



Analysis of Risk Factor Specific Mortality to Improve Neonatal Mortality Rate in a Special Newborn Care Unit: A Cross Sectional Descriptive Study

Tapan Kumar Kundu¹, Abhilash Chatterjee², Mitali Bera³, Aditi Chowdhury⁴, Riya Guchhait⁴

¹ Associate Professor, ² Senior Resident, ³ Assistant Professor, ⁴ Junior Resident

All from: Department of Paediatrics, Midnapore Medical College, Vidyasagar Road, Midnapore, West Bengal 72110, India.

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Abstract

Introduction: The proposed Sustainable Development Goal (SDG) target aims to reduce preventable deaths of newborn and reduce neonatal mortality to as low as 12 per 1000 live births by 2030. The study aimed to identify the newborns who died, why and when they died, if death was possibly preventable or probably unpreventable and identify the areas where neonatal mortality rate (NMR) reduction is possible.

Methods: A cross sectional, retrospective, descriptive study was conducted on inborn newborns at a Special Newborn Care Unit of a medical college hospital in eastern India from January 1, 2021 to December 31, 2021. Admission and mortality data regarding gender, social category, gestational age, birth weight, cause of death and age at death were collected and analysed.

Results: Live births in the institution were 14525 with 1423 sick newborns admitted to the SNCU and 309 deaths (54.37% males). Highest number of deaths occurred in birth weight $\leq$ 999 grams (88.75%) and gestational age $<$ 28 weeks (79.66%). The cause of death was perinatal asphyxia in 29.13%, prematurity $<$ 28 weeks gestation and IUGR with birth weight ($\leq$ 999 grams) in 22.98% and sepsis in 22.65%. First day deaths were 15.21%, first 2 days 33.98% and first 7 days 74.11%.

Conclusion: Mortality in the sick newborns was 21.71%. Increased mortality was observed in female gender, scheduled tribe, $<$ 28 weeks gestation, birth weight $\leq$ 999 grams. The possibly preventable deaths are most of the cases of perinatal asphyxia, sepsis and prematurity contributing to 74.76% of all deaths. To reduce NMR, interventions should target these areas.

Correspondence

Abhilash Chatterjee
Senior Resident,
Department of Paediatrics,
Midnapore Medical College,
Vidyasagar Road, Midnapore,
1/6, B. Block, D.S. Tower,
Shere Punjab, Adityapur,
Jamshedpur, Jharkhand- 831013,
India.
E-mail: abhilashchat@gmail.com

Introduction

Globally 2.4 million children died in the first month of life in 2020. Central and South Asia (23 deaths per 1000 live births) contribute 36% of global newborn deaths. Country level neonatal mortality rate in 2020 ranged from 1 death per 1000 live birth to 44.¹ India stood at infant mortality rate (IMR) of 27 and neonatal mortality rate (NMR) of 20 per 1000 live birth in the year 2020.^{2,3}

The proposed Sustainable Development Goal (SDG) target for child mortality aims to limit preventable deaths of newborn and children under three years of age. The countries are aiming to reduce neonatal mortality to at least as low as 12 deaths per 1000 live births and under five mortality to be at least as low as 25 deaths per 1000 live births by 2030.^{4,5}

The present study has been conceptualised to help document data and reduce the



mortality in NICU. We intended to identify the newborns who died, why and when they died, to classify the deaths if it was possibly preventable or probably unpreventable and to identify the areas where further reduction of NMR is possible.

Methods

A retrospective, descriptive study was conducted on inborn newborns at a Special Newborn Care Unit (SNCU) attached with a medical college hospital in eastern India for a period of one year from January 1, 2021 to December 31, 2021. The data regarding gender, social category, gestational age, birth weight, cause of death, age at death were collected after taking approval from the institutional ethics committee. Tables and figures were prepared from the data and results were analysed using descriptive statistics. Deaths were categorized as preventable or unpreventable based on established criteria. To reduce the NMR, strategies such as improving antenatal care, enhancing neonatal resuscitation, optimizing nutrition and feeding practices, strengthening infection control measures, and conducting community education and outreach can be employed.

Results

Table 1: Characteristics of admitted and deceased newborns

	No. of admitted newborns	No. of deceased newborns
Total	1423	309
Gender		
Male	823 (57.84%)	168 (54.37%)
Female	600 (42.16%)	141 (45.63%)
Social Category		
General	860 (60.43%)	181 (58.58%)
Scheduled Caste (SC)	42 (2.95%)	09 (2.91%)
Scheduled Tribe (ST)	173 (12.16%)	45 (14.56%)
Other Backward Classes (OBC)	348 (24.46%)	74 (23.95%)
Birth weight		
≤ 999 grams	80 (5.62%)	71 (22.98%)
1000 – 1499 grams	226 (15.88%)	103 (33.33%)
1500 – 2499 grams	618 (43.43%)	91 (29.45%)
≥ 2500 grams	499 (35.07%)	44 (14.24%)
Gestational age		
< 28 weeks	59 (4.15%)	47 (15.21%)
28 - < 32 weeks	149 (10.47%)	77 (24.92%)
32 - < 37 weeks	450 (31.62%)	105 (33.98%)
≥ 37 weeks	765 (53.76%)	80 (25.89%)

The demographic characteristics of the newborns admitted has been presented in the Table 1. The majority of sick newborns were admitted within the first week of life, with 1026 (72.1%) admitted on the first day, 1102 (77.44%) admitted within the first 2 days, and 1415 (99.44%) admitted within the first 7 days.

A total of 309 neonatal deaths occurred, comprising 168 males (54.37%) and 141 females (45.63%). General category contributed to 181 (58.58%) neonatal deaths, 9 (2.91%) from Scheduled Caste (SC), 45 (14.56%) from Scheduled Tribe (ST), and 74 (23.95%) from Other Backward Classes (OBC). The birth weight of neonates who died ranged from ≤ 999 grams (22.98%) to 1000 - 1499 grams (33.33%), 1500 - 2499 grams (29.45%), and ≥ 2500 grams (14.24%). Gestational age at death was < 28 weeks in 47 (15.21%) and ≥ 37 weeks in 80 (25.89%) newborns (Table 2).

To investigate the association between gender, social category, birth weight, gestational age and neonatal mortality, a chi-squared test was conducted. On applying chi square test between gender and neonatal mortality, chi square statistic was 1.95. P value was 0.163 which was not statistically significant. On applying chi square test between social category and neonatal mortality, chi square statistic was 2.15. P value was 0.542 which was not statistically significant. On applying chi square test between birth weight and neonatal mortality, chi square statistic was 353.7536. P value was < 0.05 which was statistically significant. On applying chi square test between gestational age and neonatal mortality, chi square statistic was 252.9514. P value was < 0.05 which was statistically significant. The cause of death of newborns has been shown in Figure 1.

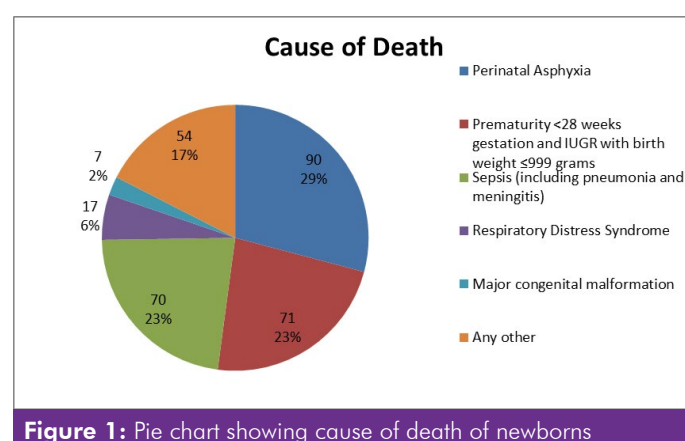


Figure 1: Pie chart showing cause of death of newborns

Table 2: Cause specific death at different ages with percentage of deaths from the same cause (when the newborns died?)

Cause of Death	Number of Deaths at age of death			
	First day	First two days	First seven days	Beyond seven days
Perinatal asphyxia	15 (16.67%)	34 (37.78%)	74 (82.22%)	90 (100%)
Prematurity (< 28 weeks gestation) and IUGR with Birth Weight ($\leq$ 999 grams)	19 (26.77%)	35 (49.3%)	54 (76.06%)	71 (100%)
Sepsis (including pneumonia and meningitis)	02 (2.86%)	07 (10%)	40 (57.14%)	70 (100%)
Respiratory Distress Syndrome	03 (17.65%)	07 (41.18%)	13 (76.47%)	17 (100%)
Major congenital malformation	03 (42.86%)	05 (71.43%)	07 (100%)	07 (100%)
Any other	05 (9.43%)	16 (30.19%)	40 (75.47%)	53 (100%)
Total	47 (15.21%)	105 (33.98%)	229 (74.11%)	309 (100%)

Deaths due to perinatal asphyxia were 15 (16.67%) on the first day, 34 (37.78%) on the first two days, and 74 (82.22%) on the first seven days (total 90 deaths). Deaths due to prematurity (< 28 weeks gestation) and intrauterine growth retardation (IUGR) with birth weight ($\leq$ 999 grams) were 19 (26.77%) on the first day, 35 (38.89%) on the first two days, and 54 (76.06%) on the first seven days, (total 71 deaths). Sepsis (including pneumonia and meningitis) was responsible for 2 (2.86%) deaths on the first day, 7 (10%) on the first two days, and 40 (57.14%) on the first seven days, total (70 deaths). Chi square test was conducted and chi square statistic was 29.42. P value was < 0.05 which was statistically significant (Table 2.)

Discussion

Total number of admissions to the SNCU was 1423. Number of newborns died was 309 (21.71%). Male female ratio was 1.2:1. Reported range in various studies was 1.2:1 to 1.7:1.^{7,8,11} Mortality of admitted males was 20.41% and 23.5% in females. Gender specific mortality was more in females but it was not statistically significant in our study. Newborns died involved general category 21.05%, SC 21.43%, ST 26.01% and OBC 21.3%. Thus, social category specific mortality rate was highest in ST category (26.01%) and lowest in general category (21.05%). It was not statistically significant in our study.

Small size at birth—due to preterm birth or small-for-gestational-age (SGA) or both—is the biggest risk factor for more than 80% of neonatal deaths and increases risk of post-neonatal mortality, growth failure, and adult-onset noncommunicable diseases.⁶ In our study, out of 59 neonates of gestational age < 28 weeks, death occurred in 47 (79.66%). Percentage of death in the gestational age 28 - < 32 was 51.68%, 32 - < 37 weeks was 23.33% and $\geq$ 37 weeks was 10.46%. Thus gestational age specific mortality was lowest in gestational age $\geq$ 37 weeks (10.46%) and highest in < 28 weeks gestational age (79.66%) which was statistically significant. In other studies, mortality in the term babies varied from 11.8% to 16.7% and in the preterm babies varied from 24.3% to

83.3%.^{7,8} In a study by Sangappa M Dhaded et al, a one-week decrease in gestational age at delivery was associated with a higher risk of mortality with a RR of 1.3 (95% CI 1.3, 1.3).⁹

In low income settings, half of the babies born at or below 32 weeks die due to lack of feasible, cost effective care such as warmth, breastfeeding support and basic care for infection and breathing difficulties whereas those survived may cause increasing burden of disability in the middle income setting. Almost all survive in high income setting.¹⁰ In our study, 59.6% babies born before 32 weeks died. More than 90% of the ELBW die in low income settings though less than 10% die in the high-income settings. In our study, 79.6% of the ELBW died.

In our study, out of 80 neonates of birth weight $\leq$ 999 grams, death occurred in 71 (88.75%). Percentage of deaths in birth weight 1000 – 1499 grams was 45.58%, 1500 – 2499 grams were 14.72% and $\geq$ 2500 grams was 8.82%. It was statistically significant that birth weight specific mortality decreased with increasing birth weight. Similar results were seen in a study by R Agrawal et al where mortality in LBW was 15.8%, VLBW was 38.0%, ELBW was 71.4% and only 12.7% in $\geq$ 2500 grams.⁷

In our study, of all neonatal deaths, perinatal asphyxia was the leading cause of death (29.13%) followed by prematurity (< 28 weeks gestation) and IUGR with birth weight $\leq$ 999 grams (22.98%), sepsis (including pneumonia and meningitis) (22.65%), any other (17.48%), respiratory distress syndrome (5.5%) and major congenital malformation (2.27%). In a study by R Rakholia et al, the major causes of death in decreasing order were prematurity (25.68%), sepsis / pneumonia / meningitis (21.6%), perinatal asphyxia (19.59%), and RDS (17.3%).¹¹ In a study by R Agrawal et al, preterm RDS (24.6%) was the commonest cause of death followed by birth asphyxia (23.8%), sepsis (23.1%) and prematurity (16.9%).⁷ Similar observations were seen in a study by Sood Ambika et al⁸ and a study in Iraq by Bushra A et al.¹²

In short term, birth asphyxia have a mortality more than 30%. Most of the deaths occur in the first few days of birth. Those survived are left with mild to moderate neurodeficit and may die from aspiration or systemic infection.¹³ In our study, mortality from asphyxia were 21.08% of the asphyxiated babies and asphyxia was the cause of death of 29.13% of deaths from all causes. There are estimated 1.39 to 3.9 million annual neonatal sepsis cases and 4,00,000 to 7,00,000 annual deaths depending upon the study and the geographical area. An estimated 84% of neonatal deaths due to infection could be prevented.¹⁴ Our study shows mortality from sepsis including pneumonia and meningitis were 51.43% of the neonates having sepsis and 23% of all deaths are due to sepsis.

In our study, mortality due to RDS were 29.31% of the neonates having respiratory distress syndrome and it was 5.5% of all deaths. In a study in Iraq, lowest case fatality rate was for RDS (12.7%).¹² In our study, mortality due to major congenital malformation were 20% of the neonates with major congenital malformation and it was 2.27% of all deaths. In a study in Iraq, highest case fatality rate was among congenital anomalies (54%).¹²

Approximately 2.8 million children die annually within the first 28 days of life with 36% deaths on first day, 37% in the next six days, and 28% between day seven and day 27.⁶ In our study, first day deaths were 47 (15.21%), first two days were 105 (33.98%), first seven days were 229 (74.11%) out of total 309 deaths. Studies by Sankar M et al and R Agrawal et al indicate that the first three days account for almost 60% of total neonatal deaths¹⁵ and 13.8% deaths occur in the first 24 hours while 75.4% deaths occur in one to six days.⁷ In a study by A Sood et al, 64.48 % neonates died at one to six days, 20.77 % were more than seven days old, while 14.75 % were less than one day old.⁸

In our study, 16.67% babies with asphyxia died on the first day and 37.78% in first two days. 82.22% deaths occurred in first seven days. In a study by M Sankar et al, 98.2% deaths due to asphyxia occurred in the first week of life.¹⁵ First day deaths due to prematurity and ELBW were 26.77% and deaths during the first week were 76.06%. In a study by M Sankar et al, more than four-fifths of deaths due to prematurity (83.2%) occurred in the first week of life; the first day (day 0) contributed around 40%.¹⁵ 57% of the sepsis cases died in the first seven days of life. In a study by M Sankar et al, less than one-half of the total deaths secondary to sepsis occurred in the first week of life.¹⁵ Our study shows 42.86% deaths due to major congenital malformation occurred on the first day and 100% deaths due to the same occurred within one week. In a study by M Sankar et al, about four-fifth deaths (78.4%) occurred in the first week of life, with the first day (day 0) contributing about 40%.¹⁵

The probably unpreventable deaths in our study are those with birth weight < 500 grams (1.9%) and death occurring in the

first day due to perinatal asphyxia (4.9%), prematurity < 28 weeks gestation and IUGR with birth weight ($\leq$ 999 grams) (6.15%), and major congenital malformation (0.97%) together contributing to 13.92% of all deaths. 80% of all newborn deaths result from three preventable and treatable conditions: complications due to prematurity, intrapartum related death (including birth asphyxia) and neonatal sepsis.^{6,16,17}

The present study highlights the need to focus on perinatal asphyxia, sepsis including pneumonia and meningitis, and prematurity < 28 weeks gestation and IUGR with birth weight ($\leq$ 999 grams) to improve neonatal mortality. Antenatal care should be improved, there should be early recognition of signs of sepsis and prompt intervention should be done at the health facilities. Improvement in intranatal care and focus on the golden minute during new born resuscitation can improve outcomes in birth asphyxia. Availability of CPAP and surfactant can prevent RDS related deaths. Number of health staffs who will provide skilled maternal and essential new born care need to be enhanced. Resuscitation skills and skills required to support newborns in the initial few days of admission can prevent prematurity.¹⁸⁻²⁰ The major focus should be on the possibly preventable deaths which are most of the cases of sepsis (22.65%), perinatal asphyxia (29.13%) and prematurity < 28 weeks gestation and IUGR with birth weight ($\leq$ 999 grams) (22.98%) contributing to 74.76% of all deaths. Interventions should be targeted in such areas.

The limitations of this study are it is a hospital based, retrospective single center study. So, it is going to be difficult to generalise our results. Further, multi centric studies would be warranted in the future to draw conclusive evidence.

Conclusion

The present study reports a death rate of 21.71% among sick newborns admitted to the SNCU. Increased mortality was observed in those born with a gestational age of less than 28 weeks or a birth weight of 999 grams or less. First day deaths accounted 15.21%, first two days 33.98% and first seven days 74.11% of all deaths. The possibly preventable deaths are most of the cases of perinatal asphyxia, sepsis and prematurity contributing to 74.76% of all deaths. To reduce NMR, interventions should target these areas.

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Conflict of Interest None

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