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Similar neonatal intensive care unit admission rates between early-term and late-term newborns delivered electively in a public maternity hospital in Brazil

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Introduction

Term births are those that occur at a gestational age (GA) of between 37 weeks and 41 weeks six days. Term newborns (NB) are considered a homogeneous group with a low risk of complications compared to preterm (< 37 weeks GA) and post-term (≥ 42 weeks GA) newborns. Until recently, little attention was paid to infants delivered within the five-week interval that includes term births. However, recent evidence suggests that term neonates born at less than 39 weeks GA have significantly increased morbidity, including respiratory distress, need for mechanical ventilation, and higher neonatal intensive care unit (NICU) admission rates compared to neonates born after that period, despite both groups being born at term [1, 2, 3].

The definition of "term birth" has significant clinical implications for the management of pregnancy complications as well as the timing of both elective and indicated delivery [2]. Proposed a new subcategory of term births called "early term" based on their increased mortality and neonatal morbidity. Thus, term NB were grouped into early term NB (ETNB), from 37 0/7 to 38 6/7 weeks of gestation, and late term NB (LTNB), from 39 0/7 to 41 6/7 weeks of gestation [2]. However, few studies have been done applying these two NB subdivisions (ETNB and LTNB), and the real need of working with these two subgroups is not yet clear.

The neonatal morbidity experienced by ETNB may result in higher NICU admission rates and increased medical and hospital costs [4, 2]. Infants born at 37 weeks GA have three times the risk of respiratory distress syndrome than NB born at 38 weeks, and NB born at 38 weeks GA have 7.5 times the rate of respiratory distress syndrome of infants born at 39–41 weeks GA. Moreover, infants born at 37–38 weeks GA have a significantly elevated risk of transient tachypnea of the newborn (TTN) and persistent pulmonary hypertension [5]. The main indications for NICU admission include congenital malformations, respiratory diseases, low birth weight, and prematurity [6]. Moreover, perinatal mortality rates (number of stillbirths and deaths between the 22nd week of gestation and seven completed days after birth) may also differ between ETNB and LTNB [7].

The World Health Organization (WHO) recommends a caesarean section rate no higher than 15% of deliveries. In Brazil, the average caesarean section rate is approximately 35%, and higher rates are associated with higher income and better social conditions in pregnant women with low obstetric risk, which indicates that high rates are influenced by non-medical factors [8].

In Brazil, few studies have compared NICU admission rates between term birth subgroups, and it is not yet known whether the results would be similar to those found in other countries. In this retrospective cohort study, we compared NICU admission rates between early-term (ETNB) and late-term (LTNB) newborns delivered electively at a public maternity hospital in Belo Horizonte, Minas Gerais, Brazil.

Material and Methods

This is a retrospective birth cohort study. Data were obtained from medical records of mothers and their newborns who were delivered at Odete Valadares Maternity Hospital/Hospital Foundation of the State of Minas Gerais (MOV/FHEMIG), Belo Horizonte, Minas Gerais, Brazil.

Medical records that met the following criteria were included in the study: 1) elective delivery, irrespective of the mode of delivery; elective delivery was defined as scheduled termination of pregnancy, labor induction or caesarean section without spontaneous labor; 2) births occurred at MOV from December 1, 2012, to November 30, 2013; 3) term birth (37 0/7 to 41 6/7 weeks GA at the date of birth); GA obtained from medical records was calculated from the date of last period (DLP) when it agreed with the ultrasound (US) date, and in case of disagreement greater than seven days, we used the GA calculated from the US date (≤ 20 weeks GA); and 4) birth of a live fetus, defined as the complete expulsion or extraction from its mother of a product of conception, irrespective of the duration of the pregnancy, which, after such separation, breathes or shows any other evidence of life, according to the CID-10 classification [9].

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The following were considered exclusion criteria for the current study: fetal morbidity that could affect neonatal vitality (preterm or post-term newborns, twinning, chromosomal disorders, perinatal infection, and intrauterine growth restriction); spontaneous labor; NB readmission; and severe maternal disease (heart disease, diabetes mellitus, hypertensive diseases of pregnancy, thyroid diseases, arthritis, kidney disease, chemical dependency, premature placental abruption, placenta previa, HIV infection, and sickle cell anemia).

Sample size was calculated based on a comparison of two proportions. Specifically, we compared the NICU admission rate for ETNB (p1) versus the NICU admission rate for LTNB (p2). We assumed that the NICU admission rate for ETNB is, at most, one third of that for LTNB, which is estimated at 20% of deliveries [10]. Thus, considering a p1 ≅ 6%, a level of significance for hypothesis testing of 5% ($\alpha = 0.05$), and a power of 80% ($\beta = 0.20$) to detect differences between the two groups (ETNB vs. LTNB) no more than three times lower in the second group (p2 ≅ 2%), a total of 298 ETNB and 596 LTNB were required, at a ratio of two LTNB for each ETNB, totaling a sample of 894 NB.

The information from medical records was processed using the Epi Info software and analyzed by descriptive statistics (mean, standard deviation, and percentages) to summarize the data [11]. Risk and protective factors for NICU admission were identified by two-tailed tests with a significance level of 5% ($p < 0.05$). Continuous variables were analyzed using the Student's t test or a non-parametric test and categorical variables were analyzed using the chi-square test or Fisher's exact test when necessary.

The study was approved by the Research Ethics Committee at College of Health and Human Ecology (FASEH – protocol number 793.061, 16/IX/2014) and Hospital Foundation of the State of Minas Gerais (FHEMIG – protocol number 814.945, 02/X/2014), Brazil.

Results

Of a total of 6438 medical records from pregnant women admitted to MOV for delivery, 908 met the inclusion criteria and were analyzed, of which 311 (34.2%) were from ETNB and 597 (65.8%) from LTNB. Of the 908 neonates, 50.1% were boys and 49.9% were girls. Additionally, 500 births (55.1%) were caesarean sections and 408 (44.9%) were vaginal births. Maternal sociodemographic characteristics grouped by NB group are shown in Table 1.

Table 1: Maternal sociodemographic characteristics and mode of delivery in early term (ETNB) and late term (LTNB) neonates delivered at Odete Valadares Maternity Hospital (MOV), Belo Horizonte, Brazil.

Variable		ETNB	LTNB	p-value
maternal age	< 20 yrs.	49	106	0.4209
	20–34 yrs.	228	440	
	≥ 35 yrs.	34	51	
smoking	yes	11	30	0.316191
	no	292	538	
medicines	yes	9	18	0.840175
	no	284	492	
alcohol use	yes	5	6	0.528476
	no	298	560	
birth	C-section	163	337	0.26096

No significant differences in 1- and 5-min Apgar scores, heart and respiratory rates of newborns, and mean age of mothers were found between the ETNB and LTNB groups ($p > 0.05$ for all). GA was significantly shorter in the ETNB than in the LTNB subgroup, whereas weight and height of infants in the LTNB group were significantly higher than in the ETNB group [Table 2].

Table 2: Gestational age (GA) at birth and anthropometric data (mean ± SD) of early term (ETNB) and late term (LTNB) newborns delivered at Odete Valadares Maternity Hospital (MOV), Belo Horizonte, Brazil.

Variable	ETNB	LTNB	p-value
GA (weeks)	38.1 ± 0.55	40.1 ± 0.8	< 0.001
weight (g)	3059.6 ± 395.64	3342.0 ± 413.77	< 0.001
height (cm)	48.0 ± 0.02	49.0 ± 0.02	< 0.001

The proportion of NB with meconium at birth was significantly higher in the LTNB subgroup (114/471, 19.5%) than in the ETNB subgroup (23/273, 7.7%; $p < 0.001$). Of NB positive for meconium, 1-min Apgar scores were significantly lower in the ETNB group (mean ± SD = 7.0 ± 1.71) than in the LTNB group (8.0 ± 1.29, $p = 0.0032$).

Of the 908 NB evaluated, 18 (1.9%) were admitted to the NICU, of which seven (38.9%) were ETNB and 11 (61.1%) were LTNB ($p = 0.80$). Additionally, of the NB admitted to the NICU, 15 (83.3%) were born by caesarean section and three (16.7%) by vaginal delivery ($p = 0.02$). The average length of stay in the NICU was 16 days, with a minimum of one day and a maximum of 85 days. NB delivered by caesarean section was hospitalized on average for 15 days, whereas the average length of stay for those born vaginally was six days.

Of the 18 NB admitted to the NICU, for three of them no information about the presence of meconium was available in their medical records. Of the remaining 15 NB, six (40%) had meconium ($p = 0.02$).

All mothers of NB admitted to the NICU reported being non-smokers and non-drinkers ($p = 1.00$) and none reported chronic drug use ($p = 1.00$).

The variables 1- and 5-min Apgar scores, height, respiratory rate, gestational age, and birth weight grouped according to NICU admission outcome are shown in Table 3.

No significant difference in maternal age was observed between NB who were admitted to the NICU (24.0 ± 7.6 yrs.) and those who were not admitted (25.8 ± 6.2 yrs.; $p = 0.3833$).

Discussion

In this study, we found no difference in NICU admission rates between early-term and late-term newborns, contrary to other studies [1, 6, 3, 13, 6] conducted a prospective cohort study and found a mean GA of 38 weeks for NB admitted to the NICU [14], shorter than the GA observed in our study. Contrary to our study, a county-based birth cohort study of 33,488 live births at all major birth hospitals in Erie County, New York, USA, found that early-term neonates had significantly higher risks for NICU or neonatology service admission than term neonates (8.8% vs. 5.3%), [3]. One factor that may have contributed to the difference observed between our study and other retrospective cohorts is that our study was conducted at a public maternity hospital, which adopts stricter protocols to determine the indication for elective delivery. Another factor is the sample size, which despite being appropriate, was smaller compared

Table 3: Neonatal characteristics grouped by NICU admission outcome of infants delivered at Odete Valadares Maternity Hospital (MOV), Belo Horizonte, Brazil.

Variable	NICU admission	N (894)	mean ± SD	p-value
height (cm)	yes	16	48.0 ± 0.04	0.6755
	no	884	49.0 ± 0.02	
1-min Apgar score*	yes	18	5.0 ± 3.1	0.0018
	no	886	8.0 ±1.3	
5-min Apgar score*	yes	18	7 ± 2.3	0.0033
	no	886	9.0 ± 0.5	
heart rate (bpm)	yes	18	138 ± 10.9	0.3755
	no	884	135 ± 12.4	
respiratory rate (irpm)	yes	17	67.0 ± 15.06	0.0001
	no	882	48.0 ± 8.55	
gestational age (weeks)	yes	18	39.0 ± 1.4	0.3615
	no	890	39.0 ± 1.2	
birth weight (g)	yes	18	3159.3 ± 589.51	0.5387
	no	889	3246.9 ± 425.33	

*1- and 5-min Apgar scores (1–10). For more details see [12].

to other studies and may have failed to capture smaller differences between the groups.

Neonatal mortality rate could not be assessed among neonates admitted to the NICU because none of them died. In a birth cohort study on the basis of singleton live births in 1995–2001, [15] found that neonatal mortality rate decreased with increasing GA from 37 (0.6 death per 1000 live births) to 39 (approximately 0.3 death per 1000 live births) weeks, but remained stable from 39 to 40 weeks.

Eighty-three percent of NB who was admitted to the NICU was born by caesarean section. Similar results have been reported in other studies. For instance, delivery by caesarean section increased the risk for NICU or neonatology service admission (12.2%) and morbidity (7.5%) compared to vaginal births [3]. In our study, the average length of stay at the NICU was two times longer for neonates born by caesarean section (15 days) than by vaginal delivery (6 days). In a prospective observational study, [16] reported a mean duration of special care stay for infants admitted to a special care unit after elective delivery of 4.6 ± 5.9 days, which supports the positive relationship between caesarean delivery and length of stay at a NICU. This relationship may be due to the fact that caesarean section is the most frequent mode of delivery in pregnancies with major obstetric risks and/or when there are complications during labor.

The proportion of NB with meconium was higher in the LTNB subgroup (19.5%) than in the ETNB (7.7%) subgroup. These results are similar to those from an American cohort study that reported rates of meconium six times higher in women with GA ≥ 42 weeks than in women who delivered at 37 weeks (18% vs. 3%, respectively) [17]. Similarly, another retrospective cohort study found an increased risk for meconium of 1.55 and 2.12 times in infants delivered at 40 and 41 weeks, respectively [18]. We also found a correlation between the presence of meconium and lower 1-min Apgar scores, as reported by [18].

Of 15 NB admitted to the NICU, six (40%) had meconium (p = 0.02). A different result was reported by [19] who found that neonates with meconium had significantly higher risks for NICU admission than those without meconium (75% vs. 53%, p = 0.04). This difference between studies may be explained by the relatively low number of neonates who met the inclusion criteria in our study and were admitted to the NICU and/or an information bias caused by failure to complete medical records; of the 18 NB admitted to the NICU in our study, three had no information about the presence of meconium in their medical records.

Lower 1-min and 5-min Apgar scores were observed in NB admitted to the NICU than in those who were not admitted. The 5-min Apgar score is a better predictor of neonatal survival than the 1-min score, because the longer asphyxia exists, the more likely that death or permanent damage will occur [20, 12].

One limitation of our study is the retrospective cohort design, which uses data from medical records completed by hospital staff rather than researchers themselves. Another limitation is that only NICU admission and mortality rates, but not morbidity rates, were investigated. Nevertheless, we obtained a considerably large sample of medical records appropriate to the calculated sample size, and the study was conducted at a public maternity hospital for high-risk pregnancies with structured protocols and greater standardization of practices regarding indications for elective delivery and mode of delivery.

Conclusion

NICU admission rates were similar between early-term and late-term neonates, suggesting that elective delivery of low-risk term pregnancies does not increase the risk for NICU admission. Prospective multicenter studies including public, private, and/or mixed maternity hospitals that also compare morbidity types and rates between early-term and late-term subgroups are needed to determine the risks for newborns delivered within the five-week interval that includes term births and the most desirable time and indications for elective delivery of low-risk term pregnancies.

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