

Original Research Article

Morbidity and mortality in relation to weight, length, body mass index and ponderal index in preterm, term and post-term neonates

Yuktika Arora^{1*}, Suman A. Yadav¹, Chaman R. Verma¹, Rupesh Masand¹, Bhagwan S. Natani¹,
Girdhari L. Sharma¹, Narbir Yadav¹

¹Department of Pediatrics, National Institute Of Medical Sciences and Research, Jaipur, Rajasthan, India.*Corresponding author: Dr. Yuktika Arora , Department of Pediatrics, National Institute Of Medical Sciences and Research , Shobha Nagar, Jaipur, India

Abstract:

Background - Effects of growth related abnormalities commence in the intrauterine period as it is a period of maximum growth. The overall fetal growth is an interplay between fetal, maternal, placental and environmental factors.

Aims and objectives - To record the morbidity, mortality in relation to weight, length, body mass index (BMI) and ponderal index (PI) in preterm, term and post-term neonates.

Materials and methods –This cross-sectional study was conducted in the neonatal intensive care unit in the Department of Paediatrics and maternal wards of the Department of Obstetrics and Gynaecology of a tertiary care teaching hospital located 50 kilometres from Jaipur city amidst rural environment from 1st Jan 2016 to 31st July 2017 involving 500 neonates and their mothers.

Results –As compared to decreased weight, a low PI was associated with high morbidity. Hyperbilirubinemia (30.5%) , respiratory distress (28.5%) and sepsis (23.6%) were the major causes of morbidity. Mortality was high in first 72 hours. There was significant decline in mortality with the increasing gestational age. The major cause of death in ELBW neonates was HMD which accounts for almost 80% of deaths. In VLBW babies, sepsis and HMD jointly accounted for almost 70% of deaths. In babies weighing 1500-2499 grams, sepsis accounted for almost 50% of total death as the primary cause of death.

Key words - Morbidity, mortality, anthropometry, neonate.

INTRODUCTION

Morbidity and mortality in newborns is directly correlated with gestational age and weight. Gestational age and birth weight were understood to be important factors of the growth, development and survival of the child. Foetal growth is dependent on genetic, placental and maternal factors. Around 1 million babies die globally every year because of prematurity of which approximately 3,75,000 neonatal deaths due to prematurity and low birth weight occur in India alone.^{1,2} Fetal growth is an interplay between Fetal, Maternal, Placental and Environmental factors. Winick et al³ have shown a cessation of cell division in the placenta about one

month before term. According to this study in pregnancies associated with growth retarded foetuses, the placenta has reduced cell number in comparison to control. Ponderal index (PI) has been mentioned as growth parameter from birth onwards. But it is irony that there are no standards for its measurement in babies in whom the growth is fastest during the intrauterine life. Weight has been the most important criteria for assessment of growth but it only picks up changes occurring acutely which may be days to a few weeks. Length proves to be a better index of growth in acute and chronic stage of deprivation or excess. Ponderal index would be the ideal parameters of true growth

in utero. NCHS, ICMR and other curves done in the past have not been updated to cover PI as the growth parameters but CDC (2000)^{4,5} and WHO(2006)^{6,7} have incorporated BMI (ratio of birth weight & length²) and they are accepted as better curves for reference.

MATERIAL AND METHODS

This was a cross-sectional study conducted in tertiary care teaching Hospital from 1st Jan 2016 to 31st July 2017 in the neonatal intensive care unit of the Department of Pediatrics and maternal wards of the Department of Obstetrics and Gynaecology. Morbidity and mortality related analysis was done on 500 newborns.

Inclusion Criteria:

- a) Newborns delivered between the gestational ages of 25 weeks to 44 weeks will be included and assessment of weight and length, sex, modified Ballard's score, BMI, PI had been done & morbidity and mortality data collected within 48hrs of birth.

b) Maternal data included age, parity, gravidity, occupation, education status, antenatal visits and antenatal, natal and neonatal information had been collected.

Exclusion criteria:

- a) All outborn babies
- b) Mothers not knowing date of LMP
- c) Multiple births
- d) Gross discrepancy of >2 weeks in assessment of gestational age by LMP and modified Ballard's score.
- e) Congenital malformed baby (i.e. cleft lip, cleft palate, tracheoesophageal fistula, urogenital anomalies, congenital

hydrocephalous, meningocele and meningomyelocele).

- f) Chronic maternal disease/ obstetrical complications known to compromise fetal growth, history of smoking, alcohol consumption or drug abuse, severe hypertension or eclampsia, diabetes mellitus or TORCH positivity

So two study groups were obtained, one in the Maternal ward side newborns and another in NICU side newborns.

Data was analysed using SPSS version 6.1 statistical software by looking at frequencies as well as tests for both numerical and categorical variables. Where comparisons were performed Chi square and Odds ratio were utilized (with 95% confidence interval) with significance set at 5%.

A written ethical clearance was taken from Ethics Committee of college and written consent was taken from patient's parents.

RESULT

The maximum number of babies 474 (39.5%) were weighing between 1500-1999 grams while minimum number of babies 60 (5%) were weighing less than 1000 grams. Maximum number of babies 427 (30.5%) were of the gestational age 31-34 weeks while only 72 (6%) babies were born before 28 weeks. The incidence of low birth weight infants is 18.9% in term gestation and 48.5% in preterm gestations. Hyperbilirubinemia was major cause of morbidity (30.5%) followed by respiratory distress (28.5%) and sepsis 118 (23.6%). Among babies <1000 gms, RDS accounts for 80% of morbidity, while recurrent apnea, sepsis and hyperbilirubinemia accounts for 70%, 60%, 40% of morbidities respectively. Those who weighed

between 1000-1499 gms, hyperbilirubinemia accounted for 40% of morbidity followed by RDS and sepsis accounting 34% and 32% respectively. Among the babies weighing between 1500-1999gms, similar pattern was observed, hyperbilirubinemia followed by RDS & sepsis, while babies between 2000-2499gms; TTNB (10.41%) was the most common morbidity. Age of the infant at the time of death and incidence of mortality: mortality in babies weighing <1000gm was 50%, in babies between 1000-1499gm it was 17.1%, in 1500 – 1999gm 8.8% and in 2000 – 2499gm it was 6.8%. Out of 19 deaths, 8

(42%) occurred within 24 hours of birth, 5 (26%) within 24-72 hours and 4 (21%) 72 hours to 7 days. The major cause of death in ELBW groups was HMD which accounts for almost 80% of deaths. In VLBW babies sepsis and HMD jointly accounted for almost 70% of deaths. Apnea (20.2%), Respiratory Distress (16.21%) were associated with low ponderal index. Low, appropriate and high PI were detected in 111 (22.52%), 234 (47%) and 155 (31%) neonates respectively. 66 cases (12.2%) were IUGR, out of whom 41 (62.1%) were in low, 17(25.8%) appropriate, and 8(12.1%) in high PI groups.

Table 1: Birth Weight and Gestational Status

Gestational Age	LBW	NBW	Total
Pre-term	149	158	307
Term	170	723	893
Total	319	881	1200

The incidence of low birth weight infants is 18.9% in term gestation and 48.5% in preterm gestations.

Table 2: Neonatal Morbidity with Respect to PI

Ponderal index	LPI	API	HPI	p values
Total no. of newborn	111	234	155	
Mean weight(kg)	2.6	3.09	3.4	<0.001
Mean height(cm)	50	49.3	47.6	<0.001

Table 3: Incidence of Morbidity according to birth weight group of LBW babies

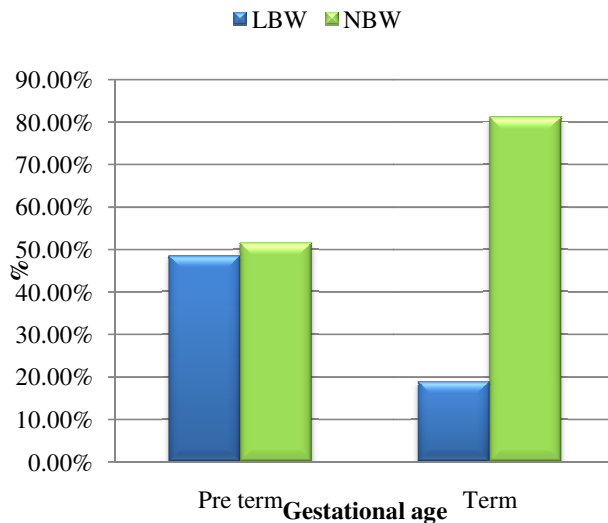
Morbidity	Total Cases n= 500 (%)	<1000 n= 24 (%)	1000-1499 n=134(%)	1500-1999 n= 198 (%)	2000-2499 n= 144 (%)
Respiratory Distress	143(28.5%)	20(80%)	45(33.9%)	45(22.7%)	75(52%)
HMD	73(40.5%)	18(70%)	35(26.4%)	18(8.8%)	3(1.7%)
TTNB	123(5.5%)	-(%)	3(1.8%)	10(5%)	15(10.41%)

Pneumonia	25(5%)	3(10%)	8(5.4%)	10(5%)	5(3.4%)
MAS	18(3.5%)	-(%)		8(3.8%)	10(6.8%)
Septicemia	118(23.6%)	15(60%)	43(32%)	48(24%)	13(8.5%)
Recurrent Apnea	68(13.5%)	18(70%)	23(17.1%)	23(11.3%)	5(3.4%)
NEC	43(8.5%)	13(50%)	18(13.2%)	13(6.3%)	-
Jaundice (NNJ)	153(30.5%)	10(40%)	53(39.6%)	58(29.1%)	33(22%)
Seizures	43(8.5%)	8(30%)	18(13.2%)	6(7.5%)	3(1.7%)
Intracranial Hemorrhage (ICH)	13(2.5%)	3(10%)	5(3.8%)	15(2.5%)	-
Hypothermia	27(13.5%)	8(30%)	28(20.7%)	28(13.92%)	8(5.1%)
Metabolic Disorders	68(8.5%)	10(40%)	18(13.2%)	13(6.3%)	3(1.7%)
Perinatal Asphyxia	48(9.5%)	5(20%)	18(13.2%)	15(7.5%)	10(6.8%)
Polycythemia	25(5.0%)	5(20%)	10(7.2%)	10(5%)	-

Table 4: Incidence of Neonatal Morbidity with Respect to PI

Variable	LPI(111)	API(234)	HPI(155)	p (chi-square)
Apnea	20.2%	13.04%	2.9%	0.007
MAS	2.7%	1.63%	0.9%	0.673
Septicemia	10.8%	5.9%	5.1%	0.255
NNJ	4.05%	-	-	0.003
Respiratory Distress	16.21%	13.58%	-	0.000
Age at hospital discharge > 7 d	23.18%	19.02%	1.9%	0.000

Graph 1: : Birth Weight and Gestational Status



DISCUSSION

The high incidence of neonatal death may only be reduced by gaining a better understanding about the nature of their problems. Prematurity and Low Birth Weight is one of the leading causes of morbidity and mortality worldwide. In our study, we observed that classification of neonates by their ponderal index is related with their morbidity and mortality profile. Low PI was associated with high morbidity. There was a significant correlation between Low PI and Apnea, Respiratory Distress and age at hospital discharge. Stokes et al⁸ also seen that PI has been proved to be a valuable index in the prediction of fetal outcome in those cases of intrauterine growth retardation. PI appears to be a better measure of infants with intrauterine growth retardation problems than birth weight percentile, this subgroup should be identified as early as possible preferably before birth. Kalimba et al⁹ has found that gestational age was found to be better predictor of the pattern of

morbidity in comparison to birth weight however we had almost similar patterns of mortality. D'Sa et al¹⁰ has shown improved survival with increase in both the birth weight and gestational age. Our study results were in accordance with Singh et al showing 100% mortality in babies with a birth weight of 500-999gms. Overall our study provides data from our institute which are similar to other studies and told about the need to improve prenatal and neonatal services. Kaur et al¹¹ shows incidence of LBW babies varies from 24-30% in their study, however it was 26.53% (319 cases) at our center which is similar. Our study shows one of the most common cause of morbidity is hyperbilirubinemia (30.5%), which was similar to Narayan S et al.¹² Other main causes were Apnea (20.20%), Respiratory Distress (16.21%), Sepsis (10.80%), MAS(2.70%). There was significant decline in mortality with the increasing gestational age evidenced by the fact that mortality in babies in < 28 weeks in our study was 44%, in 29-30 weeks it

was 26%, in 31-34 weeks 9.6% & only 7% in babies > 35 weeks of gestation. Therefore 32-34 weeks gestational age emerges as an important transition period, critical for neonatal morbidity and mortality. Thus, all efforts should be made to salvage these babies in NICU'S. Similar observations were reported by Hashemipour et al.¹³ In this study we showed that the neonates who were classified by lower ponderal index had higher neonatal morbidity than the groups with adequate ponderal index. These results are compatible with another study Firouzeh Nili et al.

SUMMARY AND CONCLUSION

The high incidence of neonatal death may only be reduced by gaining a better understanding about the nature of this problem. Prematurity and low birth weight is one of the leading causes of morbidity and mortality in our tertiary care teaching hospital as well as worldwide. It is the purpose of this study to identify specific variables which may influence the risks of neonatal death. Assess morbidity and mortality in relation to weight, length, BMI and ponderal index in preterm term and post-term neonates born.

REFERENCES

1. Singh M. Introduction to care of newborn babies. Care of the newborn. 7th ed. New Delhi: Sagar Publication;2010:6-7.
2. Elizabeth KE. Protein Energy Malnutrition. Nutrition and child development. 3rd ed. Hyderabad: Paras Publication;2004:144-145,343-346,350.
3. Winick M., Rosso P. Head circumference and cellular growth of the brain in normal and marasmic children. Journal of Paediatrics. 1969;74(5):774-8.
4. Kuczumski RJ, Ogden CL, Grummer-Strawn LM, Flegal KM, Guo SS, Wei R et al. CDC Growth Charts: United States. Adv Data. 2000;8(314):1-27.
5. Grummer-Strawn LM, Reinold C, Krebs NF. Use of World Health Organization and CDC growth charts for children aged 0-59 months in the United States. MMWR Recomm Rep. 2010;59(9):1-15.
6. De Onis M, Onyango AW, Borghi E, Siyam A, Nishida C, Siekmann J. Development of a WHO growth reference for school-aged children and adolescents. Bull World Health Organ. 2007;85:660-7.
7. World Health Organization. World Health Organization Child Growth Standards. 2006. Accessed March 5, 2012.
8. Stokes TA, Holston A, Olsen C, Choi Y, Curtis J, Higginson J, Enright L, Adimora C, Hunt CE : Preterm infants of lower gestational age at birth have greater waist circumference-length ratio and ponderal index at term age than preterm infants of higher gestational ages. J Pediatr.2012 Oct;161(4):735-41.e1. doi: 10.1016/j.jpeds.2012.03.023. Epub 2012 Apr 24.
9. Kalimba, E., & Ballot, D. (2013). Survival of extremely low-birth-weight infants. South African Journal Of Child Health, 7(1). <http://dx.doi.org/10.7196/sajch.488>
10. D'Sa, S., Pinto, D., Anousha, A., & Baliga, B. (2016). Effect of low birth weight on neonatal mortality in preterm and small for gestational age babies in a tertiary neonatal intensive care unit in India. International Journal Of Contemporary Pediatrics, 735-738. <http://dx.doi.org/10.18203/2349-3291.ijcp20162018>
11. Kaur, A., Thapar, K., Chhabra, G., & Jaslean. (2016). Morbidity and Mortality of Very Low Birth Weight Babies in a Tertiary Level NICU. Journal Of Nepal Paediatric Society, 35(3), 257. <http://dx.doi.org/10.3126/jnps.v35i3.13984>
12. Survival and morbidity of very low birth weight infants in a South American Neonatal Network. (2014). Archivos Argentinos De Pediatria, 112(5). <http://dx.doi.org/10.5546/aap.2014.eng.405>

13. Hashemipour, M., Hovsepian, S., Ansari, A., Keikha, M., Khalighinejad, P., & Niknam, N. (2017). Screening of congenital hypothyroidism in preterm, low birth weight and very low birth weight neonates: A systematic review. *Pediatrics & Neonatology*. <http://dx.doi.org/10.1016/j.pedneo.2017.04.006>.