

A prospective observational study of morbidity and mortality profile of neonates admitted to neonatal intensive care unit in a tribal area of central India

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ABSTRACT

Introduction: Globally, 2.6 (2.5–2.8) million newborns died in 2016 or 7000 every day. High neonatal mortality rate reflects the presence of unfavorable social, economic, and environmental conditions. **Objectives:** To find morbidities and causes of poor outcome in a tertiary care neonatal unit of eastern part of Maharashtra. **Materials and Methods:** The present prospective observational study was conducted in the neonatal intensive care unit of a tertiary care center, Gondia, in Central India which is situated in remote, tribal place during. Data were collected by interview method using a predesigned, semi-structured questionnaire. Neonatal variables used were total number of admissions, gender, birth weight, and gestational age, diagnosis at admission, final outcome, and duration of stay. **Results:** There were a total of 2017 admissions during the study period and out of them, 62.96% were inborn neonates and 37.04% were outborn. Males (56.67%) had slightly higher admission rate than females (43.33%). Pre-term admissions were 40.06%. The majority of admissions were due to low birth weight (LBW) (60.19%). Preterm and related complications (49.43%) were ranked highest followed by jaundice (16.46%). Out of the total 2017 neonates, 218 died following admission. Prematurity (45.41%) followed by sepsis (22.48%) were reasons for mortality among neonates. **Conclusion:** We have tried to present neonatal morbidity pattern and outcome parameters from a tertiary care neonatal center in a developing country. Prematurity, sepsis, and birth asphyxia were accounting for morbidities and mortalities. The preterm and LBW babies had significantly higher mortality even with standard intensive care.

Key words: Neonatal intensive care unit, Neonatal morbidities, Neonatal mortalities, Tribal

Globally, 2.6 (2.5–2.8) million newborns died in 2016, i.e. 7000 neonatal deaths every day. Neonatal deaths accounted for 46% of all under-five deaths, increasing from 41% in the year 2000. Five countries accounted for half of all newborn deaths: India, Pakistan, Nigeria, the Democratic Republic of the Congo, and Ethiopia [1]. The year 2015 marks the end of the millennium development goals era, and year 2016 marks the beginning of the implementation of the sustainable development goals (SDGs). The SDGs target an under-5 mortality rate of no more than 25 per 1000 live births in every country of the world in 2030, of which neonatal mortality is a major contributory factor [2].

Overall, it is estimated that up to 50% of all neonatal deaths occur within the first 24 h after birth, and 75% by 1 week of age. The most common causes of neonatal deaths are infection, prematurity, and intrapartum-related causes (birth asphyxia); the frequencies of these deaths vary between and within regions [3]. Preterm birth and related complications are the major determinants of neonatal morbidity and childhood disability [4]. In 2015, the World Bank reported that 85% of the neonatal mortality occurring around the globe is contributed by preterm birth [5].

Infant mortality is the most sensitive indicator of population health. High infant mortality rate (IMR) reflects the presence of unfavorable social, economic, and environmental conditions during the 1st year of life [6]. Unfortunately, the resource-poor settings that bear the burden of more than 98% of neonatal deaths often lack the effective vital registration systems crucial to understanding mortality and planning services or interventions [7]. There is no single solution to save the lives of newborns. The greatest success of life-saving interventions occurs when hospital- and community-based activities are linked together [8].

In India, different national programs were introduced to restrain neonatal as well as infant mortality such as Integrated Management of Neonatal and Childhood Illness, Janani Shishu Suraksha Karyakram, and Rashtriya Bal Suraksha Karyakram. Still, inadequate maternal and newborn care, lack of quality care, overdependence on higher health-care centers, and overlooked adolescence are few of factors that compelled the Government of India to adopt the concept of continuum of care recently, as emphasized in Reproductive, Maternal, Newborn, Child and Adolescent Health + A strategy [9]. India is among the few

countries that bear the highest burden of infant deaths. To avert this and other health problems, the country has made large-scale investments in primary health-care and social services over the last decade; mainly in the disadvantaged rural population. Due to these efforts, IMR was reduced from 49 to 30 deaths per 1000 live births [10].

Admission to the neonatal intensive care unit (NICU) also interrupts the mother–infant bonding and establishment of breastfeeding, which further increases morbidity and mortality [11]. While level of care, patient load, and place of delivery determine neonatal outcome, there is increased survival of very low birth weight (VLBW) infants; outcome of extremely LBW (ELBW) neonates is still unfavorable even in well-equipped centers [12]. Deaths occurring in NICUs have a major impact on infant mortality. Understanding the causes of death in NICUs and the modifiable factors associated with death has the potential to reduce infant mortality [13].

To plan how to eliminate preventable infant deaths, information is needed about the current distribution of causes of infant deaths and this has changed in recent decades. There is a paucity of information regarding the determinants of mortality for newborns in settings with the heavy burden of NICU admission. There is limited information about neonatal outcome from developing countries. The present study aims to find morbidities and causes of poor outcome in a tertiary care neonatal unit of eastern part of Maharashtra.

MATERIALS AND METHODS

This is discussed under the following sections:

Setting

The present prospective observational study was conducted in NICU of a tertiary care center, Gondia, in Central India, which is situated in a remote, tribal place. This NICU is currently a 26-bedded unit with one neonatal ventilator and two continuous positive airway pressure machines with facilities for surfactant administration and exchange transfusion. Inborn neonates as well as outborn cases referred from all over districts in the remote tribal region of eastern Maharashtra region as well as nearby areas of Madhya Pradesh and Chhattisgarh are treated.

Population

Inborn (delivered in the institute of study) as well as outborn (delivered outside) babies from all over district in the remote tribal region of eastern Maharashtra as well as nearby areas of Madhya Pradesh and Chhattisgarh were included in the study.

Design

A prospective observational study design was adopted to conduct the study.

Sample Size and Sampling Procedure/Technique

All the admitted babies to NICU were included in the study.

Measure

Data were collected by interview method using a predesigned, semi-structured questionnaire. Neonatal variables used were total number of admissions, gender, birth weight, gestational age, diagnosis at admission, final outcome, and duration of stay. Neonates were divided into two groups of inborn and outborn unit admission. Final outcome was recorded as discharged, left against medical advice (LAMA), referred for pediatric surgical indications to super specialty center, and death during hospital course. The reasons for admission were determined from the admission notes in the infant's case papers. Mortality data were collected in the form of cause of death, duration between time of admission and death, and age at death.

Data Collection

The data were collected from January 1 2017 to December 31 2017. Data were collected on a daily basis.

Ethical Consideration

Intuitional Ethics committee's permission was taken prior the start of the study. The consent from parent/guardian was taken prior start of the study.

Data Analysis

Data were analyzed using StataCorp, 4905 Lakeway Drive, College Station, Texas 77845 USA. Continuous data were presented as mean and standard deviation and range and categorical data were presented as frequency and percentage. Risk of mortality was calculated using odds ratio (OR) and 95% confidence interval.

RESULTS

Table 1 shows epidemiological characteristics of neonates admitted in NICU. There were a total of 2017 admissions during 2017, while inborn neonates (1270 [62.96%]) were higher than outborn (747 [37.04%]). Males (1143 [56.67%]) had slightly higher admission rate than females (874 [43.33%]). Pre-term admissions constituted 808 (40.06%). Majority of admissions was due to LBW (1214 [60.19%]), followed by normal birth weight (NBW) (554 [27.47%]). Majority of neonates were admitted before 3 days (1061 [52.60%]). Majority of neonates, i.e. 1585 (78.58%) were discharged after medical treatment, while 218 (10.81%) were dead, 110 (5.45%) LAMA, and 98 (4.86%) were referral for surgical indication.

Premature babies who had respiratory distress syndrome, jaundice, and who became septic after admission in the NICU were included in the prematurity and related complications'

group. Table 2 shows morbidity pattern at the time of admission. Pre-term and related complications (808 [40.06%]) were ranked highest followed by jaundice (332 [16.46%]). Other (8 [0.40%]) causes include hypothermia and hypoglycemia, hemorrhagic disease of newborn, and feeding issues admission.

Table 3 shows the mortality pattern of NICU admissions. Table 4 shows epidemiological characteristics of neonatal mortality in NICU. Prematurity (99 [45.41%]) followed by sepsis (49 [22.48%]) were the reasons for mortality among neonates. Mortality rate among inborns (59.17%) was higher than that in outborn (40.83%), also in males (56.42%) and females (43.58%). Pre-term (137 [62.84%]) neonates were having higher mortality rate. LBW admissions (81 [37.16%]) were highest followed by VLBW (74 [33.94%]). Duration between the time of admission and death was highest up to 3 days (95 [43.58%]). Majority of neonates (121 [55.50%]) died at the age of 0–6 days.

Table 5 depicts association between epidemiological characteristics of neonates and their mortality in NICU. Mortality rates among inborns (10.16%) and outborns (11.91%) were similar in the study; there was no significant difference in death rates of inborn and outborn neonates (Chi-square value = 1.21). Mortality rates among males (10.76%) and females (10.87%) were similar in our study. Furthermore, there was no significant differences (Chi-square value = 0.05). Pre-term neonates were having high mortality rate with significant difference (Chi-square value = 22.44) compared to others. Similarly, LBW (13.12%) neonates were having 2.80 times high mortality than normal. It was observed that longer NICU stay (>3 days) improved survival.

DISCUSSION

Inequities in child mortality across and within countries remain large. As compared to developed countries, neonatal mortality is still high in developing countries. A child in Southern Asia is nine times more likely to die in the 1st month than a child in a high-income country [1]. We have presented neonatal morbidity pattern and outcome parameters from tertiary care NICU in a developing country.

The present study had more neonates from inborn (62.96%). Similar result was found by Malik *et al.* (57.21%) [14]. In our study, there was a gender distribution of males = 56.67% versus females = 43.33%; a study conducted by Saini *et al.* found similar results (males = 54.56% vs. females = 45.44%) [15]. In our study, 1209 (59.94%) were term neonates; similar results were obtained from a study by Saharia *et al.* who found 65.66% and Modi *et al.* who found 54.31% [16,17]. In our study, majority of the neonates were Low Birth Weight (LBW) (60.19%) while lower results were obtained in study by Modi *et al.* (54.24%), Shridhar *et al.* found (40.55%) [16,18]. In our study, majority of neonates were discharged within 3 days (52.60%), while that in the study by Adhikari *et al.*, they found that 47.91% of neonates were admitted up to 7 days [12]. Majority of neonates (78.58%) were discharged after treatment, while higher number of neonates were observed to be discharged in a study by Modi *et al.* (88.98%) [16].

Table 1: Background characteristics of neonates admitted in NICU

Characteristics	n=2017 (%)
Birth place	
Inborn	1270 (62.96)
Outborn	747 (37.04)
Gender	
Male	1143 (56.67)
Female	874 (43.33)
Gestation	
Term	1209 (59.94)
Pre-term	808 (40.06)
Birth weight	
Normal	554 (27.47)
LBW	1214 (60.19)
VLBW	202 (10.01)
ELBW	47 (2.33)
Duration of hospital stay	
<1 day	112 (5.55)
1–3 days	949 (47.05)
4–7 days	471 (23.35)
>7 days	485 (24.05)
Outcome	
Discharge	1585 (78.58)
Referral	98 (4.86)
LAMA	110 (5.45)
Died	218 (10.81)

LAMA: Left against medical advice, NICU: Neonatal intensive care unit

Table 2: Morbidity pattern of NICU patients

Morbidity	n (%)
Pre-maturity and related complications	808 (40.06)
IUGR	189 (9.37)
Jaundice	332 (16.46)
Birth asphyxia	302 (14.97)
Sepsis	145 (7.19)
Meconium aspiration syndrome	139 (6.89)
Respiratory distress (other causes)	66 (3.27)
Major congenital malformation	28 (1.39)
Other	8 (0.40)
Total	2017 (100.00)

NICU: Neonatal intensive care unit, IUGR: Intrauterine growth retardation

Table 3: Mortality pattern of NICU patients

Causes of mortality	n (%)
Prematurity and related complications	109 (50.00)
Sepsis/pneumonia/meningitis	53 (24.31)
HIE/moderate-severe birth asphyxia	38 (17.43)
Major congenital malformation	14 (6.42)
Meconium aspiration syndrome	2 (0.92)
Others	2 (0.92)
Total	218 (100.00)

NICU: Neonatal intensive care unit

Mortality rates among inborn (10.16%) and outborn (11.91%) were nearly similar in our study, while lower results were obtained by Shridhar *et al.* (inborn = 6.69% vs. outborn = 8.36%) [18], while Modi *et al.* found lower mortality rates among outborn (6.57%) as compared to inborn (13.22%) neonates [16]. Proportion of male

neonatal mortality (56.42%) was slightly higher as compared to female neonatal mortality (43.58%). Similar results were obtained by Shridhar *et al.* (males = 59.23% vs. females = 40.77%) in Karnataka [18], Adhikari *et al.* (males = 65.21% vs. females = 34.79%) in Nepal [12], while Ranjan *et al.* found male mortality to be up to 65.30% in Patna [19]. Pre-term neonatal deaths constituted 143 (17.70%), while Saharia *et al.* found it to be 17.99% [17], Saini *et al.* found it to be 11.69% [15], and Malik *et al.* found higher (42.63%) preterm mortality proportion [14]. Mortality due to LBW (13.12%) was seen in our study, while others have found higher results. Modi *et al.* found 36.05% [16], Prasad *et al.* found 22.89% [20], and Adhikari *et al.* found 34.78% [12].

Most of the neonates, those were having with poor outcome, were belonging to premature and LBW groups. Prematurity and birth weight are important factors in determining the survival of neonates in NICU; as in our study, preterm neonates had roughly 3 times' risk of mortality compared with term neonates (OR = 2.86). Similar findings were found by Prasad *et al.* [20] and Malik *et al.* [14]. In addition, birth weight < 2500 g was also having roughly 3 times' risk of mortality compared with term neonates (OR = 2.80). Malik *et al.* found OR of 2.68 [14]. Future national programs for improving neonatal care should have a component of addressing LBW in addition to continuing care for NBW neonates.

The present study had a survival rate of 78.58% in the NICU. Similar results were found by Ranjan *et al.* (76.62%) [19]. Adhikari *et al.* found a survival rate of 82.61 [12]. The mortality rate in ELBW and VLBW was 78.72% and 36.63%, respectively. Prasad *et al.* found mortality rate in ELBW and VLBW group, respectively, to be 63.16% and 31.38% [20].

CONCLUSION

We have tried to present neonatal morbidity pattern and outcome parameters from a tertiary care neonatal center in a developing country. In 2017, a total of 2017 NICU admissions took place. Out

Table 4: Background characteristics of neonatal mortality

Characteristics	n=218 (%)
Birth place	
Inborn	129 (59.17)
Outborn	89 (40.83)
Gender	
Male	123 (56.42)
Female	95 (43.58)
Gestation	
Term	80 (36.70)
Pre-term	137 (62.84)
Post term	1 (0.46)
Birth weight	
Normal	26 (11.93)
LBW	81 (37.16)
VLBW	74 (33.94)
ELBW	37 (16.97)
Duration between the time of admission and death	
<1 day	41 (18.81)
1–3 days	95 (43.58)
4–7 days	36 (16.51)
>7 days	46 (21.10)
Age at death	
<1 day	35 (16.06)
1–6 days	121 (55.50)
>7 days	62 (28.44)

LBW: Low birth weight, VLBW: Very low birth weight, ELBW: Extremely low birth weight

Table 5: Association of characteristics of neonates with mortality

Characteristics	Total patients	Mortality n (%)	Chi-square	OR 95% CI	P value
Birth place					
Inborn	1270	129 (10.16)	1.21	1.18 (0.89–1.56)	0.2
Outborn	747	89 (11.91)			
Gender					
Male	1143	123 (10.76)	0.05	1.09 (0.89–1.34)	0.9
Female	874	95 (10.87)			
Gestation					
Term	1209	75 (6.20)	25.44	2.86 (2.13–3.83)	<0.001
Pre-term	808	143 (17.70)			
Birth weight					
Normal	554	26 (4.69)	22.92	2.80 (1.84–4.27)	<0.001
LBW	1463	192 (13.12)			
Hospital stay					
<3 day	1057	136 (12.87)	7.72	0.67 (0.50–0.89)	0.005
>3 days	956	82 (8.58)			

LBW: Low birth weight, OR: Odds ratio, CI: Confidence interval

of these, 218 (10.81%) died. Prematurity, sepsis, and birth asphyxia were accounting for morbidities and mortalities. The preterm and LBW babies had significantly higher mortality even with standard intensive care; therefore a strong and effective antenatal program with extensive coverage of all pregnant females specifically in outreach areas should be developed which will help in decreasing preterm deliveries and lowering the incidence of LBW babies. There is an interplay of different demographic, educational, socioeconomic, biological, and care-seeking factors, which are responsible for the disparities and the high burden of neonatal mortality.

WEAKNESS

The findings of the current study should be interpreted keeping in view the following limitations: Neonates who were LAMA and those who were referred to other centers due to non-availability of NICU beds and need of surgical intervention were excluded from the study and inclusion of the same could have modified the results. As it was a government hospital-based study and as most of the patients had a low socio-economic status, the results of this study may not reflect the true burden which is prevalent in the community as a whole. Maternal details were not studied in the present study. In our study, we did not divide the deaths into early and late neonatal periods. We were unable to diagnose inborn errors of metabolism due to lack of diagnostic facilities.

STRENGTHS

The large sample size is the major strength of the study. We have recruited neonates prospectively. Thorough follow-up was maintained for every neonate. Precise data regarding mortality and morbidity pattern for NICU admissions can be useful for future studies and programmatic implications.

RECOMMENDATIONS

Maternal and neonatal health-care strategies should be further strengthened for prevention of complications related to birth. Primary- and secondary-level neonatal care is essential for further reductions in NBW and LBW neonatal morbidities and mortalities. Interventions should be planned and implemented at different levels of community to prevent and reduce preterm delivery, LBW, and birth asphyxia, which are the leading causes of neonatal deaths.

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