MUST Journal of Research and Development (MJRD) Volume 6 Issue 2, June 2025
e ISSN 2683-6467 & p ISSN 2683-6475

Neonatal Complications and Mortality Risk between Preterm and Term Babies at Meta Maternity Hospital, Tanzania

Bernadether Terentius Rugumisa
Mbeya University of Science and Technology, P. O Box 131, Mbeya, Tanzania
DOI: https://doi.org/10.62277/mjrd2025v6i20010

ARTICLE INFORMATION

Article History

Received: 14th February 2025
Revised: 22nd May 2025
Accepted: 09th June 2025
Published: 30th June 2025

Keywords

Neonates
Preterm birth
Mortality
Health outcomes
Tanzania

ABSTRACT

Neonatal mortality remains a public health concern globally and in low-resource settings, with preterm birth significantly contributing to adverse outcomes. The aim of this study was to compare the risk of common adverse health outcomes between preterm and term neonates and to examine specific complications associated with neonatal mortality risk at Meta Maternity Hospital in Tanzania. 452 newborns admitted to the neonatal unit were involved, grouped as preterm and term. Health outcomes were tracked from the time of birth to the time of release from the hospital, death, or end of the neonatal period. Appropriate statistical analyses were conducted, including non-parametric tests, chi-square, logistic regression, and correlation analysis, with significance set at $p < 0.05$. Preterm neonates had significantly lower birth weight (< 2.5 kg) and Apgar scores at 1 and 5 minutes compared to term neonates ($p < 0.001$). They had 17.49- and 12.14-times greater odds of developing apnoea and respiratory distress syndrome, respectively, and were 12.82 times more likely to die. Apnoea (OR = 0.56, 95% CI: 0.31-0.95) and respiratory distress syndrome (OR = 0.11, 95% CI: 0.05-0.24) were the strongest predictors of mortality ($p < 0.05$). While jaundice was highly prevalent among both groups, it was not significantly associated with mortality, unlike other complications. Preterm birth significantly increases the risk of adverse neonatal outcomes and mortality. To improve neonatal survival at Meta Maternity Hospital, timely respiratory support and continuous monitoring of neonates with respiratory distress syndrome and apnoea should be prioritised. Routine screening and early treatment of jaundice should also be ensured for all newborns.

*Corresponding author's e-mail address: kokurugumisa@gmail.com (Rugumisa, B.T)

1.0 Introduction

Sub-Saharan Africa has the highest neonatal mortality rate, contributing to 43% of infant mortality worldwide (Moges *et al.,* 2024). Many Sub-Saharan African countries, including Tanzania, have made substantial milestones in attaining the Sustainable Developmental Goal 4 (to end preventable deaths of newborns and children under five years of age). In the past two decades, Tanzania has reduced the child mortality rate by nearly half, largely due to interventions like the malaria and malnutrition prevention program (Mwanga *et al.,* 2024; Smithson *et al.,* 2015). These interventions mainly target the causes of death post the neonatal period, leading to a significant decline in child mortality beyond the neonatal age, while the burden of neonatal deaths remains high (Ogbo *et al.,* 2019).

One of the major setbacks to ending child mortality in Tanzania is the alarmingly high rate of neonatal mortality, which is largely contributed to by prematurity and the associated complications (Chengo *et al.,* 2019; Ogbo *et al.,* 2019). Prematurity is the leading cause of mortality in children, accounting for one-third of all neonatal deaths in the country (Mrisho *et al.,* 2012). Although all neonates are at risk, preterm neonates have an even greater risk of health complications, including mortality. Putting attention on this vulnerable group will reduce a significant proportion of neonate and under-five mortality in general.

It has been the goal of many countries to reduce the rate of preterm birth. Despite intensive efforts over the years, there is only a negligible decline in the global preterm birth rates (Walani, 2020). A number of multifaceted risk factors are known, but what exactly causes preterm birth is still paradoxical. Several biomarkers for prediction of women at risk of preterm birth have been reported, but prevention of the incident has yielded very little success (Oskovi and Ozgu-Erdinc, 2018). Some known causes of preterm birth include indicated preterm deliveries, which are often medically necessary and unavoidable for women experiencing life-threatening or compromising health conditions. Indicated preterm deliveries contribute to 30–35% of all preterm births (Besser *et al.,* 2019).

In addition, the rising prevalence of non-communicable diseases (NCDs) such as hypertension, diabetes, and obesity among women of reproductive age has been identified as a significant risk factor for preterm birth (Hussein, 2017; Poon *et al.,* 2018). This concern is particularly pressing in low-income settings, especially in Africa, where preterm birth rates are already high and the burden of NCDs is rapidly increasing. Overall, preventing and reducing preterm births remains a complex public health challenge due to its multifactorial causes, ranging from biological to socioeconomic and environmental determinants. While addressing these root causes is critical, equal attention must be given to ensuring that babies born preterm continue to receive the care and interventions necessary for their survival and long-term health. A balanced approach that combines prevention with high-quality neonatal care is essential for improving outcomes for both mothers and newborns.

Neonatal health complications are well-documented and continue to pose significant challenges to healthcare systems, particularly in resource-limited settings such as Tanzania (Chengo *et al.,* 2019). Managing these complications often places a considerable strain on the health care sector. Fortunately, there are also low-cost interventions such as kangaroo care that have proven effective in bringing positive newborns' outcomes. Promoting positive health outcomes for newborns requires a multifaceted approach tailored to the readiness of health facilities, the level of care available, and the type of interventions provided. The aim of this study was to examine a set of common adverse health outcomes among preterm and term neonates at the Meta Maternity Hospital (MMH), compare the risk between the two groups, and determine the specific complications associated with mortality in this population. This assessment reflects the strength of healthcare at the hospital and identifies areas for improvement to enhance outcomes and

survival for newborns, particularly among preterm neonates.

2.0 Materials and Methods

2.1 Study Site

This study was conducted at MMH, a maternity unit of Mbeya Zonal Referral Hospital, located in Mbeya City Council. MMH is the only referral and key healthcare facility specialised in providing maternal and neonatal care services within the Southern Highlands Zone of Tanzania (Kyambille *et al.,* 2023). The hospital receives patients from surrounding districts and neighbouring regions, including referral cases requiring advanced medical attention. The hospital offers a range of reproductive health services, including antenatal, labour, delivery, and immediate postpartum care services. After delivery, newborns are typically admitted to the postnatal ward for monitoring and care until being released from the hospital. Moreover, the hospital has a Neonatal Intensive Care Unit (NICU) that provides care for premature and critically ill newborns. MMH accommodates around 500 pregnant women each month, with an average of 20 deliveries per day.

2.2 Study Design

This study was a hospital-based prospective cohort study conducted between March and May 2022. The study involved 452 newborns, divided into two groups, namely preterm babies (born at < 37 weeks gestation) and term babies (born at ≥ 37 weeks gestation). An equal number (n = 226) of newborns were recruited in each group. Data including gestational age at the time of birth, sex, birth weight, Apgar score, and health complications were collected starting from birth and continued until release from the hospital, death, or the end of the neonatal period (the first 28 days after birth). Gestational age was determined using the first day of the last menstrual period.

2.3 Inclusion and Exclusion Criteria

All live babies delivered at MMH during the study period were eligible for the study. The babies with missing data according to the pre-structured chart and whose parents did not provide written informed consent were excluded from the study. Those who left the hospital before being formally released from the hospital were also excluded. Another exclusion was for babies with congenital anomalies, such as structural ones. Babies with congenital anomalies were excluded because they are often associated with adverse outcomes that could confound the study findings.

2.4 Data Collection

Newborns were enrolled in the delivery room and then followed up to the admission wards (postnatal ward or NICU) for observation of adverse health outcomes. Details including gestational age, sex, Apgar score, birth weight, and admission ward were recorded immediately after birth. The babies were further followed, and health complications based on the pre-identified adverse neonatal outcomes were recorded in a pre-structured chart. The health outcomes were recorded as binary categorical variables. Presence of an outcome was recorded as 1 and absence as 0. Data was collected by a trained nurse from the neonatal ward, from the time of birth and continued until release from the hospital, death, or the end of the neonatal period. Generally, the minimum age for the observation of health outcomes was one day old, and the maximum age was 28 days old.

2.5 Data Analysis

The data was summarised and analysed using Microsoft Excel 2021 MSO (Version 2504, Build 16.0.18730.20186), 64-bit. Apart from the newborns' classification by gestational age, the babies were further categorised by birth weight, Apgar score, and survival status. By birth weight, the newborns were classified as either low birth weight (LBW) or normal birth weight (NBW). Babies born with less than 2500 grams were considered to have LBW, and those born with at least 2500 grams were regarded to have NBW. For Apgar scores, 7-10 was considered normal, 4-6 was moderately abnormal, and 0-3 was a critical condition requiring medical attention. The Shapiro-Wilk test was used to check for normality of the data at $p \geq 0.05$. Since the data was not normally

distributed, the Mann-Whitney U test (non-parametric alternative) was used to compare medians for birth weights, Apgar scores, and other continuous variables between the study groups.

Variables with binary outcomes were analysed by determining their proportions in either the preterm or term groups. The chi-square test was then used to compare the proportions between the groups to see if there was a significant link between the preterm and term groups, as well as other categories like sex (male or female), birth weight (low birth weight or normal birth weight), and Apgar score (normal, moderately abnormal, or critical). The chi-square test was also used for the association of health outcomes with the chance of a newborn's survival or death. To determine the strength of association between binary health complications between groups, logistic regression analysis for estimation of odds of occurrence was performed. A correlation analysis was conducted to assess the linear relationships between continuous variables (gestational age, birth weight, Apgar score, and number of days in the hospital) and statistically significant binary health outcomes.

2.6 Ethical Considerations

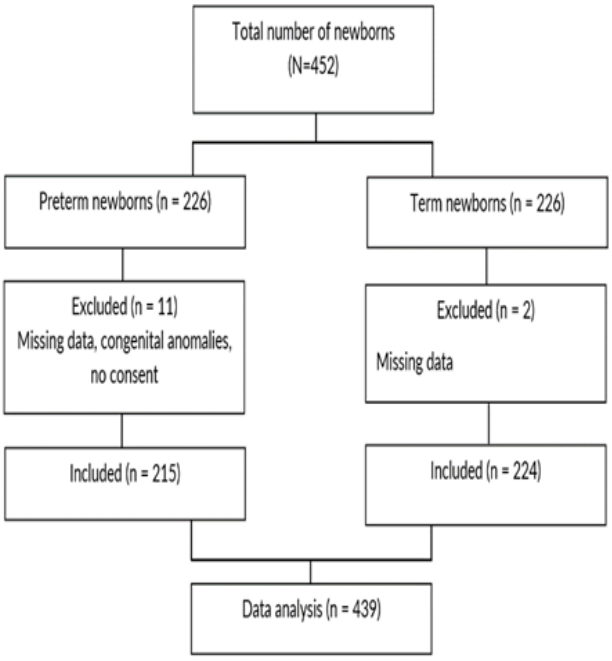
This study was approved by the Mbeya Zonal Referral Hospital with reference SZEC-2439/R.A/V.1/29. Additionally, written consent was sought from the mothers of all newborns before enrolling in the study. To maintain confidentiality, unique identifiers instead of names or hospital IDs were used.

3.0 Results

A total of 452 newborns (preterm=226 and term=226) were assessed. After data cleaning, only 215 preterm and 224 term newborns qualified for further analysis. Other babies were eliminated from the study because they did not meet some of the inclusion criteria (Fig. 1).

Figure 1

Flowchart Showing Participants' Eligibility, Inclusion, and Exclusion Process



Sex was evenly distributed between preterm and term babies. The proportion of male and female babies showed no statistically significant difference between the preterm and term groups.

The median birth weights for babies born at term and preterm were 3 kg and 1.7 kg, respectively. There was a significant difference between the groups ($p < 0.001$), indicating a higher likelihood of preterm babies having low birth weight compared to term babies. The proportion of babies with LBW was also significantly different (Table 1). More preterm babies tend to have LBW than term babies.

The distribution of Apgar scores at 1 and 5 minutes demonstrated a statistically significant difference between preterm and term babies ($p < 0.001$). Preterm babies were more likely to have moderately abnormal Apgar scores at both 1 and 5 minutes compared to term babies (Table 1). By 5 minutes most babies in both groups had improved scores, reducing the difference between the groups. However, there were still more preterm babies with moderately abnormal scores compared to term babies at the 5-minute Apgar score.

Table 1
Comparison of Baseline Characteristics between Preterm and Term Newborns

Variable		Term (%)	Preterm (%)	p-value
Sex	Male	45.2	41.7	0.51
	Female	54.8	58.3	
Birth weight	≥2500	80.17	14.81	2.76e-42
	<2500	19.83	85.19	
Apgar score at 1 minute	7-10	91.48	74.54	0.0000015
	4-6	5.83	23.15	
	0-3	2.69	2.31	
Apgar score at 5 minutes	7-10	97.31	90.74	0.0067
	4-6	2.69	9.26	
	0-3	-	-	

In determining differences in the proportion of babies experiencing specific health complications, there were statistically significant differences in the proportions of babies with apnoea, RDS, and death between the preterm and term groups (Table 2). The risk of apnoea (OR = 17.49, 95% CI: 9.46-32.36), RDS (OR = 12.14, 95% CI: 7.63-19.30), and death (OR = 12.82, 95% CI: 5.72-28.75) was evidently higher in preterm than term babies.

Table 2
The Proportions of Term and Preterm Babies for the Assessed Health Outcomes

Variable	Term (n =224)		Preterm (n = 215)		p-value
	N	%	N	%	
Apnea	5	2.2	59	27.5	<0.001
RDS	16	7.1	103	48.1	<0.001
IVH	3	1.3	17	7.9	0.237
BPD	2	0.9	16	7.4	0.076
PDA	11	4.9	34	15.8	0.105
NE	2	0.9	21	9.8	0.601
Jaundice	127	56.7	136	63.3	0.514
Pneumonia	7	3.1	19	8.8	0.592
Anemia	17	7.6	38	17.7	0.365
Sepsis	19	8.5	48	22.3	0.287
Death	2	0.9	22	10.2	0.002

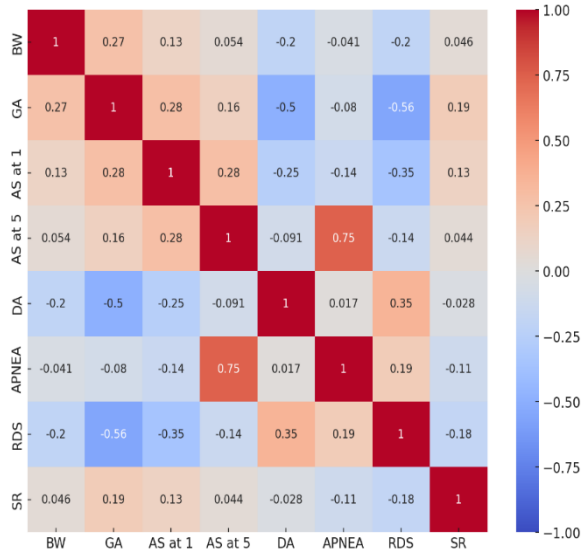
Key:*RDS = Respiratory Distress Syndrome, IVH = Intraventricular Hemorrhage, BPD = Bronchopulmonary Dysplasia, PDA = Patent Ductus Arteriosus,NE = Necrotizing Enterocolitis*

Correlation analysis demonstrated the relationship between different continuous variables and the health complications that were identified as significant risks in Table 2 (apnoea, RDS, and death) (Figure 2). The Apgar score at 5 minutes strongly correlated with apnoea (0.75). A weak positive correlation was observed between gestational age and birth weight (0.27), days admitted and RDS (0.35), birth weight and Apgar score at 1 minute (0.13), gestational age and Apgar score at 1 minute (0.28), and between Apgar scores (0.28).

The study also found moderate and weak negative correlations among variables. Moderate negative correlations were observed between gestational age and days admitted (-0.50), and Apgar score at 1 minute and RDS (-0.35). Weak negative correlations were observed between survival rate and apnoea (-0.11), survival rate and RDS (-0.18), and RDS and birth weight (-0.20).

When the proportions of all health complications were compared between babies who survived and those who died, the Chi-square test revealed, with the exception of jaundice, all other complications were strongly associated with the risk of mortality ($p < 0.05$). There was no statistically significant difference in the risk of jaundice between babies that survived and those who died ($p = 0.706$).

Figure 2
Correlation Heat Map for Continuous Variables and Significant Health Complications



Key: *BW = Birth Weight, GA = Gestational Age, AS = Apgar Score, DA = Number of Days Admitted, RDS = Respiratory Distress Syndrome, and SR = Survival Rate*

In the assessment of mortality risk, most health complications were associated with lower odds of survival; only apnoea (OR = 0.56, CI: 0.31-0.95, p-value < 0.05) and RDS (OR = 0.11, CI: 0.05-0.24, p < 0.001) were the strongest predictors of mortality. Further, NE (OR = 0.13, CI: 0.01-1.63, p = 0.115) and sepsis (OR = 0.54, CI: 0.20-1.41, p = 0.207) were notably associated with decreased survival rate. However, based on the binary logistic regression model tested, their effect was not statistically significant.

4.0 Discussion

Health complications that also account for neonatal mortality have been documented for decades as a significant public health concern across the world (Rosa-Mangeret et al., 2022). The neonatal period is critical because a newborn's ability to adapt to life outside the womb greatly impacts survival and long-term health outcomes. Health complications during the neonatal period may lead to detrimental impacts, including death, lifelong health effects, or an increased risk of more health complications later in life (Asztalos *et al.,* 2017; Sokolovskaya *et al.,* 2016). The risk of neonatal complications is disproportionate, attributable to various factors, including the gestational age at which a baby is born and the quality of health care it receives after birth (Chou *et al.,* 2019). This study compared the health complications in preterm and term neonates born at the MMH, reflecting the effect of the gestational age at the time of birth and the quality of neonatal care offered at MMH.

The study observed that sex was not a significant determinant of whether a baby may be born preterm or at term. Both male and female neonates had equal probability for any of the birth outcomes. Although some findings have reported male excess among preterm babies, some found this not to be the case in all populations (Challis *et al.,* 2013; Teoh *et al.,* 2018; Yu *et al.,* 2020; Zeitlin et al., 2002). In the analysis conducted in 24 different populations to assess the association between foetal sex and preterm birth risk, no association was found in the Black population, which is similar to the current population (Zeitlin et al., 2002). In addition, like previous studies, this study validates the higher probability of getting preterm babies with low birth weight than their term counterparts (Bilgin *et al.,* 2018; Ncube *et al.*, 2016; Pusdekar *et al.,* 2020). Given the well-established association between sex and birth weight and gestational age, the current study further explores how different factors correlated with each other and with the risk of health complications.

The risk of experiencing health complications associated with the respiratory system was higherin preterm than term babies. Preterm birth increased the risk of apnoea by 17-fold and that of RDS by 12-fold. Research shows that, as gestational age decreases, the incidence of apnoea increases, with an almost 100% incidence rate in babies born earlier than 29 weeks of gestation (Fairchild *et al.*, 2016). One well-established reason for respiratory system complications in newborns is the general immaturity of body organs. For instance, RDS is principally caused by immaturity

of lung structure and function, a common occurrence in preterm babies, which prevents surfactant from reaching the lung surface (Jobe, 1991). Unlike RDS, apnoea of immaturity is primarily caused by immaturity of the breath control system rather than lung function (Mathew, 2011). Nevertheless, both complications can be regarded as developmental complications that decrease with increasing age (Trachsel *et al.,* 2022). Therefore, it is important to strengthen the respiratory support system so as to sustain the life of preterm babies until the age that they have a better chance of surviving on their own.

The risk of mortality was significantly higher among preterm babies, with an increasing odd of 12.82. This finding underscores the vulnerability of preterm babies, whose underdeveloped physiological systems make them more susceptible to life-threatening complications (Blencowe *et al.,* 2013; Liu *et al.,* 2016). While only 1% of babies from the term group did not survive, more than 10% of babies from the preterm group died. Generally, the mortality rate observed is similar to the rate of 11.6% pre-reported in a study conducted in Ethiopia (Eshete and Abiy, 2020). The observed difference in mortality rate was further elaborated by the fact that preterm babies had 13 times the risk. Other studies have reported more or less similar risks of preterm mortality that make a range of 9 to 16 folds (De Araújo *et al.,* 2012; Kc *et al.,* 2015). The neonatal mortality rate among preterm babies is attributable to their high susceptibility to health complications resulting from physiological and pathological malfunctions and infection (Lehtonen *et al.,* 2017; Oza *et al.,* 2015; Ray *et al.,* 2017).

In the present study RDS, apnoea, and death were among the main health risks in preterm babies, and the first two complications were the main cause of the latter. The findings agree with previous studies that RDS and respiratory complications in general are the most common cause of mortality among neonates, and preterm babies are more at risk (Bulut *et al*., 2016; Habibelahi *et al.,* 2024; Juul *et al*., 2022). In this particular case, RDS and apnoea decreased survival rate by 89% and 54%, respectively. Other health complications assessed did not pass as significant causes of neonatal mortality. Nonetheless, a number of studies have established that complications like IVH, NE, BPD, PDA, and sepsis also increase the neonatal mortality rate among preterm babies (Oza *et al.,* 2015; Schindler *et al.,* 2017; Sellmer *et al.,* 2013), suggesting that the insignificance in the current data may be due to sample size or diagnostic capacity rather than a true lack of effect. Therefore, despite failure to establish causal association for these complications, they should continue to receive medical attention for the purpose of ensuring every single baby is granted a chance at life.

The present study shows that jaundice was the only complication that was highly prevalent in babies that survived and those who died. The incidence rate was around 60% in both groups. Previous studies have also reported a rate of 60 to 80% for physiological jaundice in neonates (Huang *et al.,* 2023; Rathore *et al.,* 2020). Jaundice is a common health complication in all newborns because of their immature liver function and the high turnover of foetal red blood cells after birth (Ayalew *et al.,* 2024). Moreover, the high mortality rate in both groups suggests jaundice as a significant cause of death during the neonatal period, irrespective of gestational age. Similarly, jaundice has been reported as one of the most common causes of death during the first week of the neonatal period (Eshete and Abiy, 2020).

Given that, in this study, jaundice was the most common complication affecting both term and preterm babies, calling for urgent and practical actions. Future interventions should focus on early screening and timely management of neonatal jaundice in all newborns, regardless of gestational age. Strengthening protocols for routine bilirubin checks, especially within the first 24 to 48 hours after birth, and ensuring availability of phototherapy units in all maternity facilities can help reduce the risk of severe jaundice and its long-term consequences (Olusanya *et al.,* 2018). It is also critical to provide parents and carers with awareness and education about signs of jaundice to support earlier detection and prompt care-seeking behaviour.

This study has demonstrated the association between birth weight, risk of RDS, and low Apgar score at 1 minute. Similarly, published works agree with the present data that the risk of RDS tends to increase as birth weight decreases both in preterm and term babies (Aslamzai et al., 2023; Condò *et al*., 2017; Liu *et al.,* 2014). It is not uncommon that preterm babies exerted low Apgar scores at both 1 and 5 minutes. Remarkably, the scores improved within 5 minutes, although they were still lower compared to term babies. Improvement of Apgar scores within 5 minutes reflects either the ability of healthcare providers to effectively monitor and resuscitate newborns or the availability of essential newborn care equipment at MMH (Mukhtar-Yola *et al.,* 2018; Razaz *et al.,* 2019). Moreover, similar to a previous study on clinical causes of neonatal mortality, RDS shone as a strong predictor of mortality (Habibelahi *et al.,* 2024). The critical importance of RDS as a health complication in this study argues for immediate actions to equip the NICU at MMH with necessary technical support to ensure the risk of neonatal mortality is minimised.

It was further noted that improvement in scores at 5 minutes is associated with reduced danger of suffering from apnoea, suggesting a preventable health complication. If a baby receives appropriate and good medical attention immediately after birth, good health outcomes are guaranteed. Therefore, by equipping the facility with more resources and neonatal staff training on resuscitation and respiratory support, more neonates at MMH could be rescued from the risk of apnoea and the associated mortality. Moreover, the Apgar score improved as the gestational age for which the baby was born increased. This suggests that, for a baby to have more desirable health outcomes, the length of time it stays in the womb matters. More investment is needed in interventions like progesterone therapy, nutritional supplements, and antimicrobial treatments that are known to reduce the risk of predictable preterm births (Smith *et al.,* 2009).

An analysis of birth weight revealed that increasing gestational age at the time of birth correlated with a higher birth weight and fewer days of hospitalisation. Studies confirm that gestational age (> 37 weeks) and birth weight (> 2500 g) are associated with good neonatal outcomes because after 37 weeks gestation, a normal baby is considered matured and ready to survive the outside world with little or no health complications (Kohn *et al.,* 2000). Furthermore, babies born at lower gestational age and birth weight are likely to have health complications that may require extended medical support (Kohn *et al.,* 2000). Therefore, relevant education should be given to pregnant women and health practitioners to ensure every pregnancy is a healthy journey that leads to desirable birth and neonatal outcomes, both warranting neonatal survival.

5.0 Conclusion

This study reveals that preterm neonates at MMH face significantly higher risks of complication, especially RDS and apnoea, compared to term neonates. This confirmed prematurity as a major independent risk factor for adverse neonatal outcomes. The findings underscore the critical importance of avoiding non-medically indicated early deliveries. When no maternal or foetal risks are present, efforts should prioritise allowing foetuses to reach full term to reduce preventable neonatal morbidity.

For unavoidable preterm births, particularly spontaneous or medically indicated ones, NICUs must be adequately prepared. Investments in respiratory support systems, timely clinical monitoring, skilled staff, and essential neonatal medications are essential to improving outcomes for this vulnerable group. Special attention should also be given to high-prevalence conditions like jaundice, which affects both term and preterm neonates, warranting routine bilirubin screening and early intervention protocols.

While this study offers valuable insights into neonatal complications in the Southern Highlands zone of Tanzania, several limitations should be noted. The logistic regression model did not adjust for potential confounding variables such as maternal health status or delivery conditions, which may have influenced the results. Additionally, the study was conducted in a single

referral hospital. Although MMH is the only specialised mother-and-child facility in the region, variations in resources and practices at other hospitals may limit the generalisability of these findings.

6.0 Recommendations

Future research should expand to include multiple facilities across the region and incorporate maternal and prenatal risk factors. This would allow for more comprehensive understanding of neonatal health challenges and support targeted strategies to improve neonatal survival rates nationwide. Additionally, given the higher burden and fatality of complications such as RDS and apnoea among preterm neonates, targeted strategies for early identification and proactive management of this high-risk group are essential. Finally, continuous training for healthcare providers in recognising early signs of complications and in emergency response can be critical in improving survival rates and reducing the burden of complications among neonates.

7.0 Acknowledgments

I am grateful to Ms. Florance Maissa for assistance in data collection. I am also extending my appreciation to Dr. Gaspary Mwanyika and Ms. Felister Magesa for their thoughtful reviews.

8.0 Declaration of Conflicting Interests

The author declares no conflict of interest.

9.0 References

Aslamzai, M., Froogh, B.A., Mukhlis, A.H., Faizi, O.A., Sajid, S.A. and Hakimi, Z. (2023), "Factors associated with respiratory distress syndrome in preterm neonates admitted to a tertiary hospital in Kabul city: A retrospective cross-sectional study", *Global Pediatrics*, Elsevier BV, Vol. 3, p. 100035.

Asztalos, E. V., Church, P.T., Riley, P., Fajardo, C. and Shah, P.S. (2017), "Neonatal Factors Associated with a Good Neurodevelopmental Outcome in Very Preterm Infants", American Journal of Perinatology, *Thieme Medical Publishers, Inc.,* Vol. 34 No. 4, pp. 388–396.

Ayalew, T., Molla, A., Kefale, B., Alene, T.D., Abebe, G.K., Ngusie, H.S. and Zemariam, A.B. (2024), "Factors associated with neonatal jaundice among neonates admitted at referral hospitals in northeast Ethiopia: a facility-based unmatched case-control study", *BMC Pregnancy and Childbirth, BioMed Central Ltd*, Vol. 24 No. 1.

Besser, L., Sabag-Shaviv, L., Yitshak-Sade, M., Mastrolia, S.A., Landau, D., Beer-Weisel, R., Klaitman, V., *et al.* (2019), "Medically indicated late preterm delivery and its impact on perinatal morbidity and mortality: a retrospective population-based cohort study", *Journal of Maternal-Fetal and Neonatal Medicine, Taylor and Francis Ltd*, Vol. 32 No. 19, pp. 3278–3287.

Bilgin, A., Mendonca, M., Wolke, D. and nat hc, rer. (2018), "Preterm Birth/Low Birth Weight and Markers Reflective of Wealth in Adulthood: A Meta-analysis", *Pediatrics*, Vol. 142 No. 1.

Bulut, C., Gürsoy, T. and Ovalı, F. (2016), "Short-term outcomes and mortality of late preterm infants", Balkan Medical Journal, AVES Ibrahim Kara, Vol. 33 No. 2, pp. 198–203.

Challis, J., Newnham, J., Petraglia, F., Yeganegi, M. and Bocking, A. (2013), "Fetal sex and preterm birth", *Placenta*, Vol. 34, pp. 95–99.

Chengo, R., Mowo, F., Tarimo, C.S. and Mahande, M.J. (2019), "Mortality rate and associated factors among preterm babies born in Moshi, north – Tanzania: A prospective cohort study", 4 August.

Chou, V.B., Walker, N. and Kanyangarara, M. (2019), "Estimating the global impact of poor quality of care on maternal and neonatal outcomes in 81 low- And middle-income countries: A modeling study", *PLoS Medicine*, Public Library of Science, Vol. 16 No. 12.

Condò, V., Cipriani, S., Colnaghi, M., Bellù, R., Zanini, R., Bulfoni, C., Parazzini, F., *et al.*

(2017), "Neonatal respiratory distress syndrome: are risk factors the same in preterm and term infants?", *Journal of Maternal-Fetal and Neonatal Medicine*, Taylor and Francis Ltd, Vol. 30 No. 11, pp. 1267–1272.

De Araújo, B.F., Zatti, H., Madi, J.M., Coelho, M.B., Olmi, F.B. and Canabarro, C.T. (2012), "Analysis of neonatal morbidity and mortality in late-preterm newborn infants", *Jornal de Pediatria*, Vol. 88 No. 3, pp. 259–266.

Eshete, A. and Abiy, S. (2020), "When Do Newborns Die? Timing and Cause-Specific Neonatal Death in Neonatal Intensive Care Unit at Referral Hospital in Gedeo Zone: A Prospective Cohort Study", *International Journal of Pediatrics (United Kingdom)*, Hindawi Limited, Vol. 2020.

Fairchild, K., Mohr, M., Paget-Brown, A., Tabacaru, C., Lake, D., Delos, J., Moorman, J.R., *et al.* (2016), "Clinical associations of immature breathing in preterm infants: Part 1-central apnea", Pediatric Research, *Nature Publishing Group*, Vol. 80 No. 1, pp. 21–27.

Habibelahi, A., Heidarzadeh, M., Abdollahi, L., Taheri, M., Ghaffari-Fam, S., Vakilian, R. and Daemi, A. (2024), "Clinical cause of neonatal mortality in Iran: analysis of the national Iranian Maternal and Neonatal network", *BMJ Paediatrics Open, BMJ Publishing Group*, Vol. 8 No. 1.

Huang, H., Huang, J., Huang, W., Huang, N. and Duan, M. (2023), "Breast milk jaundice affects breastfeeding: From the perspective of intestinal flora and SCFAs-GPR41/43", Frontiers in Nutrition, Frontiers Media S.A.

Hussein, J. (2017), "Non-communicable diseases during pregnancy in low- and middle-income countries", Obstetric Medicine, SAGE Publications Inc., Vol. 10 No. 1, pp. 26–29.

Jobe, A.H. (1991), "Pathogenesis of respiratory failure in the preterm infant", *Annals of Medicine, Informa Healthcare,* Vol. 23 No. 6, pp. 687–691.

Juul, S.E., Wood, T.R., Comstock, B.A., Perez, K., Gogcu, S., Puia-Dumitrescu, M., Berkelhamer, S*., et al.* (2022), "Deaths in a Modern Cohort of Extremely Preterm Infants from the Preterm Erythropoietin Neuroprotection Trial", JAMA Network Open, American Medical Association.

Kc, A., Wrammert, J., Nelin, V., Ewald, U., Clark, R. and Målqvist, M. (2015), "Level of mortality risk for babies born preterm or with a small weight for gestation in a tertiary hospital of Nepal", *BMC Public Health, BioMed Central Ltd.*, Vol. 15 No. 1.

Kohn, M.A., Vosti, C.L., Lezotte, D. and Jones, R.H. (2000), "Optimal Gestational Age and Birth-weight Cutoffs to Predict Neonatal Morbidity", *Medical Decision Making,* Vol. 20, pp. 369–376.

Kyambille, G.G., Mvuma, A., Machuve, D., Rugumisa, B. and Mang'ara, R. (2023), "Women's Barriers to Access Maternal Healthcare Services in Southern Highlands of Tanzania: A Case of Meta Maternity Hospital", *East African Journal of Health and Science, East African Nature and Science Organization,* Vol. 6 No. 1, pp. 379–387.

Lehtonen, L., Gimeno, A., Parra-Llorca, A. and Vento, M. (2017), "Early neonatal death: A challenge worldwide", Seminars in Fetal and Neonatal Medicine, W.B. Saunders Ltd, 1 June, doi: 10.1016/j.siny.2017.02.006.

Liu, J., Yang, N. and Liu, Y. (2014), "High-risk factors of respiratory distress syndrome in term neonates: A retrospective case-control study", *Balkan Medical Journal, Galenos Publishing House,* Vol. 31 No. 1, pp. 64–68.

Mathew, O.P. (2011), "Apnea of prematurity: Pathogenesis and management strategies", Journal of Perinatology, Vol. 31 No. 5, pp. 302–310.

Moges, N., Dessie, A.M., Anley, D.T., Zemene, M.A., Gebeyehu, N.A., Adella, G.A., Kassie, G.A., *et al.* (2024), "Burden of early neonatal mortality in Sub-Saharan Africa. A systematic review and meta-analysis", *PLoS ONE, Public Library of Science*, Vol. 19 No. 7 July.

Mrisho, M., Schellenberg, D., Manzi, F., Tanner, M., Mshinda, H., Shirima, K., Msambichaka, B., *et*

al. (2012), "Neonatal Deaths in Rural Southern Tanzania: *Care-Seeking and Causes of Death", ISRN Pediatrics, Hindawi Limited,* Vol. 2012, pp. 1–8.

Mukhtar-Yola, M., Audu, L.I., Olaniyan, O., Akinbi, H.T., Dawodu, A. and Donovan, E.F. (2018), "Decreasing birth asphyxia: *Utility of statistical process control in a low-resource setting", BMJ Open Quality, BMJ Publishing Group,* Vol. 7 No. 3.

Mwanga, M.K., Mirau, S., Tchuenche, J.M. and Mbalawata, I.S. (2024), "Reducing under-five mortality in Tanzania: insights from a 60-years data analysis on economic and health indicators", *Malaria Journal, BioMed Central Ltd,* Vol. 23 No. 1.

Ncube, C.N., Enquobahrie, D.A., Albert, S.M., Herrick, A.L. and Burke, J.G. (2016), "Association of neighborhood context with offspring risk of preterm birth and low birthweight: A systematic review and meta-analysis of population-based studies", Social Science and Medicine, Elsevier Ltd, 1 March.

Ogbo, F.A., Ezeh, O.K., Awosemo, A.O., Ifegwu, I.K., Tan, L., Jessa, E., Charwe, D., *et al.* (2019), "Determinants of trends in neonatal, post-neonatal, infant, child and under-five mortalities in Tanzania from 2004 to 2016", BMC Public Health, *BioMed Central Ltd.*, Vol. 19 No. 1.

Olusanya, B.O., Kaplan, M. and Hansen, T.W.R. (2018), "Neonatal hyperbilirubinaemia: a global perspective", The Lancet Child and Adolescent Health, Elsevier B.V., 1 August.

Oskovi Kaplan, Z.A. and Ozgu-Erdinc, A.S. (2018), "Prediction of Preterm Birth: Maternal Characteristics, Ultrasound Markers, and Biomarkers: An Updated Overview", *Journal of Pregnancy*, Hindawi Limited.

Oza, S., Lawn, J.E., Hogan, D.R., Mathers, C. and Cousens, S.N. (2015), "Neonatal cause-of-death estimates for the early and late neonatal periods for 194 countries: 2000–2013", *Bulletin of the World Health Organization, World Health Organization*, Vol. 93 No. 1, pp. 19–28.

Poon, L.C., McIntyre, H.D., Hyett, J.A., da Fonseca, E.B. and Hod, M. (2018), "The first-trimester of pregnancy – A window of opportunity for prediction and prevention of pregnancy complications and future life", Diabetes Research and Clinical Practice, Elsevier Ireland Ltd, 1 November.

Pusdekar, Y. V., Patel, A.B., Kurhe, K.G., Bhargav, S.R., Thorsten, V., Garces, A., Goldenberg, R.L., *et al.* (2020), "Rates and risk factors for preterm birth and low birthweight in the global network sites in six low- and low middle-income countries", Reproductive Health, *BioMed Central Ltd*, Vol. 17.

Rathore, S., Kumar VK, C. and R, S. (2020), "A critical review on neonatal hyperbilirubinemia-an Ayurvedic perspective", Journal of Ayurveda and Integrative Medicine, Elsevier B.V., 1 April.

Ray, J.G., Park, A.L. and Fell, D.B. (2017), "Mortality in Infants Affected by Preterm Birth and Severe Small-for-Gestational Age Birth Weight", *Pediatrics,* Vol. 140 No. 6, p. e20171881.

Razaz, N., Cnattingius, S., Persson, M., Tedroff, K., Lisonkova, S. and Joseph, K.S. (2019), "One-minute and five-minute Apgar scores and child developmental health at 5 years of age: A population-based cohort study in British Columbia, Canada", BMJ Open, *BMJ Publishing Group*, Vol. 9 No. 5.

Rosa-Mangeret, F., Benski, A.C., Golaz, A., Zala, P.Z., Kyokan, M., Wagner, N., Muhe, L.M., *et al.* (2022), "2.5 Million Annual Deaths—Are Neonates in Low-and Middle-Income Countries Too Small to Be Seen? A Bottom-Up Overview on Neonatal Morbi-Mortality", Tropical Medicine and Infectious Disease, MDPI, 1 May.

Schindler, T., Koller-Smith, L., Lui, K., Bajuk, B. and Bolisetty, S. (2017), "Causes of death in very preterm infants cared for in neonatal intensive care units: A population-based retrospective cohort study", BMC Pediatrics, *BioMed Central Ltd.*, Vol. 17 No. 1.

Sellmer, A., Bjerre, J.V., Schmidt, M.R., McNamara, P.J., Hjortdal, V.E., Høst, B., Bech, B.H., *et al.*

(2013), "Morbidity and mortality in preterm neonates with patent ductus arteriosus on day 3", *Archives of Disease in Childhood: Fetal and Neonatal Edition*, Vol. 98 No. 6.

Smithson, P., Florey, L., Salgado, S.R., Hershey, C.L., Masanja, H., Bhattarai, A., Mwita, A., *et al.* (2015), "Impact of malaria control on mortality and anemia among Tanzanian children less than five years of age, 1999-2010", *PLoS ONE, Public Library of Science*, Vol. 10 No. 11.

Smith, V., Devane, D., Begley, C.M., Clarke, M. and Higgins, S. (2009), "A systematic review and quality assessment of systematic reviews of randomised trials of interventions for preventing and treating preterm birth", European Journal of Obstetrics and Gynecology and Reproductive Biology, Elsevier Ireland Ltd.

Sokolovskaya, T.A., Armashevskaya, O. V. and Chuchalina, L.Yu. (2016), "The problem of reproductive health from the perspective of perinatology", Rossiyskiy Vestnik Perinatologii i Pediatrii (Russian Bulletin of Perinatology and Pediatrics), The National Academy of Pediatric Science and Innovation, Vol. 61 No. 4, pp. 55–58.

Teoh, P.J., Ridout, A., Seed, P., Tribe, R.M. and Shennan, A.H. (2018), "Gender and preterm birth: Is male fetal gender a clinically important risk factor for preterm birth in high-risk women?", *European Journal of Obstetrics and Gynecology and Reproductive Biology*, Elsevier Ireland Ltd, Vol. 225, pp. 155–159.

Trachsel, D., Erb, T.O., Hammer, J. and von Ungern-Sternberg, B.S. (2022), "Developmental respiratory physiology", Paediatric Anaesthesia, John Wiley and Sons Inc, 1 February.

Walani, S.R. (2020), "Global burden of preterm birth", *International Journal of Gynecology and Obstetrics*, John Wiley and Sons Ltd., 1 July, doi: 10.1002/ijgo.13195.

Yu, T., Chen, T.S., Liang, F.W. and Kuo, P.L. (2020), "Does sex matter? Association of fetal sex and parental age with pregnancy outcomes in Taiwan: A cohort study", BMC Pregnancy and Childbirth, *BioMed Central Ltd.*, Vol. 20 No. 1.

Zeitlin, J., Phe Saurel-Cubizolles, M.-J., De Mouzon, J., Rivera, L., Ancel, P.-Y., Blondel, B. and Kaminski, M. (2002), Fetal Sex and Preterm Birth: Are Males at Greater Risk? *Human Reproduction*, Vol. 17.