Original Article

Neonatal Outcome of the Late Preterm Infant (34 to 36 Weeks): The Singapore Story

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Abstract

Introduction: Late preterm (LP) neonates (34 to 36 weeks gestation) are often managed like term neonates though current literature has identified them to have greater complications. The primary objective of our study was to evaluate and compare morbidity and resource utilisation in LPs especially in view of paucity of Asian studies in this regard. Materials and Methods: A retrospective audit was carried out on 12,459 neonates born in KK Women's and Children's Hospital (KKWCH). The chief outcome measures were hypoglycaemia, hypothermia, respiratory morbidity, feeding problems and neonatal jaundice. Resource utilisation included neonatal intensive care unit (NICU) admission, mechanical ventilation, parenteral nutrition and length of hospitalisation. Results: Of 12,459 deliveries, 1221 (10%) were LP deliveries with a significantly increasing trend of 8.6% to 10% from 2002 to 2008 (P = 0.001). Neonatal morbidity in the form of hypoglycaemia (34 weeks vs 35 to 36 weeks vs term: 26% vs 16% vs 1%); hypothermia (5% vs 1.7% vs 0.2%); feeding difficulties (30% vs 9% vs 1.4%); respiratory distress syndrome (RDS) (4% vs 1% vs 0.1%); transient tachypnea of the newborn (TTNB) (23% vs 8% vs 3%) and neonatal jaundice (NNJ) needing phototherapy (63% vs 24% vs 8%), were significantly different between the 3 groups, with highest incidence in 34-week-old infants. Resource utilisation including intermittent positive pressure ventilation (IPPV) (15% vs 3.5% vs 1%), total parenteral nutrition/intravenous (TPN/IV) (53% vs 17% vs 3%) and length of stay (14 ± 22 days vs 4 ± 4.7 days vs 2.6 ± 3.9 days) was also significantly higher (P <0.001) in LPs. Conclusion: LP neonates had significantly higher morbidity and resource utilisation compared to term infants. Among the LP group, 34-week-old infants had greater complications compared to infants born at 35 to 36 weeks.

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Key words: Morbidity, Mortality, Respiratory distress syndrome, Total parenteral nutrition

Introduction

Neonatologists were caught looking the other way in the early part of the millennium. While they were keenly following the progress of extreme preterms and their travails, preterms born at the other end of the spectrum were being quietly ignored as "well babies". In July 2005, the National Institute of Child Health and Human Development (NICHD) held a workshop to optimise the care and outcome of the near term pregnancy and near term newborn infant. During this session, varying terms like "near term" and "borderline term" were brought together under the umbrella phrase "late preterm (LP) babies".[1] They were defined as infants born between weeks 34^{+0} to 36 and 6/7 completed weeks. This term was used to signify that this age group of preterm infants was "at risk" compared to a term population.[2]

They were also the fastest growing segment of the newborn population.[3,4] In the United States, LP birth rate rose 20% from 1990 to 2006.[5] This increase in LP deliveries is due to various factors including increasing multiple pregnancies, in-vitro fertilisation and delayed childbirth.[6] Other important factors include a combination of obstetric practices[7] and increase in complications of pregnancy.[8,9] Although most inductions and cesarean sections occur for valid obstetric indications, some are electively performed in the absence of any specified medical or obstetric indication.[10] There has been an increase in deliveries with no recorded indication and those done "at maternal request".[10] There has also been several research articles published on higher morbidities associated with LP neonates[11] including respiratory distress, hypoglycaemia, feeding difficulties and hyperbilirubinemia.

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Also of great concern is the increased risk of mortality, higher length of stay, increased cost and resource utilisation. While these "transitional" issues have been known for some time, recent studies have shown that LP infants compared with term infants face a greater risk for developmental delay and school-related problems up through the first 5 years of life.[12,13]

Current worldwide hospital statistics indicate LPs consist almost 8% to 9% of all live born infants.[6] In the absence of local data, the aims of this study were to assess the incidence of LP deliveries and to evaluate and compare their neonatal morbidity and mortality against term infants. Furthermore, we hypothesised that babies born at 34 weeks had morbidity characteristics separate from the 35- to 36-week infant. Thus, the study also aimed to further subanalyse the morbidity characteristics of the neonate born at 34 weeks in comparison to infant at 35 to 36 weeks rather than club them together as one large "LP" group. In view of the substantially higher costs involved in managing LPs, hospital resource utilisation by LP infants was also analysed in comparison to term infants.

Materials and Methods

This was a retrospective audit of an annual cohort of all babies born at gestational age between 34^{+0} to 36^{+6} weeks in KK Women's and Children's hospital (KKWCH), Singapore, from 1 January 2008 to 31 December 2008. KKWCH is the largest referral tertiary perinatal centre specialising in women and children's healthcare in Singapore,[14,15] with a delivery rate of 12,000 per year.

In our institution, babies born at 34 weeks are routinely admitted to the level 2 Special Care nursery. Infants who have completed 35 weeks and birth weight >2000 g without any other significant neonatal concerns are managed in the peripheral Well Baby nursery and are usually discharged after a 24-hour stay in the hospital. Indications for admission to the intensive care unit (ICU) included the need for respiratory support and requirement of central venous access for severe hypoglycaemia or severe growth restriction. At discharge, a referral is made to the local maternal and child health clinics, with no routine follow-up at KKWCH unless clinically indicated.

Gestational age was based on the best obstetrical assessment[16] using information on ultrasound measures and the date of the last menstrual period (LMP). Infants were followed until death or discharge to home from the hospital. The data was collected from a retrospective analysis of the International Classification of Diseases, Ninth Revision, Clinical Modification (ICD-9 CM) codes available from our hospital information database system. The data for major congenital malformations are based on a birth defect database maintained by our maternal-fetal department. Major congenital malformations (including neurological/cardiac/renal and gastrointestinal anomalies) confirmed by postnatal clinical/imaging examinations were included.

Hypoglycaemia was defined as plasma glucose levels ≤2.5 mmol/L.[17,18] Respiratory distress syndrome (RDS) was defined based on clinical signs like retractions, cyanosis, grunting, nasal flaring, tachypnea persisting more than an hour after delivery with x-ray changes.[19] Transient tachypnea of newborn was defined as tachypnea or respiratory distress that improved within 24 to 48 hours.[20] Hypothermia was defined as axillary body temperature less than 36.5ºC. Feeding problems were defined as poor suck, abdominal distention or recurrent vomiting. Neonatal jaundice was defined as any baby needing phototherapy based on the KKWCH clinical pathway guidelines. Our hospital phototherapy guidelines are described in Appendix 1 (stratifies term and LP babies into different risk groups with different levels of phototherapy).

Maternal demographic data collected included mode of delivery, plurality and presence of maternal complications such as pregnancy induced hypertension (PIH), premature rupture of membranes (PROM), antepartum hemorrhage (APH), gestational diabetes mellitus (GDM) and chorioamnionitis. Neonatal demographic data collected included birth weight, race (self-reported), gender, gestation, APGAR scores and other neonatal morbidities including hypoglycaemia, hypothermia, feeding problems, neonatal jaundice and respiratory distress due to transient tachypnea of the newborn (TTNB) and RDS.

Coders who had at least 3 years' experience with neonatology cases provided the International Classification of Diseases, Ninth Revision, Clinical Modification (ICD-9CM) diagnoses. The codes were given using physician assigned diagnoses after perusal of case notes. The analysis was done using SPSS version 16. Categorical data was processed using chi-square test and for continuous data, the student t-test was used.

Participants

Infants born at 34 weeks were classified as Group 1, while those born at 35 to 36 weeks were classified as Group 2 and the "term controls" belonged to Group 3.

Results

Out of 12,459 babies born at KKWCH in 2008, 10% were LP (Fig. 1) and 3.6% were less than 34 weeks gestation. LPs constituted 76.1% (1221/1603) of all preterm deliveries in the hospital. As seen in Figure 2, there was an increase in the incidence of prematurity less than 34 weeks gestation

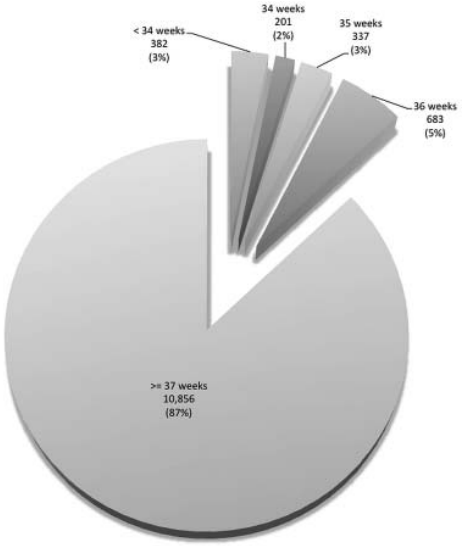

Fig. 1. Distribution of live births in KKWCH according to gestational age at birth.

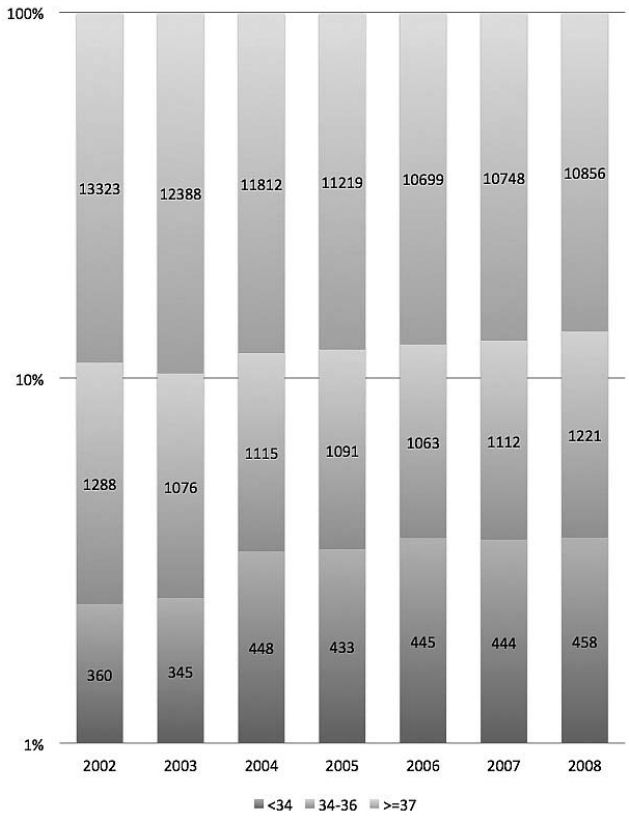

Fig. 2. Increase of late preterms versus preterm babies less than 34 weeks and term infants from 2002 to 2008 born in KKWCH.

in this period (2002 to 2008) from 2.4% (360/14971) to 3.6% (458/12535) (P <0.001). There was also a significantly increasing trend in the incidence of LP deliveries from 8.6% to 10% (P <0.003) during this period.

Maternal demographics is presented in Table 1 and with respect to ethnicity, there was a significantly higher representation of the Malays at 35 to 36 weeks compared to the term group (P = 0.001). While only 27% of the term babies were delivered by caesarean section , the incidence of lower segment caesarean section (LSCS) increased significantly to 42% at 35 to 36 weeks and 58% at 34 weeks gestation; 28.9% of Group 1 and 15.1% of Group 2 infants were twin deliveries compared to just 0.8% of Group 3 controls. Similarly 7.5% of Group 1 and 3% of Group 2 were triplet deliveries compared to none in the term group. Assisted reproductive mode of conception was significantly higher in both Group 1 and Group 2 compared to controls.

There was significantly higher incidence of major congenital malformations in LPs compared to term infants (1.8% vs 0.6%). The maternal complications, which were associated with LP deliveries included PIH, PROM, chorioamnionitis and GDM. As can be seen from Table 1, all these complications except APH were significantly higher in LP deliveries compared to term infants. Though the incidence of PIH in LPs was significantly higher than term infants, there was no significant difference between Group 1 and Group 2 infants. The incidence of PROM, however, was significantly higher in Group 1 compared to Group 2 and Group 3.

The mortality rates were low at 0.91 per 1000 (11/12077) in our study and were not significantly different between the 3 groups. Both subgroups of LPs had significantly higher incidence of 1-minute APGAR scores <7 compared to term infants (8.5% and 2.9% vs 1.2%) ($P \leq 0.001$) while the 5-minute APGAR scores were comparable.

As seen in Table 2, the incidence of neonatal complications such as hypoglycaemia, hypothermia, feeding problems and neonatal jaundice were significantly higher in LP deliveries compared to term infants and within the LP group, the complications were higher in Group1 compared to Group 2. Respiratory complications are an important cause of morbidity in the LP group and therefore were looked at separately. The rates of TTNB, RDS as well as the need for assisted ventilation were significantly higher in LPs compared to term infants (P <0.001) (Table 3).

LP infants also had other high neonatal resource utilisation in the form of antibiotics therapy, parenteral nutrition and blood transfusions (Table 3), which were again higher with decreasing gestational age groups. Only 65% of infants at 35 to 36 weeks could be managed in the Well Baby nursery compared to 90% of term infants (P <0.001). Seventy-two percent of Group 1, 29% of Group 2 and 9% of term infants needed admission to the Special Care nursery (P <0.001). Three babies who were in the 34-week gestation group were admitted into the peripheral nursery (level 1 care) even though our departmental guidelines require them to

Table 1. Maternal Characteristics and Demographics Data

	Group 1 (34 Weeks) n = 201, n (%)	Group 2 (35 – 36 Weeks) n = 1020, n (%)	Group 3 (Term) n = 10,856, n (%)	Group 1 vs Group 2 Odds Ratio (95% CI)	Group 2 vs Group 3 Odds Ratio (95% CI)
Race					
Chinese	83 (41.2)	450 (44.1)	5094 (46.9)	0.89 (0.65 – 1.22)	0.89 (0.78 – 1.02)
Malay	75 (37.3)	342 (33.5)	3020 (27.8)	0.18 (0.85 – 1.63)	1.30 (1.13 – 1.50)*
Indian	28 (13.9)	121 (11.8)	1293 (11.9)	1.20 (0.75 – 1.91)	0.99 (0.81 – 1.22)
Others	15 (7.5)	107 (10.4)	1449 (13.3)	0.69 (0.38 – 1.24)	0.76 (0.61 – 0.94)*
Age					
Average years (SD)	29.15	29.37	29.53		
Median years	30	30	30		
Type of delivery					
NVD	82 (40.8)	563 (47.8)	7248 (67)	0.55 (0.40 – 0.76)†	0.61 (0.54 – 0.70)†
Instrumental	3 (1.5)	24 (3.3)	630 (5.8)	0.63 (0.10 – 2.21)	0.39 (0.25 – 0.60)†
Caesarean section	116 (57.7)	433 (42.4)	2978 (27.5)	1.85 (1.34 – 2.54)†	1.95 (1.71 – 2.23)†
Emergency	93 (80.2)	346 (81.1)	1878 (63.1)	1.01 (0.59 – 1.75)	2.33 (1.81 – 3.00)†
Elective	23 (19.8)	87 (18.9)	1101 (36.9)	0.98 (0.57 – 1.69)	0.43 (0.33 – 0.55)†
IVF	28 (13.9)	64 (6.2)	191 (1.8)	2.41 (1.46 – 3.97)*	3.13 (2.76 – 5.05)
Multiple pregnancy					
Singleton	128 (63.7)	863 (84.6)	10761 (99.2)	0.32 (0.22 – 0.45)†	0.05 (0.03 – 0.06)†
Twins	58 (28.9)	154 (15.1)	95 (0.8)	2.28 (1.58 – 3.28)†	20.14 (15.3 – 26.48)†
Triplets	15 (7.4)	3 (0.3)	0	27.33 (7.35 – 65.76)*	NA†
Major congenital malformation	4 (2.0)	18 (1.8)	63 (0.6)	1.13 (0.037 – 3.59)	3.07 (1.75 – 5.35)†
Maternal complications					
PIH/HT	29 (14.0)	137 (13.0)	766 (7.0)	1.09 (0.69 – 1.71)	1.9 (1.56 – 2.31)†
PROM	61 (30.0)	104 (10.0)	27 (0.3)	3.83 (2.62 – 5.60)†	45.53 (29.13 – 71.60)†
Chorioamnionitis	3 (1.5)	7 (0.7)	2 (<0.1)	2.19 (0.26 – 9.48)	37.50 (7.18 – 106.34)†
APH/abruption	7 (3.5)	18 (1.8)	125 (1.1)	2.00 (0.75 – 5.18)	1.53 (0.902 – 2.57)
GDM	22 (11.0)	123 (12.3)	150 (1.4)	0.89 (0.53 – 1.48)	9.78 (7.58 – 12.63)†

APH: Antepartum haemorrhage; GDM: Gestational diabetes mellitus; HT: Hypertension; IVF: In-vitro fertilisation; NA: Not available; NVD: Normal vaginal delivery; PIH: Pregnancy induced hypertension; PROM: Premature rupture of membranes

*P <0.05

†P <0.001

be in Special Care nursery. A significantly higher number of LP infants needed admission to the neonatal intensive care unit (NICU) compared to term infants (Group 1: 26% vs Group 2: 6.4% vs Group 3: 1%, P <0.001). The mean length of stay was significantly higher in both Group 1 and Group 2 of LP infants (14 days and 4 days respectively) compared to the term group (2.6 days).

Discussion

A significantly increasing trend in the incidence of LP births was seen in our study over the last 7 years with LP births comprising 10% of all births in 2008. This increasing trend has also been reported by Tomashek and other authors.[2,11] However, in the United States, following a long period of steady increase, the first signs of a declining trend in the last 3 decades have been noted with LP birth rate decreasing from 12.8% in 2006 to 12.3% in 2008.[5] At the time of writing this article, we are seeing an increase in general awareness about LP infants.[21,22] LPs have been featured in the mainstream media and their health risks are being heavily debated.[23-25] Unfortunately, studies have shown that 51.7% of parents are unaware of the risks involved with LP delivery.[26] Thus it is the responsibility of obstetricians, perinatologists and neonatologists at an individual level and as professional societies to educate the medical community and the general public on this subject.

The higher incidence of LP infants in the Malay ethnic group could be postulated to the higher incidence of hypertension reported during pregnancy in this ethnic

Table 2. Neonatal Demographics and Morbidity: Comparison of Late Preterm and Term Cohort

	Group 1 (34 Weeks) n = 201, n (%)	Group 2 (35 – 36 Weeks) n = 1020, n (%)	Group 3 (Term) n = 10,856, n (%)	Group 1 vs Group 2 Odds Ratio (95% CI)	Group 2 vs Group 3 Odds Ratio (95% CI)
Weight					
Mean birth weight	2152 ± 453	2579 ± 412	3137 ± 397	NA†	NA†
<1.5 kg	10 (5.0)	2 (<0.5)	0	26.65 (5.44 – 79.50)†	NA
1.5 – 2 kg	69 (34.0)	72 (7.0)	25 (<0.5)	6.88 (4.64 – 10.21)†	32.90 (20.35 – 53.53)†
2 – 2.5 kg	88 (44.0)	380 (37.0)	495 (4.5)	1.31 (0.95 – 1.80)	12.43 (10.60 – 14.57)†
>2.5 kg	34 (17.0)	566 (55.0)	10,336 (95.0)	0.16 (0.11 – 0.24)†	0.062 (0.05 – 0.07)†
Neonatal morbidity					
Hypoglycaemia	53 (26.0)	160 (16.0)	114 (1.0)	1.92 (1.32 – 2.79)†	17.53 (13.55 – 22.69)†
Hypothermia	10 (5.0)	17 (1.7)	23 (0.2)	3.09 (1.29 – 7.25)*	7.98 (4.07 – 15.6)†
Feeding problems	60 (30.0)	92 (9.0)	152 (1.4)	4.29 (2.91 – 6.32)†	6.98 (5.30 – 9.20)†
NNJ needing phototherapy	133 (63.0)	243 (24.0)	847 (8.0)	6.25 (4.46 – 8.78)†	3.70 (3.14 – 4.35)†
Respiratory morbidity					
TTNB	49 (23.0)	78 (8.0)	294 (3.0)	3.89 (2.57 – 5.89)†	2.97 (2.28 – 3.88)†
RDS	8 (4.0)	15 (1.4)	11 (0.1)	2.77 (1.06 – 7.08)*	7.40 (3.15 – 17.54)†
APGAR scores					
1-min APGAR <7	17 (8.5)	30 (2.9)	137 (1.2)	3.05 (1.57 – 5.87)†	2.37 (1.56 – 3.59)†
5-min APGAR <7	4 (2.0)	8 (0.8)	43 (0.4)	2.56 (0.64 – 9.49)	1.99 (0.86 – 4.41)
Neonatal mortality (per 1000 live births)	4.97/1000	0.98/1000	0.83/1000	NA	NA

NNJ: Neonatal jaundice; RDS: Respiratory distress syndrome; TTNB: Transient tachypnea of the newborn
*P <0.05
†P <0.001

Table 3. Neonatal Resource Utilisation

	Group 1 (34 Weeks) n = 201, n (%)	Group 2 (35 – 36 Weeks) n = 1020, n (%)	Group 3 (Term) n = 10,856, n (%)	Group 1 vs Group 2 Odds Ratio (95% CI)	Group 2 vs Group 3 Odds Ratio (95% CI)
CPAP	51 (25.0)	61 (6.0)	142 (1.3)	5.34 (3.48 – 8.22)†	4.78 (3.49 – 6.59)†
IPPV	39 (15.0)	36 (3.5)	107 (1.0)	6.58 (3.95 – 10.96)†	1.86 (1.21 – 2.87)*
TPN/IV	107 (53.0)	177 (17.0)	325 (3.0)	5.42 (3.88 – 7.57)†	6.80 (5.56 – 8.31)†
Antibiotics >24 hours	69 (34.0)	66 (6.4)	195 (1.8)	7.56 (5.06 – 11.29)†	3.78 (2.81 – 5.09)†
Blood transfusion	14 (7.0)	13 (1.3)	44 (0.4)	5.80 (2.52 – 13.35)†	3.17 (1.62 – 6.11)†
Exchange transfusion	1 (0.5)	1 (0.1)	8 (<0.1)	NA	NA
Highest level of stay					
ICU	50 (24.8)	65 (6.3)	135 (1.2)	4.87 (3.17 – 7.45)†	5.41 (3.95 – 7.40)†
SCN	148 (73.6)	293 (28.7)	947 (8.7)	6.93 (4.86 – 9.90)†	4.22 (3.61 – 4.92)†
Level 1 nursery	3 (1.5)	662 (65.0)	9774 (90.0)	NA†	0.20 (0.17 – 0.24)†
Length of stay					
Mean ± 2 SD days	14 ± 22	4 ± 4.7	2.6 ± 3.9	NA†	NA†
Median	9	3	2		

CPAP: Continuous positive airway pressure; ICU: Intensive care unit; IPPV: Intermittent positive pressure ventilation; NA: not applicable; SCN: Special care nursery; SD: Standard deviation; TPN/IV: Total parenteral nutrition/intravenous
*P <0.05
†P <0.001

group.[27] Thus there is a need for closer monitoring and optimising management of this group in the periconceptional period and during pregnancy. When we looked at other maternal risk factors, there was a higher incidence of PROM in the study group, especially at 34 weeks. PROM could have been one of the causative factors for the preterm delivery in Group 1 as delivery is generally recommended in the presence of PROM ≥34 weeks.[28]

Among the LP group, a significantly higher number were conceived by assisted reproductive technology (ART) compared to term controls. This could possibly explain the higher number of multiple births in our study cohorts as ART is well known to be associated with multiple pregnancies.[29,30]

In our study, 20% of the LP deliveries were due to elective cesarean sections. The indications for these deliveries were not available to us. A recent study similarly showed that 23% of all LP deliveries had no recorded indication.[10] The American College of Obstetrics and Gynecology guidelines state that delivery before 39 weeks should only be undertaken when there is an accepted medical or obstetric complication or if fetal lung maturity has been documented.[31,32]

Our cohort had a similar incidence of RDS and TTNB when compared to other studies of LP infants.[33] The incidence of RDS in our cohort of 34-week infants was 4% and 1.4% at 35 to 36 weeks. The significantly higher odds of respiratory distress in the study cohort and the increasing trend with decreasing gestational age have been well documented. It has been shown that LP infants have reduced expression of epithelial sodium channels, which are essential to clear lung fluid after birth.[34] This possibly explains the significantly higher incidence of TTNB in the LP infant. Cesarean section before the onset of labour has been shown to increase the incidence of respiratory morbidity.[6] Greater than one third of the 34-week gestational age infants and 10% of 35 to 36 week infants needed respiratory support in our cohort. Similar figures of 23% to 33% of LP infants needing respiratory support have been reported in recent literature.[35]

In our study the LP infants were 3 to 6 times more likely to develop significant neonatal jaundice needing phototherapy. Similar figures have been reported widely with odds of 2.5 to 13 times higher risk in LPs compared to term infants. The reasons for this significant hyperbilirubinemia are believed to be due to reduced hepatic uptake, decreased conjugation and increased entero-hepatic circulation.[36] Even though the rates of neonatal jaundice are higher in LPs, rates of requirement of exchange transfusion are not significantly different. Thus, the LP infant needs to be closely monitored using high-risk criteria and aggressively treated for neonatal hyperbilirubinemia.

The 16% incidence of hypoglycaemia seen in our study in babies at 35 to 36 weeks is very similar to the figures quoted by Wang et al for this gestation.[33] The pathogenesis of hypoglycaemia in the LP infant is due to the immaturity of the hepatic enzyme systems resulting in inadequate gluconeogenesis and glycogenolysis as well as decreased glycogen stores. This is further aggravated by the presence of feeding difficulties commonly seen in this cohort of neonates.[37,38]

In our study, the LP infants had a higher incidence of feeding problems which is similar to the results of other studies.[39-41] Some of the reasons postulated for this have been decreased alertness, poor latching-on skills, decreased oromotor tone, disorganised sucking patterns and poor suck swallow coordination.[42] The immature suction pressures produced have been shown to reduce lactogenesis. Thus, there may be difficulty in establishing maternal-infant bonding and successful breastfeeding. Furthermore, feeding issues can lead to decreased caloric intake and dehydration which can further exacerbate other complications like hypoglycaemia, hyperbilirubinemia, respiratory distress and temperature instability.[43] Studies have shown that use of nipple shields and breast pumps to promote lactogenesis may help to reduce feeding issues in LP infants.[44-46] A recent study demonstrated the benefits of cup feeds over bottle feeds in LP infants to accelerate maturation of feeding behaviour.[47] The study also demonstrated that cup-fed babies have higher incidence of successful breastfeeding after discharge. This has been demonstrated in several other studies.[48-50] This was not tested in our cohort and may be a useful practice to implement.

Some of the limitations of our study include the retrospective nature and inability to adjust for confounders. Certain morbidities like hypoglycaemia are not routinely tested in term babies unless they are symptomatic. Also term babies usually develop neonatal jaundice needing phototherapy after discharge. We were unable to analyse morbidities in babies who were readmitted and therefore these rates could be underestimated in our study. Lastly, even though the gestational age of the neonates is mainly done by early dating scans or LMP dates, details of this information are not available. These limitations were unavoidable because of the nature of data collection and we intend to do a prospective study in this regard.

One of the strengths of our study lies in the fact that we have analysed babies born at 34 weeks separately from those delivered at 35 and 36 weeks. The definition of LP is arbitrary and maturation is a continuum. Our study shows that babies born at 34 weeks gestational age behaved significantly different from the 35- and 36-week gestational age newborns and had 3 times higher odds of developing respiratory distress compared to those at 35 to 36 weeks. They also had

4 times higher risk of developing hypothermia and twice the chance of developing hypoglycaemia compared to babies born at 35 and 36 weeks. We therefore believe it would be inappropriate to give recommendations on management of LPs as a whole and separate tailored guidelines for each gestation may be more appropriate. Long-term developmental follow-up of LPs have demonstrated a 36% higher incidence of developmental delay in comparison to term babies.[12] It is not known whether these issues are related to the abovementioned perinatal events, or because of brain maturation differences.[49,50] There is currently active research being done on "encephalopathy of prematurity".[51,52] An infant born at 34 gestational weeks has only 65% of the total brain weight of a term infant.[53] The further growth of the grey matter areas occur at varying rates and secondary circulatory insufficiency can lead to selected neuronal necrosis in vascular border zones.[54] Therefore the LP infant needs to be followed up longitudinally in a structured manner to monitor for growth and neurodevelopment so as to optimise the interventions and outcomes of a large high-risk vulnerable population.[2] We have now initiated a LP follow-up clinic in our hospital to monitor their neurodevelopment.

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Appendix 1

High-risk Phototherapy Criteria

Age in Hours	Off Phototherapy/ Discharge	Admit for Phototherapy	Start Single Blue Phototherapy	Start Double Blue Phototherapy	Do Double Volume Exchange Transfusion
Day 1 (<24 hours)	90	130	140	220	260
Day 2 (>24 to 48 hours)	160	180	190	250	290
Day 3 (>48 to 72 hours)	190	210	220	280	320
Day 4 to 5 (>72 to 120 hours)	190	220	220	300	340
>120 hours to day 14	220	260	260	300	340

Phototherapy Guidelines for Babies Born with Birth Weight <2 kg or at <5 Weeks PMA

Birth Weight (g)	Photo Level (mmol/L)		Exchange Level (mmol/L)	
	Normal	Abnormal	Normal	Abnormal
<1250	150	120	220	190
1250 – 1499	170	140	250	220
1500 – 1999	200	170	310	270
2000 – 2400	220	190	340	300
≥2500	260	230	400	340

PMA: Post menstrual age

Low-risk Phototherapy Criteria

Age in Hours	Off Phototherapy/ Discharge	Admit for Phototherapy	Start Single Blue Phototherapy	Start Double Blue Phototherapy	Do Double Volume Exchange Transfusion
Day 2 (>24 to 48 hours)	190	210	220	300	340
Day 3 (>48 to 72 hours)	220	250	260	320	360
Day 4 to 5 (>72 to 120 hours)	220	260	260	360	400
>120 hours to day 14	260	300	300	360	400