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ORIGINAL RESEARCH

Neonatal Mortality and Associated Factors at a Tertiary-Level Neonatal Intensive Care Unit in Mogadishu, Somalia: A Retrospective Study

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Background: Neonatal mortality is a significant global health challenge, particularly in sub-Saharan Africa. In Somalia, there is a notable absence of comprehensive reports or data on neonatal mortality rates within tertiary-level neonatal intensive care units (NICU). This study aims to identify key factors associated with neonatal mortality in Mogadishu, Somalia.

Materials and Methods: A retrospective review of medical records was conducted for neonates admitted to the Neonatal Intensive Care Unit (NICU) of Mogadishu Somali Turkish Training and Research Hospital from August 2017 to September 2019. Logistic regression analysis was employed using SPSS (version 25) to compute adjusted odds ratios (aORs) along with 95% confidence intervals (CIs).

Results: Of 1043 neonates, 63.8% (n=665) were male, with a mean age of 1.48 days. Most neonates were full-term (55.3%, n=577), while 25.8% (n=269) were preterm (<32 weeks), and 11.9% (n=124) were late preterm (33–37 weeks). In total, 25.5% (n=266) had very low birth weight (<1500 grams). The average length of stay in the NICU was 7.38 days, and the overall mortality rate was 18.7% (n=195). Indications for NICU admissions were prematurity 27.0% (n=282), followed by birth asphyxia (18.0%, n=188), neonatal sepsis (14.6%, n=152), and acute respiratory distress syndrome (12.2%, n=127). Preterm neonates had significantly higher mortality rates (OR=2.14, 95% CI: 1.32–3.47, p=0.002), and those with a birth weight of <1500 grams had an even higher risk of mortality (OR=3.85, 95% CI: 2.50–5.92, p<0.001). Lack of ANC visits was associated with increased mortality risk (OR=1.67, 95% CI: 1.09–2.54, p=0.019), while cesarean delivery was also linked to higher mortality risk (OR=1.92, 95% CI: 1.29–2.85, p=0.002).

Conclusion: The study identified a Neonatal Mortality Rate that is acceptable compared to the mortality rates in other studies in Somalia and the sub-Saharan African region. These findings inform care strategies and resource allocation in prenatal and neonatal health services.

Keywords: neonatal mortality, low-resource settings, tertiary-level NICU, preterm birth, neonatal outcomes, Mogadishu, Somalia

Introduction

Neonatal mortality, defined as the death of an infant within the first 28 days of life, remains a significant public health challenge, particularly in developing countries. This issue not only affects families but also contributes substantially to the overall global under-five mortality rate. According to a meta-analysis by Islam et al,[1] the first few days and weeks after birth are critical in terms of mortality risk. The risk of death is highest during the first week of life, with a significant number of deaths occurring within the first 24 hours after birth.[2] While global and regional efforts have shown progress in reducing child mortality.[3,4] Somalia still faces significant challenges, and its neonatal mortality rate remains among the highest in the world at 37 deaths per 1000 live births. The under-five mortality rate is also high at 117 deaths per 1000 live births.[5]

Although Somalia has made some progress since the 1990s, it remains far from achieving the Sustainable Development Goal of reducing neonatal mortality.[6–8] in addition No documentation exists regarding the high incidence

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of neonatal deaths reported by hospitals in Mogadishu, attributed to inadequate primary antenatal care, neonatal sepsis, low birth weight, prematurity, low Apgar scores, the need for resuscitation, and hypothermia. Despite the recognition of these critical issues, there remains a lack of scientific evidence to support their prevalence and impact on neonatal health outcomes.

Years of conflict and instability have taken a toll on Somalia's healthcare infrastructure. Hospitals, clinics, and neonatal care units often lack adequate resources, equipment, and infrastructure. The shortage of functioning neonatal intensive care units (NICUs), incubators, ventilators, and other essential medical equipment limits the capacity to provide life-saving interventions for critically ill newborns. The lack of a robust referral system further exacerbates the challenges faced by newborns in need of specialized care.[9,10] Maternal and neonatal infections remain a critical public health challenge, significantly impacting newborn health outcomes globally. These infections are major contributors to severe complications such as preterm birth, low birth weight, neonatal sepsis, and increased neonatal morbidity and mortality. In Somalia, maternal and neonatal infections are among the leading causes of neonatal deaths, often resulting in life-threatening conditions like sepsis. The situation is exacerbated by systemic issues, including malnutrition, lack of access to clean water, poor sanitation, and unsanitary living conditions, all of which heighten neonatal vulnerability to infections. Furthermore, socioeconomic determinants such as poverty, food insecurity, and low maternal education exacerbate these challenges.[11,12]

The scarcity of healthcare facilities, skilled healthcare providers, and essential medical supplies poses a significant barrier to timely and appropriate care for newborns. Many families lack access to prenatal care, skilled birth attendants, and postnatal follow-up, leading to missed opportunities for early detection and management of potential complications.[13,14] Somalia has faced recurrent humanitarian crises, including droughts, conflict, and displacement, which exacerbate the vulnerability of newborns. Displaced populations often lack access to adequate healthcare, nutrition, and safe environments.[15,16] The disruption of healthcare services and the breakdown of social support systems further exacerbate the risks faced by newborns in these contexts. Cultural practices and beliefs significantly influence newborn care and contribute to infant vulnerability. Traditional customs, such as delayed initiation of breastfeeding, harmful practices (eg, female genital mutilation), and home births without skilled attendants, can adversely affect newborn health. Previous studies have reported a high prevalence of preterm births, coupled with maternal complications that increase the risk of neonatal mortality.[17]

Addressing these cultural factors and promoting evidence-based practices is essential for enhancing neonatal health outcomes. Understanding the challenges surrounding neonatal mortality is essential for addressing root causes and developing effective interventions to protect vulnerable populations. Somalia has made significant progress in reducing malnutrition inequalities among children, potentially contributing to the decrease in under-five mortality rate inequities.[18] This study aims to address knowledge gap regarding neonatal mortality in Somalia by examining the associated factors influencing neonatal outcomes within a tertiary-level neonatal intensive care unit (NICU) in the Banadir Regional Administration, also known as Mogadishu Municipality, which governs Mogadishu, the capital of the Federal Republic of Somalia. It will specifically analyze factors such as complications during childbirth, length of hospital stays, infections, gestational age, prematurity, birth weight, antenatal care, and mode of delivery, along with their impact on neonatal outcomes.[19]

Materials and Methods

Study Setting, Period, and Design

This retrospective cohort study was conducted from August 2017 to September 2019, and it investigated the electronic medical records (EMRs) of neonates admitted to the NICU at Mogadishu Somali Turkish Training and Research Hospital in Mogadishu, Somalia. Mogadishu, the largest city of Somalia, has experienced significant population growth in recent years. Estimates suggest that the city's population is approximately 2.7 million residents. The city has many health facilities and centers; few are equipped with neonatal intensive care units (NICUs). The selection of this hospital based on status as national referral hospital, the specialized departments or units, and the capacity to offer a wide range of services for NICU and newborn care.

Population and Sampling Technique

The study analyzed the complete medical records of all neonates (1043 cases) admitted to the NICU during the study period after becoming eligible for the study. These neonates were assigned unique identifiers, which were then used to randomly select cases using a random number generator in Microsoft Excel. The focus of the study was on the neonatal mortality rate, specifically the number of deaths within the first 28 days of life per 1000 live births in each population or region. Only complete records of survivors (848) and non-survivors (195) were included in the analysis. Neonates who were admitted with incomplete data, such as missing admission details, demographics, birth weight, gestational age, diagnosis, maternal information, or survival outcome, were excluded. There were no other exclusion criteria. To ensure patient confidentiality, all personal identifiers were removed from the data before analysis using Microsoft Excel.

Data Collection Methods

Data were extracted from the electronic medical records (EMRs) of all neonates admitted to the Neonatal Intensive Care Unit (NICU) of the hospital. This data set included comprehensive information regarding admission details, demographics, gestational age, birth weight, diagnoses, interventions, treatments, and maternal information. To ensure consistency and reliability, a well-structured, self-developed uniform extraction format was created based on a thorough literature review and subsequently discussed with field experts. The research team comprised a diverse group of professionals, including a statistician and data analyst from the Somalia National Bureau of Statistics, a senior pediatric and congenital cardiologist, two medical doctors—one of whom was a residency doctor working in the NICU at the time of data collection—and a general practitioner, alongside the corresponding author. The senior researcher meticulously reviewed the collected data to ensure its accuracy and internal consistency. Diagnoses were classified by experienced physicians utilizing ICD-10-WHO (2019) codes for standardized categorization. In this study, neonatal mortality was defined as the dependent variable, characterized as a binary outcome indicating either live birth or neonatal death. The independent variables were categorized into three main groups: socio-demographic characteristics, which included the sex of the newborn; maternal and delivery-related characteristics, encompassing the number of antenatal care (ANC) visits and the mode of delivery; and neonatal-related characteristics, which comprised the age of the newborn at admission and discharge, gestational age, birth weight, presence of congenital anomalies, infectious diseases, and the final diagnosis at discharge. This structured approach facilitates a comprehensive examination of the factors impacting neonatal mortality.

Data Analysis

The data analysis for this study followed a systematic approach. Initially, data cleaning was performed using Microsoft Excel to ensure accuracy and consistency. Descriptive and analytical analyses were subsequently conducted using SPSS (version 25). Descriptive statistics were calculated and presented through text, tables, frequencies, percentages, means, and standard deviations. Bivariable logistic regression analysis was employed to identify potential correlations, with variables exhibiting a p-value of less than 0.25 considered for inclusion in the multivariable logistic regression analysis. To evaluate the fit of the model, the Hosmer-Lemeshow goodness-of-fit test was utilized, with a p-value of less than 0.05 indicating statistical significance for the predictive variables in the multivariate regression analysis.

Ethics Consideration

The ethical approval for this study was granted by the Mogadishu Somali Turkish Training and Research Hospital (MSTH/3391). In alignment with the hospital's established practice of securing informed consent for data usage (with the exclusion of patient names) upon admission, the requirement for individual patient consent was waived for this retrospective study, adhering to the principles outlined in the Declaration of Helsinki. This protocol ensures that the research is conducted ethically and with due consideration for patient privacy, maintaining the standards of confidentiality and respecting the principles of autonomy outlined in the ethical guidelines.

Results

Socio-Demographic Characteristics

A total of 1043 eligible participants were included, with a mean age of 1.48 ± 0.50 days, and 665 (63.8%) males were enrolled. The average length of stay in the NICU was 7.38 ± 7.9 days. Neonates were almost evenly distributed between those 0–7 days (52.3%, 545 cases) and those aged 8–28 days (47.8%, 498 cases) Table 1.

Maternal and Delivery-Related Characteristics

In this study, around two-thirds of the 655 cases (62.8%) had no ANC visits during their pregnancy of the current neonate, spontaneous vaginal delivery was the primary mode of birth 686 cases (65.8%), with cesarean sections 357 cases (34.2%). Table 1.

The Description of Neonatal Related Characteristics

The gestational age distribution of neonates was full-term (38–42 weeks) with 55.3% (577 cases), preterm (<32 weeks) with 25.8% (269 cases), late preterm (33–37 weeks) with 11.9% (124 cases), and post-term (>42 weeks) with 7.1% (73

Table 1 Characteristics of Neonates Admitted at the Neonatal Intensive Care Unit of the Mogadishu Somali Turkish Training and Research Hospital, Somalia

Variable	Frequency	Percentage
Sex		
Male	665	63.8
Female	378	36.2
Age, days		
1–7	545	52.2
≥8	498	47.8
Age-Mean	1.48 ±0.50 days	
Length of hospital stay, median (IQR)	5	2–10
Gestational age, weeks		
<32	269	25.8
33–37	124	11.9
38–42	577	55.3
>42	73	7.0
Birth weight, grams		
<1500	266	25.5
1500–2500	157	15.1
3500–4000	555	53.2
>4000	65	6.2
Indication for neonatal care unit admission		
Prematurity	282	27.0
Sepsis	152	14.6
Respiratory distress syndrome	127	12.2
Meconium aspiration syndrome	86	8.3
Asphyxia	188	18.0
Congenital malformations	93	8.9
Hypoglycemia	23	2.2
Jaundice	74	7.1
Others	18	1.7
Antenatal care visit		
Yes	388	37.2
No	655	62.8
Mode of delivery		
Spontaneous vaginal delivery	686	65.8
Cesarean section	357	34.2

cases). Birth weight classifications reveal that 53.2% (555 cases) are within the normal range (2500–4000 grams), while minimal birth weight (<1500 grams), lower weights (1500–2500 grams), and higher weight (>4000 grams) neonates account for 25.5% (266 cases), 15.1% (157 cases), and 6.2% (65 cases), respectively. The prevalent diagnosis is preterm birth, affecting 27.0% (282 cases), followed by birth asphyxia at 18.0% (188 cases), neonatal sepsis at 14.6% (152 cases), and Respiratory Distress at 12.2% (127 cases). Congenital malformation is noted in 8.9% (93 cases), meconium aspiration syndrome in 8.3% (86 cases), and clinical jaundice in 7.1% (74 cases), while hypoglycemia and other conditions are less common at 2.2% (23 cases) and 1.7% (18 cases), respectively. Table 1

Determinants Associated with Neonatal Mortality

The study reported an overall neonatal mortality rate of 18.7%, with 195 of 1043 neonates not surviving during their hospitalization (see Figure 1). A statistically significant association was observed between extended hospital stays and a decreased risk of mortality ($p = 0.003$). Specifically, neonates who survived had a median hospital stay of 7.73 days, in contrast to the 5.85 days recorded for those who did not survive. Furthermore, neonates born via spontaneous vaginal delivery (see Figure 2) and those whose mothers attended antenatal care (ANC) visits (see Figure 3) were found to have a lower risk of mortality. The analysis revealed that a gestational age below 32 weeks was significantly associated with an increased risk of mortality ($p = 0.002$) compared to full-term infants (gestational age of 38–42 weeks). Similarly, neonates weighing less than 1500 grams at birth demonstrated a markedly higher risk of mortality ($p < 0.001$) compared to those with normal birth weights (see Table 2).

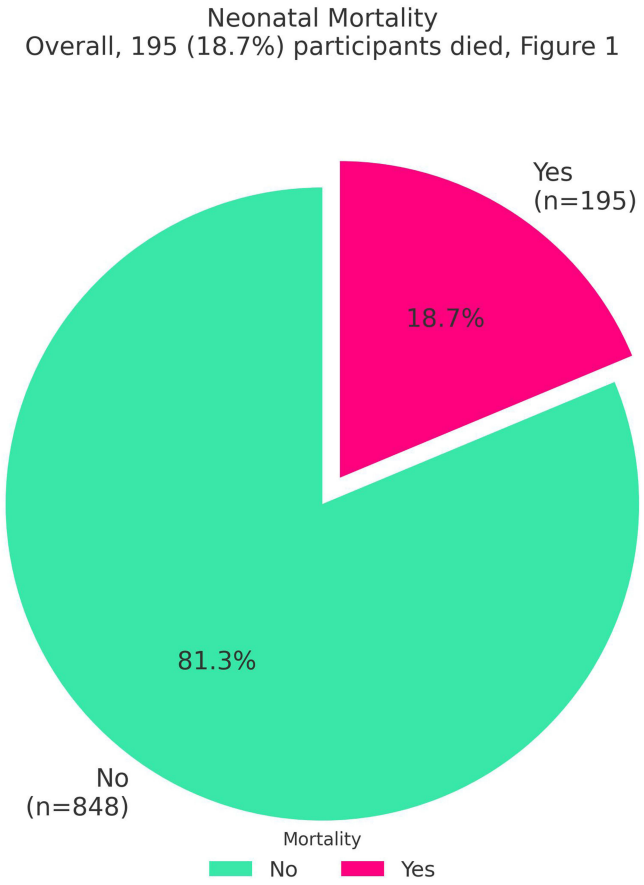

Figure 1 Proportion of neonates who survived or died at the Neonatal Intensive Care Unit of the Mogadishu Somali Turkish Training and Research Hospital, Somalia, between August 2017 and September 2019.

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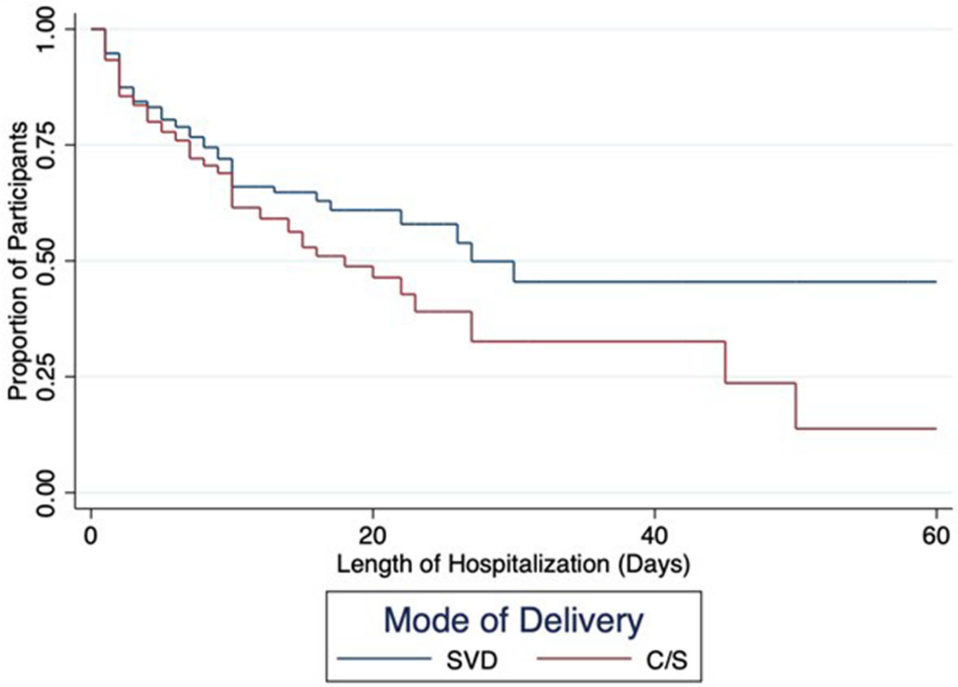

Figure 2 Illustrates the association between mode of delivery (cesarean vs vaginal) and neonatal mortality at the Neonatal Intensive Care Unit of the Mogadishu Somali Turkish Training and Research Hospital, Somalia, between August 2017 and September 2019.

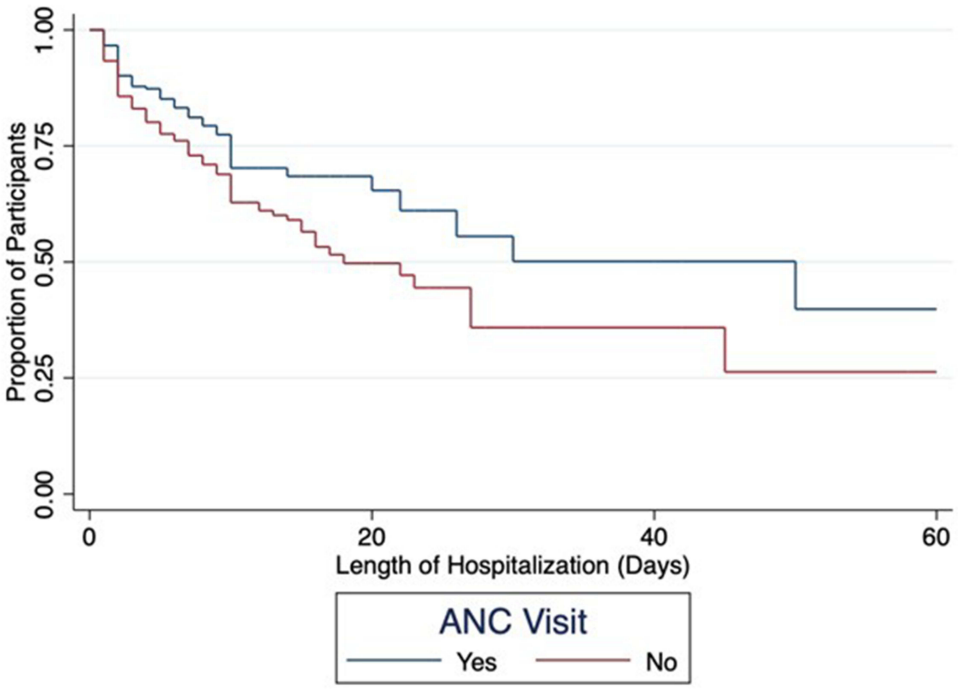

Figure 3 Shows the impact of antenatal care (ANC) visits on neonatal mortality at the Neonatal Intensive Care Unit of the Mogadishu Somali Turkish Training and Research Hospital, Somalia, between August 2017 and September 201.

Discussion

The observed neonatal mortality rate (NMR) of 18.69% at the Mogadishu Somali Turkish Training and Research Hospital is significantly lower than the national average of 37 deaths per 1000 live births.[5] Comparatively, regional estimates such as Somaliland's NMR of 42 per 1000 live births.[20] Additionally, a multicenter hospital-based study in

Table 2 Bivariate Analysis of Factors Associated with Mortality Among Neonates Admitted at the Neonatal Intensive Care Unit of the Mogadishu Somali Turkish Training and Research Hospital, Somalia, Between August 2017 and September 2019

Variable	All (n=1043) Frequency (%)	Mortality		Crude Relative Risk ratio (95% Confidence Interval)	P value
		No (n=848) Frequency (%)	Yes (n=195) Frequency (%)		
Sex					
Male	665(63.8)	548(64.6)	117(60.0)	Reference	
Female	378(36.2)	300(35.4)	78(40.0)	1.2(0.91–1.52)	0.228
Age, days					
1–7	545(52.3)	433(51.1)	112(57.4)	Reference	
≥8	498(47.7)	415(48.9)	83(42.6)	1.2(0.95–1.59)	0.110
Length of hospital stay, median (IQR), days	7(1–60)	7.73 days (SD = 8.112).	5.85 days (SD = 7.005).		0.003
Gestational age, weeks					
<32	269(25.8)	204(24.1)	65(33.3)	1.6(1.19–2.11)	0.002
33–37	124(11.9)	97(11.4)	27(13.9)	1.4(0.97–2.09)	0.070
38–42	577(55.5)	489(57.7)	88(45.1)	Reference	
>42	73(7.0)	58(6.8)	15(7.7)	1.3(0.82–2.20)	0.234
Birth weight, grams					
<1500	266(25.5)	195(23.0)	71(36.4)	1.8(1.35–2.36)	<0.001
1500–2500	157(15.1)	128(15.1)	29(14.9)	1.2(0.84–1.81)	0.281
3500–4000	555(53.2)	472(55.7)	83(42.6)	Reference	
>4000	65(6.2)	53(6.3)	12(6.2)	1.2(0.71–2.13)	0.451
ANC visit					
Yes	388(37.2)	330(18.9)	58(29.7)	Reference	
No	655(62.8)	518(61.1)	137(70.3)	1.4(1.06–1.85)	0.019
Mode of delivery					
Spontaneous vaginal delivery	686(65.8)	576(67.9)	110(56.4)	Reference	0.002
Cesarean section	357(34.2)	272(32.1)	85(43.6)	1.5(1.15–1.91)	

Mogadishu reported a neonatal mortality prevalence of 26.5%.[19] These comparisons underscore the significant achievement of this tertiary hospital, which primarily manages high-risk patients and complex pregnancies. The presence of a comprehensive neonatal unit equipped with specialized staff and resources likely contributes to these favorable outcomes. Sharing data about Somalia, where there has been little to no prior study in a specific region, can be an important step in advancing global neonatal health knowledge and fostering collaboration.[21]

This study, conducted in the Banadir region's tertiary referral NICU from 2017 to 2019, offers valuable insights into neonatal mortality within conflict-affected settings. The findings revealing a lower mortality rate within the facility compared to national data underscore the disproportionate burden faced by vulnerable children in settings with humanitarian emergencies like Somalia. Evidence-based interventions, such as those identified in systematic reviews, are critical for addressing these disparities.[22] While the mortality rate in this study is lower than that reported in relatively comparable studies conducted in Eritrea, it aligns with the mortality rate observed in Congo. Notably, the causes of neonatal mortality—prematurity, low birth weight, birth asphyxia, and infections—remain consistent across these regions.[23,24] In a similar context, joergersen et al. Reported an NMR 19.6% in a NICU in Guinea-Bissau from 2008 to 2013.[4] Seid et al. Reported a 13.3% mortality rate of 3.276 neonates followed in a NICU in Ethiopia between 2014 and 2017, suggesting that increased prenatal care services and early diagnosis and referral of neonates can reduce neonatal deaths.[25]

A health facility-based cross-sectional study on neonates admitted to neonatal intensive care units (NICUs) over five years, from January 2015 to December 2019, in Ethiopia. Several factors were significantly associated with neonatal mortality in this study. Newborns whose mothers did not undergo antenatal care follow-up faced a substantially higher

risk. Similarly, infants delivered via cesarean section showed an increased risk of neonatal mortality. Birth asphyxia was identified as a notable contributor to neonatal mortality.[26]

Somali Regional State, Eastern Ethiopia data from a separate facility-based study conducted between 2011 and 2018. The study identifies prematurity, low birth weight, birth asphyxia, and infections as significant contributors to neonatal mortality. Overall, neonatal mortality was 18.6% per 1000 live births.[27]

The WHO classification focuses on urgency, with emergency cesareans often associated with poorer neonatal outcomes due to underlying conditions, reduced preparation time, and stress. The Robson system categorizes women by obstetric factors for better analysis. Emergency deliveries have higher risks, and individual cases vary.[28–30] Comprehensive prenatal and postnatal care, along with skilled birth attendance, play a crucial role in promoting positive outcomes for high-risk pregnancies and ensuring the well-being of both mother and baby. Efforts to improve access to quality prenatal care and promote skilled birth attendance are vital in countries with limited resources, like Somalia. Kangaroo mother care is a cost-effective intervention that involves close skin-to-skin contact between the mother and the newborn. It provides warmth, promotes breastfeeding, and reduces the risk of infection. Kangaroo mother care is particularly beneficial for preterm and low birth weight infants, helping to improve survival rates. Other factors, such as postnatal care, breastfeeding support, immunizations, and community- based interventions, reduce neonatal mortality rates.[31,32] The transformative role of modern neonatal intensive care units (NICUs) in improving survival rates for critically ill newborns, Singapore's reputation for high-quality health care services, including advanced NICUs, underscores the significant impact of well-equipped facilities on neonatal outcomes.[33] This service serves as an inspirational model for low-resource settings striving to enhance neonatal care. The importance of adopting new technology for essential newborn care in resource-limiting areas can bridge the gap between advanced neonatal care systems and the realities of healthcare in countries like Somalia.[34–36]

Singapore's remarkable reduction in neonatal mortality, supported by its well-developed healthcare infrastructure, advanced medical technologies, and highly skilled healthcare professionals, serves as a model for Somalia's healthcare innovation. The Kandang Kerbau Hospital, Singapore's largest neonatal intensive care unit, stands out with one of the lowest neonatal mortality rates globally, attributed to a world record set by delivering 39,835 newborns in a single hospital in a year. The hospital has since continued to provide specialized care for women and children, and its legacy remains an essential part of Singapore's medical history, witnessing a substantial decline in the infant mortality rate from 27.4 to 2.1 cases per 1000 live births from 1965 to 2019.[37,38]

Limitations

Although the study was limited to a single-center design, which may restrict the generalizability of the findings, it represents the first of its kind conducted in Mogadishu, Somalia, utilizing primary data. Additionally, the study's observational nature limits the ability to establish causal relationships between the identified variables and neonatal mortality. Despite these limitations, the findings offer valuable preliminary insights that can guide future research. Addressing the limitations in subsequent multicenter studies could enhance the generalizability of the results and contribute to a more comprehensive understanding of neonatal mortality factors across diverse populations and clinical settings.

Conclusion

The study revealed a low neonatal mortality rate compared to the national average, with preterm birth and birth asphyxia being the most frequent diagnoses. It noted that a small percentage of mothers received antenatal care and identified a positive correlation between cesarean sections and mortality. The findings emphasize the need for interventions to reduce neonatal mortality in Somalia, such as improving access to antenatal care, enhancing neonatal care through specialized units, and addressing risk factors like preterm birth and birth asphyxia.

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Author Contributions

All authors made a significant contribution to the work reported, whether that is in the conception, study design, execution, acquisition of data, analysis, and interpretation, or all these areas; took part in drafting, revising or critically reviewing the article; gave final approval of the version to be published; have agreed on the journal to which the article has been submitted; and agree to be accountable for all aspects of the work.

Disclosure

The authors declare no conflicts of interest in this work.

References

1. Islam MA, Butt ZA, Sathi NJ. Prevalence of neonatal mortality and its associated factors: a meta-analysis of demographic and health survey data from 21 developing countries. *Dr Sulaiman Al Habib Med J*. 2022;4(3):145–152.
2. Yego F, D'Este C, Byles J, Nyongesa P, Williams JS. A case-control study of risk factors for fetal and early neonatal deaths in a tertiary hospital in Kenya. *BMC Pregnancy Childbirth*. 2014;14:1–9. doi:10.1186/1471-2393-14-1
3. Sharrow D, Hug L, You D, et al. Global, regional, and national trends in under-5 mortality between 1990 and 2019 with scenario-based projections until 2030: a systematic analysis by the UN inter-agency group for child mortality estimation. *Lancet Glob Health*. 2022;10(2):e195–e206. doi:10.1016/S2214-109X(21)00515-5
4. Pinstrup Joergensen AS, Bjerregaard-Andersen M, Biering-Sørensen S, et al. Admission and mortality at the main neonatal intensive care unit in Guinea-Bissau. *Transactions Royal Soc Trop Med Hygiene*. 2018;112(7):335–341. doi:10.1093/trstmh/try061
5. Farist L. The health status of Somalia. 2021.
6. Hug L, Alexander M, You D, Alkema L. National, regional, and global levels and trends in neonatal mortality between 1990 and 2017, with scenario-based projections to 2030: a systematic analysis. *Lancet Glob Health*. 2019;7(6):e710–e720. doi:10.1016/S2214-109X(19)30163-9
7. Morrison J, Malik SMMR. Population health trends and disease profile in Somalia 1990–2019, and projection to 2030: will the country achieve sustainable development goals 2 and 3? *BMC Public Health*. 2023;23(1):66. doi:10.1186/s12889-022-14960-6
8. Ahmed AY, Nor FA, Ahmed MY, Osman MM. Universal health coverage in Somalia: charting the path to equitable healthcare financing and governance. *Health*. 2023;15(11):1298–1317. doi:10.4236/health.2023.1511085
9. Abdullahi AM. Strategies and challenges of universal health coverage in Somalia. *Asian J Med Health*. 2023;21(8):41–54. doi:10.9734/ajmah/2023/v21i8837
10. Amsalu R, Schulte-Hillen C, Garcia DM, et al. Lessons learned from helping babies survive in humanitarian settings. *Pediatrics*. 2020;146 (Supplement_2):S208–S217. doi:10.1542/peds.2020-016915L
11. Martin-Canavate R, Custodio E, Yusuf A, Molla D, Fasbender D, Kayitakire F. Malnutrition and morbidity trends in Somalia between 2007 and 2016: results from 291 cross-sectional surveys. *BMJ open*. 2020;10(2):e033148. doi:10.1136/bmjopen-2019-033148
12. Ali DA, Mohamed NA, Ismail AI, Hassan GD. The risk factors of infant mortality in Somalia: evidence from the 2018/2019 Somali health & demographic survey. *BMC Pediatric*. 2024;24(1):486. doi:10.1186/s12887-024-04964-z
13. Somali-Swedish Action Group for Health Research and Development. Healing the health system after civil unrest. *Global Health Action*. 2015;8 (1):27381. doi:10.3402/gha.v8.27381
14. Mohamed AA, Bocher T, Magan MA, et al. Experiences from the field: a qualitative study exploring barriers to maternal and child health service utilization in IDP settings Somalia. *Int J Women's Health*. 2021;Volume 13:1147–1160. doi:10.2147/IJWH.S330069
15. Cantor D, Swartz J, Roberts B, et al. Understanding the health needs of internally displaced persons: a scoping review. *J Migration Health*. 2021;4:100071. doi:10.1016/j.jmh.2021.100071
16. Warsame AA. Somalia's healthcare system: a baseline study & human capital development strategy. 2020. Mogadishu: HIPS.: Heritage Institute for Policy Studies and City University of Mogadishu.
17. Omar AI, Mohamed AD, Farah MG, et al. Maternal risk factors associated with preterm births among pregnant women in Mogadishu, Somalia. *Children*. 2022;9(10):1518. doi:10.3390/children9101518
18. Morrison J, Malik SMMR. Health equity in Somalia? An evaluation of the progress made from 2006 to 2019 in reducing inequities in maternal and newborn health. *Int J Equity Health*. 2024;23(1):46.
19. Ali IA, Inchon P, Suwannaporn S, Achalapong J. Neonatal mortality and associated factors among newborns in Mogadishu, Somalia: a multicenter hospital-based cross-sectional study. *BMC Public Health*. 2024;24(1):1635. doi:10.1186/s12889-024-19149-7
20. Lundeby KM, Heen E, Mosa M, Abdi A, Størdal K. Neonatal morbidity and mortality in Hargeisa, Somaliland: an observational, hospital based study. *Pan Afr Med J*. 2020;37(1).
21. Uğur C, Abdullahi Yusuf A. Evaluation of newborns born in a training and research hospital in Mogadishu, Somalia, Africa. *Iranian J Neonatol*. 2020;11(3):115–119.
22. Kleinhout MY, Stevens MM, Osman KA, et al. Evidence-based interventions to reduce mortality among preterm and low-birthweight neonates in low-income and middle-income countries: a systematic review and meta-analysis. *BMJ Global Health*. 2021;6(2):e003618.
23. Andegiorgish AK, Andemariam M, Temesghen S, Ogbai L, Ogbe Z, Zeng L. Neonatal mortality and associated factors in the specialized neonatal care unit Asmara, Eritrea. *BMC Public Health*. 2020;20(1):1–9. doi:10.1186/s12889-019-7969-5
24. Mashako RM, Ngbonda D, Alworong'a O. Predictive factors of neonatal mortality in intensive neonatal care unit at goma eastern democratic republic of Congo. *J Pediatr Neonatal Care*. 2019;9(2):58–61.
25. Seid SS, Ibro SA, Ahmed AA, et al. Causes and factors associated with neonatal mortality in neonatal intensive care unit (NICU) of Jimma University Medical Center, Jimma, south West Ethiopia. *Pediatric Health Med Therapeutics*. 2019;Volume 10:39–48. doi:10.2147/PHMT.S197280
26. Woday Tadesse A, Mekuria Negussie Y, Aychiluhm SB. Neonatal mortality and its associated factors among neonates admitted at public hospitals, pastoral region, Ethiopia: a health facility based study. *PLoS One*. 2021;16(3):e0242481. doi:10.1371/journal.pone.0242481

27. Mohamed HA, Shiferaw Z, Roble AK, Kure MA. Neonatal mortality and associated factors among neonates admitted to neonatal intensive care unit at public hospitals of Somali Regional State, Eastern Ethiopia: a multicenter retrospective analysis. *PLoS One*. 2022;17(5):e0268648. doi:10.1371/journal.pone.0268648
28. Khasawneh W, Obeidat N, Yusef D, Alsulaiman JW. The impact of cesarean section on neonatal outcomes at a university-based tertiary hospital in Jordan. *BMC Pregnancy Childbirth*. 2020;20(1):1–9. doi:10.1186/s12884-020-03027-2
29. AL-Hissnawiy FF, AL-Ogaili SSC. Neonatal complications according to methods of delivery in Alzahraa maternity teaching hospital in at Najaf Alashraf City. *HIV Nursing*. 2022;22(2):2740–2744.
30. Elias S, Wolde Z, Tantu T, Gunta M, Zewudu D. Determinants of early neonatal outcomes after emergency cesarean delivery at Hawassa University comprehensive specialised hospital, Hawassa, Ethiopia. *PLoS One*. 2022;17(3):e0263837. doi:10.1371/journal.pone.0263837
31. Amsalu R, Morris CN, Hynes M, et al. Effectiveness of clinical training on improving essential newborn care practices in Bossaso, Somalia: a pre and postintervention study. *BMC Pediatric*. 2020;20(1):1–14. doi:10.1186/s12887-020-02120-x
32. Heidarzadeh M, Hosseini MB, Ershadmanesh M, Tabari MG, Khazaee S. The effect of kangaroo mother care (KMC) on breast feeding at the time of NICU discharge. *Iran Red Crescent Med J*. 2013;15(4):302. doi:10.5812/ircmj.2160
33. Ng KC, Ho LY, Quak SH, Tan KW, Ho NK, Phua KB. From the 20th to the 21st century: the first 100 years of paediatrics in Singapore. *Singapore Med J*. 2021;62(1 Suppl):S2. doi:10.11622/smedj.2021068
34. Maynard KR, Causey L, Kawaza K, et al. New technologies for essential newborn care in under-resourced areas: what is needed and how to deliver it. *Paediatrics Int Child Health*. 2015;35(3):192–205. doi:10.1179/2046905515Y.0000000034
35. Thairu L, Wirth M, Lunze K. Innovative newborn health technology for resource-limited environments. *Trop Med Int Health*. 2013;18(1):117–128.
36. Riviello ED, Letchford S, Achieng L, Newton MW. Critical care in resource-poor settings: lessons learned and future directions. *Crit Care Med*. 2011;39(4):860–867. doi:10.1097/CCM.0b013e318206d6d5
37. Yap F, Loy SL, Ku CW, Chua MC, Godfrey KM, Chan JKY. A golden thread approach to transforming maternal and child health in Singapore. *BMC Pregnancy Childbirth*. 2022;22(1):561. doi:10.1186/s12884-022-04893-8
38. Singapore, D. (2020). Singapore population. department of statistics Singapore. Available from: https://www.singstat.gov.sg/modules/infographics/population. Accessed January 13, 2023.