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Associated factors and consequences of late preterm births: results from the 2004 Pelotas birth cohort

Iná S. Santos[a], Alicia Matijasevich[a], Mariângela F. Silveira[a], Iândora K. T. Sclowitz[a], Aluísio J. D. Barros[a], Cesar G. Victora[a] and Fernando C. Barros[b]

[a]*Pós-graduação em Epidemiologia, Universidade Federal de Pelotas (UFPel), Pelotas, Brazil, and* [b]*PAHO/WHO Latin American Center for Perinatology and Human Development, Montevideo, Uruguay*

Correspondence:
Dr Iná S. Santos, Av. Duque de Caxias, 250. CEP 96030-002. Pelotas, RS, Brazil.
E-mail: inasantos@uol.com.br

Summary

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Although neonatal and infant mortality rates have fallen in recent decades in Brazil, the prevalence of preterm deliveries has increased in certain regions, especially in the number of late preterm births. This study was planned to investigate: (1) maternal antenatal characteristics associated with late preterm births and (2) the consequences of late preterm birth on infant health in the neonatal period and until age 3 months. A population-based birth cohort was enrolled in Pelotas, Southern Brazil, in 2004. Mothers were interviewed and the gestational age of newborns was estimated through last menstrual period, ultrasound and Dubowitz's method. Preterm births between 34 and 36 completed weeks of gestational age were classified as late preterm births. Only singleton live births from mothers living in the urban area of Pelotas were investigated. Three months after birth, mothers were interviewed at home regarding breast feeding, morbidity and hospital admissions. All deaths occurring in the first year of life were recorded.

A total of 447 newborns (10.8%) were late preterms. Associations were observed with maternal age <20 years (prevalence ratio [PR] 1.3 [95% CI 1.1, 1.6]), absence of antenatal care (PR 2.4 [1.4, 4.2]) or less than seven prenatal care visits, arterial hypertension (PR 1.3 [1.0, 1.5]), and preterm labour (PR 1.6 [1.3, 1.9]). Compared with term births, late preterm births showed increased risk of depression at birth (Relative risk [RR] 1.7 [1.3, 2.2]), perinatal morbidity (RR 2.8 [2.3, 3.5]), and absence of breast feeding in the first hours after birth (PR 0.9 [0.8, 0.9]). RRs for neonatal and infant mortality were, respectively, 5.1 [1.7, 14.9] and 2.1 [1.0, 4.6] times higher than that observed among term newborns. In conclusion, in our setting, the prevention of all preterm births must be a priority, regardless of whether early or late.

Keywords: *preterm births*, *late preterm births*, *neonatal mortality*, *infant mortality*, *breast feeding*, *infant morbidity*.

Introduction

In recent years, and increasing rate of preterm births has been observed in certain Brazilian regions.[1–3] In the 2004 Pelotas birth cohort, the prevalence of newborns with gestational age below 37 weeks was 15%, roughly three times the prevalence found in the 1982 birth cohort in the same city.[4,5] The well-known association between gestational age and risk of morbidity and mortality in the first year of life illustrates the importance of evaluating and improving outcomes related to preterm birth.[6]

The profound changes that took place in the Brazilian health care system in recent decades – which include its availability to all social sectors, the medicalisation of delivery and the increased availability of neonatal intensive care units (NICU) – have increased the probability of survival among preterm babies. The 30% reduction in neonatal mortality rates seen between the 1982 and 1993 Pelotas birth cohorts (from 20.1 to 14.3 per 1000 live births), the period when the first NICUs were built in the city's three largest maternity centres, probably reflects this improvement in care.[7]

The majority of studies of preterm delivery focus on gestational ages below 32 weeks. Whereas nearly all such infants are admitted to the NICU and are closely followed up, preterm infants born between 34 and 36 weeks gestation are frequently provided usual care, being perceived as having low risk. As identified by Kramer *et al.*,[6] in a population-based cohort study from the US and Canada, infants between 34 and 36 gestational weeks are at increased risk of death during infancy as compared with term births (at ≥37 gestational weeks). Several other studies have shown them to be at elevated risk for mortality and morbidity.[8–11]

In the 2004 Pelotas birth cohort, the increase in prevalence of preterm births was primarily due to the birth of babies at 34–36 completed weeks of gestation (late preterm birth).[5,8] The aim of the present study was to identify factors associated with late preterm births, and the consequences in regard to infant health during the first 3 months of life and on neonatal and post-neonatal mortality. The hypothesis being tested was that late preterm infants are at increased risk of neonatal medical problems and of dying in the first year of life, when compared with term newborns.

Methods

In 2004, a birth cohort study was carried out in the city of Pelotas, Southern Brazil. The city's five hospitals with maternity wards were visited on a daily basis. Mothers were interviewed soon after delivery, using a structured, pre-tested questionnaire. This questionnaire included questions on demographic, environmental and socio-economic variables and on the characteristics of pregnancy, labour, delivery and healthcare service utilisation. In the first 24 h after birth, children were examined by specially trained field workers who were supervised by a paediatrician. Gestational age was estimated using an algorithm based initially on the date of the mother's last menstrual period (LMP). In the absence of this information ($n = 387$; 9.2%), ultrasonography measures from the first trimester were used; and, if neither was available ($n = 292$; 6.9%), gestational age was estimated through the Dubowitz's score.[12] Only 13 newborns (0.3%) had no information on gestational age. For each method, implausible gestational ages were excluded.[13] Preterm birth was defined as birth <37 weeks of gestational age. Preterm births between 34 and 36 completed weeks of gestation age were defined as late preterm births.

All interviews and tests were carried out by nutritionists, under the supervision of a paediatrician. Children whose mothers lived in the urban area of Pelotas were visited at home 3 months after birth. At this time, mothers were interviewed by trained interviewers, using a standardised questionnaire. Information on the child's breast-feeding pattern, frequency of symptoms and diseases and use of the health care service was collected.

The monitoring of infant mortality (deaths in the first 364 days of life) included regular visits to hospitals, cemeteries, publics notaries and the Municipal Secretariat of Health. Infant deaths were classified as neonatal (age 0–27 days) and post-neonatal (age 28–365 days), and expressed as neonatal, post-neonatal and infant mortality rates (number of neonatal, post-neonatal and infant deaths per 1000 live births, respectively).

In the present study, analyses were restricted to singleton newborns whose mothers lived in the urban area of Pelotas. Family income in the month preceding delivery was expressed in minimum wages (MW) (~US$80 in 2004) and categorised as ≤1, 1.1–3, 3.1–6 and >6 MW per month. Mothers who were single, widowed, divorced, or who lived without a partner were classified as single mothers. Mother's schooling was categorised as 0, 1–4, 5–8 and ≥9 completed years of formal education. Mother's age was defined in complete years at the time of delivery and categorised as <20, 20–34 and ≥35 years. Maternal race has been associated with increased risk of low birthweight. Maternal skin colour was used as a proxy for race and was classified as white or black/mixed according to the interviewer's observation.

Smoking during pregnancy was self-reported by mothers. Mothers were defined as smokers if they smoked at least one cigarette per day during any trimester of pregnancy. Antenatal care was classified according to the number of visits during pregnancy (0, 1–3, 4–6 and ≥7). Information on morbidity during pregnancy was also self-reported by the mother and included chronic or pregnancy-induced arterial hypertension, pre-gestational or gestational diabetes mellitus, preterm labour, bleeding during the third trimester and urinary tract infection.

Type of delivery was classified as vaginal or caesarean section. Apgar at the first and fifth minute of life and information on any clinical complications following delivery were obtained directly from the newborn's hospital charts as well as from the mother. The type of hospital admission for the newborn was classified as 'together with mother', 'intensive care', or 'intermediate care'. Causes of neonatal morbidity were obtained from medical records and included information on hypothermia, hypoglycaemia, respiratory distress, sepsis, apnoea, neonatal depression or bradycardia. Information regarding breast feeding was reported by the mother. Infants were classified according to the timing of breast-feeding initiation, and timing of introduction of water, glucose, or other type of milk before the interview (which usually took place within the first 12 h following delivery). Birth and hospital discharge dates were used to calculate the duration of the newborn's hospitalisation period.

At the 3-month follow-up, information on current pattern of breast feeding was collected: exclusive breast feeding, predominant breast feeding (breast milk and herbal teas or water), partial breast feeding (breast milk and other milks – cow's milk or formula – or liquid, semi-solid, or solid food), and weaning (children who were not receiving breast milk). Jaundice after hospital discharge was recorded when the mother reported that a doctor had made such a diagnosis. Hospital admission was defined as a readmission after being discharged in the post-delivery period. Diarrhoea in the last 15 days and cough in the last 7 days were assessed by maternal report.

A quality control sub-study was carried out by two obstetricians, co-authors of the present analysis (M.S. and I.T.S.), in three of the cohort's hospitals, in which 90.6% of deliveries took place. Beginning in July 2004, all preterm births in the cohort were investigated. Medical charts were reviewed and, when necessary, obstetricians and birth attendants were interviewed.

The chi-squared test was used to compare categorical variables. For continuous variables, such as duration of hospital admission, *t*-tests were used to compare means. Two-tailed P-values < 0.05 were considered as statistically significant. In crude and adjusted analyses, the prevalence of late preterm births among all newborns was initially investigated as an outcome, with the mother's antenatal characteristics as the exposures. Subsequently, late preterm births were investigated as a risk factor for infant morbidity compared with term infants (37–41 completed weeks gestation). Adjusted prevalence ratios (APR) for late preterm births and relative risks (RR) for neonatal and 3-month morbidity as well as for infant mortality, and their respective 95% confidence intervals [95% CI] were calculated using Poisson regression, in order to estimate the strength of these associations.[14,15]

The adjusted analyses followed an a priori theoretical hierarchical model[16] of determination, to avoid adjustment for potential mediating factors. When late preterm birth was the outcome (analysis of associated factors), the first level of causality (distal variables) comprised family income, maternal years of schooling and marital status. In the second level, maternal age and maternal skin colour were included. In the third level, smoking during pregnancy, antenatal care and morbidity during pregnancy were entered. Type of delivery (proximal variable) was included in the fourth level of analysis.

When late preterm birth was the exposure of interest (analysis of the consequences of late preterm births), its effect was adjusted using maternal and perinatal characteristics. For adjusted analyses, variables with unadjusted associations at the ≤0.20 significance level were included.

Neonatal and post-neonatal mortality rates were calculated as the ratio between the number of deaths of children aged 0–27 and 28–364 days, respectively, and the number of live births. Risk of mortality was estimated for the neonatal period and for the first year of life in comparison with births with gestational age between 37 and 41 completed weeks. All analyses were carried out using Stata ® version 9.0 software.

The study protocol was approved by the Federal University of Pelotas Research Ethics Committee, a member of the National Committee for Research Ethics. Written informed consent was obtained from all mothers who agreed to participate in the study.

Results

In 2004, 4263 live births took place in the urban area of the city of Pelotas. A detailed description of the mothers can be found elsewhere.[17] Thirty-two mothers (0.8%) were lost or refused to participate in the study. After the exclusion of 84 newborns with multiple pregnancies (among whom there were 15 pairs of late preterm twins) and of 13 with missing data on gesta-

Table 1. Prevalence and factors associated with late preterm births (34–36 completed gestational weeks) among singleton pregnancies of mothers living in the urban area of Pelotas, Brazil, 2004

Variable	Prevalence of late preterms (%)	P^a	APR [95% CI][b]	P^a
Family income (MW)		0.004		0.07
≤1	13.1		1.0 [0.7, 1.5]	
1.1–3	10.0		0.8 [0.6, 1.2]	
3.1–6	8.0		0.7 [0.5, 1.1]	
>6	10.2		1.0 Reference	
Schooling (years)		0.002		0.05
0	9.3		0.9 [0.3, 2.3]	
1–4	15.0		1.5 [1.1, 1.9]	
5–8	11.0		1.1 [0.9, 1.4]	
≥9	9.4		1.0 Reference	
Single mother	15.4	0.6	0.9 [0.7, 1.1]	0.4
Age (years)		0.007		0.03
<20	13.8		1.3 [1.1, 1.6]	
20–34	10.2		1.0 Reference	
≥35	9.3		0.9 [0.7, 1.2]	
Black/mixed skin colour	12.7	0.02	1.2 [1.0, 1.4]	0.1
Maternal smoking	10.8	1.0	0.8 [0.7- 1.0]	0.05
Antenatal attendances		<0.001		<0.001
0	17.1		2.4 [1.4, 4.2]	
1–3	22.2		2.9 [2.2, 4.0]	
4–6	18.2		2.3 [1.9, 2.8]	
≥7	7.6		1.0 Reference	
Arterial hypertension	12.9	0.02	1.3 [1.0, 1.5]	0.02
Diabetes mellitus	10.7	1.0	1.2 [0.7, 2.0]	0.5
Preterm labour	15.5	0.001	1.6 [1.3, 1.9]	<0.001
Bleeding in third trimester	13.4	0.2	1.0 [0.7, 1.4]	1.0
Urinary infection	11.0	0.7	0.9 [0.8, 1.1]	0.5
Caesarean section	11.0	0.8	1.2 [1.0, 1.4]	0.09

[a]*P*-value chi-squared test.
[b]Adjusted prevalence ratios with 95% Confidence Intervals. Adjustment according to the theoretical hierarchical model. The variables single mother, maternal smoking, diabetes mellitus, bleeding in third trimester, and urinary tract infection were excluded from the final model.
MW, minimum wages.

tional age, 4134 records remained, including 447 newborns classified as late preterm (10.8%).

Table 1 presents the prevalence of late preterm births according to maternal antenatal characteristics. Maternal age <20 years was associated with an adjusted probability of late preterm birth 30% higher (PR 1.3 [95% CI 1.1, 1.6]) than that of the reference group (20–34 years). APR for late preterm was 2.4 [1.4, 4.2], 2.9 [2.2, 4.0] and 2.3 [1.9, 2.8], respectively, for mothers who did not attend antenatal care, had 1–3 visits, or 4–6 visits during the current pregnancy. The probability of late preterm delivery was 30% higher among mothers with history of arterial hypertension during pregnancy than among normotensive mothers (APR 1.3 [1.0, 1.5]). The sex of the newborn was not associated with late preterm birth.

Table 2 presents the risk of perinatal outcomes among late preterm infants (exposed) compared with term newborns, adjusted for maternal characteristics. After allowing for family income, mother's schooling, mother's age, skin colour, antenatal care and type of delivery, the risk of 1 min Apgar < 7 was 70% higher among late preterm infants (RR = 1.7 [1.3, 2.2]). After controlling for mother's schooling, mother's age, antenatal care, arterial hypertension and type of delivery, the risk of neonatal morbidity (hypothermia, hypoglycaemia or respiratory dysfunction) was almost three times higher among late preterm infants (RR = 2.8 [2.3, 3.5]) than among controls. The adjusted risk of not receiving breast milk during the first hours of life was 10% greater among late preterm than among term

Table 2. Prevalence and relative risks for neonatal clinical and nutritional outcomes among late preterms after controlling for maternal antenatal characteristics; Pelotas, Brazil, 2004

Variable	Prevalences among term infants (%)	Prevalences among late preterm infants (%)	URR [95% CI]	ARR [95% CI]	*P*
Apgar 1′ < 7	10.0	17.4	1.7 [1.4, 2.2]	1.7 [1.3, 2.2]	<0.001
Apgar 5′ < 7	1.2	3.6	3.1 [1.7, 5.5]	2.6 [1.4, 4.9]	0.002
Neonatal morbidity	8.1	25.6	3.2 [2.6, 3.8]	2.8 [2.3, 3.5]	<0.001
Intensive care[a]	30.7	56.5	1.8 [1.4, 2.4]	1.6 [1.2, 2.1]	<0.001
Breast feeding in the first 24 h	92.4	78.0	0.8 [0.8, 0.9]	0.9 [0.8, 0.9]	<0.001
Water and glucose in the first 24 h	3.9	6.5	1.7 [1.1, 2.5]	1.9 [1.3, 2.9]	0.001
Other types of milk in the first 24 h	4.0	11.4	2.9 [2.1, 4.0]	2.8 [2.1, 3.9]	<0.001

[a]Only newborns with neonatal morbidity ($n = 497$) were included.
URR, unadjusted relative risk; ARR, relative risk adjusted for maternal antenatal characteristics.

newborns (RR = 0.9 [0.8, 0.9]). The risk of receiving water and glucose or formula in the first hours of life was, respectively, 1.9 and 2.8 times higher than among term newborns. Mean duration of hospital admission was significantly longer among late preterm infants than among the controls (4.5 ± 9.0 vs. 2.3 ± 5.3 days; $P < 0.001$).

At the 3-month follow-up (Table 3), late preterm infants (exposed group) showed lower probability of being exclusively breast fed (RR 0.8 [0.7, 1.0]), as compared with term newborns after adjusting for family income, mother's schooling, mother's age, skin colour, maternal smoking, antenatal care and arterial hypertension. Risk of jaundice after hospital discharge and of reported hospital admission during the first 3 months of life were, respectively, 10% and 30% higher among late preterm births than among term newborns. However, the confidence intervals for these estimates included unity.

Table 4 presents mortality rates according to newborn gestational age. Late preterm infants showed neonatal and infant mortality rates higher than those of term newborns (roughly five and two times higher, respectively). Table 5 presents the crude and adjusted RR of neonatal and infant mortality. For late preterm infants, the highest RR was found for mortality in the neonatal period. When adjusted for maternal characteristics, RRs of neonatal and infant mortality were similar to those detected in the crude analysis.

Additional analyses were carried out to investigate the possible effect of the large number of caesarean sections on the morbidity and mortality of late preterm infants. Because caesarean sections may have been performed because of maternal complications that may also affect infant outcomes, an attempt was made to identify those with elective caesarean sections. This information is impossible to obtain from hospital records because physicians are reluctant to admit that the operation did not have a medical indication. In order to identify highly probable cases of elective sections, the following groups were excluded from the analyses: (1) all newborns whose mothers reported any

Table 3. Prevalence and relative risks for clinical and nutritional outcomes at 3 months among late preterms after controlling for maternal antenatal characteristics; Pelotas, Brazil, 2004

Variable	Prevalences among term infants (%)	Prevalences among late preterm infants (%)	URR [95% CI]	ARR [95% CI]	*P*
Breast feeding	74.9	70.6	0.9 [0.9, 1.0]	1.0 [0.9, 1.0]	0.2
Exclusive breast milk[a]	44.5	35.4	0.8 [0.7, 0.9]	0.8 [0.7, 1.0]	0.05
Diarrhoea in last 15 days	6.7	7.8	1.2 [0.8, 1.7]	1.1 [0.8, 1.6]	0.7
Cough in last 7 days	32.3	36.8	1.1 [1.0, 1.3]	1.1 [0.9, 1.2]	0.5
Jaundice after hospital discharge	22.9	25.0	1.1 [0.9, 1.3]	1.1 [0.9, 1.4]	0.2
Hospital admission	6.4	10.1	1.6 [1.1, 2.2]	1.3 [0.9, 1.9]	0.1

[a]Breast fed only ($n = 2866$).
URR, unadjusted relative risk; ARR, relative risk adjusted for maternal antenatal characteristics.

Table 4. Distribution of gestational age, absolute number of deaths in first year, and neonatal, post-neonatal, and infant mortality rates among all live births from singleton pregnancies of mothers living in the urban area of Pelotas, Brazil, 2004

	Number of births (%)	Neonatal mortality rate[a]	Post-neonatal mortality rate[a]	Infant mortality rate[a]
Gestational age (weeks)				
<32	70 (1.7)	343 (24)	28.6 (2)	371 (26)
32–33	85 (2.1)	47.1 (4)	0 (0)	47.1 (4)
34–36	447 (10.8)	15.7 (7)	6.7 (3)	22.4 (10)
37–41	3262 (78.8)	2.5 (8)	6.1 (20)	8.6 (28)
≥42	271 (6.6)	7.4 (2)	7.4 (2)	14.8 (4)
Total	4135 (100)	10.9 (45)	6.5 (27)	17.4 (72)

[a]Rate per 1000 livebirths; no. of deaths in brackets.

type of pregnancy complication (arterial hypertension, diabetes, preterm labour, bleeding during third trimester, or urinary tract infection); (2) all mothers with an onset of labour prior to arriving at the hospital; (3) all children from normal delivery. In this highly selected group of 393 babies (34 late preterm and 359 term newborns), hospitalisations lasted for 5.6 ± 6.4 days among late preterm infants compared with 2.1 ± 3.8 days among the other newborns ($P < 0.001$). The risks of neonatal depression in the first minute of life and of requiring intensive care were, respectively, two times (RR 2.6 [1.3, 5.3]) and 10 times higher (RR 10.6 [3.6, 31.0]) among late preterms than among term newborns. In spite of the low number of neonatal deaths, crude neonatal mortality rates were 29.4 vs. 2.8/1000 live births, respectively, among these late preterm and term newborns.

The sub-study undertaken by the obstetricians identified a total of 52 late preterm deliveries. Eighteen of these mothers were admitted to the maternity ward because of ongoing labour, 14 because of arterial hypertension, and 15 because of ruptured membranes alone or in conjunction with other conditions. At the time of admission, 27 of the 52 mothers presented with uterine contractions, although 16 did not have cervical dilatation. In over 95% of cases, the physician was aware of the fact that the fetus was preterm. Labour was induced for nine of these mothers, and for four there was an attempt to arrest labour. Thirty of the 52 babies were born via caesarean section. The reviewers disagreed with the obstetrician's conduct on six occasions. The researchers would have attempted to delay labour for two mothers who delivered vaginally and would have placed four mothers, of whom two were induced and two underwent caesarean sections, under observation. Although three of these newborns required intensive care (the two born vaginally whose labour the authors would have tried to arrest, and one of those that would have been placed under observation), none of the babies died.

Table 5. Unadjusted (URR) and adjusted relative risks (ARR) for neonatal and infant mortality, according to gestational age at birth, among all live births from singleton pregnancies of mothers living in the urban area of Pelotas, Brazil, 2004

	Neonatal mortality		Infant mortality	
	URR [95% CI]	ARR[a] [95% CI]	URR [95% CI]	ARR[a] [95% CI]
Gestational age (weeks)				
<32	137.5 [64.3, 294.0]	97.1 [36.6, 257.6)	42.3 [26.4, 67.9]	25.5 [12.8, 50.4]
32–33	17.9 [5.5, 58.5]	16.3 [4.3, 61.6]	5.1 [1.8, 14.3]	4.5 [1.4, 14.3]
34–36	6.1 [2.2, 16.6]	5.1 [1.7, 14.9]	2.5 [1.2, 5.1]	2.1 [1.0, 4.6]
37–41	1.0 Reference	1.0 Reference	1.0 Reference	1.0 Reference
≥42	3.0 [0.6, 14.3]	[b]	1.7 [0.6, 4.9]	0.9 [0.2, 3.7]

[a]ARR adjusted for family income, mother's schooling, mother's age, skin colour, maternal smoking, and number of antenatal attendances.
[b]Model failed to converge due to small number of observations.

Discussion

The increasing rate of preterm births that has been described in Brazil is also being observed in other countries. Davidoff *et al.*[18] examined the changing epidemiology of gestational length among singleton births in the US. The distribution of spontaneous births shifted to the left, with 39 weeks becoming the most common length of gestation in 2002, compared with 40 weeks in 1992 ($P < 0.001$). Deliveries at ≥40 weeks gestation had markedly decreased, accompanied by an increase in those at 34–39 weeks ($P < 0.001$).

The main strength of the present study is its population-based cohort design. Moreover, the rates of loss to follow-up and non-response were low (0.9% at birth and 5.5% at 3 months of life) preventing the occurrence of selection bias.

The limitations of this study include the fact that information on maternal morbidity during pregnancy and on delivery was obtained through maternal recall; however, virtually all mothers attended antenatal care and the average number of visits was 8.1, suggesting that pregnancy complications had a high likelihood of being detected.[5] Maternal skin colour was based on the interviewer's assessment and could also be subjected to misclassification. However, previous studies in Pelotas showed high agreement, with kappa values of 0.8 or above, between self-reported and observed skin colour (see http://www.epidemio-ufpel.org.br/_projetos_de_pesquisas/consorcio2005/index.php). Finally, it is possible that smoking during pregnancy is under-reported, because mothers may be aware of fetal risks associated with exposure to maternal smoking. The association between smoking and late preterm births, however, has not been demonstrated consistently in all the studies which explored this relationship, whereas its association with intrauterine growth restriction and birthweight is demonstrated time and again.[19–21]

The quality of care provided to newborns, especially those requiring intensive care, could not be evaluated. As demonstrated in other Brazilian regions, the reduction of neonatal mortality beyond what has already been achieved through the provision of NICUs may depend on the quality of care provided to newborns in these units.[2,22,23] The high neonatal and post-neonatal mortality rates observed among newborns of 32–33 weeks gestation compared with the rates reported from developed countries[24,25] suggest the need for further evaluation of the quality of the birth assistance provided in the city hospitals.

The majority of the newborns (90.8%) had their gestational age assessed through the LMP. Those whose gestational age was estimated through ultrasound or the Dubowitz's method did not differ significantly from those with a valid LMP date in terms of family income, maternal education, age, skin colour, marital status, smoking or antenatal attendance. The differences observed between mothers of late preterms and of term babies are consistent with the findings of other studies. The association with younger maternal age[2,26] and the increased risk among mothers with morbidity during pregnancy, such as arterial hypertension and preterm labour, is well known.[27–29] The negative association with the number of antenatal care attendances may be due in part to reverse causality bias, given that the mothers of preterm babies had less opportunity of having antenatal attendances because of the interruption of pregnancy.

In this study, late preterm births were not more frequent among pregnancies terminated by caesarean section. Another Brazilian study has found an association between increased caesarean section rates and preterm birth.[2] Moreover, the six discrepancies between researchers and obstetricians in the qualitative sub-study were conservative in nature: arrest of labour and observation. It cannot be disregarded that if mothers were placed under observation, a fraction of those pregnancies would have ended in spontaneous preterm delivery. However, another study conducted in Pelotas showed that mothers from lower socioeconomic strata, who generally show higher gestational risk, undergo caesarean sections less frequently than wealthier mothers.[30]

The concern has been raised that an increase in preterm deliveries may be related to errors in the estimation of gestational age.[31] The absence of a known date of LMP and poor-quality or late ultrasound evaluations may contribute to the physician's decision to induce or not to try tocolysis, or to perform a caesarean section before the completion of pregnancy. Other data from the 2004 Pelotas Cohort show that, among newborns of 32–36 gestational weeks as evaluated by date of LMP, ultrasound performed before 20 gestational weeks overestimated the gestational age by 1.5 ± 2.6 weeks.[5]

In our study, perinatal consequences of late preterm births in relation to low 1-min Apgar score, morbidity, lack of breast feeding and hospitalisation ultimately translated into a roughly sixfold greater risk of neonatal mortality among these newborns. Higher incidence of neonatal morbidity among late preterm than term infants has also been detected in other studies. Wang *et al.*,[9] comparing infants of 35–36 weeks' gestation with full-term infants (37–40 weeks' gestation) born at a tertiary hospital in Massachusetts, observed that nearly all clinical outcomes analysed differed significantly between the two groups of neonates: temperature instability, hypoglycaemia, respiratory distress and jaundice. In this study, late preterm infants were evaluated more frequently than full-term infants for possible sepsis.

Escobar *et al.*[32] in a case-control study conducted in the US found that gestational age <39 weeks was associated with twice the risk of rehospitalisation for neonatal dehydration. For those infants born at 34–36 weeks, without initial admission to the NICU, there was an association with increased risk of rehospitalisation within 2 weeks after initial nursery discharge.[33]

A review of existing published data on short-term hospital outcomes among infants born at 35 and 36 weeks gestation in multiple hospitals and NICUs in the US and England was conducted by Escobar *et al.*[34] Babies born at 35 and 36 weeks gestation experienced considerable morbidity and mortality: supplemental oxygen support for at least 1 h was required almost three times more frequently than among infants born at ≥37 weeks. Following newborn discharge, 35- to 36-week infants were more likely to be rehospitalised than term infants, and this increase was evident both within 14 days as well as later (within 15 to 182 days) after discharge.

Newborns of 30–34 weeks gestation also presented higher incidence of in-hospital outcomes and readmission within 3 months of discharge from birth hospitalisation as showed by a cohort study in the US.[35] During the birth stay, 45.7% of these newborns experienced assisted ventilation. Readmission within 3 months occurred in 11.2% of the cohort. The difference in terms of the incidence of unfavourable outcomes among late preterms when compared with term newborns is not limited to the perinatal period. As late as age 3 months, these newborns, in addition to not being breast fed, or being breast fed non-exclusively more frequently than other newborns, also showed greater incidence of hospital admissions. The lower prevalence and non-exclusive pattern of breast feeding in the late preterm group may have mediated the association between gestational age at birth and risk of neonatal mortality, and of hospital admission before the third month of life. As demonstrated previously by other studies, exclusive breast feeding is a known protective factor against hospitalisation before age 3 months, especially when due to pneumonia,[36] and against infant mortality from infections disease.[37] Moreover, late onset of breast feeding (after first day of life) and non-exclusive breast feeding were strongly associated with neonatal mortality in Ghana.[38]

Conclusions

Late preterm infants are a group of newborns anthropometrically large when compared with other infants born prematurely, and their rate of survival in developed countries is similar to that expected for term babies.[39] This is not the case in our settings, where late preterm infants show an important increase in risk of death, especially during the neonatal period. As a consequence, preterm births should be avoided and, if that is not possible, babies should be given special care by trained staff, regardless of the severity of the preterm condition.

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