ORIGINAL RESEARCH

Prevalence of neonatal intensive care unit admissions, morbidity pattern, and their outcome among newborns delivered in a tertiary care center in South Kerala

[1]Avani US,[1]Aswin S,[2]Dr. Sundar Singh,[3]Dr. Y Suba Joice,[4]Dr. S Baburaj,[5]Dr. Chithra V

[1]Final year MBBS students, Dr. Somervell Memorial CSI Medical College, Karakonam, South Kerala, India
[2]Associate professor, Department of pediatrics, Dr. Somervell Memorial CSI Medical College, Karakonam, South Kerala, India
[3]Professor, Department of Community Medicine, Dr. Somervell Memorial CSI Medical College, Karakonam, South Kerala, India
[4]Professor, Department of Pediatrics, Dr. Somervell Memorial CSI Medical College, Karakonam, South Kerala, India
[5]Junior resident, Department of Community Medicine, Dr. Somervell Memorial CSI Medical College, Karakonam, South Kerala, India

Corresponding Author
Dr. Y Suba Joice
Professor, Department of Community Medicine, Dr. Somervell Memorial CSI Medical College, Karakonam, South Kerala, India

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ABSTRACT

Background: A neonate is defined as a newborn under the age of 28 days by the World Health Organization. Due to the infant's weakened immune system and several morbidities, the neonatal period is critical. When a newborn exhibits any morbidities, the neonatal intensive care unit is notified (NICU). Kerala records the lowest neonatal mortality rate in the entire country. However, various maternal and neonatal factors and even incidents during labor can increase the probability of newborn morbidity and hence this study is an effort to estimate the prevalence of NICU admissions among newborns delivered and to enumerate the morbidity pattern and outcomes among the neonates admitted in a tertiary care center in South Kerala.

Materials and Methods:A retrospective cross-sectional study of 511 live births and NICU admission records of the neonates were collected from MRD over 8 months. After taking permission of Institutional authorities, a Semi-structured questionnaire was used to collect the data regarding birth, neonatal admission, morbidity pattern and outcomes from the records.

Results: Prevalence of NICU admissions among newborns was found to be 42.86%. Jaundice (54.4%) was found to be the major cause of NICU admission. Most of the neonates got cured and discharged (96.8%) with the majority of them staying for a period 4 to 6 days (64.4%). Maternal age group and delivery of preterm neonates <35 weeks, mode of delivery and low birth weight, mode of delivery and respiratory distress, birth weight and preterm neonates were found to have statistically significant association.

Conclusion: Prevalence of NICU admission in the study area was high (42.8%) and the major morbidity patterns contributing to NICU admission were found to be jaundice followed by respiratory distress.

Key words: World Health Organization, NICU,neonate,newborn

INTRODUCTION

The prevalence of Neonatal Intensive Care Unit admissions is changing due to the availability of better healthcare facilities, thus reducing perinatal mortality. Common causes for NICU admissions include respiratory distress, neonatal sepsis, and asphyxia.[1] Morbidity refers to any departure, subjective or objective, from a state of physiological well-being. Common factors abetting neonatal morbidity are gestational diabetes, premature deliveries, infections and birth defects.[2]Premature births increase the risk of major morbidity. They are a leading cause of

admission in neonatal care units. Advances in management have ensured better survival of preterm births, but the cost and resource limitations influence the outcome.[3]Another important reason for morbidity among neonates is infections. They account for about 2.7 million neonatal deaths annually worldwide.[4]Population-based data, which is insufficient in developing countries, is required for the design of appropriate intervention measures. In countries with high infective burden, promoting facility delivery and clean cord care can reduce neonatal infections and associated deaths. The IMR was reduced by 28% between 2015 and 2016 (National Family Health Survey-4) as compared to the values from NFHS-3. According to NFHS-4, the lowest IMR was reported from Kerala.[5] The proposed study will address the following objectives, 1. To estimate the proportion of Neonatal Intensive Care Unit admissions in a tertiary health care facility in South Kerala 2. To describe various patterns of morbidity in NICU admitted neonates 3. To enumerate the outcomes in terms of cure, death, referred 4. The maternal and neonatal profile factors associated with selected morbidity is also looked for which would aid in establishing measures of intervention to reduce morbidity among neonates.

MATERIALS AND METHODS

This was a record based cross sectional study conducted among live born neonates delivered in the OBG department of Dr. Somervell Memorial CSI Medical College, after getting approval from Institutional authorities and Institutional Ethics Committee[SMCSIMCH/EC(PHARM)03/01/08].

Report of a pilot study conducted for 3 months revealed a prevalence of NICU admissions as 19.1%. Hence, taking a relative precision of 20%, sample size calculated was 407. The criteria followed for admission to NICU were neonates with GA ≤ 35 weeks, birth weight <2 kg, respiratory distress, severe birth asphyxia, acute blood loss, birth trauma, frank sepsis, major malformations, Rh-isoimmunization, jaundice, hypothermia, abnormal cry, abdominal distension, seizure, irritability, hypocalcemia, hypoglycemia, feed intolerance and fever. Live-born babies delivered in the institution from January 2022 to August 2022 were included in the study and the data collected had details of no. of live-born neonates, NICU admission, mother's profile like age, delivery details and co-morbidity if any and neonate's profile like birth weight, morbidity pattern, duration of ICU admission and outcome, all retrieved from the records of department of Obstetrics & Gynecology (OBG) and neonatal ICU. Live born babies referred outside, those died before reaching NICU and neonates admitted for observation at NICU were excluded from study. Data was collected using a predesigned pretested semi-structured proforma and entered in excel Sheet by 12 students of the 2019 MBBS Batch who were trained for this purpose. The data was entered into Microsoft Excel spreadsheet and analyzed with IBM SPSS Statistics trial version 27. All qualitative variables were expressed in percentages and all quantitative variables were expressed as mean and standard deviation. Chi-square test was used as test of significance to look for any association between maternal profile and neonatal morbidity pattern and neonatal profile and neonatal morbidity pattern and a p-value <0.05 was considered statistically significant. Data was password protected and access to data was strictly restricted to only those related to study. The collected data will be stored for a period of 5 years.

RESULTS

From January 2022 to August 2022, 511 live births were recorded at the tertiary care centre based on the inclusion criteria. Of this the records revealed that there were 219 NICU admissions. Thus, the proportion of NICU-admitted neonates was found to be 42.86%

Table 1: Morbidity pattern of NICU admitted neonates (N= 219)

Morbidity Pattern	Number (%)
Preterm neonates (≤ 35 weeks GA)	
Yes	16 (7.3)
No	203 (92.7
Birth Weight (< 2000gms)	
Yes	20 (9.1)
No	199 (90.9)
Respiratory Distress	
Yes	94 (42.9)
No	125 (57.1)
Frank Sepsis	
Yes	3 (1.4)
No	216 (98.6)
Major Malformations	
Yes	2 (0.9)
No	217 (99.1)
Jaundice	

Yes	117 (53.4)
No	102 (46.6)
Cyanosis	
Yes	1 (0.5)
No	218 (99.5)
Hypernatraemic dehydration	
Yes	12 (5.5)
No	2.7 (94.5)
Hypoglycemia	
Yes	7(3.2)
No	212(96.8)
Feed intolerance	
Yes	9(4.1)
No	210(95.9)

Table I shows the morbidity pattern for neonatal ICU admission where, Jaundice (54.4%) is the major morbidity of NICU admission followed by respiratory distress (42.9%) and birth weight of <2 kg (9.1%).

LENGTH OF STAY (IN DAYS) OF NICU ADMITTED NEONATES (N=219)

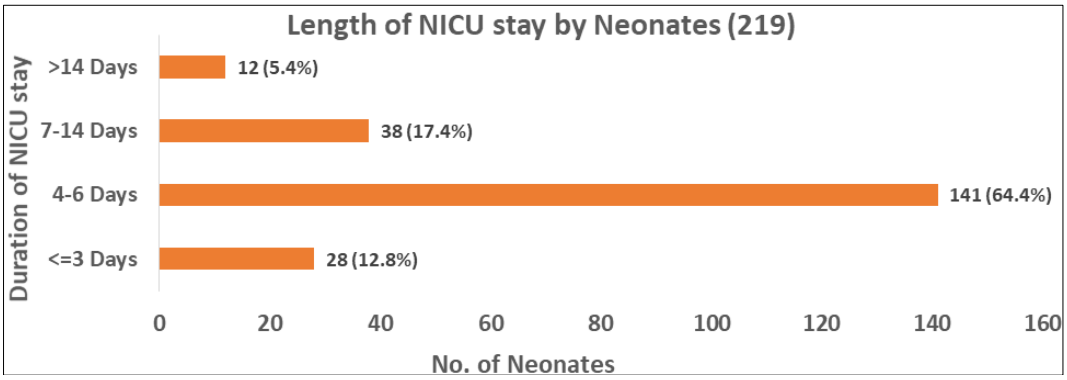

Fig 1: Length of stay (in days) of NICU admitted neonates (n=219)

As per Figure 1, the majority of the neonates were admitted to NICU for a period of 4-6 days (64.4%) followed by 7-14 days (17.4%) and ≤ 3 days (12.8%)

THE OUTCOME OF NICU-ADMITTED NEONATES (N=219)

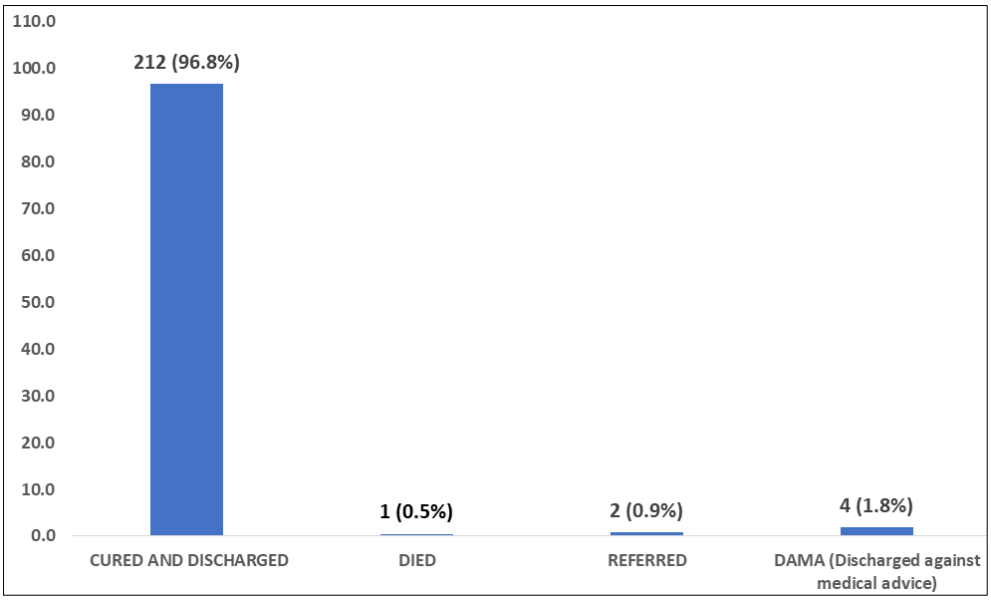

Fig 2: Outcome of NICU admitted neonates (n=219)

As per Figure 2, Among the neonates admitted to the NICU, 96.8% of the neonates were cured and discharged and 0.5% died.

Association of maternal obstetric profile and co-morbidities with selected morbidity patterns of neonates admitted to ICU

Table 2: Association of maternal obstetric profile and co-morbidities with gestational age of neonates (n=219)

Maternal obstetric profile and comorbidities	Neonates ≤35wksGA(n=16)	Neonates >35 wksGA(n=213)	P value
AGE			
18-25Yrs	6(37.5)	105(51.7)	.271
26-36Yrs	10(62.5)	98(48.3)	
Birth order			
1	9(56.3)	118(58.1)	.677
2	7(43.8)	76(37.4)	
3	0(0.0)	6(3.0)	
4	0(0.0)	3(1.5)	
Mode of delivery			
Normal vaginal delivery	5(31.3)	89(43.8)	0.489
LSCS	11(68.8)	110(54.2)	
Assisted delivery	0(0.0)	4(2.0)	
MaternalComorbiditiesGDM			
Yes	7(43.8)	58(28.6)	0.215
No	9(56.3)	145(71.4)	
Hypothyroidism			
Yes	1(6.3%)	35(17.2)	0.204
no	15(93.8%)	168(82.8)	

As per table II, majority, i.e 62.5% of the preterm neonates ≤ 35 weeks delivered were seen in the maternal age group of 26-36 years whereas majority(51.7%) of neonates above 35 weeks GA delivered were found in the maternal age group of 18 to 25 years. Majority of the neonates in both groups were found to be first order babies. Among preterm neonates ≤ 35 weeks and >35 weeks, majority delivered by LSCS. However, the differences observed in all these maternal risk factors studied did not show any statistical significance.

It was observed that 43.8% neonates ≤ 35 weeks and 28.6% neonates >35 weeks GA had mothers' with Gestational Diabetes mellitus and 6.3% and 17.2% neonates ≤ 35 weeks and >35 weeks GA respectively had mothers' with hypothyroidism. However, the differences observed in all these maternal comorbidities did not show any statistical significance.

Table 3: Association of maternal obstetric profile and co-morbidities with birth weight of neonate (n=219)

Risk factors	Neonates with birth weight < 2000g(n=20)	Neonates with birth weight ≥ 2000g(n=199)	P value
Age			
18-25 Yrs	8(40.0)	103(51.8)	.315
26-36 Yrs	12(60.0)	96(48.2)	
Birth Order			
1	15(75.0)	112(56.3)	.396
2	5(25.0)	78(39.2)	
3	0(0.0)	6(3.0)	
4	0(0.0)	3(1.5)	
Mode of Delivery			
Normal vaginal delivery	5(25.0)	89(44.7)	.129
LSCS	15(75.0)	106(53.3)	
Assisted delivery	0(0.0)	4(2.0)	
Maternal Comorbidities GDM			
yes	6(30.0)	59(29.6)	.974
no	14(70.0)	140(70.4)	
Hypothyroidism			.854

yes	3(15)	33(16.6)	
no	17(85.0)	166(83.4)	

As per table III, majority of the neonates <2000g birth weight had mothers' age in 26-35 years, however, in neonates with birth weight >2000g, mothers' were in the age group of 18- 25 years. In both the groups majority of the neonates had birth order 1. 3/4th of the neonates with birth weight <2000g, were delivered by LSCS whereas only ½ theneonates with birth weight >2000g were delivered by LSCS. However, these differences observed with respect to maternal obstetric profile were not statistically significant. Around 30% and 15% of neonates in both groups had mothers' who had gestational diabetes mellitus and hypothyroidism respectively which was again equally distributed among both groups and hence not considered as a risk factor.

Table 4: ASSOCIATION OF MATERNAL OBSTETRIC PROFILE AND CO-MORBIDITIES WITH RESPIRATORY DISTRESS (n=219)

Risk factors	Respiratory distress		P value
	Yes (n=94)	No (n=125)	
Age			
18-25Yrs	49(52.1)	62(49.6)	.711
26-36Yrs	45(47.9)	63(50.4)	
Birth order			
1	51(4.3)	76(60.8)	
2	41(43.6)	42(33.6)	.145
3	2(2.1)	4(3.2)	
4	0(0.0)	3(2.4)	
Mode of delivery			
Normal vaginal delivery	31(33.0)	63(50.4)	
LSCS	63(67.0)	58(46.4)	.002
Assisted delivery	0(0.0)	4(3.2)	
Maternal comorbiditiesGDM			
yes	28(29.8)	37(29.6)	.976
No	66(70.2)	88(70.4)	
Hypothyroidism			
Yes	10(10.6)	26(20.8)	.045
no	84(89.4)	99(79.2)	

As per table IV, in neonates with and without respiratory distress the distribution of age group of the mothers were found to be similar. Majority of the neonates in both groups belonged to birth order 1.

Among neonates with respiratory distress, 67% and 33% were delivered by LSCS and normal vaginal delivery. In neonates without respiratory distress 46.4% and 50.4% respectively were delivered by LSCS and normal vaginal delivery. This difference observed was found to be statistically highly significant(p=0.002).

Considering the maternal comorbidities gestational diabetes mellitus was found to be equally distributed in both the groups whereas, among neonates with and without respiratory distress 10.6% and 20.8% respectively had mothers who had hypothyroidism and this difference observed was found to be statistically significant(p=0.045).

Table 5: ASSOCIATION OF MATERNAL OBSTETRIC PROFILE ANDCO-MORBIDITIES WITH JAUNDICE REQUIRING INTERVENTION (n=219)

Risk factors	Jaundice requiring intervention		P value
	YES (n=117)	NO (n=102)	
Age			
18-25Yrs	60(51.3)	51(50.0)	.850
26-36Yrs	57(48.7)	51(50.0)	
Birth order			
1	74(63.2)	53(52.0)	
2	37(31.6)	46(45.1)	.055
3	3(2.6)	3(2.9)	
4	3(2.6)	0(0.0)	
Mode of delivery			
Normal vaginal delivery	51(43.6)	43(42.2)	.636

LSCS	63(53.8)	58(56.9)	
Assisted delivery	3(2.6)	1(1.0)	
Maternal comorbiditiesGDM			
yes	33(28.2)	32(31.4)	.609
no	84(71.8)	70(68.6)	
Hypothyroidism			
yes	18(15.4)	15(14.7)	.889
No	99(84.6)	87(85.3)	

As per table V, majority of the neonates with jaundice requiring intervention and no jaundice were born to mothers of 18-25 years old, were born as first order child. Majority of the neonates in both groups were delivered by c-section. And none of these maternal factors had any statistical significance. The distribution of comorbidities in mothers of these children in both groups were also found to be equal and not statistically significant.

Table 6: ASSOCIATION OF NEONATAL PROFILE WITH BIRTH WEIGHT < 2000g (n=219)

Risk factors	Neonates with birth weight <2000g (n=20)	Neonates with birth weight ≥ 2000g (n=199)	P value
Gestational age			
Preterm neonates	17 (85)	34(17.1)	<.001
Term neonates	3(15)	165(82.9)	
Apgar at 1 min			
Good Apgar score	13(65.0)	189(95.0)	<.001
Poor Apgar score	7(35.0)	10(5.0)	
Apgar at 5 min			
Good Apgar score	18(90.0)	198(99.5)	.013
Poor Apgar score	2(10.0)	1(0.5)	

As per table VI,85% of neonates with birth weight < 2000g were preterm and only 17.1% neonates with birth weight ≥2000g were preterm. This difference observed was statistically significant (p<0.001). Only 65% and 90% of the neonates had good apgar score at 1 minuteand 5 minutes respectively in birth weight <2000g neonates, however, 95% and 99.5% of the neonates had good apgar score at 1 minute and 5 minutes respectively in birth weight ≥2000g neonates and this difference observed was statistically significant (p<0.001)

Table 7: ASSOCIATION OF NEONATAL PROFILE WITH RESPIRATORY DISTRESS (n=219)

Risk factors	Respiratory distress		P value
	Yes	No	
Gestational age			
Preterm neonates	26(27.7)	25(20)	.184
Term neonates	68(72.3)	100(80)	
Birth weight			
Low birth weight	22(23.4)	30(24.0)	.918
Normal birth weight	72(76.6)	95(76.0)	
Apgar @ 1 min			
Good Apgar score	84(89.4)	118(94.4)	.170
Poor Apgar score	10(10.6)	7(5.6)	
Apgar @ 5 min			
Good Apgar score	92(97.9)	124(99.2)	.404
Poor Apgar score	2(2.1)	1(0.8)	

As per table VII, 27.7% and 20% of neonates with respiratory distress and without respiratory distress were preterm, 1/4th of the neonates in both groups were born with low birth weight. Most of the neonates in both groups had good Apgar score at 1min and 5 minutes. However, the differences observed was not found to have any statistical significance.

Table 8: Association of neonatal profile with jaundice requiring intervention (n=219)

Risk factors	Jaundice requiring intervention		P value
	Yes (n=117)	No (n=102)	
Gestational age			
Preterm Neonates	33(28.2)	18(17.6)	0.065
Term Neonates	84(71.8)	84(82.4)	
Birth weight			
Low birth weight	37(31.6)	15(14.7)	.003
Normal birth weight	80(68.4)	87(85.3)	
Apgar at 1 min			
Good Apgar score	109(93.2)	93(91.2)	.584
Poor Apgar score	8(6.8)	9(8.8)	
Apgar @ 5 min			
Good Apgar score	115(98.3)	101(99.0)	.639
Poor Apgar score	2(1.7)	1(1.0)	

As per table VIII, 28.2% and 17.6% of neonates with jaundice requiring intervention and no intervention respectively were preterm. Majority of the neonates in both groupshad good apgar score after 1minute and 5 minutes of birth. 31.6% and 14.7% of neonates with jaundice requiring intervention and not requiring intervention respectively had low birth weight and this difference observed was found to be statistically highly significant(p=0.003).

DISCUSSION

In the present study, we estimated the prevalence of neonatal intensive care unit admissions, morbidity patterns, and outcomes among newborns delivered in a tertiary care center in south Kerala. During our study period, 42.86% of neonates were admitted to the NICU. This is similar to the prevalence of admissions in government medical college, Theni, coming up to 35.93% as concluded by the study titled "Prevalence of Preterm Admissions and the Risk Factors of Preterm Labour in Rural Medical College Hospital"**,** conducted by Nandini Kuppuswami *et al*, in 2021.[6]

In the same study, 12.06% of total newborn admission were of <34 weeks of gestation, which is in parallel with our finding of 7.3% of newborns admitted being preterm.

The morbidity pattern obtained from our study was as follows: Jaundice (53.4%), respiratory distress (42.9%) and low birth weight (9.1%). This is in agreement with the study conducted by Navdeep Saini *et al*, in the year 2016, at General Hospital Chandigarh, hyperbilirubinemia, sepsis and respiratory distress were the leading causes of morbidity.[7] However, according to Ravikumar SA *et al*, in the study titled "Morbidity and mortality profile of neonates in a tertiary care centre in Tamil Nadu", most prevalent morbidities were respiratory distress (19.3%), Neonatal jaundice (14%) and then sepsis (12.9%), where the morbidities are similar.[8] The high percentage of cases of neonatal jaundice in this study could be because all cases of jaundice requiring phototherapy are admitted in NICU and treated.

According to this study, the majority of the neonates were admitted to NICU for a period of 4-6 days (64.4%), and those admitted for ≤ 3 days were 12.8%. Hence, 76.7% of those admitted spent 1-6 days in the NICU. This is much higher when compared to the study conducted by B Prakadeesh Bharathi titled"Medication errors in neonatal intensive care unit of a tertiary care hospital in South India", which stated that 59.9% patients stayed for 1-7 days.[9]

Considering outcomes, 96.8% of the neonates under present study were cured and discharged, while 0.5% died. The outcome is more positive when compared to the results of a study conducted by E. Gauchan *et al*, during the years 2010-2011, in Manipal Teaching Hospital, where only 76.9% of the admitted babies were discharged after improvement.[10]

In this study, 23.7% of the neonates admitted were of low birth weight. Similarly a study conducted by Wade Harrison concludes that while admission rates for newborns weighing less than 1500g are the highest of any birth weight category, they comprise only 13.8% of total NICU admissions.[11]

Among preterms, 43.8% had mothers with gestational diabetes, making it the co-morbidity with highest prevalence. This is not in accordance with the conclusions that Hypertensive disorders of pregnancy were the most common cause of preterm labour (21.4%), with gestational diabetes only affecting 8.1% of cases, in the study by Chaythrarao.[12]

62.5% of preterms were of low birth weight according to our study, similar to the finding that, LBW was present in 16.4% term and 64.4% preterm neonates, in the study conducted in Moradabad.[13]

According to this study, 29.8% of the babies with respiratory distress were born to mothers with gestational diabetes. This is in agreement with Donald Couston, as he states that a major outcome of gestational diabetes was an increased risk of respiratory distress in his article on "Gestational Diabetes", published in the year 2013.[14]

CONCLUSION

Prevalence of NICU admission in the tertiary care Centre of Kerala was found to be 42.86%. The major contributing morbidities to NICU admission were found to be jaundice (53.4%) followed by respiratory

distress (42.9%). Majority of neonates were admitted to NICU for a period of 4-6 days (64.4%), followed by 7-14 days (17.4%) and ≤ 3 days (12.8%). Among the neonates admitted to the NICU, 96.8% of the neonates were cured and discharged and 0.5% died. There is also a statistically significant association between mode of delivery and respiratory distress (p=0.002) and between low birth weight and preterm neonates less than 35 weeks (p=0.003).

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CONFLICTS OF INTEREST: NIL

REFERENCES

1. Al-Momani MM. Admission patterns and risk factors linked with neonatal mortality: A hospital-based retrospective study. Pak J Med Sci [Internet]. 2020 Aug 20;36(6). Available at: https://www.pjms.org.pk/index.php/pjms/article/view/2281(accessed on2022 Aug 29)
2. Principles of Epidemiology | Lesson 3 - Section 2 [Internet]. 2021. Available at: https://www.cdc.gov/csels/dsepd/ss1978/lesson3/section2.html(accessed on 2022 Aug 29)
3. Paudel L, Kalakheti B, Sharma K. Prevalence and Outcome of Preterm Neonates Admitted to Neonatal Unit of a Tertiary Care Center in Western Nepal. J Lumbini Med Coll. 2018 Dec 8;6(2):87–91.
4. Cureus | Prevalence and Associated Risk Factors of Sepsis among Neonates Admitted into Neonatal Intensive Care Units of Public Hospitals in Dhaka [Internet]. Available at: https://www.cureus.com/articles/29285-prevalence-and-associated-risk-factors-of-sepsis-among-neonates-admitted-into-neonatal-intensive-care-units-of-public-hospitals-in-dhaka (accessed on 2022 Aug 29).
5. Mishra AK, Sahanaa C, Manikandan M. Forecasting Indian infant mortality rate: An application of autoregressive integrated moving average model. J Fam Community Med. 2019 Aug;26(2):123–6.
6. Kuppusamy N, Vidhyadevi A. Prevalence of Preterm Admissions and the Risk Factors of Preterm Labor in Rural Medical College Hospital. Int J Sci STUDY [Internet]. 2016;4(9):123–6. Available at: http://galaxyjeevandhara.com/index.php/ijss/article/view/722 (accessed on2022 Dec 19)
7. Saini N, Chhabra S, Chhabra S, Garg L, Garg N. Pattern of neonatal morbidity and mortality: A prospective study in a District Hospital in Urban India. J Clin Neonatol. 2016 Jul 1;5(3):183.
8. A. R, Elangovan H, K. E, Kanagavelu A. Morbidity and mortality profile of neonates in a tertiary care centre in Tamil Nadu: a study from South India. Int J Contemp Pediatr. 2018 Feb 1; 9Bharathi BP, Raj JP, Saldanha K, Rao PNS, Devi DP. Medication errors in neonatal intensive care unit of a tertiary care hospital in South India: A prospective observational study. Indian J Pharmacol [Internet]. 2020;52(4):260–5. Available at: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7722910/(accessed on 2022 Dec 19)
9. 12. EBSCOhost | 91664121 | Clinical profile and outcome of babies admitted to Neonatal Intensive Care Unit (NICU). [Internet]. Available at: https://web.s.ebscohost.com/abstract?direct=true&profile=ehost&scope=site&authtype=crawler&jrnl=19932(accessed on 2022 Aug 29)
10. Harrison W, Goodman D. Epidemiologic Trends in Neonatal Intensive Care, 2007-2012. JAMA Pediatr [Internet]. 2015 Sep 1 169(9):855–62. Available at: https://doi.org/10.1001/jamapediatrics.2015.1305(accessed on2022 Dec 19)
11. Rao CR, de Ruiter LEE, Bhat P, Kamath V, Kamath A, Bhat V. A Case-Control Study on Risk Factors for Preterm Deliveries in a Secondary Care Hospital, Southern India. ISRN Obstet Gynecol [Internet]. 2014 Mar 13 2014:1–5. Available at: https://www.hindawi.com/journals/isrn/2014/935982/(accessed on2022 Dec 19);
12. Jain. Observational study on neonatal morbidity pattern of patients presenting to NICU of tertiary care centre, Moradabad [Internet]. Available at: https://www.jpcc.org.in/article.asp?issn=2349-6592;year=2019;volume=6;issue=1;spage=37;epage=42;aulast=Jain(accessed on 2022 Dec 19)
13. Gestational Diabetes Mellitus | Clinical Chemistry | Oxford Academic [Internet]. Available at: https://academic.oup.com/clinchem/article/59/9/1310/5621855(accessed on2022 Aug 29)