

Short Term Nutritional Outcome and Morbidity of Healthy Late Preterm Babies

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Abstract: **Background:** Latepreterm babies have significantly higher risks of adverse outcome than full-term newborns (37 weeks and 42 weeks). A study was done to study the specific needs of late preterm babies, analyse short-term nutritional outcomes and identify the risk factors and morbidity of stable late preterm babies compared to term babies. **Materials and Methods:** All singleton healthy babies born at gestational age from 34 completed up to 36+6 weeks and weighing > 1.8 kg were included as cases. The control group consisted of healthy term singleton babies' with a weight >2.5 kg and no history of NICU admission at birth. Both groups were daily assessed for frequently occurring problems (e.g., hypoglycaemia, hypothermia, poor feeding, hyperbilirubinemia). Both the groups (term and late preterm babies) were followed up for feeding issues and anthropometry till 14 weeks of chronological age. **Results:** Most frequent feeding problems observed in late preterm infants during early days (Day1-3) of hospitalization was incorrect positioning, followed by sleepy baby and mothers not perceiving enough milk. In later days of hospitalization (day 7- 14), most frequent feeding problems in late preterm included a sleepy baby and incorrect positioning. Common causes of NICU admissions in late preterm babies on Day 1 & 2, were hyperbilirubinemia and clinical sepsis as compared to term babies. On Days 3-6, it was hyperbilirubinemia and inadequate weight gain. From Day 7th–14th, the most common cause of admission in late preterm babies was hyperbilirubinemia, followed by respiratory illness & suspected seizure. At 38weeks post-conceptual age of late preterm infants mean weight, mean length and mean head circumference were significantly lower than term infants at birth. (p-value <0.01) **Conclusion:** Late preterm babies face feeding problems, morbidity, and are at risk of early growth failure. There is a need of a continuum of care after discharge from the hospital as these babies are at risk of growth failure.

Keywords: Late preterm, feeding issues, growth failure, morbidity.

INTRODUCTION

Late preterm babies are new-borns born between 34 weeks and -36⁺⁶ weeks of gestational age. These preterm babies have significantly higher risks of adverse outcome than full term new-borns (37 weeks and 42 weeks). Though, the babies that are born towards the preterm end period were traditionally assumed to be at 'low risk,' but research has demonstrated that the morbidity and mortality of the neonates related to the late preterm births (34-36 weeks) was more than that related to early term births (37–38 weeks).¹ The main reason behind this is the relative physiological and metabolic immaturity, immaturity of the gastrointestinal tract and feeding difficulties due to immaturity of the sucking movements.

The greatest challenge for management of late preterm babies is that they are often managed according to practices designed for healthy term babies. Academy of Breastfeeding Medicine has published a protocol for assisting the late preterm and early term babies with

breast feeding and prevent problems of hypoglycaemia, hyperbilirubinemia, dehydration, hospital readmission in late preterm babies.²

There is abundance of data regarding the morbidity profile of late preterm admitted to NICU. However, there is paucity of data related to stable late preterm babies. The National Perinatal Association of U.S.A published multidisciplinary guidelines for the care of late preterm babies which tells about close monitoring throughout the first 24 hours after birth and these guidelines aims to reduce risk of hypothermia, hypoglycaemia, and feeding problems.³ No such guidelines are available for the Indian set-up. So, our present study was done to study the specific needs of late preterm babies, analyse short term nutritional outcome and identify the risk factors and morbidity of stable late preterm babies compared to term babies.

MATERIAL AND METHODS

The study was a prospective longitudinal hospital-based study in a tertiary care hospital of North India. After Institutional Ethics Committee Clearance and informed consent from the parents, all singleton healthy babies born at gestational age from 34 completed up to 36+6 weeks and weighing > 1.8 kg were included in the study as cases. Babies requiring NICU admission > 48 hours (excluding those who were admitted only for phototherapy), babies with major congenital malformation, twin deliveries and with history of sibling death suggestive of inborn error of metabolism were excluded from the study. The control group consisted of healthy term singleton babies' with weight > 2.5 kg and no history of NICU admission at birth.

The cases and control group babies who fulfilled the inclusion criteria were included in the study after taking consent from the parents. Gestational age was documented in completed weeks from the date of mother's last menstrual period or antenatal ultrasonography of first trimester. If both are not available, then gestational age was estimated using New Ballard score.⁴

Standard growth charts of new-borns and modified Fenton growth chart for preterm babies⁵ were used to classify the babies as appropriate for gestational age (AGA), small for gestational age (SGA) and large for gestational age (LGA). Initiation of breast feeding at the earliest was tried with daily weight monitoring till discharge. All babies were managed as per standard guidelines for new-born care.

Mothers were counselled for breast feeding immediately and daily during rounds. Breast feeding observation assessment was done daily. All mothers had supervised breastfeeding at least 5-6 times daily to prevent hypoglycaemia. Blood sugar estimation was done as standard care for all low-birth-weight/SGA babies. All mothers were advised to give skin to skin contact after birth.

All babies were evaluated for clinical jaundice daily. A transcutaneous bilirubin (by Dräger JM-105) estimation was done in babies who were visibly jaundiced and range of phototherapy was based upon American Academy of Pediatrics (AAP) and National Institute for Health and Clinical Excellence (NICE) bilirubin charts.^{6,7} Treatment of such babies was done as per these guidelines for management of jaundice.

Both the groups were daily assessed for frequently occurring problems (e.g., hypoglycaemia, hypothermia,

poor feeding, hyperbilirubinemia). Babies who were too sleepy to feed or had excessive weight loss (7% weight loss in 3 days or 3% in one day) were counselled to give expressed breast milk (EBM) after direct breast feeding.

Babies with no apparent medical problem were discharged along with mother and were counselled about care of low birth weight at home. Close monitoring of growth (weight, length, head circumference) was performed at discharge, and then on subsequent follow up (using Modified Fenton's growth chart 2016 up to 50 weeks post-conception⁵ and WHO growth charts 2016 (from 50 weeks post-conception till 14 weeks after birth).⁸

Both the groups (term and late preterm babies) were followed till 14 weeks of chronological age. Anthropometry was done at the time of discharge and thereafter on follow-up at 7-14 days, 28 days, 42 days, 10 weeks and 14 weeks. Weight was measured by using 'Seca 354 electronic weighing machine' nearest to 0.1 kg. Length was measured by Harpenden's infantometer with a precision of 1mm and head circumference was measured by using non-stretchable tape by a cross-tape method. Babies with values below 10th percentile were labelled to be having early growth failure.

On every follow up, parents were asked about feeding difficulties and counselling was done accordingly. Adequacy of feeds was checked by history. Feed was considered adequate if baby slept for 2-3 hours without waking up after breast feeding, passed urine at least 6-8 times in 24 hours and gained weight.

STATISTICAL ANALYSIS

The data entry was done in the Microsoft EXCEL spreadsheet and the final analysis was done with the use of Statistical Package for Social Sciences (SPSS) software, IBM manufacturer, Chicago, USA, ver. 23.0. Categorical variables were represented in the form of number and percentage (%). The quantitative data were presented as the means $\pm$ SD. Association of the variables which were quantitative in nature were analysed using the Chi-Square test. If any cell had an expected value of less than 5, then chi square with Yates's correction test was used. Univariate analysis was done to calculate odds ratio and confidence interval. Multiple logistic regression analysis was done with various dependent and independent variables and adjusted odds ratio was calculated. P-value of less than 0.05 was considered statistically significant.

RESULTS

There were a total of 961 deliveries during the study period out of which 172 were late preterm and 688 were term babies. In the present study, 192 babies (96 each in late preterm and term babies' group) were enrolled as per the inclusion criteria. Flow diagram showing patients for enrolled the study (Figure 1).

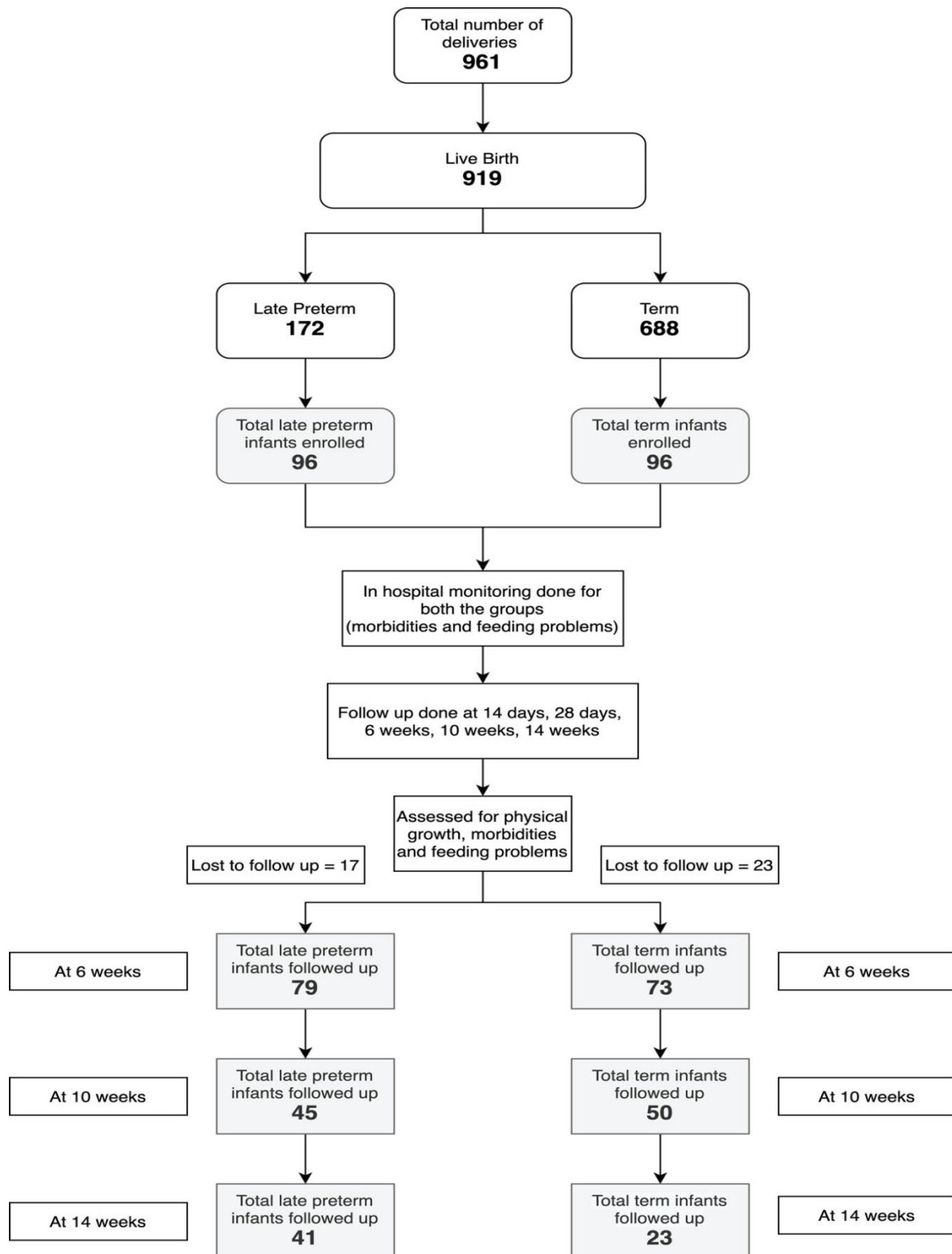


Table 1: Baseline characteristics of late preterm and term babies and their mothers.

Characteristics	Late preterm - 96 N (%)	Term - 96 N (%)	p-value
Gender			
Male	53 (55.2)	47 (48.9)	0.38
Female	43 (44.7)	49 (51)	
Mean Gestational Age (weeks) + SD	35.29 + 0.76	38.78 + 1.07	
Parity			

1	22 (22.9)	30 (31.2)	0.26
2	18 (18.7)	30 (31.2)	0.08
>3	56 (81.1)	36 (37.5)	0.03
Maternal Age (years)	25.3 + 3.48	26.1 + 3.76	0.91
Maternal Risk Factors Absent	46 (47.9)	80 (83.3)	<0.001
Maternal Risk Factors Present	50 (52.0)	16 (16.6)	
Maternal Hb (g/dL)	9.2 + 0.38	11.15 + 0.25	0.66
Maternal BMI (kg/m2)	22.5 + 3.98	23.11 + 3.85	0.928
Hb = Hemoglobin, BMI = Body Mass Index, SD = Standard Deviation			

A significant difference (p-value <0.001) was observed in the maternal risk factors amongst the late preterm and term babies. Multiparity was observed more (81.1%, n=56) in case of late preterm babies as compared to mothers of term babies (37.5%, n=36) with a significant difference (p-value = 0.03).

Table 2: In - hospital assessment of feeding problems

	DAY 1			DAY 2			DAY 3			DAY 7th-14th		
Issues	Late preterm N=96	Term N=96	p-value	Late preterm N=96	Term N=96	p-value	Late preterm N=96	Term N=96	p-value	Late preterm N=79	Term N=73	p-value
No Feeding problems	7	29	<0.0001	16	55	<0.0001	19	79	<0.0001	24	39	0.02
New-born with multiple feeding problems	53	35	0.009	31	5	<0.0001	8	3	0.214	22	20	0.95
Supplemented with top feed	0	0	-	0	0	-	29	10	0.0006	24	0	0.0001
Sleepy Baby	14	3	0.011	25	1	<0.0001	7	2	0.172	10	2	0.036
Incorrect positioning	55	39	0.020	31	12	0.001	2	3	1	9	7	0.601
Perceived Not enough milk	15	10	0.28	13	7	0.156	6	3	0.491	5	16	0.016
Retracted Nipple	6	3	0.491	5	2	0.248	0	0	-	0	0	-
Breast Engorgement	0	0	-	2	2	0.615	9	1	0.022	6	0	0.028
Maternal Illness	0	0	-	0	1	0.3173	0	1	0.3173	4	0	0.121
Cracked Nipple	0	0	-	3	1	10.61	4	1	0.364	0	10	0.0015

Table 2 shows that in the early days of life (Day 1 and Day 2), more late preterm babies had one (or many) feeding problems as compared to term babies (p-value=0.009). However, in the later days (Day 3 and Day 7th–14th) there was no significant difference found between the late preterm and term babies (p value=0.95).

Sleepy babies were found to be more in the late preterm group as compared to term babies and there was a significant difference observed (p-value <0.0001).

Table 3: In - hospital morbidity profile assessment

	DAY 1 -2			DAY 3 - 6			DAY 7th – 14th		
Reason for Admission	Late preterm N=96	Term N=96	p-value	Late preterm N=96	Term N=96	p-value	Late preterm N=79	Term N=73	p-value

	N=96								
Hyperbilirubinemia	4	2	0.678	2	1	0.638	5	2	0.44
Clinical Sepsis	2	1	1	0	0	1	0	0	-
Hypothermia	0	0	0.157	0	0	-	0	0	-
Vomiting	0	0	-	0	0	-	0	0	-
Inadequate Weight Gain	0	0	1	1	0	0.210	0	0	-
Respiratory Illnesses	0	0	-	0	0	0.317	1	0	1
Suspected Seizure	0	0	-	0	0	-	1	0	1
Jitteriness	7	1	0.070	2	3	0.1	0	0	-
Total	6	3	0.329	3	1	0.590	7	2	0.16

Table 3 shows that number of NICU admissions were more in late preterm babies compared to term babies. On Day 1 & 2, common causes reported in late preterm babies were hyperbilirubinemia (n=4), clinical sepsis (n=2) as compared to term babies. This was not significant. On Days 3-6, cause of hospital admission in late preterm babies was hyperbilirubinemia (n=2) and inadequate weight gain (n=1). From Day 7th–14th, most common cause of admission in late preterm babies was hyperbilirubinemia (n=5) followed by respiratory illness (n=1) & suspected seizure (n=1).

Table 4: Feeding method analysis on Follow - up Visits

	DAY 28			6 WEEKS			10 WEEKS			14 WEEKS		
	Late Preterm (N=79)	Term (N=73)	p-value	Late preterm (N=79)	Term (N=73)	p-value	Late preterm (N=45)	Term (N=50)	p-value	Late preterm (N=41)	Term (N=23)	p-value
Exclusive Breast Feeding	29	36	0.116	28	36	0.010	14	35	0.00015	11	12	0.042
New born with multiple feeding problems	30	16	0.036	19	15	0.601	19	6	0.00083	15	1	0.010
Not Exclusively breast feed	26	15	0.086	22	10	0.02	31	12	0.00001	30	11	0.042

Table 4 shows that on follow-up, more late preterm babies had feeding problems as compared to term babies. In assessing exclusive breast feeding, it was observed that at 4 weeks, there was no significant difference found between the late preterm and term babies (p value=0.116).

However, in 6th week fewer late pre term babies (n=28) were exclusively breast fed as compared to term babies (n=36), (p-value = 0.01), more late preterm babies had multiple problems (n=19), compared to term babies (n=15). In 14th week fewer late preterm babies (n=11) were exclusively breast fed as compared to term babies (n=12) with significant p-value = 0.042, more late preterm babies had multiple problems (n=15), compared to term babies (n=1) with a p value= 0.010.

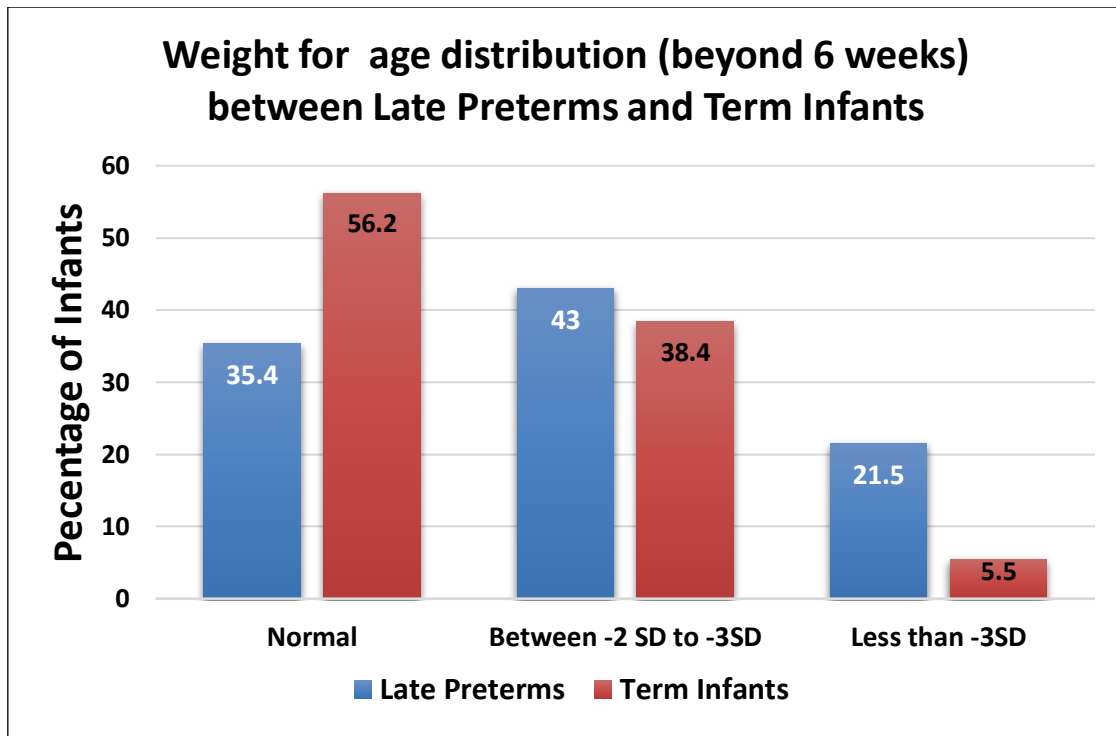


Figure 2: Comparison of weight for age distribution between late preterm and term babies beyond 6 weeks of age. (* Standard taken from WHO charts for term babies and Fenton charts for late preterm babies)

There was significant difference between late preterm and term babies in their mean weight, length and head circumference was statistically significant (p value <0.01). Between $-2SD$ to $-3SD$ and less than $-3SD$ babies, weight for age was significantly higher in late preterm group compared to term group (p value <0.01) (Figure 2).

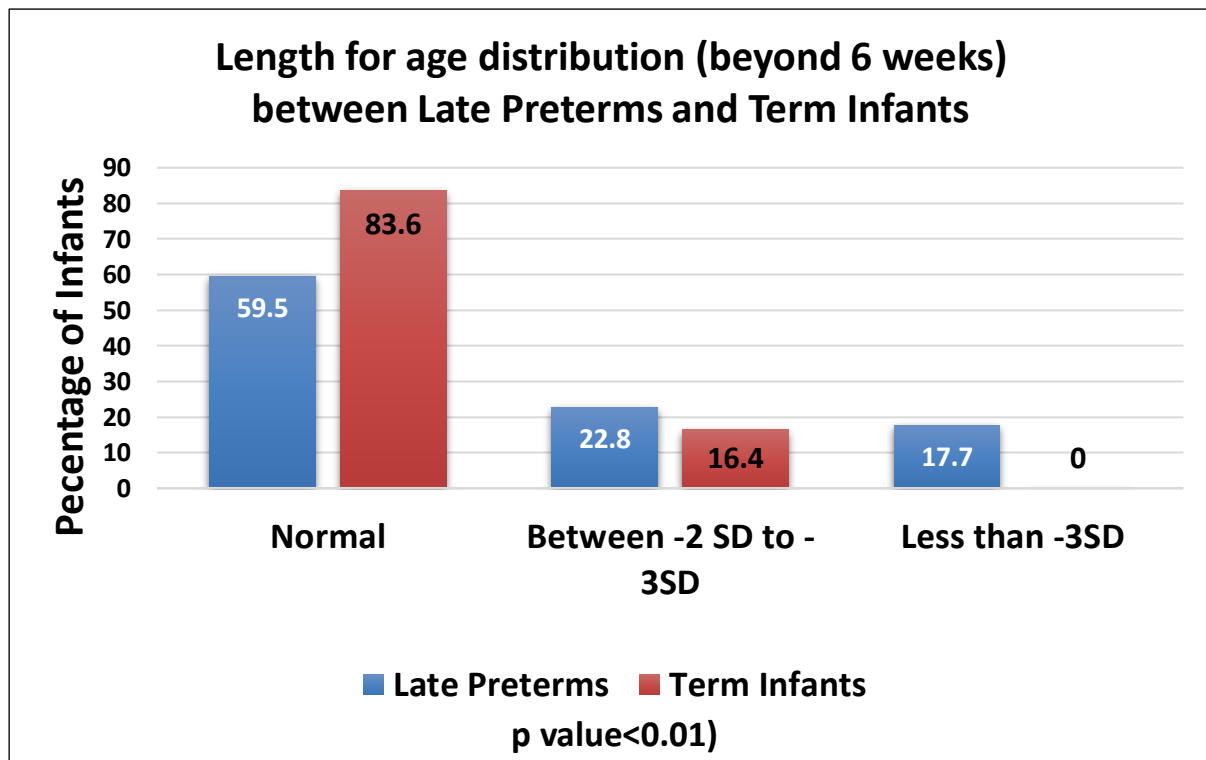


Figure 3: Comparison of length for age distribution between late preterm and term babies beyond 6 weeks of age. (*Standard taken from WHO chart for term babies and Fenton chart for late preterm babies)

(Above values were not taken at a single visit, since children came at different times)

Number of babies were significantly higher in late preterm group compared to term group (p value <0.001) between -2SD TO-3SD and less than -3SD (Figure 3). Above values were not taken at a single visit, since children came at different times.

Table 5: Growth outcomes of the late preterm at 14 weeks of age (Risk of growth faltering)

	Crude odds ratio (95% CI)	Adjusted odds ratio (95% CI) *
Weight between -2SD TO-3SD	2.33 (1.21-4.48)	2.01 (0.97-4.13)
Length between -2SD TO -3SD	3.46 (1.61-7.46)	2.82 (1.26-6.29)

*Adjusted for sex, maternal BMI, Exclusive breast feeding

On univariate analysis, as compared to term births, late preterm births was associated with higher odds of being underweight and length between -2SD & -3SD. Multiple logistic regression analysis was done and adjusted odds of being underweight [2.01 (95% CI: 0.97-4.13)] and between -2SD & -3SD [2.82 (95% CI: 1.26-6.29)] were both found statistically significant in late preterm babies compared to term babies (p value <0.01)(Table 5)

DISCUSSION

The present study aimed to study the short-term feeding problems, morbidity and physical growth of late preterm babies compared with term babies. In the present study, there was no significant gender predisposition observed which was similar to the findings observed in other studies.^{1,9}

Feeding difficulties was observed in fewer late preterm babies (n=7 (day 1), n=17 (day2), n=24 (day3)) as compared to term babies (n=29 (day1), n=55 (day2), n=39 (day3)). In first 2 days of life, similar proportion of term and late preterm babies were given only breast milk feed. However, it was seen that by the end of 2 weeks more late preterm babies were supplemented by additional top milk as compared to term babies. Similar observation was noted in another study.¹⁰ Our study found a statistically significant lower prevalence of breastfeeding on follow up (at 6, 10 and 14 weeks) among late preterm babies compared to term babies.

The present study revealed that late preterm babies (Day1 n=14, Day2 n=25) are significantly more likely to tire out while breast feeding than term babies (Day 1 n=3, Day2 n=1). Late preterm babies achieve less effective sucking and swallowing. Many late preterm babies require repeated assistance and support before achieving consistent, nutritive breast-feeding. Initially, supplementation with expressed breast milk or formula feed often is required.¹¹ Among other significant problem faced was incorrect positioning and attachment which was more among late preterm infant than term babies. Other issues observed were perception of inadequate milk, retracted nipple, cracked nipple, breast engorgement and maternal illness.

Fatigue during breast feeding may set in earlier and more frequently in late preterm babies.⁸ Mothers may need to express breast milk and give it by katori, spoon or paladai. On day 3, more late preterm babies (n=8) were given expressed breast milk by katori spoon than term babies (n=0) and the difference was significant. At 14 weeks of age also, significantly more late preterm babies (n=20) were being given feeds by katori spoon than term babies (n=10). It was also found that late preterm babies

had more than one feeding problems at an instance. However, in the later days i.e. on day 3 and day 7-14th days, these feeding problems reduced in late preterm babies and were comparable to that of term babies. This could possibly be due to the lactation counselling and support provided to the mothers. However, on follow up at 28 days, 6, 10 and 14 weeks more late preterm babies came with multiple feeding problems.

In this study, on analysis of morbidity assessment, hypothermia on day 1 was significantly more in late preterm babies (n=14 vs n= 3 in term). This is despite the fact that these babies were kept in the same bed as the mother. Many other factors such as wet nappy and not having appropriate clothing for baby also play a role. A study by Wang found that late preterm babies were more likely to present with temperature instability.¹² In another study, hypothermia was the primary reason for admission in 5.2% of all late preterm babies who were admitted to the NICU.¹³

In our study, hypoglycaemia was more in late preterm babies, with significant difference on 2nd day of life (n=4). In another study also, low blood sugar was found 3 times more in late preterm babies.¹² Jitteriness was present in late preterm and term babies with late preterm having this problem on day 1, n=7 vs 1 in term babies, while on 2nd day number was almost equal in both the groups. Parker et al. (1990) revealed that 44% of healthy full-term babies from 8 to 72 hours of age demonstrated some degree of jitteriness; 23% of the babies were jittery only when they were startled, crying, or upset, and 21% of the babies were jittery during periods of alertness.¹⁴ Low birth weight and prematurity are considered as risk factors for jitteriness. But till date no study has shown a significant correlation between jitteriness and late preterm babies.

In our study late preterm had more clinical jaundice compared to term babies. Clinical jaundice significantly peaked at 3rd- 6th day of life (late preterm babies n=11, term babies n=3). Our results were similar to other studies like Sarci et al which stated that late preterm babies were 2.4 times more likely to develop significant hyperbilirubinemia than term babies. They also stated that late preterm had significantly higher bilirubin levels

on day 5 and day 7, indicating that these babies have a relatively delayed bilirubin peak with a tendency to persist for a longer duration.¹⁵

During the first few days after birth, new born loses extracellular fluid equivalent to about 10% of body weight.¹⁶ Excessive weight loss is defined as more than 7% weight loss in 3 days or 3% in one day. In our study, more late preterm babies had excessive weight loss compared to term babies. This difference was significant on day 2 (n=20 in late preterm, n=10 in term babies).

Late preterm neonates have unique susceptibility to infection and have higher incidence of early-onset sepsis and nosocomial infection.^{17,18} In our study, 2 late preterm babies were admitted to NICU on day 1 as compared to 1 term infant for clinical sepsis. In another study, it was stated that late preterm babies have approximately four times the odds for being screened for sepsis than term babies (36.7% versus 12.6%; OR: 3.97, $P < 0.01$).¹²

The studies conducted by Jaiswal et al. and Rather et al. also reported significant higher incidence of jaundice in late preterm cohort when compared to term counterpart.^{19,20} In this study, 4 patients were admitted in NICU for hyperbilirubinemia on day 1 among late preterms while only 2 patients among term babies. In another retrospective study, Maisels and Kring reported that babies at 35–36 weeks, 36–37 weeks, and 37–38-weeks gestation were 13.2, 7.7, and 7.2 times more likely to be readmitted to the hospital and require phototherapy for significant hyperbilirubinemia than those 40-week gestation.²¹

In the present study, NICU admissions were more for late preterm babies than the term babies but there was no significant difference. Most common reason for readmission at 7–14th day was hyperbilirubinemia, while at 6 and 14 weeks it was clinical sepsis followed by inadequate weight gain. In another study, jaundice and infection were the most common causes for hospital readmission for both late preterm and term babies.²² Study by Kristin N. Ray (2013) found that odds of hospitalization generally decreased with increasing gestational age (GA), with the exception of 34 to 36 weeks' GA.²³ One previous study of babies ≥ 33 weeks' GA also reported greatest hospitalization risk among 36-week GA babies.²⁴ Various other studies have demonstrated that late-preterm babies may be up to 3 times more likely to be readmitted than term babies commonly for hyperbilirubinemia, sepsis evaluation, and feeding difficulties.¹³

More of late preterm babies were having length below 3rd percentile in the study. In a study by Santos et al, he found that the strength of the association between late preterm birth and stunting was more compared to term.²⁵ In a study by Gianni (2012) it was shown that, at 1 month of corrected age, late preterm achieved a mean

body weight value comparable with their counterparts by the third month of corrected age and they showed a great increase in fat mass than their counterparts at birth (“catch-up fat”).²⁶

By using Fenton growth charts, it was found that early growth failure was significantly more in late preterm babies (both weight and length between -2SD to -3SD, less than -3SD were more among late preterm). The reference standards used are different for term and preterm babies so comparisons may not be valid. Odds of having extrauterine growth retardation (EUGR)/Early growth failure are significantly higher in late preterm babies as compared to term babies. Despite growing faster, late preterm children were at increased risk of underweight and stunting during the first two years of life.²⁵

Limitations in our study:

Although this was a hospital-based study, not all postnatal hospital readmissions and the observational stays could be linked to the birth records, which led may lead to underestimating the true risk of neonatal morbidity. Although we could distinguish pre-existing from pregnancy-related medical conditions, we were not able to assess their independent impact on neonatal morbidity. Assessment of neonates was taken at different time points by different observers which could have led to interobserver differences. Besides, neurodevelopment outcome was also not studied.

CONCLUSION

The major problem observed was difficulty in establishing and maintaining lactation in mothers of late preterm babies. The study observed that late preterm babies faced feeding problems, morbidity and are at risk of early growth failure. The mothers of late preterm babies require help from lactational counsellors during the first few weeks. The current guidelines for facility-based care of new-borns need to have separate guidelines for management of late preterm babies roomed in with mothers in maternity wards. This is especially important in view of high rate of lactational problems, and hyperbilirubinemia observed in late preterm babies. There is also a need of continuum of care after discharge from hospital as these babies are at risk of growth failure.

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