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Predictors of In-Hospital Mortality of Preterm Newborns at University Teaching Hospital of Butare Neonatology Department

Habimana Samson[1,*], Basonga Emmy[2], Rosemary Okova[1]

[1]*Mount Kenya University, Kigali, Rwanda*
[2]*University of Rwanda, Kigali, Rwanda*

ABSTRACT

Introduction: Neonatal mortality in Rwanda is still high, especially among preterm infants, despite the improvements in mortality rate among other neonates attributed to the implemented measures and strategies since the mid-2000s in Rwanda. This study is aimed to determine predictors of mortality at the University Teaching Hospital of Butare (CHUB), Huye, Rwanda

Methods: This retrospective cross-sectional study was conducted on 427 participants from July 2018 to June 2019.

Results: Of all infants enrolled in this study, 51.1% of newborns were female. The mean birth weight, maternal age, and duration of labor were 1.58 ± 0.52 kg, 30.7 ± 6.8 years, and 3.16 ± 6.59 hours, respectively. Most participants had attended antenatal care services (ANC) (95.1%) and had no concerning obstetrical history (83.1%). The most common mode of delivery was spontaneous vaginal delivery (SVD) (51.5%) at the hospital (93.1%). Receiving Kangaroo mother care (KMC) was a protective factor in in-hospital mortality (OR: 0.63; 95CI: 0.028-0.140, p<0.001). Respiratory distress was associated with a 3-time high risk of mortality (OR: 3.132; 95CI: 1.26-7.745, p=0.013).

Conclusion: This study showed that KMC and respiratory distress were the only studied factors associated with in-hospital mortality of preterm infants at the CHUB.

***Corresponding author:**
Dr. Samson Habimana
Mount Kenya University
Email: habimanasam115@gmail.com
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INTRODUCTION

The neonatal mortality rate is the probability that a child will die before reaching 28 completed days of life, expressed per 1,000 live births [1]. The neonatal mortality rate is a closely watched public health indicator because it reflects the access of children and communities to basic health interventions such as vaccination, medical treatment of infectious diseases, and adequate nutrition [1]. In Rwanda, the neonatal mortality rate is 17.9% deaths per 1,000 live births, slightly higher than the global neonatal mortality of 16·8% deaths per 1000 live births [1]. Rwanda Four-Year summary Report of Maternal and Newborn Deaths, 2012-2015 showed that 61% of neonatal mortalities were from low birthweight (<2500g), and most (63%) occurred in district/ provincial hospitals, with major causes of death being birth asphyxia (39%), prematurity (32%) and sepsis/infection (10%) [2].

Golden hour (first hour of life of newborn) activities, such as antenatal counseling and team briefing, delayed cord cramp, preventing hypothermia, respiratory support, cardiovascular system support,

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early nutritional care, prevention of infection, monitoring/recording as well as communication with the family has been found to decrease the prevalence of hypothermia, hypoglycemia, intraventricular hemorrhage, bronchopulmonary dysplasia, decreasing mortality [3].

Worldwide, all countries have missed the (Millennial Development Goal 5 (MDG5) of reducing child mortality by a third by 2015. To achieve this goal, quality improvement projects have been implemented to improve neonatal morbidity and mortality of preterm babies [4]. In Rwanda, some policies like ushering in community health workers, evidence-based practices, strong political leadership have led to reducing maternal mortality rate but not the neonatal mortality rate of preterm newborns [2]. Therefore, this study evaluated the predictors of in-hospital mortality of preterm newborns at the University Teaching Hospital of Butare (CHUB), Huye, Rwanda, which is one of the high-level healthcare facilities in Rwanda.

METHODS

Research design: This a retrospective follow-up study with quantitative methods targeting all preterm (<37 gestational weeks) newborns admitted at CHUB neonatology department from July 2019 to June 2020.
Data have been collected from patients' files (from an archive of the hospital).
Data were extracted from the newborn personal medical file using a data collection sheet. The sheet was pilot-tested on 40 28-day-old preterm birth newborns to ensure consistency, and the finding was used to make questions clear. A Cronbach alpha has been found to be 0.74.

Data analysis: Data were entered into excel and then imported into SPSS version 24. Descriptive statistics [percentages, mean, and standard deviation (SD)] was computed, and a comparison of survival curves was made (Log-rank test and p-value <0.05 was considered as significant). Measurement of association between predictors of survival and time to death was done using cox-regression analysis.

Ethical considerations: Ethical approval was obtained from CHUB ethical committee. Confidentiality, as well as anonymity, were insured during this study

RESULTS

We collected data of 427 neonates admitted to the CHUB neonatology department. The mean birth weight, maternal age, and duration of labor were 1.58 ± 0.52 kg, 30.7 ± 6.8 years, and 3.16 ± 6.59 hours, respectively. The majority (26.2%) were from the Huye district (where the hospital is built), followed by Gisagara (24.6%). Most participants had attended antenatal care services (ANC) (95.1%) and had no bad obstetrical history (83.1%). The most common mode of delivery was spontaneous vaginal delivery (SVD) (51.5%) at the hospital (93.1%). Almost half (51.1%) of newborns were female. Table 1 and 2 shows further details of the participants' characteristics.

Table 1: *Maternal and neonatal characteristics of study participants*

Variables	Mean ± SD
Maternal age (Years)	30.71 ± 6.827
Weight at birth (Kg)	1.58 ± 0.52
Labor (Hours)	3.16 ± 6.59

SD: Standard deviation

As shown in Table 3, KMC and respiratory distress were significantly associated with in-hospital mortality. KMC was associated with a significant decrease in mortality (OR = 0.63; 95CI = 0.028-0.140) (p<0.001), while respiratory distress was associated with three times increased risks of mortality (OR = 3.132; 95CI = 1.26-7.745) (p=0.013).
This study showed that gestational age (GA) influenced survival of preterm newborns. The preterm newborns with > 32 weeks GA are more likely to survive than those with < 37 week GA (Figure 1).

DISCUSSION

The mortality of premature babies is a major public health concern, highlighting the need to identify the factors that contribute to the infant mortality of these populations in order to effectively direct local intervention programs. Therefore, this study evaluated the predictors of in-hospital mortality of preterm newborns at the CHUB.

Table 2: *Socio-demographic characteristics of study participants*

Variable		Number (%)
Residence		
	Huye	112 (26.2)
	Gisagara	105 (24.6)
	Nyanza	54 (12.6)
	Ruhango	51 (11.9)
	Nyamagabe	39 (9.1)
	Nyaruguru	26 ((6.1)
	Muhanga	8 (1.9)
	Karongi	12 (2.8)
	Rusizi	11 (2.6)
	Nyamasheke	2 (0.5)
	Nyarugenge	1 (0.2)
	Kamonyi	4 (0.9)
Attendance of at least one ANC		
	No	5 (1,2)
	Yes	406 (95.1)
Previous bad obstetrical history		
	No	355 (83.1)
	Yes	62(14.5)
Mode of delivery		
	SVD	220 (51.5)
	Emergency cesarean section	140 (32.8)
	Elective cesarean section	50 (11.7)
Place of birth		
	Hospital	400 (93.7)
	Health center	7 (1.6)
Sex of neonate		
	Female	218 (51.1)
	Male	207 (48.9)
Neonate cried immediately at birth		
	No	83 (19.4)
	Yes	340 (79.4)
Bag and mask resuscitation		
	No	352 (82.1)
	Yes	71 (16.6)
Perinatal asphyxia		
	No	404 (94,6)
	Yes	21 (4.9)
Respiratory distress		
	No	175 (41.0)
	Yes	251 (58.8)
Hypoglycemia on admission		
	No	392 91.8)
	Yes	34 (8.0)

Findings showed that KMC associated with up to 40% decrease in mortality and respiratory distress tripled the risk of mortality among premature babies. This aligns with previous studies indicating that KMC decreased mortality in premature and low birth weight babies. A systematic literature review comparing KMC and conventional neonatal care showed that KMC leads to a 40% reduction in the mortality of infants [5]. This review also showed that KMC reduces hypothermia, nosocomial infection, and hospital length of stay, benefiting the infant in growth breastfeeding and enhancing

Table 3: *Factors associated with in-hospital mortality*

			95.0% CI	
Variables	***p*-value**	**OR**	**Lower**	**Upper**
Newborn heated with radiant	0.089	1.468	0.943	2.286
Newborn received KMC	0.000*	0.63	0.028	0.140
Neonate received phototherapy	0.609	0.798	0.337	1.891
Newborn diagnosed with sepsis	0.287	0.762	0.462	1.257
Jaundice	0.563	1.265	0.57	2.808
Neonatal hypoglycemia on admission	0.349	1.389	0.698	2.762
Neonatal hypothermia on admission	0.104	1.494	0.921	2.426
Newborn diagnosed with respiratory distress	0.013*	3.132	1.26	7.745
Perinatal asphyxia	0.651	1.201	0.544	2.651
Bag and mask resuscitation	0.587	1.359	0.45	4.104
Newborn cries immediately at birth	0.722	1.211	0.422	3.472

*OR: Odd ratio; CI: Confidence interval; KMC: Kangaloo mother care; * Statistically significant*

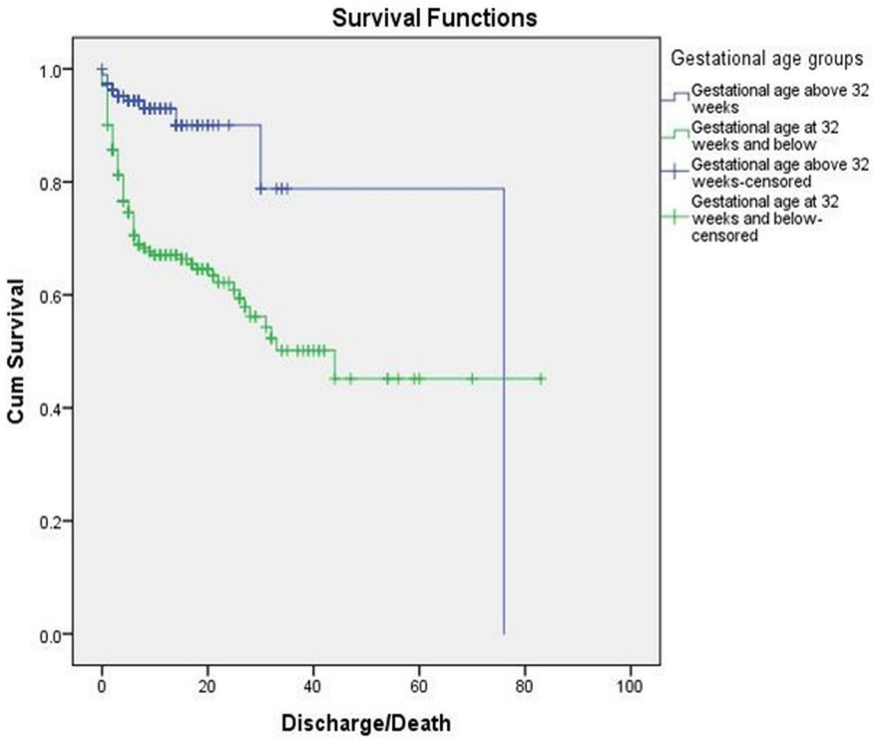

Figure 1: *Survival analysis between extreme and very preterm and preterm newborns*

mother-infant attachment [5]. KMC is a type of newborn care that involves skin-to-skin contact with the mother or another caregiver [6]. A study in Uganda found that KMC reduced mortality in preterm infants by 6 times [7]. One of the well-known risk factors is distress syndrome and our study confirmed it [8,9]. Our findings are also the same as found by Cupen, Barran and Singh in Trinidad and Tobago, where the length of time on a ventilator machine has been found to be associated with time to death among preterm neonates [10]. This may not be due to the harmful effects of ventilator machines or ventilator techniques but rather to the fact that preterm neonates requiring ventilation are the ones having respiratory problems, including respiratory distress syndrome, and they are known to be associated with mortality among preterm neonates. Apart from respiratory distress, there are other factors identified by previous research studies. A Ugandan study found that preterm infants born to HIV-positive mothers had 5 times higher mortality risks, and newborns not exclusively breastfed had 4 times increased mortality risks [7].

A study conducted in Iran by Haghighi et al. [11] found that gestational age is associated with mortality, and extremely preterm neonates (those born at 28 weeks and below) were less likely to survive than other groups aligning with our findings that < 32 weeks GA preterm neonates were less likely to survive compared to > 32 weeks GA preterm neonates. Similar findings were reported in other previous studies [12]. This may be due to insufficient surfactant production among < 32 weeks GA preterm newborns [13]. Surfactant is a protein produced by lung cells starting 24-28 weeks GA of pregnancy, and by 35 week GA, most neonates have an adequate amount [14]. The lack of surfactant is also associated with an increased risk of respiratory distress syndrome, which might explain higher mortality rates among newborns with lower GA [13,15].

This study was limited by its design which has limitations in determining causal-effect relationships as it is cross-sectional. This study was also conducted in one hospital, which might affect the generalizability of its findings. Finally, we have not exhaustively studied all factors determining the in-hospital mortality of newborns, and we recommend more extensive multi-center studies to deeply explore this area.

CONCLUSION

In this study, predictors of death among preterm neonates included respiratory distress syndrome. Meanwhile, receiving KMC (Kangaroo mother care) has been to be protective (preventive predictor) for time to death. This highlights that measures and strategies are needed to prevent mortality for preterm babies by tackling the factors identified. We recommend the CHUB authorities, the Rwanda Ministry of Health and partners take measures such as promoting maternal health, increasing access to quality care during pregnancy and childbirth, improving neonatal care, and promoting and encouraging KMC and family education. There should be further studies extending beyond one institution in order to better understand and fight against neonatal mortality in Rwanda.

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