Original Article

Neonatal deaths of low birth weight newborns

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ABSTRACT

To analyze the main characteristics of low birth weight infants that deceased in Cuiabá, Mato Grosso. A study conducted from a cohort composed of live infants with birth weight of 500 -2499 grams who progressed to death before completing 28 days of life. The data were obtained from the Live Births Information System and Mortality Information System. Of the 3,404 studied newborns, 238 progressed to death (7.0%). Prevalent deaths were among males, weighing between 500 and 999 grams, Apgar < 7 in the first and fifth minute with a congenital anomaly (p<0.001); with mothers younger than 20 years (p=0.033); who attended one to six prenatal appointments (p=<0.001). The results showed that neonatal deaths were related to the quality of obstetric and neonatal attention, as they were mostly avoidable deaths.

Descriptors: Low Birth Weight; Epidemiology Descriptive; Infant Mortality; Pediatric Nursing.

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INTRODUCTION

Babies with low birth weight are vulnerable to the risk of death, especially early death, besides health problems, in comparison to newborns with adequate weight. Currently, in Brazil, the low birth weight (LBW) represents alone the primary risk factor associated to death during the neonatal period, being present in 65% of deaths in the first 28 days of life[1]. Thus, improvements in the quality of pre-natal attention reflect the decrease of the neonatal mortality index, as well as, investments of the health services in the quality of delivery assistance[2].

The World Health Organization (WHO) defines that every baby born weighing less than 2,500 grams is considered low birth weight infant, and still, can be classified as extreme low birth weight (≤ 999 grams) or very low birth weight (≤ 1.499 grams) [3].

The LBW can be related to premature delivery, birth before 37 gestational weeks, as well as, associated with the restriction of intrauterine growth or the relationship between both situations. It is estimated that per year, 15 to 20% of all births in the world are LBW[3].

LBW newborns have been the object of many studies in countries like Colombia, India, Indonesia, Taiwan and Africa, investigating not only the predictors of neonatal mortality but also risk factors for birth with low weight[4-6]. In the national context, despite the high levels of neonatal mortality among LBW newborns, few are the studies analyzing mortality in this group of children[7-9], as well as in Cuiabá, capital of a State in the Central-West Brazilian region[10].

Considering the presence of differences in neonatal mortality in different regions of the country, that maternal and newborn characteristics have an important role in birth conditions and infant survival and, that neonatal mortality represents 67.1% of the total deaths in Cuiabá[11], the conduction of this study is justified. It aims to analyze the main characteristics of low birth weight infants who deceased in Cuiabá, Mato Grosso.

METHODS

A descriptive study of a cohort of all low birth weight newborns, residents of Cuiabá/MT, Brazil, who progressed to death during the neonatal period, between 01 January 2011 and 31 December 2014.

The data was collected of the Live Births Declaration (LBD) and Death Declaration (DD), available by the Epidemiological Vigilance of the Health State Secretary of Mato Grosso. The data was organized in two sets with the information extracted from each declaration (LBD and DD), respectively.

After, the linkage technique was applied between the two datasets. This technique consists in the integration of information of two or more independent sets, through common variables. It has been broadly used as it favors the recovery of incomplete and inconsistent registries contributing to the improvement of information quality. The deterministic linkage was done through the Excel® software, from the connection of key-fields: LBD number; date of birth; sex and maternal age. The integration of sets resulted in 96.5% of connection. A new dataset was built, and the variables were selected and categorized according to LBD and DD.

During the studied period, we had 3,477 low birth weight newborns, and in the sample selection process the NB with birth weight lower than 500 grams (69) and anencephalic (04) were excluded, resulting in the total sample of 3,404 live low birth weight newborns. From those, 238 progressed to death. Thus, we included 3,166 LWB newborns survivors and 238 LWB newborns who died during the neonatal period.

The following variables were selected for analysis: from the newborn (birth weight; sex; Apgar in the 1st and 5th minute and presence of anomaly), from the mothers (age, color/race, marital status and occupation); from the assistance (type of delivery; type of pregnancy; pre-natal consultation; pregnancy duration and place of birth. The primary cause of neonatal deaths was also analyzed and obtained in the Mortality Information System (SIM), which has a reference the International Classification of Diseases – 10th revision (ICD 10).

For data management and analysis, the Microsoft Excel® 2016 Program and the Statistical Package for the Social Sciences (SPSS) version 17.0 were used. The Chi-Square (χ^2) test was used to compare proportions according to the relative frequency of variables related to deaths, with a significance level of 5% ($p < 0.05$) and for the analysis of primary causes of fatalities, absolute and relative frequencies were used.

The research project was approved by the Ethics in Research Committee, under the protocol nº 1283.468/2015 in consonance with the CNS Resolution nº 466/2012 of the National Health Council.

RESULTS

From the 3,404 newborns included in the study, 238 progressed to death (7.0%). The neonatal mortality rate was 70 deaths/1000 LB. The highest number of deaths, 177 (74.4%) occurred during the early neonatal period (rate of 52 deaths/1000 LB). From those, 73 (41.2%) were in the first 24 hours after delivery and 61 (25.6%) in the late neonatal period (18 deaths/1000 LB).

There was a higher prevalence of deaths (55.3%) among male LWB newborns, weighing between 500-999 grams (49.2%), Apgar < 7 in the first minute (84.9%) and in the fifth minute of life (56.7%) and with congenital anomaly (12.2%) ($p < 0.05$) when compared to those who survived, and this difference was statistically significant (<0.05) (Table 1).

Table 1: Characteristics related to low birth weight newborns who died and survived according to variables related to the newborn. Cuiabá, MT, Brazil, 2011-2014.

Neonatal Characteristics	Low birth weigth newborns						χ^2 (p-value)
	Deaths		Survivors*		Total sample		
	n (238)	%	n (3166)	%	n (3404)	%	
Sex*							
Male	131	55.3	1427	45.1	1558	45.8	9.24 (0.002)
Female	106	44.7	1739	54.9	1845	54.2	1
Birth weight (g)							
500 to 999	117	49.2	100	3.1	217	6.4	942.41 (<0.001)
1,000 to 1,499	52	21.8	274	8.7	326	9.6	146.87 (<0.001)
1,500 to 2,499	69	29.0	2792	88.2	2861	84.0	1
Apgar 1st minute**							
≤ 7	202	84.9	752	23.9	954	28.0	407.59 (<0.001)
≥ 8 to 10	36	15.1	2401	76.1	2437	72.0	1
Apgar 5th minute**							
≤ 7	135	56.7	237	7.5	372	11.0	548.81 (<0.001)
≥ 8 to 10	103	43.3	2917	92.5	3020	89.0	1
Presence of anomaly*							
Yes	29	12.2	52	1.6	81	2.4	106.02 (<0.001)
No	208	87.8	3103	98.4	3311	97.6	1

Sources: Live Births Information System (SINASC) and Mortality Information System (SIM), Brazil.
Footnotes: * Survivors: Apgar 1st minute (13); Apgar 5th minute (12); Presence of Anomaly (11). / ** Ignored: Deaths: sex (1); presence of anomaly (1)

Regarding maternal characteristics of newborns who died, it was seen: greater predominance of deaths among mothers aged < 20 years (23.5%) than those aged ≥35 years (10.9%) p = 0.033. It is noteworthy that despite the importance of maternal age extremes, the higher number of deaths occurred between the NB of mothers 20-34 years (65.6%) (Table 2).

Table 2: Characteristics related to low birth weight newborns who died and survived according to maternal variables. Cuiabá, MT, Brazil, 2011-2014.

Maternal Characteristics	Low birth weight newborns						χ^2 (p-value)
	Deaths		Survivors*		Total sample		
	n (238)	%	n (3166)	%	N (3404)	%	
Maternal age (years)							
< 20	56	23.5	528	167	584	17.1	4.52 (0.033)
20-34	156	65.6	2226	70.3	2382	70.0	0.23 (0.631)
≥ 35	26	10.9	412	13.0	438	12.9	1
Maternal color/race**							
Black	12	5.1	184	5.9	196	5.8	1.35 (0.717)
Yellow	1	0.4	19	0.6	20	0.6	
White	51	21.4	750	23.9	801	23.7	
Brown	174	73.1	2183	69.6	2357	69.9	
Maternal marital status**							
Without partner	81	34.6	936	29.6	1017	30.0	2.60 (0.107)
With partner	153	65.4	2225	70.4	2378	70.0	1
Maternal occupation**							
Paid activity***	103	43.3	1502	47.7	1605	47.3	1.69 (0.192)
Home activity	135	56.7	1650	52.3	1785	52.7	1

Sources: Live Births Information System (SINASC) and Mortality Information System (SIM), Brazil.
Footnotes: * Survivors: Maternal color/race (30); marital status (5); maternal occupation (14) / ** Ignored: Deaths: marital status (4) / *** Within the occupations, health professionals (6.0%) and teachers (5.0%) were noted.

Regarding assistance characteristics related to pregnancy and delivery, it was seen that 101/42.4% of deaths resulted from vaginal births when compared to survivors (p=0.034), mothers with one to six pre-natal consultations had higher proportions of deaths compared to those with ≥ 7 appointments (p< 0.001) (Table 3).

Table 3: Characteristics related to low birth weight newborns who died and survived according to assistance variables related to the pregnancy and delivery. Cuiabá, MT, Brazil, 2011-2014.

Assistential Characteristics	Low birth weight newborns						χ^2 (p-value)
	Deaths		Survivors*		Total sample		
	n (238)	%	n (3166)	%	n (3404)	%	
Type of delivery							
Vaginal	101	42.4	1127	35.6	1228	36.1	4.49 (0.034)
Cesarean	137	57.6	2039	64.4	2176	63.9	1
Type of pregnancy**							
Multiple	42	17.6	560	17.7	602	17.7	0.00 (0.979)
Unique	196	82.4	2601	82.3	2797	82.3	1
Prenatal appointment**							
None	11	4.9	57	1.9	68	2.1	23.40 (0.000)
1 to 6	138	61.9	1223	39.7	1361	41.2	49.22 (<0.001)
≥ 7	74	33.2	1798	58.4	1872	56.7	1
Pregnancy duration (weeks)**							
<37	214	93.0	1888	60.7	2102	63.0	95.80 (<0.001)
≥ 37	16	7.0	1220	39.3	1236	37.0	1
Place of birth							
Hospital	235	98.7	3141	99.2	3376	99.2	0.60 (0.438)
Others	3	1.3	25	0.8	28	0.8	1

Sources: Live Births Information System (SINASC) and Mortality Information System (SIM), Brazil.
Footnotes: * Survivors: Type of pregnancy (5); prenatal appointment (88); pregnancy duration (58) / ** Ignored: Deaths: pre-natal appointments (15) pregnancy duration (8)

From the 238 deaths studied, 196 (82.3%) were considered avoidable, due to causes related to disorders arising in the perinatal period. Within the basic causes of death, notably the fetus and NB affected by maternal factors and complications during pregnancy, labor, and delivery (68/34.7%), infection specific of the perinatal period (55/28.0%) and respiratory and cardiovascular disorders (43/22.0%). Other not clearly avoidable causes, congenital malformations, corresponded to 42/17.6% of total deaths, with a predominance of malformation of the circulatory system (Table 4).

Table 4: Distribution of the basic cause of death of low birth weight newborns. Cuiabá, MT, Brazil, 2011-2014.

Basic Causes of Death (ICD X)	n	%
Certain conditions originating in the perinatal period	**196**	**100**
Respiratory and cardiovascular disorders specific to the perinatal period (P20- P29)	43	22.0
Haemorrhagic and heamatological disorders of fetus and NB (P50-P61)	5	2.5
Infections specific to the perinatal period (P35- P39)	55	28.1
Disorders related to length of gestation and fetal growth (P05-P08)	11	5.6
Fetus and NB affected by maternal factors and by complications of pregnancy, labor and delivery (P00-P04)	68	34.7
Other disorders originating in the perinatal period (P90-P96)	9	4.6
Transitory endocrine and metabolic disorders specific to fetus and NB (P70-P74)	3	1.5
Birth trauma (P10-P15)	2	1.0
Congenital malformations, deformations and chromosomal abnormalities	**42**	**100**
Congenital malformations of the circulatory system (Q20-Q28)	13	31.0
Congenital malformations of the respiratory system (Q30-Q34)	4	9.5
Congenital malformations of the digestive system (Q38-Q45)	3	7.1
Congenital malformations of the urinary system (Q60-Q64)	2	4.8
Congenital malformations and deformations of the musculoskeletal system (Q65-Q79)	8	19.0
Other congenital malformations (Q80-Q89)	10	23.8
Congenital malformations of the nervous system (Q00 – Q07)	2	4.8
Total	**238**	**100**

Within the disorders originated in the perinatal period, the following severe aggravations were predominant: sepsis, fetus and newborn affected by premature rupture of membranes, hyaline membrane disease, fetus and newborn affected by hypertensive maternal disorders and non-specific infection.

DISCUSSION

In this investigation there was a trial to analyze the characteristics of mothers of low birth weight newborns who died, characteristics of these newborns and the survivors, configuring as neonatal mortality characteristics in Cuiabá, Mato Grosso, during 2011 to 2014.

About the characteristics of low birth weight newborns, the present study showed a predominance of deaths in the early neonatal period, especially among the extreme low birth weight (ELBW), a result similar to other studies in the country[7-8,12]. Also in the prospective cohort with 627 live births with a gestational age of 23-31 weeks and birth weight of 500-1499g, in 19 public maternities of nine capitals in the Northeast region of Brazil, the neonatal mortality in the first 24 hours was high (9.4%)[9].

The literature has found that these early deaths result from complications in the pregnancy and delivery and they are associated with antenatal conditions, to peripartum and inadequate attention to newborns during the delivery[9,13].

A study conducted in Burkina Faso concluded that the factors that increase the risk of death in the population of low weight can be fought with better health assistance practices and that special attention should be given in the first days of life, due to the vulnerability of the newborn in the external environment[14].

Regarding the newborn biological characteristics, national studies emphasize the LBW, especially the extreme low birth weight as an associated factor to neonatal death[9,13], similar to the results in the present study. The prematurity and low birth weight were the main factors associated to neonatal death in the *Pesquisa Nascer Brasil*, being the extreme premature babies and those with extreme low birth weight with 200 to 300 times higher chance to die in the first 28 days of life in comparison to term newborns and with birth weight ≥ 2500g[15].

A retrospective cohort that assessed neonatal mortality of very low birth weight (< 1500g), in a public hospital in Rio de Janeiro, showed that mortality was higher among children of lower weight (500-749g)[8]. A study conducted in São Paulo reaffirmed these findings showing that for neonates of extreme low birth weight (<1000g), the probability of death was 5.5 times higher than in the group weighting 1000 to 1499g. The results also found that there were no survivors among them with weight lower than 700g[7].

Another biological characteristics found in low birth weight newborns who died in the present study was the male sex, considered a predictive variable for neonatal death in children of low birth weight, considering that in a study in the Northeast region of Brazil, male very low birth weight newborns had a risk three times higher of death compared to female[9]. One of the arguments for this highlight is the late maturing of fetal lungs, increasing the incidence of respiratory aggravations, one of the leading causes of neonatal death[13], and also that the female sex has better adaptation and response to oxidative stress, which influences fetal growth and survival[16].

Regarding the Apgar, the results of this study are consonant with the association reported in other studies between the low values of Apgar levels in the first minute, and especially, in the fifth minute of life, with the occurrence of neonatal death, independently of the birth weight[13]. Equally, in a cohort with 213 newborns weighing less than 1500g, in the south region of São Paulo city, the Apgar <7 in the fifth minute was associated to neonatal death[7], as well as, in a prospective cohort with 627 live births with gestational age of 23-31 weeks and birth weight of 500-1499g, in nine capitals of the Northeastern region of Brazil, where a strong association was seen of the Apgar score in the 5th minute <7 with death in the first 24 hours of life[9].

The Apgar index in the first minute of life reflects vitality conditions of the newborn, and it relates to the quality of assistance at birth. On the other hand, low indexes in the fifth minute of life point to the not recovery of the low index in the first minute of life, signalizing that the severity of the newborn was kept high and it could justify the negative outcome[17].

The association between congenital malformations and neonatal death has been demonstrated in national studies, independently of the birth weight[15,17], a finding also seen in this study, with the percentage of 12.2% of congenital malformations in children with LWB. A study that investigated the maternal and infant factors associated to neonatal mortality in Cuiabá/MT, with secondary data for births and deaths in 2010, showed in the final model that children with congenital anomaly were the ones presenting higher chance of death during neonatal period (OR=17.78; CI 95%:6.68-47.27) [2].

It is undeniable the importance of congenital malformations in studies about neonatal mortality, once they are the second cause of infant death in the country, responding for 30% of neonatal deaths in some Brazilian

cities[18]. Regarding the congenital anomalies or malformations being considered morphological and/or functional changes detectable at birth[18], notably its identification and diagnosis might not be possible right after the delivery, once some malformations need late evaluation and diagnosis[19], as it is the case of certain cardiopathies, which can lead to under notification in the LBD. Thus, the use of this data available in the information system has to be considered with caution.

About maternal characteristics, those pointed as the main risk factors for neonatal mortality are age, unfavorable life conditions, low maternal level of education and, mothers without a partner[20-21]. In this investigation, only maternal age was associated with deaths of low birth weight newborns, and variables as education and maternal life conditions were not analyzed.Still notable, despite higher risks for death of low birth weight neonates are in extreme maternal age groups, very young women and those with advanced age[20], in the present study, more than 65% of mothers of deceased neonates were between 20-34 years.

Regarding the assistance characteristics related to pregnancy and delivery, it was observed that association between the neonatal death in low weight newborns and the inadequate prenatal follow-up (less than six appointments), what was also observed in research developed in Rio de Janeiro[8]. This result has also been seen in research with LBW children previously conducted in Cuiabá[10]. It has to be highlighted that in the present study, almost total (90.0%) of neonates were less than 37 weeks of gestational age, which might have influenced the number of prenatal appointments. Within the assistance characteristics related to delivery, gestational age lower than 37 weeks was noted, similarly with other results of studies where prematurity was a significant risk factor for neonatal death[8,12].

The quality of pregnancy accompaniment is described in the literature as an important risk factor for neonatal mortality, especially the variables referring to the conduction or not of prenatal, number of appointments, early start of accompaniment and professional training[20]. Moreover, the adequate prenatal accompaniment allows the identification of pregnancy intercurrences, preventing the birth of children of very low weight and neonatal deaths[7].

An integrative literature review about infant mortality and prenatal assistance found that this relationship refers to the insufficient number of appointments or the low-quality attention to the pregnant woman. According to studies analyzed in this review, even when the number and the routine of prenatal appointments were adequate, there were avoidable deaths, reaffirming that not only the number of appointment and routine are important, but the attention quality during pregnancy needs to be considered[22].

The increase of coverage and quality in pre-, intra- and postnatal appointments could avoid 71% of neonatal deaths globally[23]. In the present study, the quality of prenatal accompaniment was not assessed, it was only counted the number of appointment, which can be considered a study limitation.

The research *Nascer no Brasil*, a study with hospital base composed by puerperal women and their newborns, conducted in February 2011 to October 2012, with interviews and assessment of medical records, pointed to problems in the attention quality related to the assistance process during prenatal and delivery, indicating non-satisfactory quality of assistance[15].

Regarding the cause of deaths in Cuiabá/MT, the higher number of fatalities in LBW had as main cause the affections originated in the perinatal period (82%). They were considered avoidable deaths, such as the scenario

of causes for neonatal deaths in the country[1]; similar to another study conducted in the same city[24]. Avoidable infant deaths are preventable, entirely or partially, by effective actions of health services[25].

The great number of avoidable neonatal deaths identified in the present study signals the existence of problems related to assistance to pregnancy, delivery/birth and puerperium and the need of improvements in services assisting the maternal-infant clientele, as well as, investment s in the capacitation of health professionals.

It is notable the importance to identify the causes of death in the focus of avoidability to build indicators to improve the quality of health attention, for the planning of preventive and assistance interventions[24], as well as, to assess and monitor the quality of health attention[25].

Authors[15] defend the need to give more visibility to assistance processes and to perinatal outcomes, as well as, the implementation of good practices in Brazilian maternities in the labor and delivery, to prevent avoidable neonatal deaths, and, consequently, reduction of infant mortality.

Within the limitations of this study, it is noteworthy the measurement bias through the use of secondary data, the non-inclusion of variables as family income, breastfeeding, cigarette consumption, not available in the information systems used. Besides the non-exploration in this analysis of the number of previous fetal losses, complexity and legal nature (private/public) of the hospital where the child was born, among other variables. Despite these limitations, the results allowed to recognize the neonatal mortality behavior and the profile of mothers of low weight newborns, offering data to plan actions to reduce neonatal deaths of these newborns, as well as, to subsidize the planning and assessment of local policies.

CONCLUSION

The results allow to conclude that neonatal mortality in the first 24 hours of life is high, and occurred mainly in male children, of extreme low weight, of gestational age < 37 weeks and with low vitality at birth and, as the main causes of death were the affections originated during perinatal period, therefore considered avoidable deaths. On the other hand, mothers of newborns that progressed to death were mainly 20-24 years, had less than seven prenatal appointments and had a cesarean section delivery.

In this context, the findings show that neonatal deaths are related to the obstetrics and neonatal attention quality offered by health services and can be used by health managers and professionals as indicators to monitor and reduce mortality rates, as well as, to assess the effectiveness of few programs directed to the maternal-infant population.

Considering the presented results and reflections, it is understood as necessary more investments in research that assess the prenatal attention quality, assistance conditions to delivery and immediate care at birth in our reality.

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