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*Original Research Article*

# Patterns of Morbidity among Newborns Admitted In SNCUs of Odisha, India

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## ABSTRACT

**Background:** Odisha has the highest Neonatal mortality in India at 32/1000 live births. Thirty Special Newborn Care Units in the state provide specialized newborn care. We aimed to examine the patterns of morbidities among the admitted newborns and their immediate outcomes.
**Methods:** Patient-wise data was extracted from online software for all SNCUs for the period Jan 2015 to Dec 2017. Causes of admission; by type of admissions, birth weight, gestational age and outcomes of commonest morbidities were examined including the variations across years.
**Results:** The common causes of admission were HIE / Moderate to severe birth Asphyxia (29.09%), Prematurity / LBW (25%), Jaundice (15%) and Infections (Sepsis / Pneumonia / Meningitis) (15%). Birth Asphyxia and Prematurity / Low Birth Weight were the leading causes of admission among Inborns and Outborns respectively. Proportion of Birth Asphyxia was nearly ten percentage points higher among Inborns, while the proportions of infections were two times higher among Outborns. Birth Asphyxia admissions from health facility referrals were thrice that of community referrals. Sepsis admissions from community referrals were two times that of health facility referrals. Of the newborns admitted for Birth Asphyxia, 44% were of normal birth weight and 45% weighed between 1500 to 2500 gms. Birth Asphyxia had the lowest survival rate ranging from 64% to 60% among Inborn and Outborn respectively.
**Conclusion:** Birth Asphyxia is the leading cause of newborn morbidity, followed by Prematurity and Infections. Improved Obstetric management and early access to Caesarean sections are key interventions which may lead to reduction in Birth Asphyxia.
***Key words:*** Newborn morbidity, Newborn mortality, Birth Asphyxia, Inborn, Outborn

## INTRODUCTION

Globally, half of all neonatal deaths are concentrated in five countries, namely, India (24%), Pakistan (10%), Nigeria (9%), DR Congo (4%) and Ethiopia (3%). [1] In India, among all states, the neonatal mortality rate of Odisha is the highest in the country and translates into nearly 25000 newborn deaths annually in the state. The neonatal mortality of Odisha is 32 per 1000 live births [2] and contributes to more than half of the under-five mortality. In comparison, the National NMR is 24, IMR is 34 and U5 MR is 39 per 1000 live births. [2] Four states in the country namely, Uttar Pradesh, Bihar, Madhya Pradesh, Rajasthan account for 58% of the total infant deaths in the country. Among states, the neonatal mortality rate ranges from 32 in Odisha to 6 per 1000 live births in Kerala. [2] Further, there are significant differences between various districts ranging from 27 in

Jagatsingpur to 71 per 1000 live births in Bolangir. [3] However, Bargarh & Dhenkanal have the second highest NMR at 46 per 1000 livebirths, while 15 districts range, from 29 to 37 per 1000 live births. [3]

Though there is steady increase in institutional delivery upto more than 85%, in the state, [4] the decline in the neonatal mortality is not commensurate to the increase in institutional deliveries. To address the high neonatal mortality, many cost effective and proven interventions have been implemented in the state like - early initiation of breast feeding, proper umbilical cord care, maintaining temperature of baby, early identification of danger signs and referral, care of low birth weight and premature babies etc. Interventions are being delivered through community and facility based programmes. The community programmes are being delivered through schemes like Home based newborn care by the ASHA, Integrated Management of Newborn & Childhood Illnesses by AWWs and ANMs. The facility based newborn care programmes are being delivered through Newborn care corners, Newborn Stabilization Units and Special New Care Units. [5]

To increase the reach of specialized facility based care for newborn babies, Special Newborn Care Unit was piloted in Mayurbhanj district of Odisha in 2007. The Special Newborn Care Units provided specialized treatment and care to the newborns with extreme low birth weight, infections, jaundice, birth asphyxia, respiratory distress etc. After successful piloting, SNCUs have been scaled up state wide and 30 units were functional by March 2015. These units were mostly located at District Headquarter Hospitals and Medical Colleges. As per the SNCU online database, 5000 newborns were being admitted to the units every quarter with a mortality rate ranging from 2% to 20% across units. To facilitate access to the SNCUs Government of Odisha had introduced dedicated transportation facilities for mothers and newborn through "102" ambulance services, since August 2014. [6] Availability of transportation would enable the newborns to avail timely access leading to an improvement in survival. Timely and early access to the treatment is a major factor impacting on the mortality rates among newborn.

Studies elsewhere in the country have shown that the major causes of admission and death, were Birth Asphyxia, Sepsis and Low Birth Weight/ Prematurity. [7] A cross sectional study to assess the functioning of SNCUs across 8 rural districts of the country found that the leading causes of admissions and death were Birth Asphyxia, Low birth Weight / Prematurity, Sepsis and Jaundice. [8] This study also concluded that case fatality was high among very low birth and out born babies. Studies have concluded that there is a high burden of neonatal death due to preventable causes like asphyxia and infections and health policies must ensure increased access to essential services to target sick neonates. [8] A study in a tertiary facility in Odisha concluded that majority of babies were Outborn and there was possibility of delay and lack of appropriate quality of care at the referring facilities. Infections / Sepsis followed by Birth asphyxia was the commonest causes of admissions. [9] No studies were seen within India which examined the morbidities at state level and the variables affecting it.

In this study, we aimed to examine the patterns of morbidities among the SNCU admitted newborns and their outcomes for all the 30 SNCUs in the state for a three-year period. The causes of admission; by type of admissions, birth weight, gestational age and outcomes of commonest morbidities were examined including the variations across years.

The purpose of the study was to understand the patterns of morbidities with an objective to formulate specific recommendations to reduce neonatal mortality.

## MATERIALS AND METHODS

This is a descriptive retrospective study using secondary data, which included thirty SNCUs in the State of Odisha. The study period was from 1st January 2015 to 31st December 2017. The data included of all newborns admitted during the study period which was further segregated into Inborn (neonates born in the same hospital where the SNCU was located) and Outborn (neonates delivered in other non-SNCU facilities or home and referred to the SNCU). The demographic characters included in the study were type of admission, gestational age, birth weight, type of referral, indication for admission and outcomes. Referral status of the Outborn babies, further included community or facility referred. Admission diagnoses were categorized (such as prematurity, respiratory distress, infection, etc.).

All analyses reported in this paper are restricted to infants less than 28 days of age at admission. Primary disease was considered as final diagnosis even if the baby developed complications of primary disease or having more than one disease. WHO definitions were used for Term, Preterm, Low Birth Weight (LBW), Very Low Birth Weight (VLBW), Extreme Low Birth Weight (ELBW) and congenital malformation. Meconium aspiration syndrome was neonates diagnosed on basis of history, clinical and radiological findings. Neonatal jaundice was diagnosed after assessment of serum bilirubin and in pathological zone as per AAP charts. Sepsis was diagnosed by clinical and appropriate lab screening tests. [5]

## STATISTICAL ANALYSIS:

The data was entered in Microsoft EXCEL sheets 2016 version from the SNCU online database. Descriptive statistics were used to assess demographic, clinical characteristics as well as neonatal outcomes. SPSS software 21.0 version was used to tabulate the descriptive statistics and epi info software 7.0 version was used for the analysis of Chi squared tests to test the strength of association between Inborn and Outborn neonates in respect to morbidities and mortality. Outborn neonates further were divided into health facility referred and community referred to analyze the association with morbidities and their immediate outcomes.

## RESULTS

Between January 2015 and December 2017, 128838 babies were admitted in the 30 Special Newborn Care Units in the state. Of the total babies admitted, 65454 (50.8%) were Inborn ie they were born at the same health facility where the SNCU is located and 63384 (49.2%) were Outborn ie they were born at facilities where there is no SNCU or at home. Of the outborn babies, 48369 (37.54%) were referred from other health facilities while 15015 (11.65%) were referred from the community. Out of the total babies admitted in SNCUs, 70.53% were discharged alive, 10.62% died, 14.31% were referred and 4.54% Left against medical advice. The gender distribution among the admitted newborns was 77530 (60.18%) males and 51273 (39.80%) females. Thirty-five (0.03%) babies were classified as ambiguous.

### Causes of admission

As seen in Table 1, nearly one-third of the newborns were diagnosed with Hypoxic Ischaemic Encephalopathy / Moderate to severe birth Asphyxia (29.09%). One fourth of the admissions were due to Prematurity / Low birth weight (25.29%), followed by Jaundice (15%) and Infections (Sepsis/Pneumonia/Meningitis) (15%).

**Table 1: Proportions of the different morbidities in the SNCUs**

| Morbidities | Number (%) |
|---|---|
| HIE/moderate- severe birth Asphyxia | 37500 (29.11) |
| Prematurity / Low Birth Weight | 32589 (25.29) |
| Jaundice requiring phototherapy | 20527 (15.93) |
| Sepsis/Pneumonia/Meningitis | 18717 (14.53) |
| Others | 9828 (7.63) |
| Major Congenital malformation | 1720 (1.34) |
| Meconium aspiration syndrome | 1923 (1.49) |
| Hypothermia | 2265 (1.76) |
| Respiratory distress syndrome | 2599 (2.02) |
| Hypoglycaemia | 1173 (0.91) |
| Total | 128838 (100) |

**Variation in pattern of morbidity over time**

There was no significant change in the causes of admissions over the period of three years. Birth Asphyxia continued to constitute nearly 30% of the admissions while Prematurity / Low Birth Weight (LBW) constituted about one fourth of the admissions. Jaundice and Infections (Sepsis/ Pneumonia/Meningitis) also continued to maintain the same proportions over the three-year period.

**Table 2: Patterns of morbidities over time**

| Morbidities | 2015 Number (%) | 2016 Number (%) | 2017 Number (%) |
|---|---|---|---|
| HIE/moderate- severe birth Asphyxia | 11294 (28.87) | 13391 (29.93) | 12814 (28.49) |
| Prematurity / Low Birth Weight | 9657 (24.69) | 11222 (25.08) | 11709 (26.03) |
| Jaundice requiring phototherapy | 6325 (16.17) | 6344 (14.18) | 7857 (17.47) |
| Sepsis/Pneumonia/Meningitis | 5416 (13.85) | 6754 (15.10) | 6547 (14.55) |
| Others | 3556 (9.09) | 3413 (7.63) | 2859 (6.36) |
| Respiratory distress syndrome | 764 (1.95) | 947 (2.12) | 888 (1.97) |
| Hypoglycaemia | 415 (1.06) | 510 (1.14) | 248 (0.55) |
| Major Congenital malformation | 485 (1.24) | 523 (1.17) | 712 (1.58) |
| Meconium aspiration syndrome | 491 (1.26) | 649 (1.45) | 783 (1.74) |
| Hypothermia | 713 (1.82) | 985 (2.20) | 567 (1.26) |
| Total | 39116 (100) | 44738 (100.00) | 44984 (100) |

After applying Single table Chi-square test these observations were found to be highly significant with a p value <0.0001 *(Chi squared value 698.5 Degree of freedom=18)*

**Variation in morbidity pattern over type of admission**

Among the Inborn babies, incidence of Birth asphyxia was 34%, followed by Prematurity / LBW (22%), Jaundice (19%) and Infections (9%). Among the Outborn admissions, incidence of Prematurity / LBW was 28%, followed by 25% of Birth asphyxia and Infections (20%). The proportion of Birth Asphyxia was nearly ten percentage points higher among the Inborns as compared to Outborns. The proportion of infections among Outborns was twice that of Inborns.

**Table 3: Morbidity pattern among Inborns and Outborns**

| Morbidities | Inborn Number (%) | Outborn Number (%) |
|---|---|---|
| HIE/ Moderate- severe birth Asphyxia | 21944 (33.53) | 15555 (24.54) |
| Prematurity / LBW | 14604 (22.31) | 17984 (28.37) |
| Jaundice requiring phototherapy | 12434 (19.00) | 8092 (12.77) |
| Sepsis/ Pneumonia/ Meningitis | 5994 (9.16) | 12723 (20.07) |
| Others | 4809 (7.35) | 5019 (7.92) |
| Hypothermia | 1507 (2.30) | 758 (1.20) |
| Hypoglycaemia | 776 (1.19) | 397 (0.63) |
| Major Congenital malformation | 684 (1.05) | 1036 (1.63) |
| Meconium aspiration syndrome | 1431 (2.19) | 492 (0.78) |
| Respiratory distress syndrome | 1271 (1.94) | 1328 (2.10) |
| Total | 65454 (100%) | 63384 (100%) |

After applying Single table Chi-square test these observations were found to be highly significant with a p value <0.0001 *(Chi squared value 5651.39 Degree of freedom=9)*

**Variation in morbidity pattern among type of admission and over time**

Over the period of three years, the proportion of Birth Asphyxia and Prematurity among Inborns and Outborns remained nearly constant. A marginal increase of three percentage points in Jaundice cases was seen among the Inborns while the proportion did not change in the Outborns. With respect to Infections, a marginal increase of two percentage points was seen among Inborns while a slight decline of one percentage point was seen among Outborns.

**Table 4: Morbidity pattern among type of admissions over time**

| Year | 2015 | | 2016 | | 2017 | |
|---|---|---|---|---|---|---|
| Morbidities | Inborn Number (%) | Outborn Number (%) | Inborn Number (%) | Outborn Number (%) | Inborn Number (%) | Outborn Number (%) |
| HIE/ moderate- severe birth Asphyxia | 6964 (33.04) | 4330 (24.00) | 7573 (34.53) | 5818 (25.51) | 7407 (33.00) | 5407 (23.99) |
| Prematurity / LBW | 4637 (22.00) | 5020 (27.83) | 4848 (22.10) | 6374 (27.95) | 5119 (22.81) | 6590 (29.24) |
| Jaundice requiring phototherapy | 3939 (18.69) | 2386 (13.23) | 3760 (17.14) | 2584 (11.33) | 4735 (21.10) | 3122 (13.85) |
| Sepsis/ Pneumonia/ Meningitis | 1775 (08.42) | 3641 (20.18) | 1981 (09.03) | 4773 (20.93) | 2238 (09.97) | 4309 (19.12) |
| Hypothermia | 537 (02.55) | 176 (0.98) | 664 (3.00) | 321 (1.41) | 306 (1.36) | 261 (1.16) |
| Hypoglycaemia | 277 (1.31) | 138 (0.76) | 350 (1.60) | 160 (0.70) | 149 (0.66) | 99 (0.44) |
| Others | 1985 (9.42) | 1571 (8.71) | 1546 (7.05) | 1867 (8.19) | 1278 (5.69) | 1581 (7.01) |
| Meconium aspiration syndrome | 396 (1.88) | 95 (0.53) | 510 (2.33) | 139 (0.61) | 525 (2.34) | 258 (1.14) |
| Respiratory distress syndrome | 368 (1.75) | 396 (2.2) | 481 (2.19) | 466 (2.04) | 422 (1.88) | 466 (2.07) |
| Major Congenital malformation | 197 (0.93) | 288 (1.6) | 221 (1.01) | 302 (1.32) | 266 (1.19) | 446 (1.98) |
| Total | 21075 (100) | 18041 (100) | 21934 (100) | 22804 (100) | 22445 (100) | 22539 (100) |

After applying Single table Chi-square test these observation were found to be highly significant with a p value <0.0001 *(Chi squared value 6562.33 Degree of freedom=45)*

**Variation in morbidity pattern among Outborn admissions**

Among the Health Facility referred, Prematurity / LBW and Birth Asphyxia constituted nearly 30% of admissions each, while Infections was the third leading cause of admission at 17%. Among the Community referred newborns, Infections was the leading cause with 30% contribution followed by Prematurity / LBW and Birth Asphyxia. Of the total Outborn admissions 24% were Community referrals.

**Table 5: Variation in morbidity pattern among Outborn (Health facility and community referred) admissions**

| Morbidity | Health Facility Referred | Community Referred |
|---|---|---|
| Prematurity / LBW | 14534 (30.05) | 3450 (22.98) |
| HIE/ Moderate- severe birth Asphyxia | 13955 (28.85) | 1600 (10.66) |
| Sepsis/Pneumonia/Meningitis | 8250 (17.06) | 4473 (29.79) |
| Jaundice requiring phototherapy | 4948 (10.23) | 3144 (20.94) |
| Others | 3518 (7.27) | 1501 (10) |
| Major Congenital malformation | 853 (1.76) | 183 (1.22) |
| Meconium aspiration syndrome | 423 (0.87) | 69 (0.46) |
| Hypothermia | 512 (1.06) | 246 (1.64) |
| Respiratory distress syndrome | 1073 (2.22) | 255 (1.70) |
| Hypoglycaemia | 303 (0.63) | 94 (0.63) |
| Total | 48369 (100.00) | 15015 (100) |

After applying Single table Chi-square test these observations were found to be highly significant with a p value <0.0001 *(Chi squared value 3903.14 Degree of freedom=9)*

**Variation in Outcomes of common morbidities across types of admission**

The survival rate was the highest for Jaundice and lowest for Birth Asphyxia across both categories. The survival rate for Jaundice and Prematurity /LBW was similar across Inborns and Outborns. The survival rate for Birth Asphyxia and Infections was three percentage points higher among Inborns as compared to Outborns. Further, there were minor variations of one to two percentage points in the mortality rates across the types of admission and morbidities.

**Table 6: Variation in Outcomes of common morbidities across types of admission**

| | HIE/ moderate- severe birth Asphyxia Number (%) | | Jaundice requiring phototherapy Number (%) | | Prematurity / LBW Number (%) | | Sepsis/ Pneumonia/ Meningitis Number (%) | | Others Number (%) | |
|---|---|---|---|---|---|---|---|---|---|---|
| Outcome | Inborn | Outborn | Inborn | Outborn | Inborn | Outborn | Inborn | Outborn | Inborn | Outborn |
| Discharge | 12499 (63.5) | 10864 (60.3) | 10685 (94.3) | 8613 (93.54) | 10961 (67.9) | 11140 (67.36) | 6309 (73.9) | 7270 (71.09) | 3875 (79.9) | 3812 (76.36) |
| Expired | 2602 (13.2) | 2523 (14.2) | 14 (1) | 24 (0.28) | 2274 (14.1) | 2433 (14.91) | 765 (9.0) | 1154 (11.33) | 145 (3.0) | 151 (3.17) |
| LAMA | 586 (3.0) | 529 (3.0) | 329 (2.9) | 258 (2.97) | 955 (5.9) | 921 (5.58) | 351 (4.1) | 342 (3.46) | 279 (5.8) | 316 (6.37) |
| Referred | 3987 (20.3) | 3909 (22.4) | 305 (2.7) | 298 (3.21) | 1947 (12.1) | 1957 (12.15) | 1115 (13.1) | 1411 (14.11) | 550 (11.3) | 700 (14.10) |
| Total | 19674 (100) | 17825 (100) | 11333 (100) | 9193 (100) | 16137 (100) | 16451 (100) | 8540 (100) | 10177 (100) | 4849 (100) | 4979 (100) |

After applying Single table Chi-square test these observations were found to be highly significant with a p value <0.0001 *(Chi squared value 9487.64 Degree of freedom=27)*

**Place of delivery with respect to the common morbidities of admitted newborns**

Approximately 80% of the newborns admitted with commonest morbidities, were born at the public facilities at various levels.

**Table 7: Place of delivery with respect to the common morbidities**

| Place of delivery | HIE/moderate severe birth Asphyxia Number (%) | Jaundice requiring phototherapy Number (%) | Prematurity / LBW Number (%) | Sepsis/ Pneumonia/ Meningitis Number (%) | Others Number (%) |
|---|---|---|---|---|---|
| Govt Health facilities (CHC, PHC, SDH, DH, Med Coll, SC) | 30658 (81.76) | 16964 (82.65) | 25880 (79.42) | 14910 (79.66) | 8084 (82.25) |
| Transit | 296 (0.79) | 140 (0.68) | 470 (1.44) | 133 (0.71) | 89 (0.91) |
| Private nursing home | 2100 (5.60) | 1284 (6.26) | 1783 (5.47) | 1141 (6.10) | 565 (5.75) |
| Home | 1197 (3.19) | 634 (3.09) | 1654 (5.08) | 824 (4.40) | 413 (4.20) |
| Unknown | 3248 (8.66) | 1504 (7.33) | 2801 (8.60) | 1709 (9.13) | 677 (6.89) |
| Total | 37499 (100) | 20526 (100) | 32588 (100) | 18717(100) | (100) |

After applying Single table Chi-square test these observations were found to be highly significant with a p value <0.0001 *(Chi squared value 444.59 Degree of freedom=16)*

**Pattern of morbidity and mortality in Birth Asphyxiated newborns across birth weight**

Of the 37499 newborns admitted with Birth Asphyxia, 16638 (44%) weighed more than 2501 gms, while another sizeable proportion of 45% weighed between 1501 to 2500 gms. Of the total Birth Asphyxia admitted newborns the mortality was 14%. Of all the newborns who died due to Birth Asphyxia, 41% were more than 2500 gms and 47% weighed between 15001 to 2500 gms.

**Table 8: Pattern of morbidity and mortality in Birth Asphyxiated newborns across birth weight**

| Birth weight | Morbidity Number (%) |
|---|---|
| <1000 gm | 329 (0.88) |
| 1000 gm - 1500 gm | 3724 (9.93) |
| 1501 gm - 2500 gm | 16808 (44.82) |
| >2501 gm | 16638 (44.37) |
| Total | 37499 (100) |

After applying Single Table Chi-square test these observations were found to be highly significant with a p value <0.0001 *(Chi squared value 22.94 Degree of freedom=9)*

## DISCUSSION

Our study reports specific morbidities and immediate outcomes of the neonates admitted to SNCUs. This data added to the limited literature on these important determinants of neonatal survival. The Inborn and Outborn admission rates in this study were 50.8% and 49.2% respectively. Other studies reported higher Inborn admissions of 71.7% and 75.6% as compared to Outborn admissions of 28.3% and 24.4%. Our findings were comparable to a study from Uttarakhand which reported 46.46% Inborn and 53.54% Outborn admissions. [9-12] Majority of the admissions were males (60.18%) as compared to female babies (39.80%). Similar findings were also seen in studies conducted by Shah et al and Jena et al. [9,13] Further studies might need to be done to understand preferential health seeking behavior favouring male newborns.

The common morbidities seen in the admitted babies are Birth Asphyxia (29.11%), Prematurity (25.29%), Jaundice (15.93%) and Infections (14.53%). The overall morbidity is 29.11% which is much higher than that of the National Neonatal Perinatal Database (8.3%). Birth asphyxia and Jaundice were more common in Inborns whereas Prematurity / Low Birth Weight and Infections were higher among Outborns. The incidence of Birth Asphyxia in Inborns

(33.53%) is nearly ten percentage points higher than the Outborns (24.54%).Other studies from Bihar (18.2%) and Assam (16.2%) also reported higher Birth Asphyxia rates. [11,14,15] The significantly higher rate of Birth Asphyxia indicates lack of regular quality antenatal care, delayed referral of high-risk mothers, lack of access to health facilities, inadequate quality of intranatal care, lack of timely Caesarean sections in cases of prolonged labour and inadequacies in prompt and effective neonatal resuscitation. Further studies might throw light on the determinants mentioned above.

Morbidity data revealed that 25.29% (Inborn – 22.31%, Outborn - 28.37%) were Low Birth Weight /Preterm in the present study. This is on contrast to other studies wherein the LBW / Preterm varied from 11 to 50%. [16-19]

The incidence of neonatal Jaundice (Inborn 19%, Outborn 12.77%) was comparable to other studies (Neogi et al (18%), Sridhar et al 7%). [8,10] Counseling to explain families about physiological jaundice and the need to continue adequate breastfeeding is one of the key factors to reduce neonatal Jaundice. The incidence of Infections was twice as high among Outborns (20.07%) as compared Inborns (9.16%). The NNPD has reported a higher rate of Sepsis / Infections in Outborn births (39.7%). [15] However, the overall incidence of Infections in this study (14.53%) was lower than that reported from a survey of eight SCNUs across the country by Neogi et al in 2009 (18%). [8] Prevalence of Infections both among Inborns and Outborns is a matter of serious concern. This indicates lack of adequate sanitation and aseptic measures.

The total neonatal mortality rate in this study was 10.62%. Higher mortality was seen amongst Outborns (11.5%) as compared to Inborn (8.92%) babies, which is similar to Ranjan study. [20] The fatality rate of major morbidities did not show any significant differences between Inborns and Outborns. The referrals and their outcomes need further investigation. Birth asphyxia (13.7%) and Prematurity (14.5%) were the commonest causes of mortality followed by Infections (10.16%) which was unlike other studies where Infections were the commonest causes of mortality followed by Prematurity/ LBW and Birth asphyxia. [9,13,21] In the developed countries, extreme prematurity, asphyxia, and congenital anomalies were the chief causes as seen a study in Canada by Simpson *et al.* [22]

Referral rate (14.20%) was seen to be higher as compared to other studies, [12] this might have been due to the fact that, all the units provide Level II SNCU services and are being referred for ventilatory support or additional interventions to tertiary centers.

Studies regarding care of newborn in the community revealed that IMNCI (Integrated Management of Neonatal & Childhood Illnesses) programme was limited to ANMs, leaving the stewardship of role of AWWs to ICDS. It also indicated that the coverage of HBNC (Home Based Newborn Care) was low (Care of Newborn at community and home; Neogi, Zodpey). [8]

There are no studies in the country that provide state level information collated from different units. Further analysis of the Outborn babies revealed that incidence of Birth Asphyxia was three times (28.85%) higher among Health Facility referred as compared to Community referred (10.66%). Our study also reported that, only 24% of the Outborn referrals were community referred. Further, lower referrals of Birth Asphyxia from community might indicate lack of identification of asphyxia or death due to lack of resuscitation among home delivered newborns. Even if identified, access to appropriate services might be an issue. Since about 80% of the admitted babies were born in public facilities, strengthening of skills and capacities of the Labour room staff has the potential to have a far-reaching impact. Intervening within the golden minute is critical.

The available literature is mostly based on the data from single or few newborn care units across the country. Most

of the studies are mortality based and emphasize on the different variables like weight, gestation age, birth place etc. This study focused on the morbidities with a view to identify areas which need to be addressed to reduce neonatal deaths. The data from this study could be used to identify key interventions which need to be implemented and inform health policy and planning for the state. Referral of these newborns without stabilization, temperature maintenance, oxygenation, and ventilation if in apnea is counterproductive to survival. The variation in occurrence of Infections as compared to other studies, may be due to the variation in the health practices being followed in the community and competency of health professionals in providing essential appropriate newborn care. Survival rates of Birth Asphyxia babies are much lower than the other morbidities and there is a possibility of brain damage which may not be immediately apparent. Follow up of these babies with specific assessment of developmental milestone might reveal if the growth trajectory is on the normal path.

About 16000 newborns admitted due to Birth Asphyxia are more than 2500 gms in weight who are otherwise stable babies and had the best chance to survive normally. Investing in interventions to prevent Asphyxia would lead to survival of this cohort of normal birth weight infants and a considerable proportion of the cohort within the 1500 to 2500 gm babies as well.

Along with survival "intact survival" needs to be ensured. Perinatal asphyxia and infection are important preventable causes of mortality, which must be urgently addressed, if the state hopes to accelerate the gains achieved and work towards Sustainable Development Goals by 2030.

**Limitations**

Because of retrospective nature of the study using secondary data, cause of admission was determined by the information available in the existing online records. Maternal details were not fully available and were not studied completely in the present study. The study had not divided the newborn deaths into early and late neonatal period. The outcome of the Referred and Left Against Medical Advice (LAMA) neonates was not determined.

## CONCLUSION

This study is first of its kind in the country which examined the morbidities with its variables at the state level over a period of three years. Our study found that Birth Asphyxia was the leading cause of morbidity and mortality. These could be prevented by improving important preventive services like quality antenatal care, timely referral and prompt intervention at the health facilities. Strengthening the follow up of the discharged babies could help identify any developmental delays and early linkage to the RBSK (Rashtriya Bal Surakshya Karyakram) programme. There is a need to understand the "Levels of delay" (delay in decision making, delay in accessing transport and delay on reaching the facility) and the referral pathway taken to reach the health facilities. The high proportion of Birth Asphyxia in the Inborn babies underscores the need to focus on issues around prolonged labour, quality of intranatal care, readiness for Caesarean section as necessary and newborn resuscitation. Investing on skills and capacities of the Labour room staff and ensuring adequate human resources will go a long way in improving quality of intra-natal care. Focus on intranatal care and newborn resuscitation within the "golden minute" would help prevent Birth Asphyxia. The SNCUs could be strengthened with availability of CPAP (Continuous Positive Airway Pressure) and surfactants to manage premature newborns thereby reducing RDS related deaths. Capacities of the delivery room staff need to be enhanced to be able to provide skilled maternal and essential newborn care. Effective functioning of the Newborn Stabilisation Units and New Born Care corners would offset the need to refer babies who could otherwise be stabilized and managed at the lower level facilities thereby avoiding unnecessary referrals and

the transport stress. Strengthening quality of delivery care and the process of labour in the state would go a long way in reducing newborn complications.

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