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Types, Management and Factors associated to the Outcome of Congenital Anomalies among Neonates in the Neonatal Intensive Care Unit of the Limbe Regional Hospital

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Abstract: Background: Congenital abnormalities are a major contributor to perinatal and infant morbidity and mortality. The impact is more severe in countries of low socio-economic status with majority of infants who die from congenital anomalies. Epidemiologists have reported numerous investigations of the prevalence and etiology of congenital anomalies, but analyses of mortality have focus on the contribution of these disorders to perinatal and infant death rates rather than to the survival of affected infants. The aim or objectives was to determine the prevalence, associated factors to outcomes of congenital anomalies among neonates in the Neonatal unit of the Limbe Regional Hospital from 2017 to 2022.

Method: This was a hospital-based retrospective study conducted from November 2022 to July 2023. A data extraction form was used to collect data from 2815 complete neonatal files admitted between 2017 and 2022 using an exhaustive sampling technique. Incomplete files were excluded. Ethical clearance was obtained from the University of Buea, faculty of health sciences Institutional review board, administrative clearances were obtained from the South West Regional Delegation of Public Health, and Limbe Regional Hospital. Data was entered using MS Excel, and exported to SPSS version 25 for analysis. Univariate analysis was done using descriptive statistics. Chi square test was used to test for association between variables while Logistic and cox regression models were used to test for significant determinants and outcome of congenital abnormalities (α=0.05).

Results: Congenital anomalies accounted for (3.5%) neonatal hospital admissions in the Limbe Regional Hospital. As for the management (34.7%) of the neonates with congenital anomaly were on medical treatment while (22.4%) underwent surgical procedures. The average period of hospital stay was 6.450±9.324 days. From 2017 to 2022, majority of the neonates 76.5% got discharged while (18.4%) died. Congenital abnormalities accounted for 5.8% of the total neonatal deaths with majority of the birth defect fatalities occurring during the neonatal period. The highest rate of mortality in this study was found in post-surgical cases (61.1%). Babies with nervous system abnormalities were found to have the poorest prognosis compared to other groups of anomalies (X^2: 8.375, df:1, P: 0.004). Primiparity, male sex, forceps delivery, low birth weight and surgical management were significant risk factors for mortality.

Conclusion: Congenital anomaly is a major indication for neonatal admissions and mortality in the Limbe Regional Hospital. The highest rate of mortality in this study was found in post-surgical cases. Babies with nervous system abnormalities were found to have the poorest prognosis There is

Vol. 3 No. 9 (2025)
ISSN: 2995-5483

the need to establish a surveillance system for congenital anomaly and efforts should be made to raise awareness of the occurrence and risk factors of congenital anomaly in Cameroon to improve on the outcome.

Key words: Abnormalities, Congenital, Hospital, Limbe Regional Hospital, Neonates, Outcome.

1. Background of the study

Congenital anomalies make an important contribution to infant mortality. They remain a leading cause of death among infants in many countries in the world [1]. The World Health Organization defines Congenital Anomalies (CA) as functional, metabolic and even structural deficiencies that may be isolated or multiple in nature, which are existing at birth [1]. Congenital anomalies can be categorized into two; major and minor anomalies. Major congenital anomaly is defined as a structural abnormality present at birth which has a significant effect on function or social acceptability; examples: cleft lip, spina bifida [2]. Minor congenital anomaly is defined as a structural abnormality present at birth, has minimal effect on clinical function but may have a cosmetic impact, for example, pre-auricular pit [3]. These disorders are classified as structural or functional and can result in critically damaging effects on the lives and health of infants [1].

Birth defects are a major contributor to perinatal and infant morbidity and mortality. Globally, an estimated 8 million newborns are born with a birth defect every year [4]. Nine out of every ten children born with a serious birth defect are in low- and middle-income countries [5]. The most common severe birth defects are heart defects, neural tube defects and Down syndrome, but there are many others, which can be caused by one or more genetic, infectious, nutritional or environmental factors [6].

Worldwide, there are variations in the incidence of congenital anomalies and related infant mortality between geographical regions. As a rough calculation, it has been recorded that 3-7% of infants are diagnosed with birth defects. In the United States of America, birth defects are the leading cause of infant deaths, accounting for 20% of all infant deaths [7]. Based on the WHO report in 2013, the rates of total structural and functional birth defects were higher in the regions of Eastern Mediterranean and South-East Asia with respective prevalence rates of 69 per 1,000 and 51 per 1,000 live births every year [8,9]. In 2019, birth defects contributed to at least 117 000 deaths in the South-East Asian Region, equal to around 22% of the global total [5]. Consanguineous marriages, a practice common in the Middle East is associated with increased incidence of anomalies [9]. In Iran, about 2.8% of the anomalies reported were from familial marriages as compared to 0.9% from non-familial marriages [10].

Globally, as in Cameroon, birth defects are becoming recurrent with abnormal babies seen in various hospitals [11, 12]. The happiness and excitement that comes with the birth of a baby is gradually fading away in some families in the country. Deaths due to congenital anomalies in Cameroon increased from 0.03 % in 2003 to 0.06 % in 2017 growing at an average annual rate of 4.59% [12].

Most of the causes of birth defects in humans are idiopathic. According to WHO, approximately 50% of all birth defects cannot be linked to a specific cause [1]. Maternal illnesses like diabetes mellitus and rubella, folic acid deficiency, consumption of medicinal and recreational drugs like thalidomide, tobacco, certain environmental chemicals and high doses of radiation are factors that can cause birth defects [13]. The pattern of birth defects varies from one geographical region to another and also difference in time. A newborn baby is considered the beginning of hopes and dreams, and becoming a parent is one of life ‘s greatest joys. Seeing a child with birth defect challenges those dreams [14].

Due to serious potential impact on health, wellness and survival, the World Health Assembly emphasized Congenital anomaly. As a global public health priority in 2010 and addressed the urgent

Vol. 3 No. 9 (2025)
ISSN: 2995-5483

need for action [11]. As a contribution to data on congenital abnormalities in Sub Saharan Africa, this study aims to narrow the information gap on, the outcomes of congenitally malformed children which is unsatisfactory [15].

2. MATERIALS AND METHODS

2.1. Study Design

This study was a hospital-based cross-sectional study with the retrospective review (chart review) of files of neonates admitted in the Neonatal ICU of the Regional Hospital Limbe (LRH) from 1st January 2017 to 31st December 2022 (6 years). The choice of a retrospective design is to allow us determine the outcome of congenital anomalies in Limbe Regional Hospital, from January2017 – December 2022.

2.2. Study period

This study ran for 9 months from November 2022 to August 2023.

2.3. Study Area

The study was carried out in Limbe Regional Hospital, a regional referral hospital in the South West Region of Cameroon. It is located in the Limbe Health District, one of the 20 Health Districts that make up the South West Region. It has a bed capacity of 200 and has been in existence since 1940. One of the specialized units is Neonatology Unit, others being the surgical unit, UPEC, Maternity, Emergency Unit and Critical Care Unit [16].

The Neonatology Unit receives babies from the hospital's labor ward and from the operating theatres as well as from outside the hospital as referrals from private hospitals. It is subdivided into several sections namely; Neonatal intensive Care Unit (NICU), Kangaroo Mother Care and Nursery for the premature babies. There are 9 incubators, 10 cots and 3 phototherapy lamps. The unit is headed by a pediatrician who follows up with the children daily and is assisted by a general practitioner and 10 registered nurses work in the Neonatology Unit. It was estimated that 10.0% of admissions to the Neonatology Unit were neonates with congenital anomalies [16].

The Limbe Regional Hospital (LRH) is one of the biggest referral hospitals in the South West Region of Cameroon. Apart from its environs in Limbe, LRH serves patients from all over the region and beyond; and therefore has a large catchment area. Neonates born with congenital anomalies are referred from far and wide to LRH for specialized care. Therefore, this makes it the ideal study area as its subjects are a true representation of the whole population [16],(figure 1).

Vol. 3 No. 9 (2025)
ISSN: 2995-5483

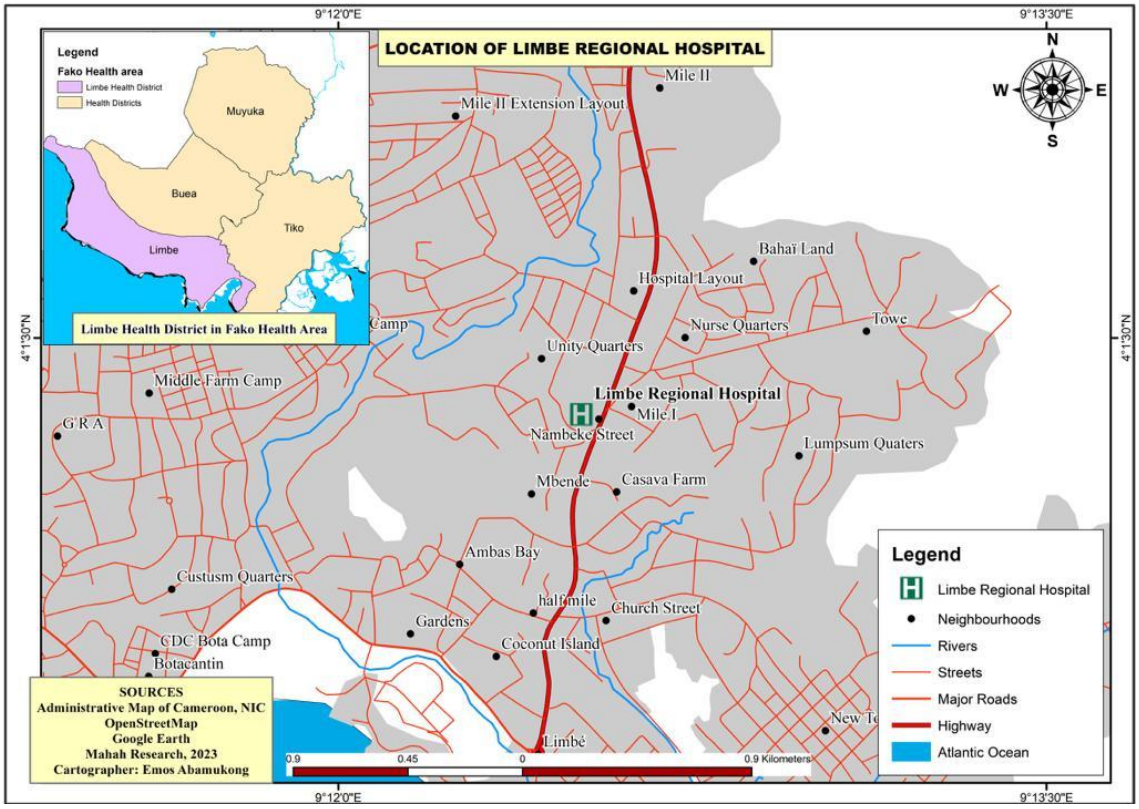


Figure 1: Map of Limbe Health District showing the Limbe Regional Hospital

2.4. Study Population

The study included files of all neonates admitted at the Neonatology Unit in the Limbe Regional Hospital from 2017 to 2022.

2.4.1. Inclusion Criterion

Files of neonates admitted at Neonatology Unit of the LRH from 2017 to 2022 that were available and complete.

2.4.2. Exclusion Criteria

Incomplete and missing files of neonates admitted at Neonatology Unit of the LRH from 2017 to 2022.

2.5. Sample of the Study

The study sampled all eligible neonatal files at Neonatology Unit of the LRH from January 2017 to December 2022.

2.6. Sampling Procedure

Purposive sampling technique was used to sample the neonate files or records based on the inclusion criterion.

2.7. Data Collection Instrument

A data extraction form created on an excel spread sheet was used as the main tool for data collection (Appendix 1). The form consisted of the following sections:

Section A: Neonatal information (gender, age at admission, place of birth, weight at birth).

Section B: Prevalence of congenital anomalies.

Section C: Outcome of Congenital Anomalies (Type of therapy, feeding method, duration of hospitalization, outcome-discharged/died, referral, and disability).

Vol. 3 No. 9 (2025)
ISSN: 2995-5483

2.8. Pre-testing

The data extraction form was pretested among 50 randomly selected neonatal files at the Neonatology Unit of Buea Regional Hospital. Pre-testing was done a month prior to commencement of data collection after making all necessary modifications.

2.9. Validation and Reliability of the Data Collection Tools

Validity of the research instrument was ensured through the pre-test study to check the accuracy of the data extraction form so that the data obtained from the study would be true and accurate.

Reliability was tested through Test-Retest reliability method. Reliability was also ensured by pre-testing which was carried out in Buea Regional Hospital. Completed data extraction forms were checked daily and errors corrected.

2.10. Ethical Consideration

After developing the research protocol, the investigator sought ethical approval from the Faculty of Health Sciences Institutional Review Board, University of Buea , the Regional Delegation of Public Health for South West (Appendix 4) and the Limbe Regional Hospital administration (Appendix 5). The information collected from the neonatal files were kept highly confidential and within limits of research objectives. The study primarily intended to provide valuable information that would be used to improve the care of newborns with congenital anomalies.

2.11. Data Collection Procedure

After obtaining the aforementioned authorizations, permission was sought from the Major of the neonatal unit to gain access to the admissions registers. The total number of neonates admitted from 1st January 2017 to 31st December 2022 was obtained. The registers used over the years at the Neonatology Unit were examined and each patient file was traced in the archives (Figure 2). The files were checked based on the inclusion criteria and only eligible files which had complete information were used to extract data. Information extracted included the type, risk factors and outcome of the congenital anomalies in the unit. Data collection was done by the researcher, who was assisted by three trained assistants within 3 months (February-April 2023).

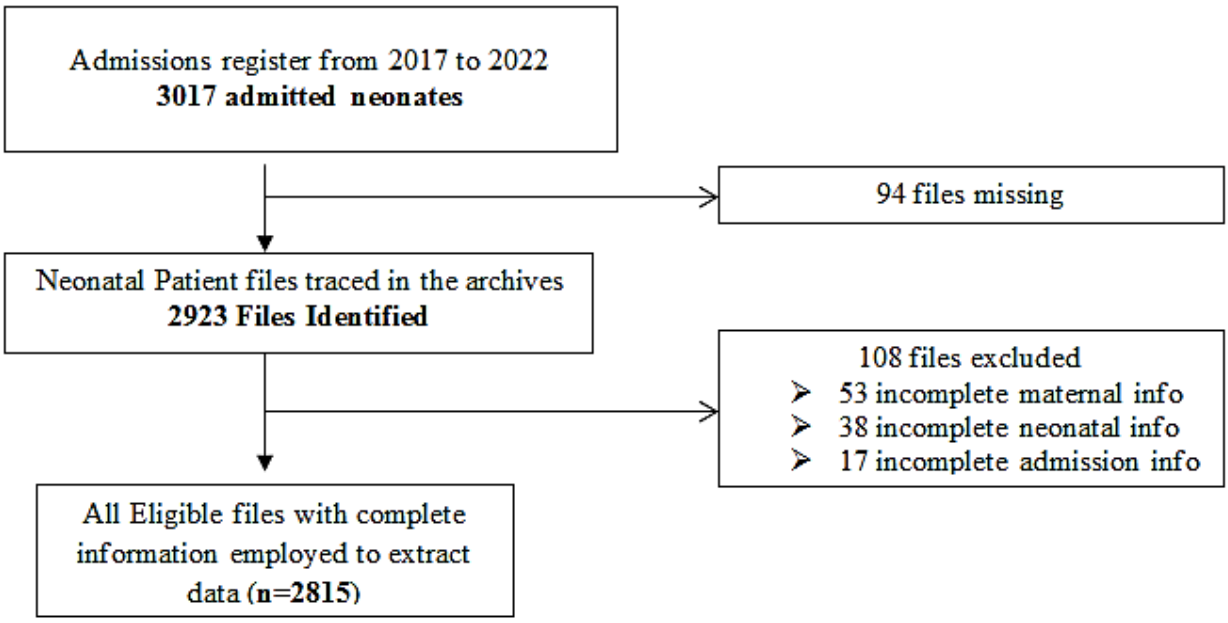


Figure 2: Procedure for data extraction from neonate files at the neonatal unit of LRH

2.12. Data Management

2.12.1. Data entry and cleaning

Data extracted from neonate files were entered directly on the extraction form in MS excel 2016. Each file was coded for easy referral and to ensure confidentiality since patient names were not included. Filled data was checked for completeness and consistency. Inconsistent information was eliminated and unclear responses clarified from the files.

2.12.2. Data analysis

Data was exported to Statistical Package for the Social Sciences (SPSS) computer software, version 25 for analysis. Congenital anomalies in this study were structural defects that were present at birth or identified during the neonatal period, either clinically or through investigation modalities. The abnormalities were categorized using the European Surveillance of Congenital Anomalies (EUROCAT) guidelines [17].

Univariate analysis was performed in order to obtain descriptive statistics. Frequency, percentages, means, modes and medians and standard deviation was used to summarize the data. The prevalence of CA was calculated as the proportion of neonates with CA among the total number of neonates admitted during the study period.

Bivariate analysis was also performed using chi square test in order to examine associations between the independent variables and dependent variable (Associations of neonatal characteristics and maternal socio-demographic factors with congenital anomalies. All statistics were tested at the 95% confidence level (α=0.05). Bivariate Cox regression analysis was used to assess variables that were significantly associated with neonatal mortality at $p<0.2$, and significant variables were included in a multivariate Cox regression analysis to determine the predictors of 28-day mortality among neonatal admissions at $p<0.05$. The results were presented using frequency tables, pie/bar charts and line graphs. Scientific conclusions were then drawn from the findings with a statistical significance that was set at $p<0.05$.

3. Results

3.1. Types of Congenital Anomalies Amongst the Admitted Neonates in LRH

Majority of the neonates were female (56.0%), with most of them born per normal vaginal delivery (75%) while (3.5%) had Congenital Anomalies (CAs). Generally, from the year 2017 to 2022, congenital defects of the gastrointestinal system were the most prevalent 32 (32.6%), among which were 9 Akyloglossia, 5 Intestinal malrotation, 4 Intestinal obstruction, 4 Impeforated anus, 3 Omphalocele, 2 Bifid epiglottis, and one Pyloric stenosis, Duodenal atresia, Hepatoblastoma, Oesophageal atresia, and Laparoschisis (Table 5). Nervous system abnormalities were second in line with 14 (14.3%) cases (6 Hydrocephalus, 2 Encephalocele, 1 Anencephaly, and 5 Spinal bifida), followed by cardiovascular malformations 11 (11.2%), musculoskeletal malformations 8(2 Brittle bone, 2 Genu Valgum, 3 Hip dysplasia, 1 Arthrogryposis), genitourinary defects 7(1 Congenital Pyelonephritis, and 6 Hypospadias), Integumentary system defects 7 (5 Nevus sebaceous, and 2 milia Cyst), 4 (4.1%) down syndrome, 4 congenital infections (3 toxoplasmosis and 1 syphilis) and 2 defects of the respiratory system (Diaphragmatic hernia). The finding revealed that the most common types were structural congenital anomalies, (Table 1).

Table 1: Types of Congenital Anomalies amongst the Admitted Neonates (n=98) in LRH, 2017 to 2022

System Involved	Categories	Frequency	Percentage
Cardiovascular Nervous	Cardiac malformations- unspecified	**11**	11.2
	Hydrocephalus	**6**	6.1
	Encephalocele	2	2.0
	Anencephaly	1	1.0
	Spinal bifida	**5**	5.1
Musculoskeletal	Brittle bone	2	2.0
	Genu Valgum	2	2.0

	Hip dysplasia	**3**	3.0
	Arthrogryposis	1	1.0
	Club foot	3	3.0
Respiratory Gastrointestinal	Diaphragmatic hernia	2	2.0
	Intestinal obstruction	**4**	4.1
	Intestinal malrotation	**5**	5.1
	Pyloric stenosis	1	1.0
	Omphalocele	3	3.0
	Duodenal atresia	1	1.0
	Hepatoblastoma	1	1.0
	Impeforated anus	**4**	4.1
	Akyloglossia	**9**	9.2
	Bifid epiglottis	2	2.0
	Oesophageal atresia	1	1.0
	Laparoschisis	1	1.0
	Cleft lip	4	4.1
	Cleft palate	2	2.0
Genitourinary	Congenital Pyelonephritis	1	1.0
	Hypospadias	**6**	6.1
Integumentary	Nevus sebaceous	**5**	5.1
	Milia Cyst	2	2.0
Chromosomal	Down syndrome	**4**	4.1
Congenital Infections	Toxoplasmosis	3	3.0
	Syphilis	1	1.0

3.2. Management of Neonates with Congenital Abnormalities

Averagely the admitted neonates stayed in the hospital for 6.450±9.324 days with a minimum duration of less than 24hrs to a maximum duration of 140 days. All the children with congenital abnormalities received medications. However, 34 (34.7%) were on medical treatment only, 40 (40.8%) were following a diet therapy, 2 (2.0%) were placed on phototherapy, and 22 (22.4%) underwent surgical procedures (chi square: 64.566, df: 1, pvalue: <0.001), (Figure 3)

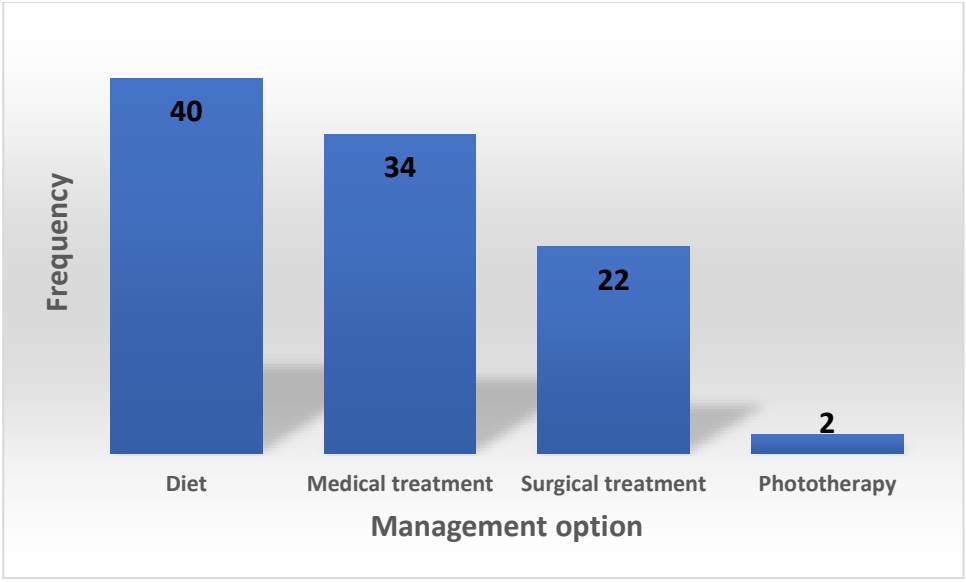


Figure 3: Management of neonates with congenital abnormalities at the LRH

3.3. Outcome of Neonates with Congenital Abnormalities

Majority of the admitted neonates with congenital abnormalities got discharged 75 (76.5%); among which 37(49.3%) were referred and 50 (66.7%) had disabilities. 5(5.1%) left the hospital against medical advice while 18 (18.4%) died (X^2: 144.630, df:1, P:<0.001). (Figure 4)

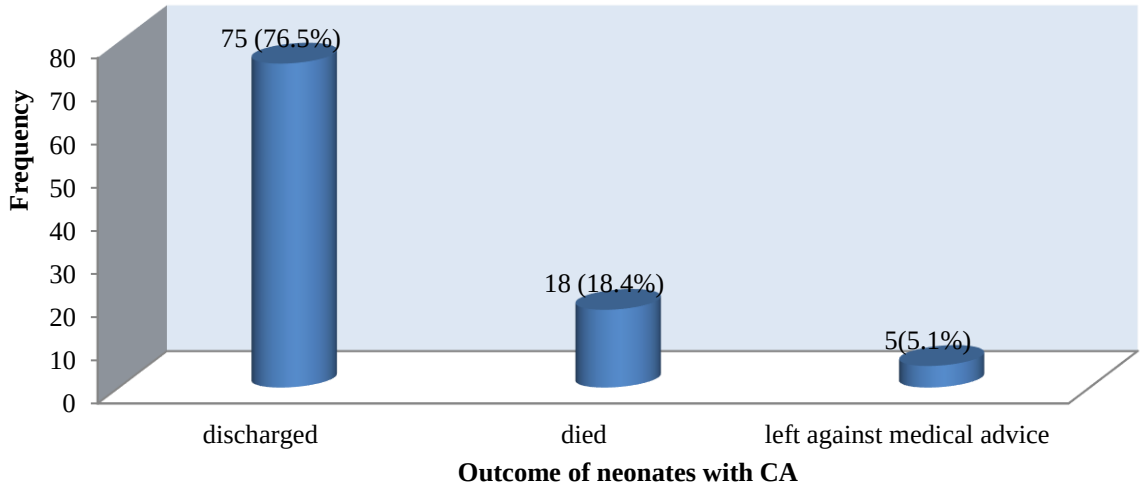


Figure 4: Outcome of neonates with congenital abnormalities in the LRH

3.4. Outcomes of neonates with Congenital Anomalies (CA) on different therapies

Of the 98 neonates with CAs, 34(34.7%) neonates were only on medical treatment amongst which 27 (79.4%) were discharged, 5 (14.7%) died, and 2 left the hospital against medical advice. For the 22(22.4%) neonates who underwent surgery 11 (50.0%) died and surgery was associated with 61.1% of the CA deaths (X^2: 94.311, df:3, P:0.022). Of the 40 on nutritional therapy,35 (87.5%) got discharged while 2 (5.0%) died and 3(7.5%) were discharged against medical advice and lastly all the 2 babies on phototherapy were discharged alive (Figure 5).

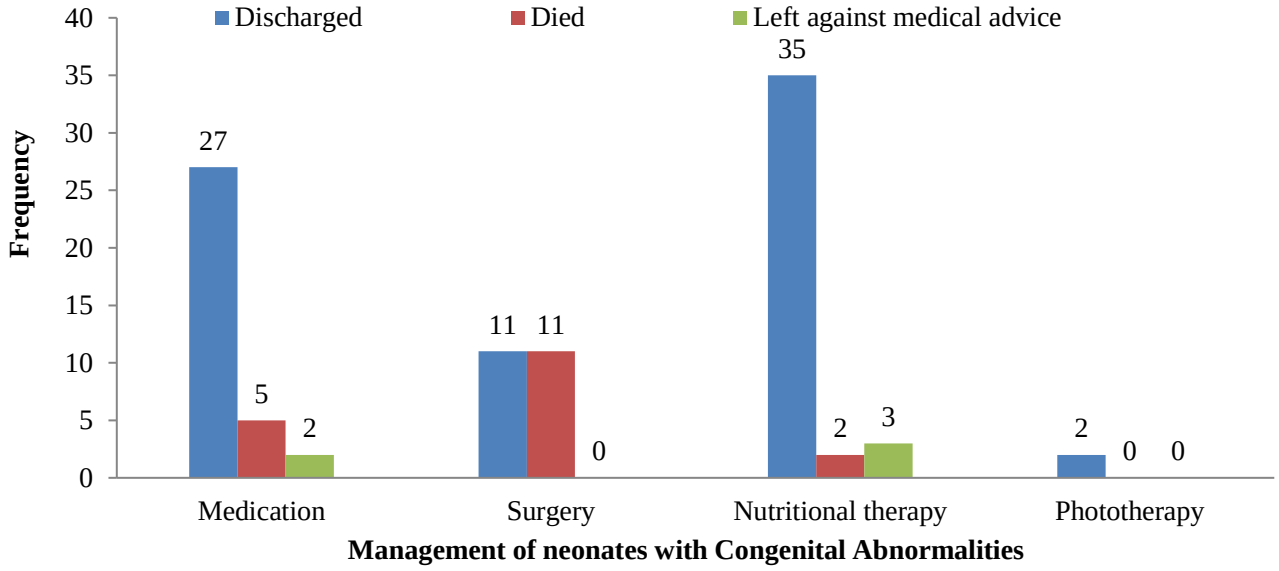


Figure 5: Outcomes of neonates with CA on different therapies

3.5. Outcome of neonates diagnosed with specific congenital abnormalities

A total of 18 deaths were recorded with those with specific congenital abnormalities, amongst which Cardiac malformations caused the highest number of deaths 5 (27.8%), followed by hydrocephalus with 4 (22.2%) deaths; encephalocele, spinal bifida, and intestinal obstruction each accounted for 2 (11.1%) deaths, while omphalocele, hip dysplasia, and anencephaly were associated with one death case each (X^2: 138.758, df: 50, P: <0.001). (Figure 6).

Vol. 3 No. 9 (2025)
ISSN: 2995-5483

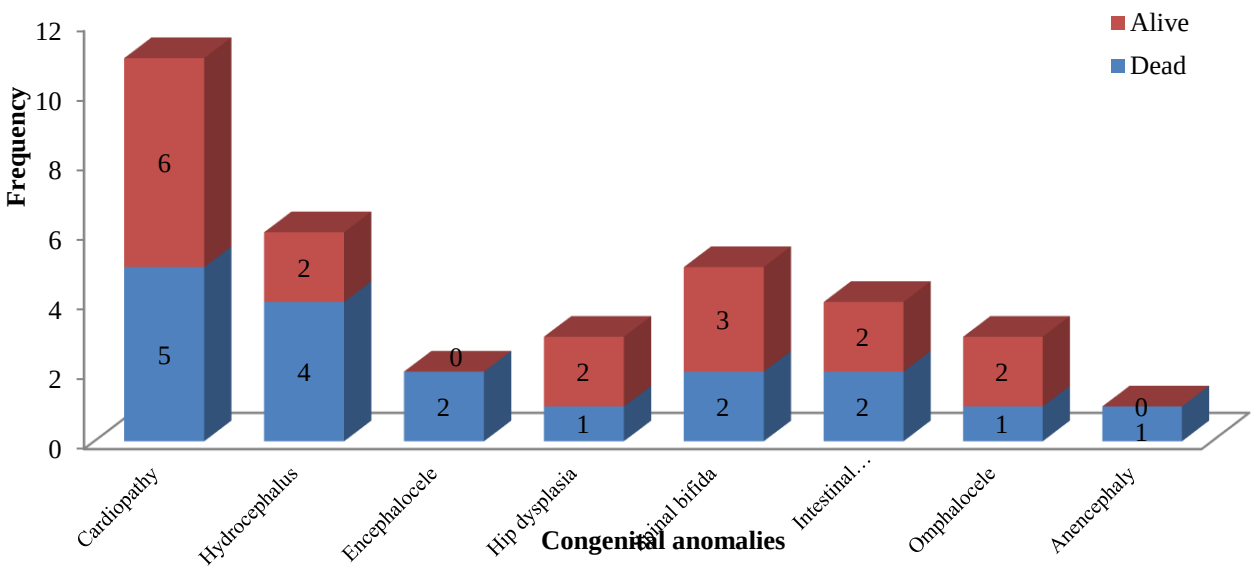


Figure 6: Outcome of neonates diagnosed with specific congenital abnormalities

3.6. Survival of Neonates with Congenital Abnormalities

3.6.1. Cumulative Survival of Neonates with Congenital Abnormalities

Congenital anomalies accounted for 5.8% (17/293) of the total neonatal deaths (X^2: 10.095, df 1, P: 0.001). The probability of the neonates surviving decreased progressively as the days of hospitalization increased (Hazard ratio: 1.46, P: 0.000, 95% CI: 16.974-45.026).(Figure 7)

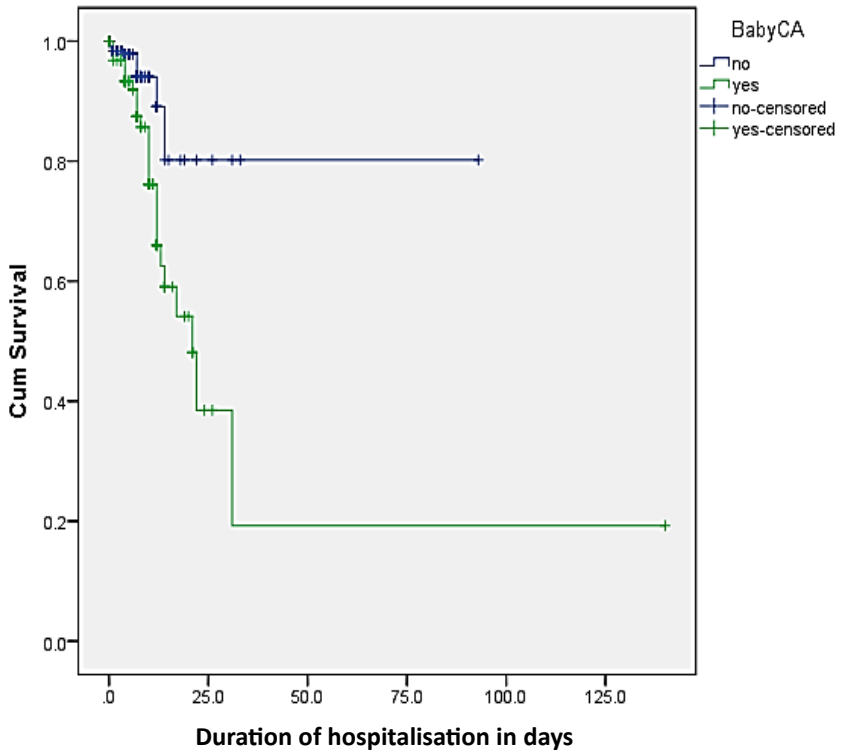


Figure 7: Survival days of neonates with congenital abnormalities

3.6.2. Survival of Neonates with Different Types of Congenital Anomalies

Cumulatively, by the end of the neonatal period all the babies diagnosed of encephalocele and anencephaly were dead; the only anencephaly child died within the first week of life (day 1) while the last encephalocele case died within the second week of life (day 8). The proportion of babies who

Vol. 3 No. 9 (2025)
ISSN: 2995-5483

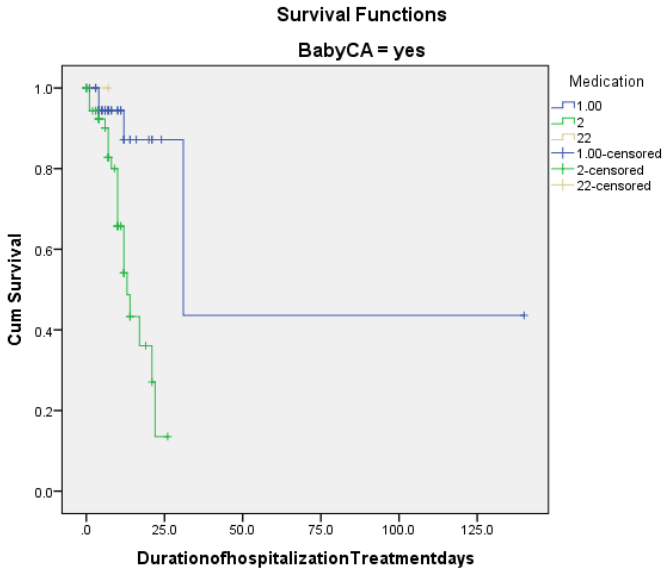
survived by day 28 after birth were 33.3% for hydrocephalus cases, 50.0% for intestinal obstruction cases, 54.5% for cardiac malformations cases, 60.0% of spinal bifida cases and 66.7% of omphalocele cases. Infants with nervous system abnormalities were found to have the poorest prognosis compared to other groups of anomalies (X^2: 8.375, df:1, P: 0.004). (table 2)

Table 2: Cumulative percentages of neonates born with congenital abnormalities surviving to 28 days

Congenital Anomalies	Average survival time for those who died in days	Cumulative percentages surviving				P value
		Week1 (day1-7)	Week2 (day8-14)	Week3 (day15-21)	Week4 (day22-28)	
Cardiac malformations	6	81.8	72.7	63.6	54.5	0.015
Hydrocephalus	3	66.7	66.7	50.0	33.3	<0.001
Encephalocele	4	50.0	0.0	0.0	0.0	<0.001
Spinal bifida	15	100.0	80.0	80.0	60.0	0.024
Intestinal obstruction	9	100.0	50.0	50.0	50.0	0.030
Omphalocele	8	100.0	66.7	66.7	66.7	0.015
Anencephaly	1	100.0	0.0	0.0	0.0	<0.001

3.6.3. Survival of Neonates with Congenital Anomalies on Different Management Strategies

Neonatal survival rate was influenced by the different management therapies. Surgery drastically reduced the survival time as no child who underwent surgery survived more than 28 days while 85.2% of those on medications were still alive (X^2: 0.041, df: 1, P value: 0.987). Also, by 28 days after birth, 43.1% and 100% of those on nutritional and phototherapy respectively were still alive (X^2: 10.095, df: 1, P value: 0.001) (Figure 8).



Vol. 3 No. 9 (2025)
ISSN: 2995-5483

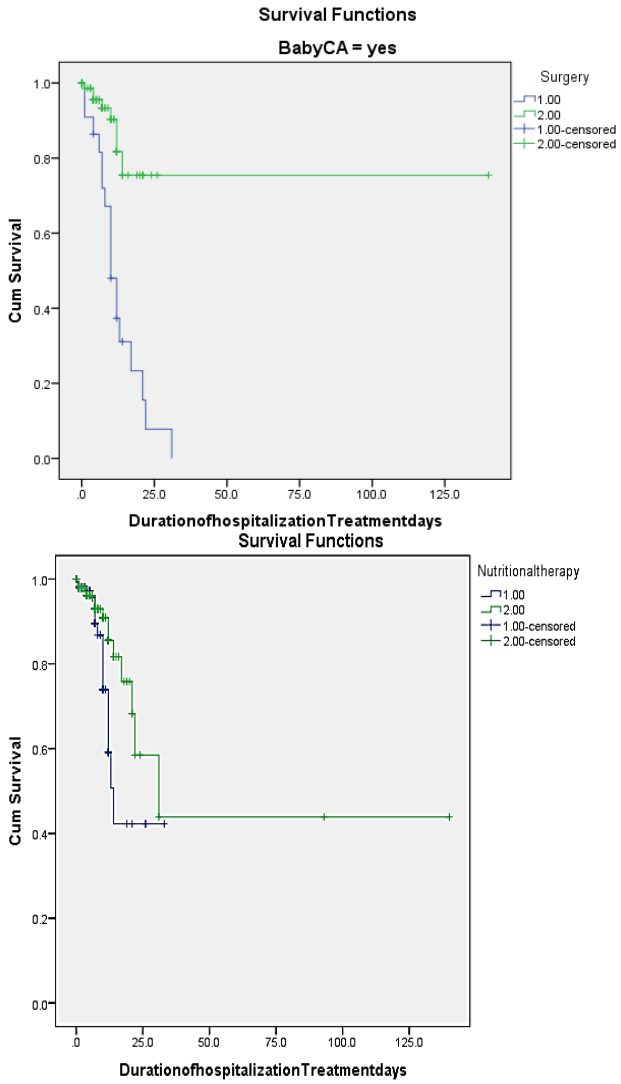


Figure 8: Cumulative survival of neonates with congenital anomalies on different therapies

3.6.4. Factors of Neonatal Mortality among Neonates with Congenital Abnormalities

Primiparity, male newborn, forceps delivery, low birth weight, presence of a congenital malformation, and surgical management were significant hazards for neonatal death. The risk of a neonate dying in the hospital was significantly higher among women who delivered their first babies (16.0 times), male neonates (1.0 times), neonates born via forceps delivery (17.6 times), neonates with low birth weight (2.6 times), neonates with CA (3.2 times), and neonates who were operated upon (6.6 times). Attending ANC during pregnancy, older gestational age, and nutritional therapy were associated with reduced risk of neonatal death and these were found significant at the 95% level of significance. Multiparity and normal birth weight also reduced the risk of neonatal death though not statistically significant. (Table 3).

Table 3: Factors of Neonatal Mortality among Neonates Admitted at the Neonatal ICU

Variables	Crude HR	SE	Wald	df	P value	Adjusted HR	95.0% CI	
							Lower	Upper
Baby sex								
Male	1.047	1.355	22.018	1	**0.014**	1.049	2.522	15.904
Female (Ref)						0		
Gestational age								
Post term	0.828	1.187	8.486	1	**0.016**	0.288	3.223	23.430
Term	0.277	1.121	16.297	1	**0.005**	0.587	1.398	32.308

Preterm						0		
Mode of delivery Vagina	-1.599	.509	9.855	1	**0.002**	0.202	0.074	0.548
Forcep	2.868	.813	12.436	1	**<0.001**	17.602	3.575	86.665
CS						0		
Birth weight Below normal	1.517	1.655	14.621	1	**0.031**	2.676	1.464	6.058
Normal	0.337	0.584	0.332	1	0.565	0.400	0.445	4.402
Above Normal	0.619	0.625	0.980	1	0.322	0.857	0.545	6.320
Macrosomic						0		
Started feeding Yes	0.451	.227	3.945	1	0.047	0.569	1.006	2.448
No						0		
Parity Primipara	2.775	1.360	4.163	1	**0.041**	16.032	1.115	230.427
Multipara	2.226	1.410	2.493	1	0.114	0.261	0.584	146.793
Grand multipara						0		
ANC in pregnancy Yes	0.063	1.456	5.448	1	**0.020**	0.896	1.186	7.073
No						0		
Congenital Anomaly Yes	1.329	1.413	10.365	1	**0.001**	3.265	0.118	0.595
No						0		
Surgery Yes	1.895	5.356	28.369	1	**<0.001**	6.649	3.311	13.352
No						0		
Nutritional therapy Yes	0.348	2.177	3.859	1	**0.039**	0.416	1.001	2.004
No						0		

DISCUSSION

Outcomes of Neonates with Congenital Abnormalities

In this study, more than a quarter of the neonates with CA were on medical treatment only, close to half were following a diet therapy, a minority were placed on phototherapy, and about a quarter underwent surgical procedures. With availability of modern technologies, more anomalies can be diagnosed in the antenatal period, for parents to either terminate the pregnancy or continue with it, and manage after delivery using several medical therapies [18, 19]. In a Danish study which included a cohort of two million children, 3,400 had surgery for pyloric stenosis [20].

A majority of neonates with birth defects were discharged home after initial management in the Limbe Regional Hospital. The finding of this study was higher than that conducted in Ghana whereby only a third of neonates with congenital defects survived [21]. This was however similar to the observation made in another tertiary care facility in Ghana, which analyzed congenital malformations in the general pediatric population but excluded chromosomal and cardiac defects. In that study, the overall mortality rate was 33.5%, despite corrective surgery [22]. The level of neonatal care is an important determinant in neonatal admission outcomes. Although great progress has been made towards neonatal survival at the Limbe Regional Hospital, despite its challenges with resources, it appears the major congenital abnormalities require more specialized services, including expertise and logistics for prompt intervention.

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The mortality rate among neonates with CA was close to one percent. This was far lower than the 16.9% observed in Ibadan Nigeria [23]. This was higher than that reported in South-West Nigeria, where they investigated the perinatal factors associated with neonatal mortality and found a 3.1% contribution by congenital abnormalities [18]. In this same study, the authors relied on self-reports and reports from health attendants where medical records were not available [18]. Our finding revealed CA as the 6th leading cause of mortality, thus highlighting the need to enforce preventive and curative strategies. This finding concurs with the joint World Health Organization (WHO) and March of Dimes (MOD) meeting which reported that 7% of all neonatal mortality and 3.3 million under five deaths were due to CAs [24]; but however differs with a study who reported that congenital anomalies were the fourth leading cause of global neonatal mortality after preterm birth, intra-partum complications and sepsis [25].

The highest rate of mortality in this study was found in post-surgical cases unlike in other studies where improved access to early cardiac surgery in infants with septal defects contributed to increased long-term survival by prevention of development of pulmonary arterial hypertension and eisenmenger syndrome, the conditions of high-risk mortality [22]. This disparity may be due to late referrals, insufficiency in trained staff, and inadequate supply of surgical equipment to handle difficult cases which further worsened the prognosis of neonates with congenital malformation needing immediate surgery in the Limbe Regional Hospital.

The most prevalent conditions associated with death in this study were cardiac malformations, and central nervous system malformation specifically hydrocephalus, encephalocele, and spinal bifida. These results are consistent with other reports showing that congenital anomalies are important causes of NICU admissions and deaths [16]. This finding underscores the importance of developing strategies to reduce the occurrence of congenital anomalies and improve prenatal diagnosis by abdominal sonography and echocardiography.

Low birth weight significantly increased the risk of neonatal mortality by about three while Attending ANC during pregnancy, older gestational age, and nutritional therapy were associated with reduced risk of neonatal death. This shows the importance of antenatal clinics where pregnant women are educated on healthy practices, given supplements like folic acid and closely followed up. There is an improvement in both the number of ANCs and the women who attend ANCs since the launch of the universal health coverage with the issue of health vouchers for pregnant women that covers ANC, delivery and 42 days post-partum. Other studies have reported similar findings with parity of more than three, maternal age and low birth weight being associated factors for mortality [26].

We found that only 5.6% of all live born neonates with CAs survived past the neonatal period, with notable variations in survival between anomaly types. Babies with nervous system anomalies had the poorest prognosis specifically encephalocele and anencephaly whereas a study in Atlanta USA reported 57% surviving to age 1 year [27]. The survival of babies with congenital heart disease to 28 days of age in the LRH (54.5%) was lower than past reports from Northern England (82%) and the Czech Republic (80%) [28,29]. The discrepancy in prognosis can be explained by the presence of more advanced, quality, skilled and well established healthcare systems in developed countries.

Conclusion

The average period of hospital stay was 6.450±9.324 days with a minimum duration of less than 24hrs to a maximum duration of 140 days. Majority of the neonates got discharged while a few died. Congenital abnormalities accounted for six percent of the total neonatal deaths with majority of the birth defect fatalities occurring during the neonatal period. Babies with nervous system abnormalities were found to have the poorest prognosis compared to other groups of anomalies. Primiparity, male sex, forceps delivery, low birth weight, presence of a congenital malformation, and surgical management were significant hazards for neonatal death.

CONSENT. Applicable consent form and the information sheet were duly integrated along with the respective data collection instruments. All the study participants were clearly informed about the

objectives, procedures, risks and benefits, privacy and confidentiality issues of the study. Finally, written and informed consent was obtained from each study participant.

ETHICAL CONSIDERATIONS

The administrative clearance was obtained from the Regional Delegation of Public Health for the South-West Region. Ethical approval was obtained from the institutional review board, of the Faculty of Health Sciences, University of Buea. Authorization was gotten from the director of the Regional hospital Limbe.

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COMPETING INTERESTS. Authors have declared that no competing interests exist.

AUTHORS' CONTRIBUTIONS. This work was carried out in collaboration between all authors. Authors MN, TE, and ME conceived the study, authors MN and ME designed the study. Authors MN, ME, supervised the study and provide major contributions in writing the manuscript. Author TE managed literature search and wrote the first manuscript while author MN analyzed the data and all authors proofread the manuscript and approved the final manuscript.

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