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Study of hematological parameters in low birth weight babies in predominantly breastfeed infants, born at term gestation in 2 to 4 weeks of age

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Abstract
Over 130 million babies are born every year, and more than 10 million infants die because of Low Birth Weight. Low birth weight refers to birth weights below 2500 grams. The risk of mortality during the neonatal period of LBW infants and mainly of VLBW babies is much higher compared to the risk of normal weight infants because the former are highly exposed to birth asphyxia, hypothermia, hypoglycaemia, trauma, respiratory disorders and infections(1). Low birth weight has been consider as one of the important causes of neonatal deaths. Around 15% of newborn infants weight less than 2500 gm, the proportion ranging from 6% in developed countries to >30% in some parts of the world(3). The present study was planned to assess the hematological parameters in Low birth weight babies in predominantly breastfeed infants, born at term gestation in 2 to 4 weeks of age.

Keywords: Low birth weight. Hematological parameters., exclusively breastfeed infants

Introduction
Globally 2.6 million children die in the first month of life, around 7000 newborn deaths are occurring every day with about 1 million dying on the first day and close to 1 million dying within the next 6 days. Children who died within the first 28 days of birth were suffering from conditions and diseases associated with lack of quality care at birth or skilled care and treatment immediately after birth(4). In India, out of 25 million babies born, around one million babies die every year. India is contributing around 25% of neonatal mortality around the world. According to national family health survey-4 (NFHS4), the current neonatal mortality rate is 29 per 1000 live birth, accounting for nearly 77% of all the infant death (57/1000) and nearly half of the under-five child deaths (74/1000) [5].

Neonatal sepsis, hypoxic ischemic encephalopathy, preterm birth and LBW are the commonest causes of neonatal morbidity and mortality [6]. The prevalence of LBW differs widely among countries even though the sources and the consistency of national statistics has already pointed out; differing from one country to another [1]. LBW is commonly used as an indicator of health status and is an important subject of national concern and a focus of health policy. World health organization estimates that 25 million LBW babies are born annually worldwide and 95% occur in developing countries [7]. LBW is the strongest determinant of infant morbidity and mortality in India. Regional estimations of LBW include 28% in south Asia, 13% in sub-Saharan Africa and 9% in Latin America. Amongst regions, South Asia had the highest incidence of LBW; with one in four newborns being LBW. Indian Statistical Institute reported nearly 20% of new born had LBW in India during 2011 [8].

Neonatal death among infants weighing 1500–2500 grams is 20 times higher than among infants of normal weight [9, 10]. LBW is considered as the single most important predictor of infant mortality, mainly of deaths within the first months of life [11]. It is also a significant determinant of infant and childhood morbidity, mainly of neurodevelopment impairment such as mental retardation and learning disability [12]. LBW infants are also at greater risk of neuro-sensory disabilities such as mental retardation, seizure disorders, cerebral palsy, or learning disabilities. The percentage of neonatal deaths because of LBW differs depending upon the quality of care available and the prevalence of LBW.

Normally, the better the quality of neonatal care the higher the ratio of death attributable to LBW. In developed countries, around 30% to 50% of neonatal death were caused by LBW but amongst these patients, the mortality was confined to the extremely premature babies [1].

Dramatic changes occur in the blood and bone marrow of the newborn during the first hours and days after birth and there are rapid fluctuations in the quantities of all hematologic elements. The values of most of the hematological parameters i.e mainly hemoglobin concentration, packed cell volume, reticulocyte count and red cell indices are highest on the first day of life and thereafter declines over the third day and the sixth week of life [13]. Low birth weight (LBW) infants have diminished iron reserves and are at greater risk of developing iron deficiency. Iron supplementation was recommended in LBW infants from 2 months of age. However, in developing countries two thirds of LBW infants are born at full term but are growth restricted [14]. Since iron transfer was believed to be related to gestational age, and similar iron nurture had been shown in small for gestational age (SGA) and appropriate for gestational age (AGA) babies [15].

Factor responsible for decline in hematological parameters in the newborn are decrease in blood erythropoietin concentration soon after birth, reducing the erythropoietin rate. In addition, transient hemolysis is higher during the first few weeks after birth as compared to other. With the aim of assessing the hematological parameters in Term LBW babies, current study had been planned in Dr. D. Y. Patil medical, hospital and research center Pune in predominantly breast-fed infants at age of 2 – 4 weeks.

Materials and Methodology

It was a Observational, comparative study. The study was done in baby care clinic and PNC ward at DR D.Y. Patil Medical College, Hospital and Research Centre, Pimpri, Pune, The study was carried out over a period of 2 years, Institute Ethics Committee clearance was obtained before the start of the study. Term healthy low birth weight babies of 2 to 4 weeks of age and Exclusive breastfeed neonates were included in the study.

Two hundred thirty cases meeting the criteria are included for the present study.

Sample size is calculated based on the previous studies using the formula.

$$n = Z \frac{p(1-p)}{L}$$

n= sample size z= stastical for a level of confidence, p=Expected prevalence, L= allowable error, Prevalence = 20%, Allowable error = 5%.

For the level of confidence of 95%, which is conventional, Z value is taken as 1.96.

$$n = \frac{(1.96)*0.8*0.2}{0.05.}$$

= 245.8=245. The sample size came out to be 245 by using the software SSP.

Results

The current study was a hospital based prospective observational study conducted at Dr. D Y Patil Medical College, Hospital and research center, Pimpri, Pune for evaluating the hematological parameters in term gestation and Low birth weight (LBW). Total 245 neonates were born in D.Y Patil Medical college and Hospital, Pimpri, Pune were selected for the study. Data such as age, sex, birth weight, blood groups and Complete blood count were taken. All the data complied into MS excel spreadsheets and analyzed using IBM-SPSS version 20.0. The following were the results of the current study.

Age and Sex wise distribution of neonates

Table 1: Age and Sex wise distribution of neonates

Age	Sex		Total (%)
	Male (%)	Female (%)	
14 – 21 days	67 (51.5)	67 (58.3)	134 (54.7)
22 – 28 days	63 (48.5)	48 (41.7)	111 (45.3)
Total	130 (100.0)	115 (100.0)	245 (100.0)
Chi square test: 1.113, df = 1, p value 0.291			

Among male neonates (n=130), 51.5% were 14 – 21 days old (n=67) and 48.5% were 22 – 28 days old (n=63). Among female neonates (n=115), 58.3% were 14 – 21 days old (n=67) and 41.7% were 22 – 28 days old (n=48). By applying Chi square test, the relationship of age and sex was found to be statistically non-significant (p>0.05).

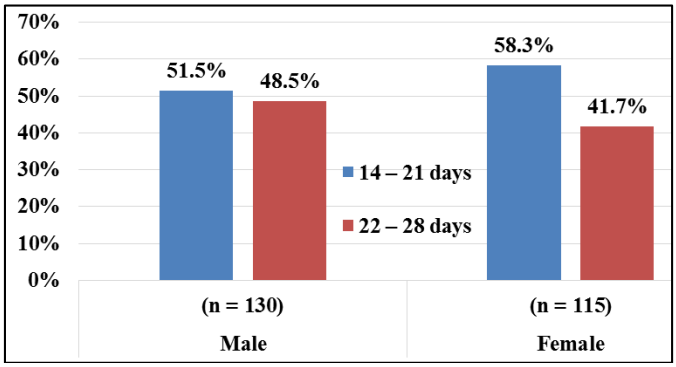

Fig 1: Age and Sex wise distribution of neonates

Distribution of neonates based on birth weight

Table 2: Distribution of neonates based on birth weight

Birth weight	No of neonates	Percent
1.0 – 1.49 kg	21	8.6
1.50 – 1.99 kg	86	35.1
2.0 – 2.49 kg	138	56.3
Total	245	100.0

In present study, majority of neonates (56.3%) had birth weight between 2.0 – 2.49 kg (n=138), followed by 35.1% neonates who had birth weight between 1.5 – 1.99 kg and 8.6% neonates had birth weight between 1.0 – 1.49 kg.

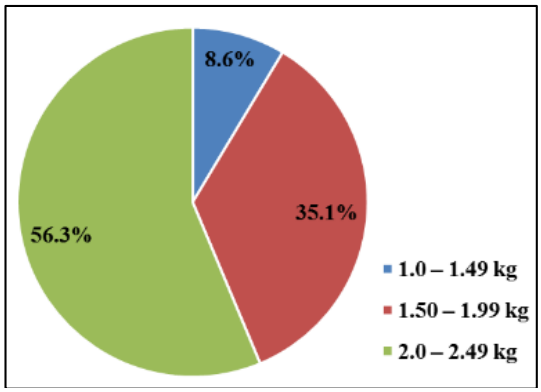

Fig 2: Distribution of neonates based on birth weight

Distribution of neonates based on Age and Birth weight

Table 3: Distribution of neonates based on age and birth weight

Birth weight	Age		Total (%)
	14 – 21 days (%)	22 – 28 days (%)	
1.0 – 1.49 kg	7 (5.2)	14 (12.6)	21 (8.6)
1.50 – 1.99 kg	51 (38.1)	35 (31.5)	86 (35.1)
2.0 – 2.49 kg	76 (56.7)	62 (55.9)	138 (56.3)
Total	134 (100.0)	111 (100.0)	245 (100.0)
Chi square test: 4.612, df = 2, p value 0.100			

Among 14 - 21 days old neonates (n=134), 56.7% had birth weight between 2.0 – 2.49 kg, 38.1% neonates had birth weight between 1.5 – 1.99 kg and 5.2% neonates had birth weight between 1.0 – 1.49 kg. Among 22 – 28 days old neonates (n=111), 55.9% had birth weight between 2.0 – 2.49 kg, 31.5% neonates had birth weight between 1.5 – 1.99 kg and 12.6% neonates had birth weight between 1.0 – 1.49 kg. By applying Chi square test, the relationship of birth weight and age was found to be statistically non-significant (p>0.05).

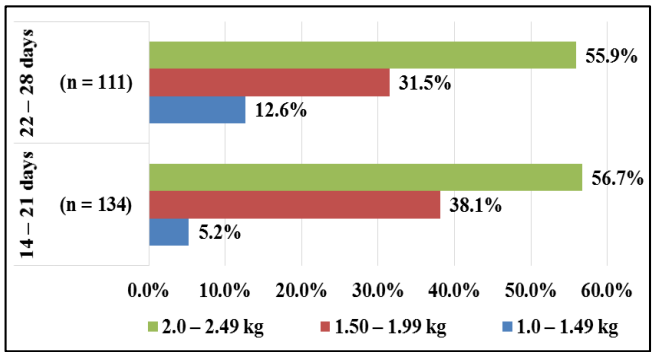

Fig 3: Distribution of neonates based on age and birth weight

Hematological parameters in LBW neonates

Table 4: Hematological parameters in LBW neonates

Hematological parameters	Minimum	Maximum	Mean	SD
Hemoglobin (gm/dl)	7.2	16.9	13.1	1.7
Total leucocyte count per ml	3600	17000	8192.2	2541.8
Platelet count (lakh/ml)	2.0	7.0	2.83	0.86
Packed cell volume (PCV)	23.1	51.5	40.4	5.7
Mean corpuscular volume (MCV, fl/red cell)	79.8	111.6	93.7	6.6
Mean corpuscular hemoglobin (MCH, pictograms/red cell)	25	45.4	34.6	3.3
Mean corpuscular Hb concentration (MCHC, gm/dl)	30.1	44.2	34.1	2.3

In present study among small for the gestational age babies, mean value of hemoglobin was 13.1 ± 1.7 gm/dl with minimum 7.2 gm/dl and maximum 16.9 gm/dl. Mean value of total leucocyte count was 8192.2 ± 2541.8 per ml with minimum 3600/ml and maximum 17000/ml. Mean value of platelet count was 2.83 ± 0.86 lakhs per ml with minimum 2.0 lakhs/ml and maximum 7.0 lakhs/ml. Mean value of total PCV was 40.4% ± 5.7% with minimum 23.1% and maximum 51.5%. Mean value of MCV was 93.7 ± 6.6 fl/red cell with minimum 79.8 fl/red cell and maximum 111.6 fl/red cell. Mean value of MCH was 34.6 ± 3.3 picograms/red cell with minimum 25 picograms/red cell and maximum 45.4 picograms/red cell. Mean value of MCHC was 34.1 ± 2.3 gm/dl with minimum 30.1 gm/dl and maximum 44.2 gm/dl.

Distribution of neonates based on hemoglobin level

Table 5: Distribution of neonates based on hemoglobin level

Hemoglobin level	No of neonates	Percent
< 12 gm/dl	59	24.1
12 – 17 gm/dl	186	75.9
> 17	0	0
Total	73	100.0

In present study, more than three fourth of neonates (75.9%) had hemoglobin level between 12 – 17 gm/dl (n=186) and remaining 24.1% neonates had hemoglobin level below 12 gm/dl (n=59).

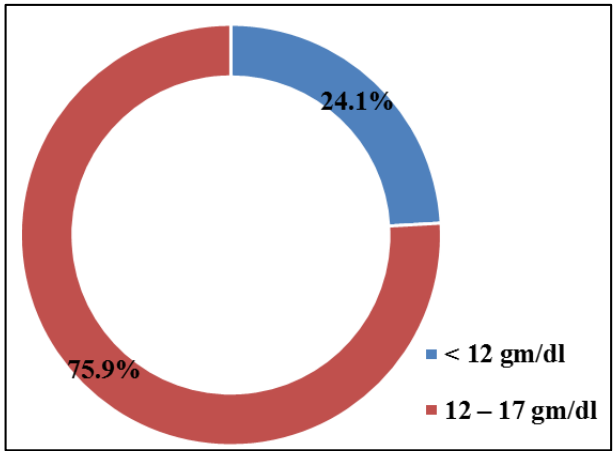

Fig 4: Distribution of neonates based on hemoglobin level

Distribution of neonates based on total leucocyte count

Table 6: Distribution of neonates based on total leucocyte count

Total leucocyte count	No of neonates	Percent
< 5150/ml	14	5.7
5150 – 22000/ml	231	94.3
> 22000/ml	0	0
Total	245	100.0

In present study, majority of the neonates (94.3%) had total leucocyte count between 5150-22000 per ml (n=231) and remaining 5.7% neonates had total leucocyte count below 5150/ml (n=14).

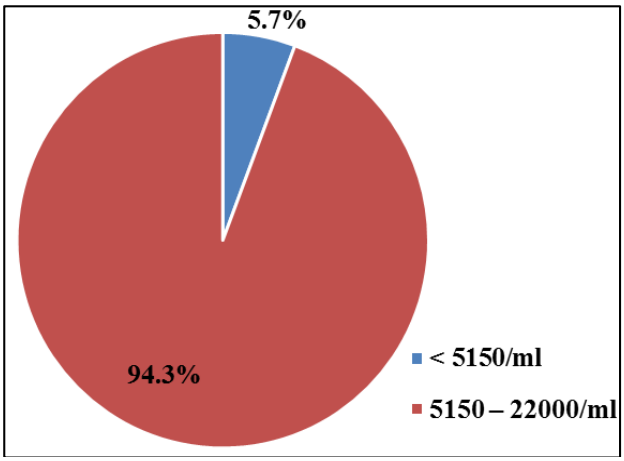

Fig 5: Distribution of neonates based on total leucocyte count

Distribution of neonates based on Platelet level

Table 7: Distribution of neonates based on Platelet level

Platelet level	No of neonates	Percent
< 1.5	0	0
1.5 – 4.5 lakhs/ml	237	96.7
> 4.5 lakhs/ml	20	3.3
Total	245	100.0

In present study, majority of neonates (96.7%) had platelet level between 1.5 – 4 lakhs per ml (n=225) and remaining 3.3% neonates had platelet level more than 4 lakhs/ml (n=20).

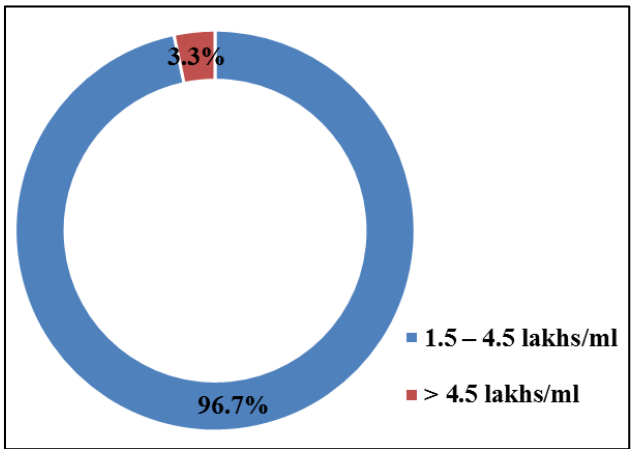

Fig 6: Distribution of neonates based on Platelet level

Distribution of neonates based on Mean Corpuscular Volume (MCV)

Table 8: Distribution of neonates based on Mean Corpuscular Volume (MCV)

Mean Corpuscular Volume (MCV)	No of neonates	Percent
< 93.3 fl/red cell	112	45.7
93.3 – 118.3 fl/red cell	133	54.3
> 118.3 fl/red cell		
Total	245	100.0

In present study, more than half of neonates (54.3%) had Mean Corpuscular Volume (MCV) between 93.3 – 118.3 fl/red cell (n=133) and remaining 45.7% neonates had MCV below 93.3 fl/red cell (n=112).

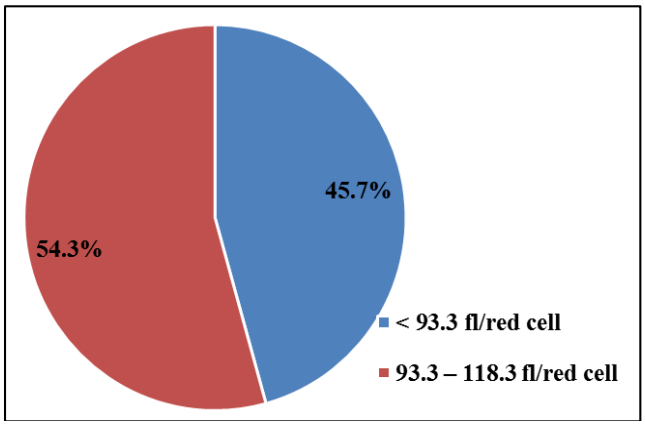

Fig 7: Distribution of neonates based on Mean Corpuscular Volume (MCV)

Distribution of neonates based on Mean Corpuscular Hemoglobin (MCH)

Table 9: Distribution of neonates based on Mean Corpuscular Hemoglobin (MCH)

Mean Corpuscular Hemoglobin (MCH)	No of neonates	Percent
<30.8 picograms/red cell	15	6.1
30.8 – 39.2 picograms/red cell	214	87.3
> 39.2 picograms/red cell	16	6.5
Total	245	100.0

In present study, more than four fifth of neonates (87.3%) had Mean corpuscular hemoglobin (MCH) between 30.8 – 39.2 picograms/red cell (n=214) and 6.5% neonates had MCH > 39.2 picograms/red cell (n=16) and 6.1% neonates had MCH < 30.8 picograms/red cell.

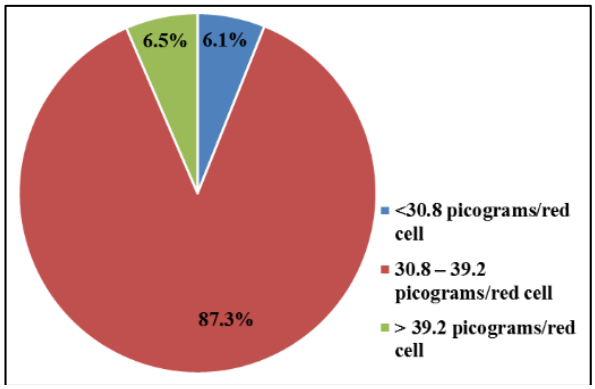

Fig 8: Distribution of neonates based on Mean Corpuscular Hemoglobin (MCH)

Distribution of neonates based on mean corpuscular hemoglobin concentration (MCHC)

Table 10: Distribution of neonates based on mean corpuscular hemoglobin concentration (MCHC)

Mean Corpuscular Hemoglobin Concentration (MCHC)	No of neonates	Percent
< 28.2 gm/dl	0	0
28.2 – 36.7 gm/dl	228	93.1
> 36.7 gm/dl	17	6.9
Total	245	100.0

In present study, majority of neonates (93.1%) had Mean corpuscular hemoglobin concentration (MCHC) between 28.2 – 36.7 gm/dl (n=228) and 6.9% neonates had MCHC > 36.7 gm/dl (n=17).

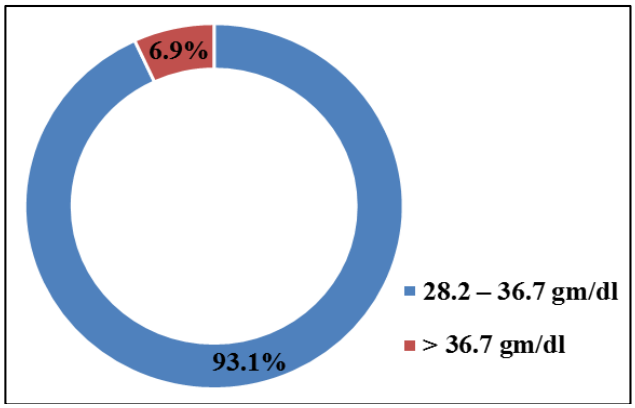

Fig 9: Distribution of neonates based on mean corpuscular hemoglobin concentration (MCHC)

Age wise comparisons of neonates based on hematological parameters

Table 11: Age wise comparisons of neonates based on hematological parameters

Hematological parameters	Age		P values
	14 – 21 days	22 – 28 days	
Hemoglobin (gm/dl)	13.9 ± 1.8	12.3 ± 1.2	<0.001
Total leucocyte count (per ml)	8371.6 ± 2719.2	7975.7 ± 2303.1	0.226
Platelet count (lakh/ml)	2.85 ± 0.90	2.81 ± 0.80	0.726
PCV	42.7 ± 5.8	37.5 ± 4.0	<0.001
MCV (fl/red cell)	96.2 ± 6.1	90.8 ± 6.0	<0.001
MCH (pictograms/red cell)	35.2 ± 3.7	33.8 ± 2.5	0.001
MCHC (gm/dl)	34.6 ± 2.7	33.5 ± 1.5	<0.001

Mean values of hemoglobin was significantly higher in 14 - 21 days old neonates (13.9±1.8 gm/dl) comparing to 22 – 28 days old neonates (12.3±1.2 gm/dl) (p<0.05). Mean values of total leucocyte count was non-significantly higher in 14 - 21 days old neonates (8371.6±2719.2 per ml) comparing to 22 – 28 days old neonates (7975.7±2303.1 per ml) (p>0.05). Mean values of platelet count was also non-significantly higher in 14 - 21 days old neonates (2.85±0.9 lakh/ml) comparing to 22 – 28 days old neonates (2.81±0.8 lakh/ml) (p>0.05). Mean values of PCV was significantly higher in 14 - 21 days old neonates (42.7±5.8 %) comparing to 22 – 28 days old neonates (37.5±4%) (p<0.05). Mean values of MCV was significantly higher in 14 - 21 days old neonates (96.2±6.1 fl/red cell) comparing to 22 – 28 days old neonates (90.8±6 fl/red cell) (p<0.05). Mean values of MCH was significantly higher in 14 - 21 days old neonates (35.2±3.7 picograms/red cell) comparing to 22 – 28 days old neonates (33.8±2.5 picograms/red cell) (p<0.05). Mean values of MCHC was significantly higher in 14 - 21 days old neonates (34.6±2.7 gm/dl) comparing to 22 – 28 days old neonates (33.5±1.5 gm/dl) (p<0.05).

Sex wise comparisons of neonates based on hematological parameters

Table 12: Sex wise comparisons of neonates based on hematological parameters

Hematological parameters	Sex		P values
	Male	Female	
Hemoglobin (gm/dl)	13.1 ± 1.8	13.2 ± 1.77	0.648
Total leucocyte count (per ml)	8431.5 ± 2566	7921.7 ± 2497.5	0.117
Platelet count (lakh/ml)	2.86 ± 0.88	2.80 ± 0.83	0.627
PCV	40.3 ± 5.8	40.4 ± 5.6	0.934
MCV (fl/red cell)	93.4 ± 6.9	94.1 ± 6.4	0.443
MCH (pictograms/red cell)	34.5 ± 3.3	34.7 ± 3.4	0.599
MCHC (gm/dl)	34.0 ± 2.2	34.2 ± 2.2	0.605

Among males mean values of hemoglobin (13.9±1.8 gm/dl) was non-significantly lower comparing to females (13.2±1.8 gm/dl) (p>0.05). While mean values of total leucocyte count was non-significantly higher among males (8431.5±2566 per ml) comparing to females (7921.7±2497.5 per ml) (p>0.05). Mean values of platelet count was also non-significantly higher among males (2.86±0.88 lakh/ml) comparing to females (2.80±0.83 lakh/ml) (p>0.05). Mean values of PCV was non-significantly higher in females (40.4±5.6%) comparing to males (40.3±5.8%). Mean values of MCV was non-significantly higher in females (94.1±6.4 fl/red cell) comparing to males (93.4±6.9 fl/red cell). Mean values of MCH was nearly same in both male (34.5±3.3 picograms/red cell) and females (34.7±3.4 picograms/red cell). Mean values of MCHC was also nearly same in both

male (34±2.2 gm/dl) comparing to females (34.2±2.2 gm/dl).

Conclusion

The current observational study was conducted in term LBW neonates to evaluate the hematological parameters at 14 – 28 days of life. Mean values of hemoglobin, hematocrit, MCV, MCH and MCHC were significantly higher among 14–21 days old but the values declined in 4th week of life. But no stastical difference were observed between males and females.

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