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Original Research Article

A COMPARATIVE STUDY ON MORBIDITY AND MORTALITY PROFILE OF INBORN AND OUTBORN NEONATES ADMITTED IN THE SPECIAL NEWBORN CARE UNIT OF BANKURA SAMMILANI MEDICAL COLLEGE & HOSPITAL: A RETROSPECTIVE ANALYSIS

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Abstract

Background: We conducted the present study to compare the morbidity and mortality profile between inborn and outborn neonates, on which published literature is sparse across the globe. **Materials and Methods:** The Level III Special Newborn Care Unit was the area of this record-based retrospective study. After excluding the neonates who were sent to a higher centre and left against medical advice, 35957 neonates in total were registered. There was a five-year study period (2109–2023). Using a pre-designed proforma, the relevant information was obtained from the Special Newborn Care Unit's computer. Data analysis was done using EpiInfo (3.5.1) software. The continuous and categorical variables were expressed in terms of mean and standard deviation and rate and ratio, respectively. The chi-square test was done to compare categorical variables. A P value <0.05 was set as statistically significant. **Result:** 32.31% of the 35957 neonates were outborn, while 67.69% were inborn. The male-to-female neonate ratio was 1.51:1, whereas the inborn-to-outborn ratio was 1.27:1. Low birth weights occurred in 56.33% of outborn babies and 58.24% of inborn babies. 14.69% of all neonates were small for date. The most common indication for admission was neonatal jaundice, which accounted for 24.61% of outborns and 36.84% of inborns. The majority of the outborn deaths (54.88%) were caused by neonatal sepsis, while the most frequent cause of inborn deaths (37.1%) was birth asphyxia. The deaths among inborn and outborn were 10.23% and 8.77%, respectively. The case fatality rate of sepsis, birth asphyxia, and different groups of birth weight was higher in outborns than inoborns. **Conclusion:** Gender discrimination, death rate, and case fatality rate among outborn were higher than inborn neonates.

INTRODUCTION

Neonatal deaths worldwide account for a significant proportion of child deaths in most countries.[1] Approximately 4 million of the 130 million babies born each year die during the newborn stage.[2] India accounts for almost ¼ of all newborn deaths worldwide.[3] While in the country as a whole, the ratio of neonatal deaths to infant deaths is 70.6%; in rural regions, it can range from 60.9% to 71%. Neonatal mortality rates vary by state. Madhya Pradesh, West Bengal, and Goa have neonatal mortality rates of 47, 15.5, and 8 per 1000 live births4. Both direct and indirect risk factors contribute to increased neonatal mortality. Prematurity (27%), sepsis (26%), birth asphyxia (23%), congenital defects (7%), others (7%), tetanus (7%), and diarrhoea (3%) were the most common direct causes of neonatal deaths, according to a Lancet study.[5] Neonatal mortality can result from a wide range of indirect causes, such as socioeconomic and medical aspects, in addition to direct causes.[6] The place of delivery is also a factor in determining neonatal death. Previous studies revealed that there were higher survival rates if preterm and low birth weight (LBW) babies were born in tertiary perinatal centres (inborn) than elsewhere (outborn).[7,8]

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Many published literatures report the morbidity and mortality profile of neonates without distinguishing between the inborn and outborn. As a result, information about inborn and outborn neonates is scarce in India and around the world. To bridge the information gap, the present study reviewed the morbidity and mortality profiles of inborn and outborn neonates.

Aim

The study objectives to compare the morbidity and mortality profiles of inborn and outborn neonates.

MATERIALS AND METHODS

Study Area: Special Newborn Care Unit (SNCU), Department of Paediatrics, Bankura Sammilani Medical College & Hospital (B.S.M.C.H), West Bengal. Study design: record-based retrospective study. Stud subjects: neonates (0–28 days old) of both inborn and outborn. Study Period: 5 years (January 2019–December 2023). Sample Size: 35957. Inclusion criteria: All neonates admitted to SNCU from 1st January 2019 to 31st December 2023 were included by the complete enumeration method. Exclusion criteria: Those neonates were referred to a higher centre and left against medical advice (LAMA). A total of 375 and 88 neonates were referred and LAMA, respectively. Sample Design: All neonates fulfilling the inclusion criteria. Parameters to be studied: gender, birth weight, gestational age, diagnosis, and outcome. Study technique: A predesigned proforma was used to retrieve relevant information from SNCU's computer, where data was compiled electronically on a monthly as well as yearly basis. Subsequently, retrieved data was put into the Microsoft Excel sheet for analysis. Data analysis: EpiInfo (3.5.1) software, developed by Centres for Disease Control and Prevention (CDC) in Atlanta, Georgia (US), 2008, was used to analyse data. The continuous variable was expressed in mean and standard deviation and categorical in rate and ratio. Comparison of categorical variables was done by the Chi-Square test, and a P value <0.05 was set as statistically significant.

Operational Definitions

Neonate: It refers to the period of ≤ 28 days after birth.[9,10]

Inborn neonate: A neonate born and treated at the same healthcare facility.[11,12]

Outborn neonate: A neonate born outside the health care facility where they received care.[11,12]

RESULTS

A total of 35957 neonates were admitted to SNCU during the study period. Of these, 67.69% were inborn and 32.31% were outborn. The ratio of inborn to outborn was 2.09:1. Male to female neonates' ratio in outborn was 1.51:1. Whereas, it was 1.27:1 in the case of inborn. In combination, the male-to-female baby ratio was 1.34:1, and this gender discrimination was significant statistically (P value = <0.0000001), as shown in [Table 1].

In both categories, admission of low birth weight (LBW), including very low birth weight (VLBW) and extremely low birth weight (ELBW), was more than the normal birth weight. Among outborn, 43.67%, 45.16%, 9.67%, and 1.5% babies had normal birth weight, LBW, VLBW, and ELBW, respectively. Whereas in the case of inborn babies, 41.76%, 49.71%, 7.68%, and 1.7% babies were of normal birth weight, LBW, VLBW, and ELBW, respectively. The difference between the admission of inborn and outborn concerning birth weight was statistically significant (P value = <0.0000001), as illustrated in [Table 2].

Though 57.43% and 56.32% of inborn and outborn, respectively, completed the 37-week gestation before birth, a substantial portion of the neonate did not reach maturity. Out of which, 30.36% and 12.20% of the inborn and 31.05% and 12.64% of the outborn delivered between 34 and <37 weeks and <34 weeks of gestation, respectively. The difference between inborn and outborn concerning gestational age was statistically insignificant (P value = 0.128) as depicted in [Table 3].

The four most common causes of SNCU admission of inborn and outborn babies were neonatal jaundice, birth asphyxia, sepsis, and others, which include prematurity without complications, minor congenital anomalies, and healthy babies admitted for observation. Among inborn, 36.84%, 12.48%, and 18.22% of neonates had neonatal jaundice, sepsis, and birth asphyxia, respectively. Whereas in the outborn, 24.61%, 23.60%, and 10.82% of neonates had neonatal jaundice, sepsis, and birth asphyxia, respectively. Comparison of inborn and outborn neonates concerning morbidity profiles was statistically significant (P value = <0.0000001), illustrated in [Table 4].

Prematurity, birth asphyxia, and sepsis were the three most common causes of neonatal death in both inborn and outborn. 28%, 28.76%, and 37.99% of inborn neonatal deaths were shared by prematurity, sepsis, and birth asphyxia, respectively. Whereas, prematurity, birth asphyxia, and sepsis contributed 16.33%, 22.9%, and 54.88% of neonatal death among outborn. Birth asphyxia was accountable for the most inborn neonatal death. Whereas, sepsis was the most common cause of neonatal death among outborn. The contribution of different mortality profiles to neonatal death and its comparison between inborn and outborn was significant statistically (P value = <0.0000001), as shown in [Table 5].

The survival rate among inborn neonates was higher than that of outborn neonates (91.23% vs. 89.77%). In other words, the death rate among the inborn was less than the outborn neonates (8.77% vs. 10.23%). The difference in outcome pattern between outborn and inborn neonates was insignificant statistically (P value = <0.0000093) as shown in [Table 6].

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The case fatality rate (CFR) was inversely proportional to the birthweight of neonates noted in the present study. CFR among normal birth weight (≥ 2500 grammes) neonates were 4.05% and 5.42% of inborn and outborn, respectively. Whereas, CFR of ELBW neonates were 78.48% and 84.48% of inborn and outborn, respectively. Considering the sepsis and birth asphyxia, CFR among outborn neonates was higher than the inborn neonates and was statistically significant (P value <0.05), as shown in [Table 7].

The present study revealed that among the death neonates, only 23.47% of babies completed their first week of life before death. In other words, 76.53% of neonatal deaths occurred within 24 hours after birth. The comparison between inborn and outborn neonates concerning age of death was statistically significant (<0.0000001), as illustrated in [Table 8].

Table 1: Gender-wise admission of inborn and outborn neonates.

*Gender	†Inborn (%)	Outborn (%)	Total (%)	P value
Male baby	13600 (37.42)	6998 (19.46)	20598 (57.28)	
Female baby	10739 (29.87)	4620 (12.85)	15359 (42.72)	<0.0000001
Total (%)	24339 (67.69)	11618 (32.31)	35957 (100)	

*Male to female baby ratio of inborn neonates = 1.27:1 and outborn neonates = 1.51:1.
†Inborn to outborn ratio = 2.09:1.

Table 2: Birth weight-wise admission

Birth weight (grams)	Inborn (%)	Outborn (%)	Total (%)	P value
≥2500	10165 (41.76)	5073 (43.67)	15238 (42.38)	
1500-2499	12100 (49.71)	5247 (45.16)	17347 (48.24)	
1000-1499	1638 (6.78)	1124 (9.67)	2762 (7.68)	<0.0000001
<1000	436 (1.79)	174 (1.5)	610 (1.7)	
Total	24339 (100)	11618 (100)	35957 (100)	

Table 3: Gestational age-wise admission

Gestational Age (Weeks)	Inborn (%)	Outborn (%)	Total (%)	P value
≥37	13979 (57.43)	6,543 (56.32)	20522 (57.07)	
≥34- <37	7390 (30.36)	3607 (31.05)	10997 (30.58)	0.128
<34	2970 (12.20)	1468 (12.64)	4438 (12.34)	
Total (%)	24339 (100)	11618 (100)	35957 (100)	

Table 4: Morbidity profile

Variables	Inborn (%)	Outborn (%)	Total (%)	P value
Neonatal jaundice	8967 (36.84)	2859 (24.61)	11826 (32.89)	
Birth asphyxia	4435 (18.22)	1257 (10.82)	5692 (15.83)	
Sepsis	3037 (12.48)	2743(23.60)	5780 (16.07)	
Respiratory distress syndrome	176 (0.72)	107 (0.92)	283 (0.79)	
Meconium aspiration	43 (0.18)	4 (0.03)	47 (0.13)	<0.0000001
Hypoglycaemia	35 (0.14)	23 (0.20)	58 (0.16)	
Hypothermia	17 (0.07)	31(0.27)	48 (0.13)	
Major congenital anomaly	325 (1.34)	356 (3.06)	681 (1.89)	
Others	7304 (30.01)	4238 (36.48)	11542 (32.1)	
Total (%)	24339 (100)	11618 (100)	35957 (100)	

Table 5: Mortality profile

Variables	Inborn (%)	Outborn (%)	Total (%)	P value
Birth asphyxia	811(37.99)	272(22.9)	1083 (32.59)	
Sepsis	614(28.76)	652(54.88)	1266 (38.1)	
Prematurity	598(28)	194 (16.33)	792 (23.83)	
Meconium aspiration	7(0.33)	4(0.34)	11 (0.33)	<0.0000001
Major congenital anomaly	59(2.76)	24(2.02)	83 (2.5)	
Respiratory distress syndrome	17 (0.8)	10(0.84)	27 (0.81)	
Others	29(1.36)	32(2.7)	61 (1.84)	
Total death	2135 (100)	1188 (100)	3323 (100)	

Table 6: Outcome of neonates

Variables	Inborn (%)	Outborn (%)	P value
Discharge	22204 (91.23)	10430 (89.77)	
Death	2135 (8.77)	1188 (10.23)	0.0000093
Total admission	24339 (100)	11618 (100)	

Table 7: Case fatality rate

Variables	Subgroup	Inborn	Outborn	P value
Birth weight (grams)	Survived	9753 (95.95)	4798 (94.58)	0.00015
≥2500	Death	412 (4.05)	275 (5.42)	

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1500-2499	Survived	11146 (92.12)	4804 (91.56)	0.226
	Death	954 (7.88)	443 (8.44)	
1000-1499	Survived	1212 (73.99)	801 (71.26)	0.123
	Death	426 (21.33)	323 (28.74)	
<1000	Survived	93 (21.33)	27 (15.52)	0.129
	Death	343 (78.48)	147 (84.48)	
Sepsis	Survived	2423 (79.78)	2091(76.23)	0.0012
	Death	614 (20.22)	652 (23.77)	
Birth asphyxia	Survived	3624 (81.71)	985 (78.36)	0.0084
	Death	811 (18.29)	272 (21.64)	

Table 8: Age (day) at death

AGE	Inborn (%)	Outborn (%)	Total (%)	P value
<1 day	632 (29.60)	110 (9.26)	742 (22.33)	
1-6 days	1165 (54.57)	636 (53.54)	1801 (54.20)	<0.0000001
≥7 days	338 (15.83)	442 (37.21)	780 (23.47)	
Total (%)	2135 (100)	1188 (100)	3323 (100)	

DISCUSSION

A total of 35957 neonates were admitted during the study period. Out of which, 67.69% of neonates were inborn, and the rest, 32.31%, were outborn. Similar to the present study, Uppal K et al. reported that inborn and outborn neonates were 69.2% and 30.8%, respectively.[13] In contrast to the present study, Begam J et al,[14] reported that among all the neonates admitted to the SNCU, 56.9% were out-born and 43.1% were inborn. The number of deliveries in the mother institute, the number of levels II SNCU, the number of deliveries of that specific healthcare facility from which the sick neonates will be transferred, the differences in the infrastructure's facilities, the close proximity between referring and receiving units, and occasionally parents' demands to care for their neonates where the better facilities are available can all contribute to variations in the frequency of outborn and inborn admission in the level III SNCU.

Inborn had a male to female neonatal ratio of 1.27:1. In contrast, the outborn ratio was 1.51:1. The ratio of 1.34:1 when combined showed statistically significant gender discrimination (P value = <0.0000001). The male-to-female ratio in this study is similar to that reported by Adikane H et al,[15] which is 1.4:1. Gender inequalities were also noted by other authors in their study.[16,17] Gender discrimination is a grave concern that requires thorough investigation at the level of the community. Of inborn neonates, 41.76% had a normal birth weight, whereas 58.24% had a low birth weight. However, of outborn neonates, 43.67% had a normal birth weight, and 56.33% had a low birth weight. P value = <0.0000001 indicated a statistically significant difference in the admission pattern of inborn versus outborn based on birth weight. Compared to the current study, Kawale S et al,[18] and Kumar M K et al,[19] showed that 34.47% and 39.8%, respectively, of neonatal admissions were LBW. The socioeconomic status and standard of obstetric care in the specific area where the study carried out are reflected in the varying percentage of LBW neonates. Among LBW neonates, small-for-date (SFD) newborns made up a sizable fraction. We discovered it by deducting the percentages of term birth from the percentages of LBW neonates. It was 14.69% in the present study, and these infants experienced a variety of problems, including meconium aspiration syndrome and hypoglycaemia. Multiple factors are causing the birth of a LBW baby. Genetic, demographic, social, dietary, maternal health during pregnancy, preterm birth, and multiple pregnancies are among the factors that several authors reported.[20-22] The aforementioned factors are significant in explaining the differences in the frequency of LBW babies across national and regional levels. So, stakeholders should address these issues to prevent the birth of LBW neonates in the future.

The present study showed the four most common causes of all neonatal admissions. These were neonatal jaundice (32.89%), birth asphyxia (15.83%), sepsis (15.9%), and others (32.1%). Other categories included preterm neonates without complications and apparently healthy ones admitted for observation. Excluding others, neonatal jaundice was the most common cause for admission. 36.84% of inborn and 24.61% of outborn had jaundice. We found greater percentages of newborn jaundice in inborn; this could be because of early diagnosis and admission. The outborn neonates had less jaundice because the Level II SNCU had a phototherapy unit. Sepsis affected 23.60% of outborn neonates and 12.48% of inborn neonates. This disparity might result from the higher proportion of sepsis-affected neonates who were referred from level II care or from home births where an unclean environment was present. Because the majority of asphyxiated neonates (hypoxic encephalopathy I and II) were treated in the Level II SNCU, the present study showed reduced percentages of outborn neonates with birth asphyxia admitted. The prevalence of birth asphyxia was 18.22% and 10.82% in inborn and outborn, respectively. Similar to this study, a number of other investigations revealed a similar pattern of morbidity with varying frequency.[16,23,24]

In the present study, neonatal mortality and discharge frequency were 9.24% and 90.76% of all neonates, respectively. Kumar R et al,[24] reported 11.41% neonatal mortality, which is comparable to the

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present study. Rakholia et al,[16] and Prasad V et al,[23] reported 20.53% and 18.69% neonatal deaths, respectively, which are higher than the present study. The present study showed higher percentages of neonatal death in outborn compared to inborn (10.23% vs. 8.77%). Congruent with the present study, other published literature also reported the difference between inborn and outborn neonatal mortality. One study showed 13.6% vs. 6.6%25, while another one reported 14.67% vs. 9.80%.[24] Many factors contributed to the higher mortality rates among outborn neonates. These include inadequate stabilisation and assisted ventilation before or during transport and the actual transfer itself.[26,27]

Prematurity, birth asphyxia, and sepsis were the three most common causes of neonatal death in both outborn and inborn neonates. Birth asphyxia (37.99%) was the most common cause of death among inborn neonates, whereas sepsis (54.88%) was the main contributor for outborn death. Similar to the present study, Bokade CM et al.28 and Kumar R et al,[24] reported that sepsis was the most common cause of outborn neonatal deaths, while Soni LK et al,[29] reported that birth asphyxia was the most common cause of inborn neonatal death.

The case fatality rate (CFR) of birth asphyxia and sepsis was higher in outborn than inborn neonates. It was 21.64% vs. 18.29% and 23.77% vs. 20.22%, respectively. Kumar R. and his colleagues,[24] reported a similar observation in their research work. We observed that CFR is inversely proportional to the birthweight of neonates, and the death rate among outborn was also higher than inborn. It was 5.42% vs. 4.05%, 8.44% vs. 7.88%, 28.74% vs. 21.33%, and 84.48% vs. 78.48% for normal birth weight, LBW, VLBW, and ELBW neonates, respectively. Chen WH et al,[30] reported similar observations to what we have found.

This study showed that 9.26% of outborn and 29.60% of inborn neonates died within 24 hours after birth. The lower rate among outborn may be the death of a critically ill neonate before transfer or in-utero transfer of a high-risk pregnancy to tertiary care. The present study also showed that 37.21% of outborn died after the completion of 1 week of their lives, and it was 15.83% for inborn. The admission of outborn neonates at an older age may make the difference. 23.47% of all neonates completed their first week of life before death. In other words, 76.53% of neonates succumbed within the 1st week of life, which is similar to Baruah MN et al,[25] and Sridhar PV et al.[17]

Limitation of the present study

The present study has several limitations. First, it was a record-based retrospective study. So, we missed several vital determinates of morbidity and mortality. These were the obstetrical and medical history, type of pregnancy (single or multiple), age at admission and presenting clinical features of neonates, mode of delivery and mode of transport of outborn neonates, distances between Level II and tertiary care, and socioeconomic factors. While comparing the morbidity and mortality profiles between outborn and inborn neonates, adjustment for these risk factors is essential. Secondly, the single-centred tertiary health care-based study leads to selection bias. Therefore, the observed value could not be generalised. Third, we didn't know the outcome of neonates—those who were referred to the higher centre and took LAMA. Fourth, we didn't figure out the gender-wise morbidity and mortality profile because this information was not recorded.

CONCLUSION

Gender discrimination is a serious social issue observed in the present study. So, it should be addressed at the community level. The number of outborn was less than inborn neonates (32.31 vs. 67.69%). Among outborn and inborn admission, LBW neonates had more than normal birth weight, and it was 56.33% vs. 43.67% and 58.24% vs. 41.76%, respectively. The single most common cause of neonatal admission was neonatal jaundice, and it was 24.61% and 36.84% of outborn and inborn, respectively. The neonatal death rate was higher in the outborn neonates than the inborn (10.23% vs. 8.77%). Neonatal sepsis (54.88%) was accountable for most of the outborn deaths, whereas birth asphyxia (37.99%) was the most common cause of inborn death. Considering the different groups of birth weight, sepsis, and birth asphyxia, CFR was more common in outborn than inborn neonates. Health awareness at the community level, strengthening of the newborn stabilizing unit and SNCU at different levels, and training of all healthcare providers at all healthcare facilities should be adopted to bring down the neonatal mortality rate to 12/1000 live births by 2030.

Despite having several limitations, literature regarding such a detailed comparison of morbidity and mortality profiles between inborn and outborn neonates is lacking at regional, national, as well as international levels. Lastly, a sizable portion (14.6%) of SFD neonates, a noteworthy observation, were admitted during the study period.

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