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Early neonatal mortality in Caxias do Sul: a cohort study

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Abstract

Objectives: to establish the profile of neonates in Caxias do Sul city, and to study early neonatal mortality, its causes and related variables.

Methods: this cohort study enrolled 5,545 newborns, which were followed up to 7 days after birth. The probability of early neonatal mortality was calculated and multiple logistic regression was performed to relate all studied variables to the outcome of early neonatal death.

Results: the observed probability of early neonatal mortality was 7.44 per thousand live births. The incidence of premature births and low birth weight was 9.4% and 8.1%, respectively. Fifty five percent of the neonates were born through cesarean section, which were related to socioeconomic and educational level. Previous history of neonatal mortality, maternal age > 35 years, gestational age, Apgar score < 7, male sex and low birth weight were related to early neonatal death. The main cause of death was hyaline membrane disease, followed by congenital cardiopaties, extreme preterm and abruptio placentae.

Conclusion: even though the observed probability of early neonatal mortality was low, some deaths may have been avoided if better prenatal and delivery care, as well as newborn assistance had been offered.

J Pediatr (Rio J) 2000; 76(3): 200-6: early neonatal mortality, perinatal health, newborn.

Introduction

Infant mortality is currently considered an avoidable event, and an indicator of the quality of living and of the health services available to a population. For Leal,[1] infant mortality also reflects the health of a population, a notion encompassing the social, political, and ethical well-being of a given social organization.

In the past decades, an accentuated decrease in infant mortality has occurred throughout the world, as shown in the 1997 Unicef report. In Brazil, the infant mortality rate decreased from 118 per 1,000 live births, in 1960, to 48 per 1,000 live births between 1987 and 1996; however, regional variations are still very pronounced.

Infant mortality has decreased mainly as a result of a decrease in postneonatal deaths, which are the most susceptible to prevention efforts, such as vaccination programs, stimulus to breast feeding, and control of diarrheal diseases. Neonatal mortality, in turn, results from a close and complex relationship between biological, social and health care variables, so that a decrease in neonatal deaths is slower and more difficult.

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Currently, two-thirds of the deaths among infants occur along the 1st month (neonatal mortality), and around 50% of all the deaths that take place in the 1st year happen during the 1st week of life (early neonatal mortality). The increasing importance of the early neonatal component in the constitution of the infant mortality rate has generated several studies regarding the causes and factors that determine death during this period.[2-5]

Data from the State of Rio Grande do Sul Department of Health[6] show that in the city of Caxias do Sul, in 1995, the infant mortality rate was 20 per 1,000 live births, and the neonatal mortality rate was 12.7 per 1,000 live births, while the average for the State, in the same period, was 18.7 and 10.7, respectively.

Taking into consideration the fact that Caxias do Sul is one of the most developed cities in the state of Rio Grande do Sul, with an annual per capita income of US$ 9,900.00, it is fair to ask why the neonatal health indicators are not in keeping with this income level. In this sense, it is important to know the causes of neonatal death in Caxias do Sul and the correlations between early neonatal mortality and biological and social variables, so that guidelines may be set for the reduction of neonatal mortality, and, as a consequence, of infant mortality itself. The aim of this study was to assess early neonatal mortality and related factors in Caxias do Sul, during the year of 1995.

Methods

The study population was constituted by all residents of Caxias do Sul born in hospitals from December 5, 1994, to December 5, 1995. Home births were not included in the study, and they constituted 0.6% of the births in Caxias do Sul in 1995.[7]

The total population included 5,638 children. Out of this group, 93 newborns were excluded because they had incomplete questionnaires; therefore, 5,545 newborns were included in the study. This is a cohort study in which all the newborns were observed until the 7th day of life. The characteristics of the newborns and of their mothers, gestational and delivery history, as well as the most frequent causes of death during the 1st week of life were assessed.

Data were collected by trained interviewers who made a daily visit to all the maternity sites in the city and interviewed the mothers, applying a standard questionnaire to collect information regarding socioeconomic variables and gestational and delivery aspects. To gather information regarding deaths during the 1st week of life, we reviewed hospital charts and records and files from the Regional Health Office, where death certificates are centralized. No deaths were registered among the 93 newborns that were excluded from the study.

All the information was stored in an EPI-Info data base (version 6.0).[8] A univariate analysis was performed to correlate the study variables with the outcome under analysis (early neonatal death). The variables that were statistically significant in the univariate analysis (marital status, maternal weight, history of stillbirth, prenatal examination, weight gain along the pregnancy, mode of delivery, sex of the newborn, gestational age, birth weight, relationship between birth weight and gestational age), as well as the relevant clinical-epistemological variables (maternal education, family income), were included in the multivariate model (multiple logistic regression). Multiple logistic regression analysis was carried out using the Statistical Package for the Social Sciences (SPSS). A $p<0.05$ was considered significant. The associations are presented as relative risk (RR), with a correspondent 95% confidence interval (95% CI).

The probability of early neonatal death during the studied period was calculated based on a total of 5,638 live births. The probability of early neonatal death was also calculated in terms of each of the most important variables in the study. Probability of early neonatal death is defined as the number of neonatal deaths during the 1st week of life (168 post-natal hours) per 1,000 live births in a given period of time at a given place.

Results

From a total of 5,638 live births in Caxias do Sul in 1995, 42 babies died during the 1st week of life, resulting in a probability of early neonatal death of 7.44 per 1,000 live births.

Early neonatal mortality was higher on the 1st day of life, with 20 deaths. This number decreased progressively during the following days (Figure 1).

Table 1 presents the probability and the relative risk for early neonatal death according to several maternal variables.

According to the multivariate analysis, which aimed to control confusion factors, the significant independent risk factors for early neonatal death were maternal age of 35 years or more and history of stillbirth.

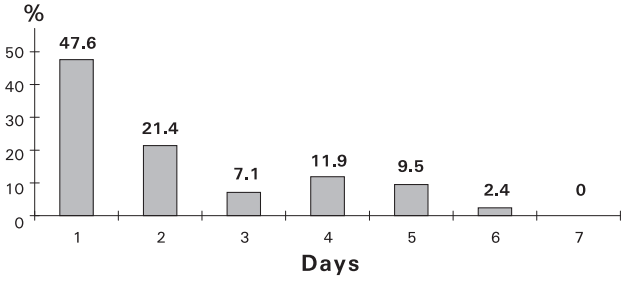

Figure 1 - Death of newborns in relation to days of life, Caxias do Sul, Brazil, 1995

Table 1 - Probability and relative risk (RR) for early neonatal death according to maternal variables, Caxias do Sul, Brazil, 1995

Characteristics	Probability	Non-adjusted RR (CI 95%)	Adjusted RR (CI 95%)
Age (years)			
under 20	8.9	1.31 (0.60-2.88)	4.10 (1.00-16.92)
20-34	6.8	1.00	1.00
35 or more	10.3	1.51 (0.66-3.45)	4.52 (1.26-16.14)
Education			
none	19.6	4.61 (0.43-49.94)	4.62 (0.58-36.75)
some elementary education	9.2	2.17 (0.52-9.07)	2.37 (0.60-9.34)
elementary education	7.1	1.68 (0.34-8.27)	2.31 (0.27-19.11)
secondary education	3.2	0.75 (0.13-4.45)	1.65 (0.79-12.61)
higher education	4.3	1.00	1.00
Marital status			
married	6.2	0.40 (0.20-0.78)	0.70 (0.38-5.04)
single	15.5	1.00	1.00
Gestations			
1	6.9	0.86 (0.45-1.43)	1.35 (0.37-4.92)
2, 3, 4	8.0	1.00	1.00
5 or more	8.4	1.05 (0.32-3.47)	2.29 (0.17-29.96)
Abortions			
yes	9.4	1.28 (0.54-3.02)	1.62 (0.31-8.37)
no	7.3	1.00	1.00
Stillbirth			
yes	32.9	4.60 (1.45-14.61)	18.25 (2.74-21.86)
no	7.2	1.00	1.00
Maternal weight			
<50 kg	12.4	2.03 (1.09-3.78)	1.29 (0.36-4.62)
50 kg or more	6.1	1.00	1.00

The probability and relative risk for early neonatal death among live births in terms of gestational and delivery variables are shown in Table 2. Among these variables, it was observed that newborns who had an Apgar score lower than 7 in the 1st minute of life presented a considerably higher risk of dying during the 1st week of life. This risk remained high and significant after the multivariate analysis. The other variables in Table 2 were not associated with early neonatal death.

When analyzing the probability of early neonatal death and the relative risk according to the characteristics of the newborns, we observed that the relative risk was 4.16 times higher for males than for females (Table 3). Table 3 also shows data regarding early neonatal mortality in the studied population in terms of gestational age. The incidence of prematurity in this study was 9.4%. We observed that the risk of dying among premature newborns (< 37 weeks) was five times higher than among the group with 39 to 41 weeks, chosen as the reference group. There was a sharp increase in mortality as gestational age decreased. Finally, Table 3 shows the absence of difference in mortality during the 1st week of life when low-weight, average and high-weight newborns are compared.

Birth weight is also an important factor influencing the risk of dying during the neonatal period. In this study, the incidence of low birth weight was of 8.1%. Table 4 describes the probability of neonatal death according to birth weight.

As the birth weight increased, the risk of dying decreased drastically. The relative risk values obtained were statistically significant for all weight ranges below 2,500 g. The risk of dying during the 1st week of life was six times higher for low-weight newborns when compared to newborns weighing 2,500 g or more at birth.

In relation to sex, we verified that early neonatal mortality was higher among male newborns in all the weight ranges.

In short, the newborns who died during the 1st week of life were, in general, male (64.3%), premature (76%), and presented a birth weight below 2,500 g (81%).

In relation to maternal characteristics, 19% of the mothers were teenagers, 67% did not have a steady partner, 57% did not work, 2.4% did not have any formal education, and 69% used the Brazilian Public Healthcare System (SUS) for the delivery.

Table 5 presents the basic causes of death of 42 newborns who died during the early neonatal period. Hyaline membrane disease was the main basic cause of death (21.4%), followed by congenital cardiopathies (14.3%), extreme prematurity (11.9%) and premature placental separation (11.9%).

Table 2 - Probability and relative risk (RR) for early neonatal death according to gestational and delivery variables, Caxias do Sul, Brazil, 1995

Characteristics	Probability	Non-adjusted RR (CI 95%)	Adjusted RR (CI 95%)
Number of prenatal medical appointments			
none	40.9	10.82 (4.55-25.75)	1.85 (0.70-4.89)
1-5	18.5	4.90 (2.35-10.22)	1.19 (0.51-2.76)
6 or more	3.8	1.00	1.00
Weight gain during pregnancy			
<7 kg	21.7	6.23 (3.32-11.67)	1.15 (0.66-2.00)
7 kg or more	3.5	1.00	1.00
Mode of delivery			
Caesarian	5.5	0.54 (0.29-0.99)	1.60 (0.54-4.77)
normal	10.3	1.00	1.00
Apgar score			
<7	70.1	31.57 (15.83-62.93)	10.11 (3.13-32.66)
7 or more	2.2	1.00	1.00

Table 3 - Probability of early neonatal death (PEND) and relative risk (RR) of live births according to the newborns' characteristics, Caxias do Sul, 1995

Characteristics	Probability	Non-adjusted RR (CI 95%)	Adjusted RR (CI 95%)
Sex			
male	9.7	1.79 (0.96-3.36)	4.16 (1.22-14.25)
female	5.5	1.00	1.00
Gestational age (weeks)			
<37	70.5	49.64 (17.67-139.48)	5.58 (1.02-30.91)
37-38	2.0	1.41 (0.31-6.27)	1.64 (0.29-9.16)
39-41	1.4	1.00	1.00
42 or more	–	–	
Gestational weight/age			
SGA	20.4	2.61 (0.81-8.42)	1.50 (0.24-9.17)
AGA	7.8	1.00	1.00
LGA	1.8	0.23 (0.03-1.66)	0.41 (0.10-1.80)

When multiple causes of death were analyzed, it was verified that 76.2% of the newborns were premature, and 40.5% presented hyaline membrane disease.

Discussion

The probability of early neonatal death in Caxias do Sul (7.44 per 1,000 live births) is below the State average, which was 8.10 per 1,000 live births during the same period(6). It is also below the average of most Brazilian cities. In the city of Pelotas, state of Rio Grande do Sul, Menezes et al.[9] observed an early neonatal mortality rate of 11.7 per 1,000 live births in the year of 1993. In 1994, in the city of São Paulo, state of São Paulo, Almeida et al.[10] observed an early neonatal mortality rate of 12 per 1,000 live births.

However, when compared to developed countries, the probability of early neonatal death found in our study was twice as high as that found in Spain, for example, which presented an early neonatal mortality rate of 3.32 per 1,000 live births in 1991.[11]

Almost 50% of these deaths occurred on the 1st day of life, and this fact is in agreement with reports by other authors.[3,12] These early deaths affect highly compromised newborns, such as the extreme premature newborns, and those with malformations that are not compatible with survival. However, it is important to emphasize that the increasing technological sophistication of neonatal intensive care units promotes an artificial delay of death in many newborns who have few chances of survival; these babies might die on the following days, or even after the early neonatal period. Therefore, a possible decrease in mortality

Table 4 - Probability and relative risk (RR) for early neonatal death according to birth weight. Caxias do Sul, Brazil, 1995

Weight (g)	Probability	Non-adjusted RR (CI 95%)	Adjusted RR (CI 95%)
<1,500	407.4	315.06 (97.23-1020.97)	58.82 (22.88-7648.00)
1,500-1,999	55.55	42.96 (9.79-188.45)	6.16 (2.33-819.00)
2,000-2,499	16.07	12.43 (2.99-51.77)	2.87 (1.11-373.00)
2,500-2,999	2.22	1.72 (0.35-8.51)	1.39 (0.01-230.00)
3,000-3,499	1.29	1.00	–
3,500-3,999	1.83	1.43 (0.24-8.53)	1.61 (0.01-230.00)
4,000 or more	–	–	–
<2,500	70.9	44.21 (20.45-95.59)	5.93 (1.18-29.77)
2,500 or more	1.6	1.00	1.00

Table 5 - Basic causes of death among newborns who died in the early neonatal period, Caxias do Sul, Brazil, 1995

Cause of death	Number	%
Hyaline membrane disease	09	21.4
Congenital cardiopathy	06	14.3
Extreme prematurity	05	11.9
Early detachment of placenta	05	11.9
Nosocomial infection	03	7.1
Chorioamnionitis	03	7.1
Maternal infection	02	4.8
Septicemia	01	2.4
Prolapse of umbilical cord	01	2.4
Diaphragmatic hernia	01	2.4
Neonatal anoxia	01	2.4
Meconium aspiration syndrome	01	2.4
Maternal diabetics	01	2.4
Intense fetal distress	01	2.4
Anencephalia	01	2.4
Maternal hypertension	01	2.4
Total	42	100.0

rates during the 1st week of life does not necessarily mean an improvement in the care offered to pregnant women and newborns.

In the study of maternal variables related to early neonatal mortality, maternal age of 35 years or more and previous history of stillbirth were risk factors for early neonatal death.

Victora et al.[2] did not find any relationship between history of abortion or previous stillbirth and early neonatal mortality. Those authors observed that the most important antecedents in terms of death during the 1st week of life were history of previous neonatal death or previous low-weight newborn. That finding must be taken with caution, since it was based on a small number of events (stillbirths), as suggested by the wide confidence interval of the calculated relative risk.

In relation to the mother's age, the risk of neonatal death among mothers older than 35 years and among teenagers has been reported by other authors.[13] In that study, mothers younger than 20 years also presented risk for neonatal death.

Concerning maternal education, the babies of illiterate mothers presented a risk for neonatal death that was 4.5 times higher than the risk faced by the babies of mothers with a university degree. The small number of illiterate mothers, with only one neonatal death in this group, may have contributed to the lack of statistical significance in terms of this finding. It is also important to emphasize that for several newborns who died, the hospital chart did not contain information about maternal education.

Some authors[5] have suggested a relationship between marital status and early neonatal mortality, with babies of single mothers presenting a higher chance for neonatal death. This tendency was initially observed in this study, but it disappeared after the multivariate analysis.

In the studied population, we observed that women without a steady partner were more illiterate than married women (1.9% and 0.7%, respectively); those women also had a lower family income, with 64.2% depending on the public system (SUS) for health care. Among the mothers with a stable marital relationship, only 44% used SUS. In addition, 37.2% of the single mothers were teenagers, and 6.8% had not received any prenatal medical advice. Thus, single mothers presented a lower socioeconomic and educational status than married women, and these variables constituted a confusion factor in the analysis of both groups.

In relation to gestational and delivery variables, having a prenatal examination appears as one of the most important aspects. Several studies have demonstrated the importance of prenatal advice in the prevention of neonatal morbidity and mortality. In the city of Pelotas, state of Rio Grande do Sul, Victora et al.[2] verified that women who did not have a prenatal examination presented a risk for perinatal loss 3.6 times higher than women who showed up for ten or more medical appointments, revealing a strong association between early neonatal mortality and the number of medical appointments along the pregnancy. Another researcher12 found an early neonatal mortality rate of 27 per 1,000 live births in the group of mothers who had not received prenatal care; this rate dropped to 7 per 1,000 live births in the group of mothers who went to more than seven prenatal medical appointments. This association was also found in another study, which established that 17.9% of the mothers of newborns who died had not received prenatal care, and 29% had gone to fewer than six medical appointments. However, these findings were not statistically significant in the multivariate analysis, possibly because of the small number of mothers who had not received prenatal care in that study.

In relation to the mode of delivery, it was verified that, in Caesarian sections, the risk for neonatal death was 60% higher than in the normal delivery group, although no statistical significance was found regarding this finding.

The incidence of Caesarian sections had a clear relationship with the socioeconomic and educational level of the patients. Among illiterate mothers, the incidence of Caesarian sections was 37.2%, with rates increasing progressively and reaching 82% among mothers with a university degree. The same phenomenon was found in relation to the mother's occupation: mothers who did not work presented the lowest rates of Caesarian section. In relation to health insurance, 31.5% of the operative deliveries were among SUS patients, and 78% were among private health insurance patients. Similar data have been reported in other countries, and this problem seems affect several nations.[14-16]

When analyzing characteristics of the newborns in relation to mortality during the 1st week of life, we verified that the risk of dying was four times higher in males than in females. When the study population was stratified according to gestational age, higher mortality was observed among male newborns in all the gestational age groups below 39 weeks.

Other authors[17-19] have reported similar results, with girls presenting higher chances of survival in all groups with the same birth weight and gestational age. One of the main reasons for the lower mortality rate among female newborns is fetal lung maturity, which occurs earlier in females, decreasing the incidence of respiratory problems, which are among the main causes of death during the neonatal period.

Gestational age was strongly associated with neonatal mortality, since premature newborns are at higher risk for becoming sick and dying during the neonatal period. A previous study3 found a probability of death of 239.8 per 1,000 live births in the premature group, with a relative risk 52 times higher in comparison to the group of term newborns.

The incidence of prematurity remains around 9 or 10% in developed countries. There has not been any important decrease in these rates during the past decades, since it is too difficult to impact most of the factors involved. In this study, the incidence of prematurity was 9.4%. It is important to emphasize that in the group of 37 to 38 weeks, the risk for dying was 60% higher than in the group with 39 to 41 weeks. This is a major finding in our environment, since the number of elective Caesarian sections between 37 and 38 weeks of gestation is very high.

Similarly, the increase in mortality was inversely proportional to birth weight. The incidence of low weight obtained in this study (8.1%) was somewhat lower than the State average in the same period (8.4%). Despite the improvement in the population's socioeconomic and nutritional status during the past years, the incidence of low-weight newborns has remained stable, showing the complexity of the involved factors and the need for more detailed investigations regarding the reasons behind the low weight.

In this study, a survival of 56.9% was found among newborns weighing less than 1,500 g.

The high rates of mortality reported in Brazilian studies contrast with the ones obtained in more developed countries, where heavy investment in technology applied to neonatal intensive care units have drastically decreased neonatal mortality, mainly among extremely low-weight newborns (< 1,000 g). A study with newborns weighing from 500 to 800 g[20] found over 50% of survival. According to Roth et al.,17 the survival among all newborns weighing less than 1,500 g was 84.1% in 1993.

The relationship between gestational age and weight is important for the division of newborns into subgroups with peculiarities in terms of neonatal events. It is also important from a death risk perspective, since each group presents different neonatal mortality rates. The highest probability of early neonatal death was in premature newborns who were small for their gestational age (150.0 per 1,000 live births), almost twice as high as among preterm newborns of appropriate size for gestational age (79.0 per 1,000 live births). Term newborns of adequate age had a 1.6 probability of early neonatal death per 1,000 live births. A study in Santo André,[10] state of São Paulo, found a probability of neonatal death of 134 per 1,000 live births among premature newborns who were small for their gestational age, with a risk of dying eight times higher in relation to newborns of appropriate size for gestational age.

Hyaline membrane disease was the main basic cause of death in this study. It should be emphasized that in the year of the study (1995), lung surfactants were not covered by SUS. Therefore, only private health insurance patients could benefit from this drug, which is proven to considerably decrease the number of deaths caused by hyaline membrane disease. Currently, all SUS patients receive this medication, a fact that resulted in a decrease in the mortality rate.

Also remarkable is the high incidence of congenital cardiopathies causing early neonatal death. Cardiopathies were the second most important cause of death, immediately after hyaline membrane disease. Further studies are required to specifically investigate this finding.

The careful analysis of the medical charts showed that 30% of the babies who died presented pathologies that could have been avoided or that could have their effects minimized through good prenatal care and adequate follow-up during delivery. Such disorders include hospital infection, maternal infections, mainly chorioamnionitis, maternal hypertension, diabetes, fetal distress, perinatal asphyxia, and infant infections. These pathologies were present in 30% of the deaths in the studied population, revealing deficiencies in the care provided for these children, at both institutional and medical levels.

Another aspect that could be emphasized is pediatric care in the delivery room. Although the care provided during the 1st minutes of life is crucial for decreasing neonatal morbidity and mortality, it was observed that the most SUS patients who died did not receive such care; a pediatrician was called only in risk situations, and valuable minutes were wasted with resuscitation of newborns in serious danger.

Thus, the most needy patients, who are less privileged in both socioeconomic and educational terms and for whom a great number of risk factors are potentially present, were left without any assistance, or received insufficient care. Priority was given to patients of high socioeconomic status, who are at low risk for delivery complications.

The characteristics of the mothers whose newborns died reflect low socioeconomic and educational backgrounds when compared to the general study population, and show the complexity of the social factors involved in the death of a newborn. The intimate relationship between poverty,

poor life conditions, and early neonatal mortality becomes evident.

Therefore, it is essential that pregnant women at risk be identified early, when receiving prenatal care, and that they receive special attention during pregnancy and delivery. Health resources should be directed preferably at these groups, since these women are the ones who give birth to high-risk newborns, who may die during the 1st days of life.

Finally, it is important to emphasize that to achieve the morbidity and mortality rates of developed countries, it is necessary to ensure adequate socioeconomic and educational development and an equitable distribution of resources, since early neonatal mortality clearly reflects the quality of life and the degree of development of a nation.

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