Original Article

Early Outcomes and Associated Factors in Neonates with Extremely Low Birth Weight Admitted to the Neonatal Intensive Care Unit at Selected Referral Hospitals in Kigali

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Cite as: Bankundiye M, Meharry P, Baziga V, Umubyeyi P, Dusingizimana V, Nsengiyumva R, et al. Early Outcomes and Associated Factors in Neonates with Extremely Low Birth Weight Admitted to the Neonatal Intensive Care Unit at Selected Referral Hospitals in Kigali. Rwanda J Med Health Sci. 2026;9(1): *177-190*. https://dx.doi.org/10.4314/rjmhs.v9i1.13.

Abstract

Background
Every year, 15 million preterm births occur worldwide, and attendant complications are the main reason for mortality in children under five. A small proportion have extremely low birth weight (ELBW), needing close assistance to survive. There is limited information about ELBW neonates born in Rwanda.

Objective
To assess the early outcomes and associated factors of ELBW neonates at three selected referral hospitals in Rwanda.

Methods
This study conducted in 2020 was of retrospective cross-sectional design. Information was extracted from 108 files of ELBW neonates admitted to neonatal units in a referral hospital in Kigali, Rwanda.

Results
The major cause of death was severe prematurity (45.10%). The majority of neonates with ELBW (52.8%) survived in the neonatal unit, and there was association with continuous positive airway pressure (81.48%) and ventilator (14.81%). Likewise, there was association between birth weight and neonatal outcome (p=0.004).

Conclusion
This study revealed that the major cause of death of neonates with ELBW is severe prematurity associated with avoidable neonatal infection. However, the majority of ELBW neonates do survive. Continuous positive airway pressure, and ventilator machine are mostly used. Thus, strengthening preventive measures of preterm birth and infection prevention control are recommended to reduce deaths among ELBW neonates.
Rwanda J Med Health Sci 2026;9(1):177-190

Keywords: Neonates, extremely low birth weight, outcome, maternal factors

Background

An extremely low birth weight (ELBW) neonate weighs less than 1000 grams at birth and, is at heightened risk of morbidity and mortality.[1] Although this vulnerable group accounts for only 1% of all live births, when combined with very low birth weight (VLBW) neonates, they contribute up to 90% of mortality in the first year of life. In 2022, more than 40% of all deaths in children occurred in the neonatal period worldwide whereby 2.5 million neonates died in the first month of life.[1] Among these, many were born prematurely with low-birth weight (LBW) jeopardizing their survival, health, and development, most notably in low-income countries (LIC).[2]

The care and conditions of neonates designated as ELBW continue to be a global challenge for healthcare providers (HCPs) and institutions.[3] Twenty million LBW (< 2500 g) newborns enter the world with a marked disadvantage, while those at a higher weight are more likely to survive and thrive.[4] The ELBW neonates comprise a unique subclass of LBW and is an important indicator of newborn health status, a principal determinant of survival and future physical and cognitive development. [5] Survival rates of ELBW neonates have increased significantly in recent years due to enriched antenatal and perinatal care, modern technology, and clinical expertise to care for smaller and less mature infants. [6,7] However, infants born before 28 weeks, 90% of them still die within the first few days of life in LIC, while only a smaller number of less than 10% die in HIC.[8–10]

The care of ELBW neonates is now focused on preventive measures as survival at an earlier gestational age raises concerns about neurodevelopmental outcomes and other morbidities, especially in LIC compared to high-income countries (HIC).[8–11] Generally, above 50% of neonatal deaths in low- and middle income countries are preventable through conventional and well-known cost-effective interventions , high-quality prenatal and post-partum care, neonatal resuscitation, thermal care, nasal continuous positive airway pressure, infection control and prevention, and antibiotic stewardship. Fulfilling these interventions necessitates advocacy regarding health policies that encourage improved neonatal care at the national level, and education and training at the clinical practice level.[12] In addition, a half of premature newborns died due to lack of basic care for infections and respiratory problems in LIC.

In sub-Saharan Africa (SSA) public hospitals, survival of ELBW neonates is still low. Neonates are a vulnerable subgroup predisposed to a higher morbidity rate, potentially leading to long-term survival if anticipated and timely managed.[6]

In Rwanda, a retrospective chart review of patients admitted to the University Teaching Hospital Kigali (CHUK) between 2011 and 2014 found that 63.7% of neonates with ELBW died.[13] The existing research in Rwanda has emphasized mortality, while little else about the outcomes of ELBW neonates within the first 28 days of life has been published. Thus, the outcomes of this vulnerable population have been underreported other than mortality, resulting in a poor understanding of their health outcomes. However, in other countries, studies have been conducted to show the magnitude of the problem.[13] ELBW neonates are very small and often regarded and not recorded, considered not viable.[14]

This study was motivated by the fact that there is high vulnerability of this population to mortality and serious complications. Given that ELBW neonates represent a significant challenge in neonatal care due to their underdeveloped organ systems and increased risk of morbidity, the study aimed to fill critical gaps in local data regarding survival rates, risk factors, and clinical management practices.[13]

This study sought to contribute to evidence-based strategies that can improve neonatal care, inform policy decisions, and ultimately enhance survival and quality of life for ELBW infants in resource-limited environments. Also, it was conducted to obtain a broader and deeper analysis of the early outcomes of ELBW neonates. The study assessed the outcomes of ELBW neonates, including the causes of death, methods of respiratory support, association between demographic factors, APGAR (appearance, pulse, grimace, activity and respiration) score and outcomes of ELBW neonates. In addition, the association between respiratory support and outcomes of ELBW neonates at three selected referral hospitals in Kigali was assessed.

Methods

Study design and setting

This study was of retrospective cross-sectional design, involving 108 files of neonates admitted to the NICU and Neonatology at selected referral hospitals in Kigali, Rwanda, in 2020. The study locations included the University Teaching Hospital of Kigali (CHUK), Rwanda Military Hospital (RMH), and King Faisal Hospital Rwanda (KFHR). The three hospitals have specialized neonatal nurses, neonatologists, pediatricians and pediatric residents, on staff or call providing care twenty-four hours a day, 7 days a week. Anesthesia, emergency medicine, neurosurgery, pediatric surgery, ophthalmology, ear, nose, and throat (ENT), and internal medicine are among the specialties that provided support.

The referral hospitals chosen serve as tertiary care centers, receiving referrals from lower-level health facilities across the country. The NICUs are equipped to manage high-risk neonates, including those with ELBW, defined as weighing less than 1000 g at birth. The setting provides a controlled environment for comprehensive neonatal care and facilitates the collection of clinical data needed to assess early outcomes and associated risk factors among ELBW infants (1).

Sample

The target population was all the ELBW neonates aged up to 28 days) admitted and recorded in the register of the NICU and Neonatology Units at the hospitals, admitted from 1st January to 31st December, 2020. The total number of newborns admitted to the neonatal units was 108, which included 51 (47.2%) at CHUK, 23 (21.3%) at KFHR, and 34 (31.4%) at the RMH. As the overall number of files for neonates with ELBW was too small, all files were universally sampled, Figure 1. Neonates born with congenital anomalies incompatible with life were not admitted in NICU.

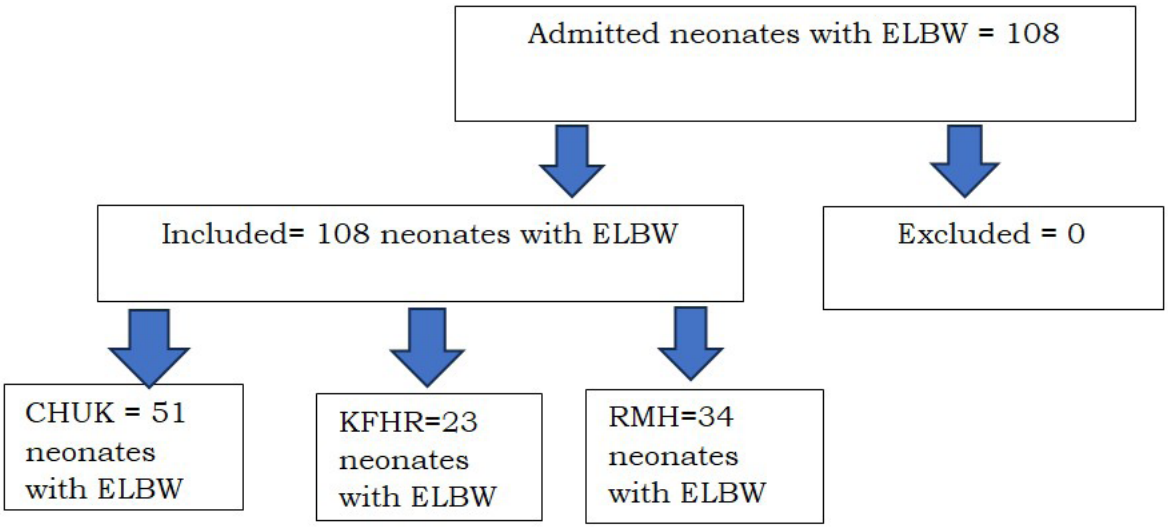

Figure 1. Flow chart of the sample

Measures

A medical record checklist, as a standardized tool, was used to systematically extract relevant data from patients' historical medical records. The tool used was a checklist that was not modified, adapted or translated; thus, the validity and reliability test was not applicable.[15] The checklist was prepared in English.

This checklist ensures consistency and completeness in data collection by outlining specific variables of interest aligned with the study objectives. The researcher, went through the records, referred to the checklist and extracted the required information. Then, the relevant sections of the checklist for each record are marked accordingly. Maternal and neonatal demographics were considered independent variables, while the hospitalization course was considered dependent. The types of data collected by the researcher included neonatal characteristics such as gender, place of birth, APGAR score, birth weight, and gestational age. Lastly, the ICU and Neonatology hospitalization course and level of care included neonatal composite, neonates requiring respiratory support, and cause of death.

To verify completeness, the researcher ensured that no key data points were missing on the checklist, and all the necessary fields were filled. Once the data had been entered into the checklist, the researcher double-checked the records for errors, inconsistencies, or missing information to ensure accuracy. In addition, consistency was monitored by multiple reviewers who independently assessed a subset of the records. The researcher made an overall oversight to ensure the checklist was being used correctly.

Data collection

The retrospective data collection was conducted from 1st January, 2020 to 31st December 2020. All of the neonates with ELBW during the entire study period had chart review checklist of neonatal records and the hospital computerized database. Data were gathered from the files of neonates who had been hospitalized in the NICU or neonatology at the three study sites. Permission to enter the hospital's archives and Open Clinic (the integrated hospital information management system) where the data were stored, was given by the research committee. No consent from the neonate's parent was required due to the retrospective nature of the study.

Data analysis

Software for Statistics and Data Science, STATA 12 - version 21 (College Station, TX, USA) was used to enter and analyze the data in the codebook. The maternal and newborn demographic factors were analyzed descriptively (frequency distribution, mean, standard deviation, minimum and maximum values). The chi-square test was applied to determine the relationship between variables and was considered significant at a p value of <0.05.

Ethical consideration

Ethical approval was obtained from the University of Rwanda, College of Medicine and Health Sciences, Institutional Review Board, Ref: CMHS/IRB/191/2021. In addition, the study permits were obtained from Kigali University Teaching Hospital (EC/CHUK/103/2021); permission from Rwanda Military Hospital and King Faysal Hospital, Rwanda.

As a retrospective study involving medical record review, participant consent was not necessary. Confidentiality and anonymity of the NICU registration book and neonatal file content were maintained. In addition, no personal identifying information was collected; instead, a code number was placed on each data sheet to provide anonymity and confidentiality. Furthermore, data were stored in secured computer with personal pass word to prevent leaks. No personal identifying information was collected; instead, a code number was placed on each data sheet to provide anonymity and confidentiality.

Results

There were 5168 live births from January 1st to December 31st, 2020, and the proportion of ELBW neonates admitted to the NICU and Neonatology was (2.08%) at the three selected hospitals. Data collected from the ELBW neonatal files included 51 (47.2%) from CHUK, 23 (21.3%) from KFHR, and 34 (31.4%) from RMH.

Description of the study population

Findings from this study revealed that the majority of ELBW neonates were male. Likewise, most of the ELBW neonates, were born at the referral hospital . Those born at a site other than the referral hospital were later transferred for further management. Birth weight of ELBW neonates was categorized into four classes, 901-1000 g; 801-900g, 701-800 g and 500-600 g.

Table 1. Description of the study population

Variables	N	%	Min.	Max.	Mean	SD	Median
Gender							
Male	57	52.78					
Female	51	47.22					
Place of birth							
Referral hospital	91	84.26					
District hospital	13	12.04					
Health center	3	2.78					
Home	1	0.93					
APGAR score							
APGAR at 1 min			1	9			
1-5	34	36.17					
6-7	43	45.74					
8-10	17	18.09					
APGAR at 10 min			1	10			
1-5	18	19.15					
6-7	34	36.17					
8-10	42	44.68					
Birth weight (g)			500	1000	881.32	132.6	910
500-600	6	5.5					
601-700	4	3.7					
701-800	18	16.7					
801-900	23	21.3					
901-1000	57	52.8					
Total	**108**	**100**					
Gestational age (days)							
<168 (24 wks.)	1	0.93	156	245	199.57	13.77	197
169-196 (24-28 wks.)	51	47.22					
197-224 (28-32 wks.)	55	50.92					
>224 days (> 32 wks.)	1	0.93					
Total	**108**	**100**					

Note: wks = weeks; min= minutes; g= grams; APGAR: aspect, pulse, grimace, activity and respiration.

The less representative class was 601-700 g. In addition, descriptive statistics showed that the maximum birth weight was 1000 g and the minimum birth weight was 500g. Also, the distribution of ELBW neonates with regard to birth weight was confirmed by the central measure tendencies.

Concerning the APGAR score, at 1 min post birth, the majority of neonates had an APGAR of 6-7; and at 10 min, the majority, had an APGAR of 8-10 (Table 1). Regarding the gestational age of ELBW neonates, the gestational age was categorized into four classes: <168 days (24 Weeks), the second class (169-196 days [24-28 weeks]), the third class (197-224 days [28-32 weeks]) and the fourth class (>224 days [> 32 weeks]). The most representative class regarding the gestational age is 197-224 days (28-32 weeks) followed by the class between 169 -196 days (24-28 weeks). Both first and four classes (<168 days [24 Weeks]) and (>224 days [>32 weeks]) were less represented in the sample. This distribution is confirmed by the central measure tendencies. Also, the table below displays the maximum gestational age of 245 days (35 weeks) and minimum of gestational age of 156 days (22 weeks & 3 days).

Outcome of ELBW neonates

The majority of neonates in the neonatal unit survived (Figure 2). The duration of stay in the hospital ranged from 10 to 28 days for those who survived, with an average stay of 26 days. The neonates that died stayed between 1 to 20 days, with an average of four days. In contrast, the neonates that survived stayed between 10 to 28 days.

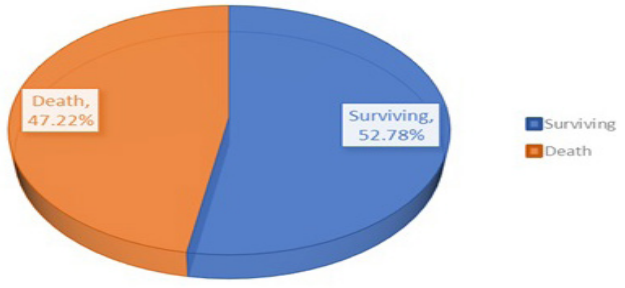

Figure 2. Distribution of outcome for ELBW neonates

Causes of death among ELBW neonates

The major cause of death in neonates with ELBW was severe prematurity, followed by neonatal infection and respiratory distress syndrome (Table 2).

The majority of deaths among ELBW neonates were caused by the severe prematurity and the neonatal infection, while the cardiorespiratory failure and dissemination intraventricular coagulation were less frequent among the cause of death of ELBW neonates. However, one neonate with ELBW who died could have been suffering from two or more conditions at the same time.

Table 2. Causes of death among ELBW neonates

Items	n(%)
Respiratory distress syndrome	15 (29.41)
Neonatal infections	17 (33.33)
Necrotizing enterocolitis	6 (11.76)
Severe prematurity	23 (45.10)
Cardiorespiratory failure	1 (1.96)
Dissemination intraventricular coagulation	1 (1.96)
Intraventricular Haemorrhage	3 (5.88)

Methods of respiratory support of newborns

Findings related to respiratory support for the neonates are presented (Figure 3). The most frequently used respiratory support was CPAP and the ventilator machine.

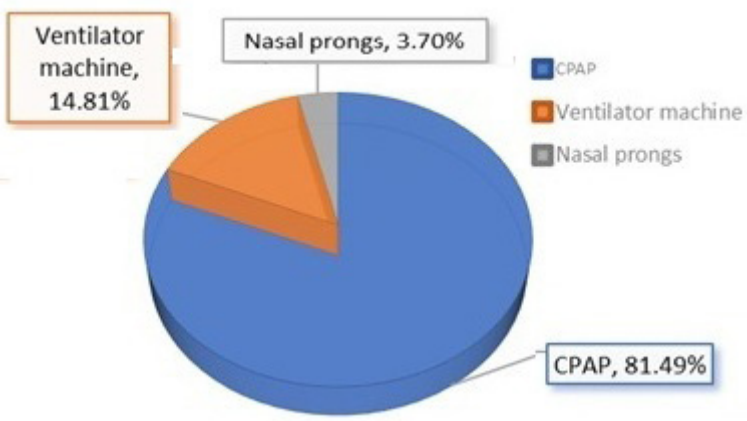

Figure 3.Methods of respiratory support of newborns

Significant associations between demographic factors (gender, birth weight and gestational), APGAR, and outcome of ELBW neonates

Neonates' outcomes

The Chi-square test was used to determine whether there is a significant association between categorical variables such as gender, place of birth, birth weight, gestational age, APGAR scores, and outcomes using the Chi-square test. ELBW neonates' outcomes.

Findings revealed a significant (strong) association between birth weight and neonatal outcome. The highest proportion of neonates who survived was in the birth weight category 901-1000 g. (Table 3).

Socio-demographic variables (gender, birth weight, gestational age) served as independent variables and outcomes of ELBW neonates as dependent variables. Associations were considered to be statistically significant when they had a p-value of less than 0.05 in the chi-square test.

Only significant association between independent and dependent variables are reported. The Chi-square test indicated strong associations between gender and outcome of ELBW neonates, birth weight and outcome of ELBW neonates and gestational age and outcome of ELBW neonates. In addition, the table below displays the proportions showing how different categories of gender, birth weight and gestational age are associated with the neonatal surviving and death.

For example, male ELBW neonates had higher survival rates than female ELBW neonates. In terms of birth weight, ELBW neonates weighing between 901 and 1000 g were more likely to survive compared to those in lower weight categories. Regarding gestational age, ELBW neonates older than 224 days (>32 weeks) showed better survival outcomes than those of lower gestational ages.

Table 3. Association between gender, birth weight and gestational age and outcome of ELBW neonates

Sociodemographic	Outcomes			*P*-Value
	Surviving	Death	Total	
	n(%)	n(%)	n(%)	
Gender				
Male	32 (56.15)	25 (43.85)	57 (100)	0.459
Female	25 (49.01)	26 (50.99)	51 (100)	
Birth weight				
500-600 g	2 (33.33)	4 (66.67)	6 (100)	0.004
601-700 g	1 (25)	3 (75%)	4 (100)	
701-800 g	5 (27.78)	13 (72.22)	18 (100)	
801-900 g	9 (39.13)	14 (60.87)	23 (100)	
901-1000 g	40 (70.17)	17 (29.83)	57 (100)	
Gestational age				
<168 days (24 weeks)	0 (0)	1 (100)	1 (100)	0.224
169-196 days (24-28 weeks)	23 (45.09)	28 (54.91)	51 (100)	
197-224 days (28-32 weeks)	33 (60)	22 (40)	55 (100)	
>224 days (>32 weeks	1 (100)	0 (0)	1 (100)	

Associations between respiratory support and outcome of ELBW Neonates

The chi-square test was used to compute the associations between neonatal respiratory support and the outcome of ELBW neonates. These neonatal respiratory supports include continuous positive airway pressure, a respiratory machine, nasal prongs and a facial mask. Findings from this study revealed a significant relationship between continuous positive airway pressure, a respiratory machine and a facial mask. However, the Pearson chi-squared test did not indicate a relationship between nasal prongs and outcome of ELBW neonates.

In addition, findings from this study showed that respiratory support correlated with the outcome of ELBW neonates. The ELBW neonates who received CPAP survived longer than the ELBW neonates who did not. Also, the facial mask was correlated with the outcome of ELBW neonates. Lastly, the ventilator machine was negatively correlated with the outcome of ELBW neonates.

Statistically significant associations were also found between the APGAR at 1 min post-delivery and outcome and at 10 min and the neonatal outcomes. The 1 min APGAR score of 6-7 had the highest survival, the 5 min APGAR score of 8-10 had the highest survival, and the 10 min APGAR score of 8-10 had the highest survival. The Chi-square test was used to compute the associations between APGAR and the outcome of ELBW neonates. There was a statistically significant association between APGAR at 1 minute and outcome, and APGAR at 10 minutes and outcome after delivery (Table 4).

Table 4. Association between respiratory support, APGAR and outcomes of ELBW neonates

Interventions	Outcomes				
	Surviving n (%)	Deaths n (%)	Total n (%)	Chi square	*P* Value
CPAP					
Yes	48 (54.55)	40(45.45)	88 (100)	0.59	0.440
No	9 (45)	11 (55)	20 (100)		
Ventilator machine					
Yes	5 (31.25)	11 (68.75)	16 (100)	3.49	0.002
No	52 (56.52)	40 (43.48)	92 (100)		
Nasal prongs					
Yes	2 (50)	2 (50)	4 (100)	0.01	0.910
No	55 (52.88)	49 (47.12)	104 (100		
Facial mask					
Yes	3 (75)	1 (25)	4 (100)	0.82	0.364
No	54 (51.92)	50 (48.08)	104 (100)		
APGAR Score					
APGAR at 1 min					
1-5 score	8 (23.53)	26 (76.47)	34 (100)	22.37	0.001
6-7 score	29 (67.42)	14 (32.56)	43 (100)		
8-10 score	14 (82.35)	3 (17.65)	17 (100)		
APGAR at 10 min					
1-5 score	2 (18.18)	9 (81.82)	11 (100)	19.61	0.001
6-7 score	7 (28)	18 (72)	25 (100)		
8-10 score	42 (72.41)	16 (27.59)	58 (100)		

Discussion

This retrospective cross-sectional study addresses the critical topic of ELBW neonates, which was conducted at three referral hospitals in Kigali. The purpose of this study was to assess early outcomes and associated factors in neonates with extremely low birth weight admitted to the neonatal intensive care unit at selected referral hospitals in Kigali. Based on the study objectives, the key findings were the cause of death among ELBW neonates, the outcomes of ELBW neonates, methods of respiratory support of newborns, the association between demographic factors, APGAR score and outcomes of ELBW neonates and the association between respiratory support and outcomes of ELBW neonates.

Cause of death among ELBW neonates

According to the findings of the current study, severe prematurity is the leading cause of death among newborns with ELBW, followed by neonatal infection. In contrast to a study conducted in South Korea, found that infection was the leading cause of mortality in ELBW newborns (50%), followed by RDS/BPD (22%), congenital abnormalities (13.5%%).[18] A study conducted in Ethiopia revealed that neonates weighted <1000g were died mostly due to immaturity (28%). [19] In Soudi Arabia the most common causes of mortality among ELBW infants were pulmonary hemorrhage and neonatal infection, followed by respiratory distress syndrome.[16]

In Africa, Ethiopian study revealed similar findings to the current study in term of causes of death among ELBW neonates. These findings indicated the causes of death as follows; hypothermia (75.26%), sepsis (69.07%), RDS (49.83%), jaundice (13.4%), congenital anomaly morbidities (8.25%). [20] The causes of ELBW in neonates are largely the same worldwide because they stem from universal biological processes (like prematurity and growth restriction) and common maternal health issues thattranscend geography and healthcare systems.

However, a study conducted in the Western Province of Rwanda revealed that neonatal mortality was significantly associated with Trisomy 21(adjusted odds ratio (AOR): 20.7, 95% CI:2.44 - 154.17).[21] Also, this study is not consistent with the study conducted in China revealed the neonatal respiratory syndrome as the most common (85.2%) cause of death among neonatal extremely low birth weight.[22] The newborn with respiratory distress syndrome (RDS) requiring surfactant therapy, an adjusted multivariate logistic regression revealed a birth weight of less than 1000 grams, hyperglycemia, and intraventricular hemorrhage advanced grade were significant predictors of mortality. [16] Severe prematurity leads in resource limited settings because neonates often do not survive the immediate complications of immaturity, while in well-resourced settings, improved survival shifts mortality toward secondary causes such as infection.

Outcome of ELBW neonates

Findings from the study revealed that the majority of ELBW neonates survived. Two studies from South Africa showed higher survival rates, with 63.3% in the Western Cape,[23] and 66.5% in Johannesburg. [23] Survival rates to discharge have been reported as 63% in Thailand, 62.02% in China, and 34% in Germany.[24] In contrast, only 14.3% of ELBW and 20% of preterm neonates survived. Survival of ELBW neonates can be related to income designation of countries, with 18% (11% - 28%) in LIC, 28% (21% - 35%) in LMIC, and 39% (36% - 42%) in HIC.[24] A study conducted in the USA revealed that the incidence of neonatal death ranged between 0.2% (at 36 weeks of gestation age) to 76.56% (at 22 weeks of gestation age). [25] However, a study conducted in China revealed a decreased survival rate among ELBW neonates (55.1%). In addition, the finding was not consistent with the study in Saudi Arabia which the survival rate was 74.1%.[16] The ELBW neonates can survive and thrive, especially with advanced care, but face high risks of short- and long-term complications.

Outcomes are improving globally, but survival and quality of life still depend on access to timely, specialized neonatal care.

Methods of respiratory support of newborns

The findings for this study show that continuous positive airway pressure (CPAP) and mechanical ventilation is effective in promoting the survival of ELBW neonates. These findings are consistent with the study conducted in Turkey indicating the importance of neonatal respiratory support for ELBW neonates.[26]

Findings from this study showed that a large proportion of ELBW neonates required respiratory support, particularly continuous positive airway pressure (CPAP) and mechanical ventilation. A study conducted in Mexico revealed that neonates under 28 weeks of gestational age necessitate intubation and mechanical ventilation, with the risk increasing as gestational age decreases.[19] Furthermore the newborn received invasive mechanical ventilation (IMV) were 70% before initiating continuous positive airway pressure, while still in the Maternity unit.[27] Invasive mechanical ventilation continues to be the foundation for preterm babies with RDS that need respiratory support.[28] The preferred method of respiratory support for preterm infants is now nasal continuous positive airway pressure combined with non-invasive ventilation (NIV) in India.[28] In China, the incidence of complications included RDS (85.2%), at 28 days with oxygen dependent (63.7%), ROP (39.3%), IVH (29.4%), NEC (12.0%), and 8% of periventricular leukomalacia.[29]

Associations between demographic factors, APGAR, and ELBW Neonate outcomes

Findings from this study revealed a significant association between birth weight and outcome of ELBW neonates, suggesting that a higher number of ELBW neonates died with birth weight < 700g. Also, the current study showed that a substantial number of ELBW neonates who died were between 24 and 28 weeks and less than 24 weeks of gestational age. These findings are in alignment with studies conducted in India and China, whereby a higher number of non-survivors were < 750g at birth and < 28 weeks of gestational age.[10] Roy showed that the mortality rate was highest in 26-30 weeks' gestation babies weighing <800g. [30] A study conducted in the USA revealed that the incidence of neonatal death ranged between 0.2% (at 36 weeks of gestation age) to 76.5% (at 22 weeks of gestation age). [31] These results underscore the extreme vulnerability of neonates at the lowest thresholds of viability. Birth weight below 700g and gestational age under 28 weeks are well-established risk factors for poor outcomes due to physiological immaturity, particularly of the respiratory, neurological, and immune systems.

A study conducted in China found similar results, indicating an association between sociodemographic factors (gender, birth weight, and gestational age) and ELBW neonatal outcomes.[32] In addition, the same findings were found in a study conducted in Central Saudi Arabia, Hong Kong and Mexico, indicating an association of outcome (survival and death) rate with the gestational age and birth weight.[33] These findings were consonant with Indian results which confirmed that newborn >750 g at birth and > 26 weeks of gestation survived more than newborns less than 750g at delivery and less than 26 weeks of gestation.[34]

The current study findings revealed that APGAR score is correlated with the outcome of ELBW neonates, implying that an increase in APGAR score increases ELBW neonates survival and a decrease in APGAR score results in an increase of death of ELBW neonates. These findings are consistent with a study conducted in the United States, which found that an increase in the APGAR score between 5 minutes and 10 minutes was associated with lower neonatal mortality.[35]

Likewise, the study conducted in Central Saudi Arabia revealed a correlation between the outcome of ELBW neonates and the APGAR score.[33] Demographic factors, including gestational age, sex, birth weight, APGAR scores, and maternal/ socioeconomic status, are all significantly associated with ELBW outcomes. These indicators help clinicians predict survival and plan interventions.[36]

Associations between respiratory support and ELBW neonate outcomes

The current study's findings revealed that respiratory support such as continuous positive airway pressure, ventilator machine and facial mask, was associated with the outcome of ELBW neonates. This study is consistent with the study conducted in India, indicating continuous positive airway pressure and mechanical ventilation were associated with the outcome of ELBW neonates.[35] However, studies conducted in Australia have shown that invasive ventilation is the only primary mode of respiratory support in ELBW neonates.[37] A study conducted in South Africa revealed that nasal continuous positive airway pressure was not associated with improved survival. [38] The variation between countries may be attributed to differences in clinical guidelines, including variations in protocols that prioritize stabilization approaches or alternative management strategies.

Strengths and limitations

The study was conducted at three hospitals, but in the capital city of Kigali, where better resources are available. Thus, the results cannot be generalized to the whole country. Secondly, a retrospective study design was selected as the country was under COVID-19 restrictions, though data collection was still hindered even while accessing the files.

This was a retrospective study with the limitation of only using information available in the neonates' files; consequently, there could be some overlap between the maternal chronic, gestational, and preeclampsia hypertensive disorders. In addition, our review was limited to documented cases only at the hospital, and it didn´t include deaths of neonates born outside the hospital. Furthermore, this may underrepresent the total number of deaths in the catchment area.

Conclusion

The findings revealed that neonates in the three hospitals during 2020 weighed less than one kilogram, and the major cause of death of neonates with ELBW was severe prematurity associated with neonatal infection, which could be avoided. Thus, preventive measures such as enhancing the utilization of antenatal care services and, early identification and referral of high-risk pregnancy and neonates could reduce the neonatal deaths. Findings from the study revealed that the majority of ELBW neonates survived and continuous positive airway pressure and Ventilator machine were used to improve health status of the ELBW neonates admitted in neonatal intensive care units. Lastly, this study revealed significant association between birth weight and outcome of ELBW neonates suggesting that a higher number of ELBW neonates died with birth weight < 700g.

Further research of a longitudinal design following the ELBW neonates after discharge and reporting on achieving milestones during infancy or longer is warranted. A mixed methods study on the reasons why pregnant women drink alcohol, and some studies targeting the continued concern of maternal hypertensive disorders that cause considerable harm to Rwandan neonates are essential.

Author's contributions

The principal investigator (PI) has been involved in all steps of research process, such as conceptual, design, empirical, analysis and dissemination phases. Co-authors contributed in data analysis, manuscript writing and editing.

Conflict of interest

The authors declare they have no potential or actual conflict of interest.

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