 cases of neonatal morbidity and mortality were reported among 122 participants. Significant associations were observed with mother's level of education, occupation, and residence. Neonatal morbidity and mortality was highest among children aged 24 hours to 7 days ( $n = 15$ ; 12.3%), followed by those aged 0 - 24 hours ( $n = 4$ ; 3.3%) and 8 - 28 days ( $n = 4$ ; 3.3%), though this association was not statistically significant ( $p = 0.49$ ). More female neonates ( $n = 16$ ; 13.1%) experienced morbidity and mortality compared to males ( $n = 7$ ; 5.7%), but again, the relationship was not significant ( $p = 0.46$ ). Regarding maternal age, the highest occurrence was among mothers aged 20 - 34 years ( $n = 11$ ; 9.0%) and 14 - 19 years ( $n = 6$ ; 4.9%), with a  $p$ -value of 0.165, showing no significant association. However, a statistically significant association was observed with mother's education level ( $p = 0.009$ ). Mothers with primary education reported the highest burden ( $n = 13$ ; 10.7%), followed by those with secondary ( $n = 8$ ; 6.6%) and tertiary education ( $n = 2$ ; 1.6%), suggesting that lower education is linked to higher neonatal complications. Occupation was also significantly associated ( $p = 0.05$ ). Mothers who were farmers recorded the highest number of affected neonates ( $n = 12$ ; 9.8%), followed by others ( $n = 7$ ; 5.7%) and students ( $n = 3$ ; 2.5%). No morbidity or mortality was reported among teachers. This indicates that certain occupational categories, possibly linked to socioeconomic status or health access, influence neonatal outcomes. In terms of religion, no significant relationship was found ( $p = 0.160$ ), although most affected cases were among Muslims ( $n = 18$ ; 14.8%). Regarding residence, neonatal morbidity and mortality was significantly higher in rural areas ( $n = 21$ ; 17.2%) compared to urban settings ( $n = 2$ ; 1.6%), with a  $p$ -value of 0.05, implying poorer neonatal outcomes in rural environments. Finally, marital status showed no statistically significant relation-

ship ( $p = 0.353$ ), even though the majority of affected cases were among married mothers ( $n = 17$ ; 13.9%).

**Table 2.** Association between various socio-demographic variables and neonatal morbidity and mortality.

Variable	Characteristic	Neonatal morbidity and mortality		Chi square (p value)
		Present	Absent	
Age of the child	0 - 24 hrs	04 (3.30)	29 (23.8)	1.42 (0.49)
	24 hrs - 7 days	15 (12.3)	57 (46.7)	
	8 days - 28 days	04 (3.30)	13 (10.7)	
Sex of the child	Male	07 (5.70)	34 (27.9)	0.128 (0.46)
	Female	16 (13.1)	65 (53.3)	
Age of the mother	Above 40 yrs	01 (0.80)	06 (4.90)	5.180 (0.165)
	35 - 40 yrs	05 (4.10)	23 (18.9)	
	20 - 34 yrs	11 (9.00)	61 (50.0)	
	14 - 19 yrs	06 (4.90)	09 (7.40)	
Level of education of the mother	Primary	13 (10.7)	58 (47.5)	10.08 <b>(0.009)*</b>
	Secondary	08 (6.60)	34 (27.9)	
	Tertiary	02 (1.60)	07 (5.70)	
Occupation	Student	03 (2.50)	08 (6.60)	9.619 <b>(0.05)*</b>
	Farmer	12 (9.80)	51 (41.8)	
	Trader	01 (0.80)	19 (15.6)	
	Teacher	00 (0.00)	05 (4.10)	
	Others	07 (5.70)	16 (13.1)	
Religion	Christian	02 (1.60)	18 (14.8)	3.662 (0.160)
	Muslim	18 (14.8)	77 (63.1)	
	Others	03 (2.50)	04 (3.30)	
Residence	Urban	02 (1.60)	14 (11.5)	9.01 <b>(0.05)*</b>
	Rural	21 (17.2)	85 (59.7)	
Marital status	Married	17 (13.9)	58 (47.5)	3.261 (0.353)
	Single	04 (3.30)	35 (28.7)	
	Divorced	02 (1.60)	05 (4.10)	
	Widowed	00 (0.00)	01 (0.80)	

\*-statistically significant at 0.05 significance level.

### 3.4. Determinants of Neonatal Morbidity and Mortality

**Maternal determinants of neonatal morbidity and mortality such as pre-existing medical conditions**

A p-value of 0.59 indicates that the association between maternal conditions

and neonatal death is not statistically significant. Looking at specific conditions, syphilis was associated with the highest number of neonatal deaths ( $n = 6$ , 26.1% of all deaths), including deaths from asphyxia ( $n = 2$ ), sepsis ( $n = 1$ ), congenital anomalies ( $n = 1$ ), meningitis ( $n = 1$ ), and neonatal tetanus ( $n = 1$ ). Malaria contributed to 6 neonatal deaths as well (26.1%), primarily from premature birth ( $n = 3$ ), sepsis ( $n = 2$ ), and asphyxia ( $n = 1$ ). Hypertension accounted for 3 deaths (13.0%), including sepsis ( $n = 2$ ) and other causes ( $n = 1$ ). HIV and gonorrhoea were each linked to 1 neonatal death (4.3% each), both due to premature birth. Obesity and congenital anomalies contributed 1 death each (4.3%), and chlamydia had no reported deaths. Interestingly, among mothers with no reported medical condition, 5 neonatal deaths occurred (21.7%), scattered across various causes such as asphyxia, premature birth, congenital anomalies, and others. Despite some maternal conditions being present, the majority of neonates survived ( $n = 99$ ; 81.1%), and survival was observed across all maternal health categories, for example, malaria ( $n = 23$  survivors), syphilis ( $n = 13$  survivors), and even among all diabetic and chlamydia cases (See **Table 3**).

**Table 3.** The table explores the relationship between various maternal pre-existing medical conditions and causes of neonatal mortality.

	Cause of neonatal mortality						
	Asphyxia	Premature birth	Neonatal sepsis	Congenital anomalies	Meningitis	Neonatal tetanus	Others
Diabetics	0	0	0	0	0	0	0
HIV	0	1	0	0	0	0	0
Syphilis	2	0	1	1	1	1	0
Gonorrhoea	0	1	0	0	0	0	0
Chlamydia	0	0	0	0	0	0	0
Malaria	1	3	2	0	0	0	0
Obesity	0	0	0	0	1	0	0
Hypertension	0	0	2	0	0	0	1
None of the above	1	1	0	2	0	0	1

#### Maternal determinants of neonatal morbidity and mortality such as the type of gestation

**Table 4** examines the association between the type of gestation (twin vs. single) and causes of neonatal mortality, with a total of 23 deaths recorded. The p-value of 0.998 indicates that there is no statistically significant association between whether a pregnancy was a twin or single gestation and the occurrence or cause of neonatal death. All 23 neonatal deaths occurred in single gestation pregnancies, including deaths from asphyxia ( $n = 4$ ; 17.4%), premature birth ( $n = 6$ ; 26.1%), neonatal sepsis ( $n = 5$ ; 21.7%), congenital anomalies ( $n = 3$ ; 13.0%), meningitis ( $n = 2$ ; 8.7%), neonatal tetanus ( $n = 1$ ; 4.3%), and other causes ( $n = 2$ ; 8.7%). In contrast, no deaths were reported among twin pregnancies (0%). Despite this appar-

ent difference in frequency, the very small number or absence of twin cases in the mortality group leads to a non-significant p-value (0.998). This suggests that in this sample, the type of gestation (single or twin) had no meaningful statistical impact on the risk or type of neonatal death. The results may be influenced by the small sample size or a very low number of twin pregnancies in the study.

**Table 4.** Maternal determinants of neonatal morbidity and mortality such as the type of gestation.

	Cause of neonatal mortality							No death
	Asphyxia	Premature birth	Neonatal sepsis	Congenital anomalies	Meningitis	Neonatal tetanus	Others	
<b>Twin</b>	0	0	0	0	0	0	0	3
<b>Single</b>	4	6	5	3	2	1	2	96
<b>Total</b>	4	6	5	3	2	1	2	99

#### Maternal determinants of neonatal morbidity and mortality such as parity

**Table 5** below presents the association between maternal parity (primiparity, multiparity, and grand multiparity) and the causes of neonatal mortality, with a reported **p-value of 0.018**, indicating a statistically significant association between parity and neonatal death causes. Out of the total 23 neonatal deaths, primiparous mothers (first-time mothers) accounted for the majority (n = 17; 73.9%) of deaths, including deaths from premature birth (n = 5; 21.7%), asphyxia (n = 2; 8.7%), neonatal sepsis (n = 3; 13.0%), congenital anomalies (n = 3; 13.0%), meningitis (n = 2; 8.7%), and other causes (n = 2; 8.7%). Multiparous mothers (those with 2 - 4 previous births) contributed to only 2 deaths (8.7%), one each from premature birth and neonatal sepsis. Grand multiparous mothers (5 or more previous births) accounted for 4 deaths (17.4%), mainly from asphyxia (n = 2), sepsis (n = 1), and neonatal tetanus (n = 1). The significant **p-value (0.018)** suggests that parity has a meaningful influence on neonatal mortality, with primiparity being strongly associated with higher risk of neonatal death across a broad range of causes. This could reflect less experience with childbirth, increased complications in first pregnancies, or delays in recognizing danger signs.

**Table 5.** Maternal determinants of neonatal morbidity and mortality such as parity.

	Cause of neonatal mortality						
	Asphyxia	Premature birth	Neonatal sepsis	Congenital anomalies	Meningitis	Neonatal tetanus	Others
<b>Primiparity</b>	2	5	3	3	2	0	2
<b>Multiparity</b>	0	1	1	0	0	0	0
<b>Grand multiparity</b>	2	0	1	0	0	1	0

#### Fetal determinants of neonatal morbidity and mortality

**Table 6** a strong and statistically significant association (**p = 0.0001**) between foetal determinants and the causes of neonatal mortality, highlighting how specific conditions lead to particular death outcomes. Among the 23 deaths recorded,

neonatal sepsis as a foetal condition was responsible for the highest proportion (n = 7; 30.4%), including 5 deaths directly from sepsis and 2 from premature birth. Premature birth as a foetal factor contributed to 6 deaths (26.1%), mostly due to prematurity (n = 4), asphyxia (n = 1), and other causes (n = 1). Birth asphyxia led to 3 deaths (13.0%) from asphyxia, while congenital anomalies caused 2 deaths (8.7%) under the same category. Other isolated causes included low APGAR score (n = 1; 4.3%), and miscellaneous conditions (e.g., meningitis, neonatal tetanus) accounted for 3 deaths (13.0%). Notably, there were no deaths linked to multiple gestation, hypoglycaemia, or intrauterine growth restriction.

**Table 6.** Fetal determinants of neonatal morbidity and mortality.

	Cause of neonatal mortality						
	Asphyxia	Premature birth	Neonatal sepsis	Congenital anomalies	Meningitis	Neonatal tetanus	Others
Premature birth	1	4	0	0	0	0	1
Congenital Anomaly	0	0	0	2	0	0	0
Birth asphyxia	3	0	0	0	0	0	0
Multiple gestation	0	0	0	0	0	0	0
Hypoglycemia	0	0	0	0	0	0	0
Neonatal sepsis	0	2	5	0	0	0	0
Low APGAR score	0	0	0	1	0	0	0
IUGR	0	0	0	0	0	0	0
Others	0	0	0	0	2	1	1

#### Health care related determinants of neonatal morbidity and mortality

**Table 7** presents the association between health care-related determinants and causes of neonatal mortality, with a p-value of 0.28, indicating no statistically significant relationship between the quality or availability of health care services and neonatal death outcomes in this sample. Most of the deaths (n = 15; 65.2%) occurred among neonates whose mothers received no prenatal care or appropriate neonatal care, with deaths distributed across all causes: asphyxia (n = 4), congenital anomalies (n = 3), sepsis (n = 2), others (n = 2), meningitis (n = 2), premature birth (n = 1), and neonatal tetanus (n = 1). In contrast, among those with access to prenatal care, only 4 deaths occurred (premature birth n = 3; sepsis n = 1), and among those exposed to quality neonatal care practices, 4 deaths were also recorded (premature birth n = 2; sepsis n = 2). Although the numbers suggest poorer outcomes when no care was received, the lack of statistical significance (p = 0.28) implies that these differences could be due to chance, and that health care-related factors did not show a definitive impact on neonatal mortality within this dataset.

#### Environmental determinants of neonatal morbidity and mortality

Of the total 23 neonatal deaths, most occurred during the rainy season (n = 14; 60.9%), primarily due to premature birth (n = 5), asphyxia (n = 3), sepsis (n = 2), and isolated cases of congenital anomalies, meningitis, and others. The dry season

accounted for 9 deaths (39.1%), with sepsis ( $n = 3$ ) being the most common cause, followed by congenital anomalies ( $n = 2$ ), and one case each of asphyxia, premature birth, tetanus, and others. No neonatal deaths were recorded under the 'climate change' category. Despite the higher number of deaths in the rainy season, the high p-value (0.906) shows that seasonal variations or environmental factors had no significant statistical impact on neonatal mortality in this study population. This is presented in **Table 8** below.

**Table 7.** Health care related determinants of neonatal morbidity and mortality.

	Cause of neonatal mortality						
	Asphyxia	Premature birth	Neonatal sepsis	Congenital anomalies	Meningitis	Neonatal tetanus	Others
Access to prenatal care	0	3	1	0	0	0	0
Quality of neonatal care practice	0	2	2	0	0	0	0
None	4	1	2	3	2	1	2

**Table 8.** Environmental determinants of neonatal morbidity and mortality.

	Cause of neonatal mortality						
	Asphyxia	Premature birth	Neonatal sepsis	Congenital anomalies	Meningitis	Neonatal tetanus	Others
Climate change	0	0	0	0	0	0	0
Dry season	1	1	3	2	0	1	1
Rainy season	3	5	2	1	2	0	1

## 4. Discussion

The socio-demographic data revealed that most mothers were aged between 20 - 34 years (59.0%) and lived in rural areas (86.9%). This pattern aligns with findings from other sub-Saharan African settings, where young, reproductive-age women dominate antenatal and postnatal service utilization [16] [17]. The high female neonatal proportion (66.4%) likely reflects random distribution within the study sample rather than a biological sex imbalance. A significant number of respondents were farmers (51.6%) with only primary education (58.2%), indicating a predominance of low socio-economic and educational status, consistent with evidence that maternal education and socioeconomic status influence neonatal outcomes [18] [19].

Premature birth (27.3%) and neonatal sepsis (22.7%) were the most common morbidities. These findings echo patterns reported globally, where prematurity and infections are leading contributors to neonatal morbidity and mortality [20] [21]. The presence of neonatal tetanus, though minimal (4.5%), suggests persisting gaps in maternal immunization or sterile delivery practices, especially in rural settings [22].

Although most socio-demographic variables did not show significant associa-

tions with neonatal outcomes, maternal education ( $p = 0.009$ ), occupation ( $p = 0.05$ ), and residence ( $p = 0.05$ ) were statistically significant. Lower education levels were associated with higher neonatal morbidity and mortality, corroborating evidence linking maternal illiteracy to poor neonatal outcomes [18] [23]. Farmers were most affected, likely due to limited healthcare access and demanding work hours [19] [24]. Rural residence was a key determinant, consistent with studies showing higher neonatal mortality in rural areas due to weaker health infrastructure [4] [16].

Although no statistically significant association was found ( $p = 0.59$ ), maternal conditions such as syphilis and malaria were leading contributors to neonatal deaths (26.1% each). This aligns with WHO data identifying maternal infections as major preventable causes of perinatal mortality in sub-Saharan Africa [8]. Notably, 21.7% of neonatal deaths occurred among mothers with no reported medical conditions, suggesting either undiagnosed conditions or healthcare access limitations [9].

All neonatal deaths occurred in single gestation pregnancies, although this was not statistically significant ( $p = 0.998$ ). Parity, however, showed a significant association with neonatal mortality ( $p = 0.018$ ), with most deaths occurring in primiparous mothers (73.9%). This supports prior studies identifying first-time mothers as a high-risk group due to limited childbirth experience and reduced antenatal preparedness [12] [13]. Fetal conditions showed a very strong association with neonatal death ( $p = 0.0001$ ), with sepsis and prematurity as leading contributors. Birth asphyxia and congenital anomalies also played critical roles, highlighting the importance of skilled birth attendance and early anomaly detection [14] [20] [21]. Although most neonatal deaths were among neonates whose mothers had limited prenatal or neonatal care, the association was not statistically significant ( $p = 0.28$ ). This trend aligns with observations that inadequate access to maternal and neonatal healthcare is a key driver of neonatal mortality in rural contexts [8] [16]. Although more deaths occurred during the rainy season (60.9%), the association was not statistically significant ( $p = 0.906$ ), reflecting findings from tropical regions where seasonal variation alone does not consistently predict neonatal outcomes [9] [24]. However, seasonal factors may indirectly influence outcomes through increased infection rates or impaired access to health facilities.

## 5. Conclusions

The study identified prematurity (27.3%), neonatal sepsis (22.7%), and birth asphyxia as the most frequent patterns of neonatal morbidity and mortality. These findings are consistent with global and regional data, which show these conditions as the leading causes of neonatal deaths in low-resource settings. Despite various neonatal morbidities being observed, most deaths occurred during the early neonatal period and were more prevalent during the rainy season, though this was not statistically significant. This suggests that environmental conditions and

healthcare access during certain periods may exacerbate already fragile neonatal outcomes.

Among the significant risk factors, maternal parity ( $p = 0.018$ ), maternal education ( $p = 0.009$ ), occupation ( $p = 0.05$ ), and rural residence ( $p = 0.05$ ) were identified as major contributors to neonatal morbidity and mortality. Primiparous mothers and those with only primary-level education were particularly associated with higher risks of neonatal death. Fetal factors, especially sepsis, prematurity, and congenital anomalies, were also strongly and significantly associated with mortality ( $p = 0.0001$ ). These findings underline the importance of targeting first-time mothers, improving maternal education, and strengthening prenatal and neonatal care services, especially in rural areas, to reduce neonatal mortality.

## 6. Study Limitations

The single-center design limits generalizability to other settings within Cameroon or sub-Saharan Africa. Second, retrospective review of hospital records may have led to incomplete or missing data, potentially biasing results. Third, some analyses involved small cell sizes, reducing statistical power and increasing the likelihood of type II errors.

## Conflicts of Interest

The authors declare no conflicts of interest.

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