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ORIGINAL ARTICLE

Risk factors for perinatal asphyxia in newborns attended at a tertiary public maternity hospital

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Asphyxia Neonatorum,
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Abstract

Objectives: To assess the profile of newborn that were assisted in a maternity from a tertiary referral hospital in Distrito Federal (DF) and the risk factors for perinatal asphyxia. **Methods:** Quantitative, retrospective, cross-sectional, descriptive study, using secondary data. The population of the study were RN born in the Children Maternal Hospital of Brasília (HMIB) in the period from January 2017 to June of 2018. The data were obtained through SINASC of the Secretary of Health of DF. Asphyxia was defined as Apgar < 6 in the 5th minute and mother and newborn variables were studied. Statistical analysis were performed by EpiInfo 2010 and ethics approval for the study was obtained from Ethics and Research Committee. **Results:** Over the period considered in this study, 5,358 RNs were born. The prevalence of perinatal asphyxia was 2%. The variables maternal age < 20 (OR=2), number of prenatal visits < 7 (OR=7.5), vaginal delivery (OR=1.7), gestational age < 37 weeks (OR=21.4) and birth weight < 2500g (OR=27.38) were significantly associated with the occurrence of perinatal asphyxia. **Conclusions:** A high perinatal asphyxia prevalence in HMIB was found in comparison literature. Actions to create opportunities of qualification of health professionals to assist pregnant women and RN in order to provide early identification and prevention are suggested to the reversal of this situation.

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INTRODUCTION

The leading causes of infant mortality are prematurity and perinatal asphyxia[1,2]. Perinatal asphyxia occurs as a consequence of significant tissue hypoperfusion and decreased oxygen supply caused by a number of factors during delivery, at birth, or within the first few minutes after birth[3,4]. It is the most severe cause of acquired brain injury (ABI) in full-term newborns. Sequelae from ABI include cerebral palsy, mental retardation, learning disabilities of varying degrees, and epilepsy[3,5].

Four million neonates suffer from asphyxia every year in the world, of which one million develop severe sequelae and one million die[6,7]. The morbimortality associated with perinatal asphyxia in full-term newborns (FTN) and preterm newborns (PTN) is a relevant matter in perinatology[5,6]. In Brazil, early neonatal deaths linked to perinatal asphyxia amount to 40% of all early neonatal deaths of newborns with birth weights ≥2500g without congenital malformation[8]. Yet, death by perinatal asphyxia can be easily prevented with early diagnosis and treatment. Therefore, high rates of perinatal asphyxia reflect poor perinatal care provided to mothers and newborns[2].

The diagnostic criteria for asphyxia vary considerably in the literature. The Apgar score at 1 and 5 minutes after birth is a simple and easy way to identify neonates at risk of complications connected to perinatal asphyxia. However, the Apgar score alone has its limitations. For example, the Apgar score is not used in the prescription of neonatal resuscitation procedures, but only in the assessment of patient response to the performed procedures[3].

A total of 56,426 children were born in the Federal District in 2017. On the same year, 3,426 children were born at HMIB. Neonates weighing less than 2500g accounted for 18% all births at HMIB (SINASC-Giass/Divep/SVS/SES/GDF).

A significant number of early neonatal deaths caused by perinatal asphyxia in low risk newborns – infants with birth weight ≥2500g without congenital malformation – have been reported in our region. A study conducted by the Neonatal Resuscitation Program revealed that 5-6 early deaths of low risk infants occurred per day in Brazil in the 2005-2010 time period for causes tied to perinatal asphyxia, two of which by meconium aspiration syndrome. Most of the infants died on the day of birth[9].

This study investigated the records of newborns seen at HMIB and analyzed them for perinatal asphyxia risk factors. The information collected in this study may be used as input in public policy implementation, communication campaigns on the sequelae of perinatal asphyxia, and in the development of strategies to decrease the number of cases of neonatal asphyxia.

METHODS

This descriptive quantitative retrospective cross-sectional study based on secondary data collection included neonates born at HMIB from January 2017 to June 2018.

The HMIB is a public tertiary hospital managed by the Federal District Department of Health. High-complexity cases in the areas of pediatrics, gynecology, and obstetrics are referred to the HMIB.

Data were obtained from the Live Birth Information System (SINASC) maintained by the Federal District Department of Health.

Our study looked into infants diagnosed with neonatal asphyxia based on having an Apgar score below 6 at 5 minutes as a dependent variable. Independent mother and neonate variables included mother age, number of prenatal care visits, type of delivery, gestational age (GA), birth weight (BW), and newborn sex. Some newborn records did not contain the information needed to calculate prevalence or estimate associations with independent variables.

Microsoft Excel 2013 was used to process isolated data sets and produce charts and tables. Descriptive statistical analysis was performed on software package EpiInfo 2010 (CDC, Atlanta, USA). The number of observations for each variable was set. Categorical and numerical variables were described as absolute and relative frequencies. Risk factor effect was measured using odds ratios (OR) with 95% confidence interval (95% CI). Statistical significance was set at 5% ($p \leq 0.05$). Odds ratios greater than 1 indicated risk, while OR below 1 indicated a protective effect.

The study complied with the criteria set out in the Declaration of Helsinki and attained approval from the Ethics Committees of HMIB and the Foundation for Education and Research in Health Sciences (FEPECS/SES/DF; certificate no. 2.359.674). Consent from newborn families was not required, since the study was based on secondary data collected from an information system.

RESULTS

A total of 5,358 infants were born at HMIB from January 2017 to June 2018, 108 with an Apgar score < 6 at 5 minutes, yielding a prevalence of perinatal asphyxia of 2%. The records of 17 newborns (0.3%) did not cite the Apgar score at 5 minutes.

Most of the infants were born to mothers aged 20-34 years (68.5%). Adolescent mothers (age < 20 years) accounted for 13% of the deliveries at HMIB in the studied period; 3.3% were aged less than 14 years. Women aged 35 years and above accounted for 18.3% of the deliveries. Teenage pregnancy was a risk factor for perinatal asphyxia (OR = 2; 95% CI: 1.2-3.2; p=0.005). No significant correlation was found with mothers in the opposite end of the spectrum (aged 35+ years) (p=0.17).

Most of the mothers had more than six prenatal care visits (65.8%). However, 10.3% went to three or fewer visits, and 40.2% of the individuals in this subgroup did not go to prenatal care visits at all. The records of 114 newborns (2.1%) did not mention the number of prenatal care visits their mothers

attended. Attending fewer prenatal care visits (< 7) was a risk factor for perinatal asphyxia (OR = 7.5; 95% CI: 4.7-11.8).

More than half (53%) of the newborns included in our study were delivered through cesarean sections, followed closely by vaginal delivery (45.5%). The type of delivery was not mentioned in 1.5% of the cases. Vaginal delivery was associated with asphyxia (OR = 1.7; 95% CI 1.2-2.6; p = 0.004), whereas delivery by cesarean section protected newborns against asphyxia (OR = 0.56; 95% CI: 0.4-0.8; p = 0.004).

Nearly three quarters (72.5%) of the infants were born after full-term pregnancies, while 21% were born prematurely (GI < 37 weeks), 3.2% were post-term newborns (GI of 42+ weeks), and 3.3% of the records did not mention GI at birth. Prematurity was strongly correlated with perinatal asphyxia (OR = 21.4; 95% CI: 12.3-37.2).

Most of the infants (54.6%) were born weighing between 3000g and 4000g. More than three quarters (77.4%) of the infants had normal birth weight. Low birth weight neonates (BW < 2500g) accounted for 17.8% of the studied population, while large for gestational age infants amounted to 4.7% of the sample. Low birth weight was a risk factor for perinatal asphyxia (OR 23.8; 95% CI: 14.3-39.7). Interestingly, being large for gestational age was not correlated with asphyxia (OR = 0.9; 95% CI: 0.1-6,7; p = 0.9).

There were slightly more male infants included in the study (51%) compared with female infants (49%). No statistically significant correlation was found between gender and asphyxia (p = 0,9).

Tables 1 and 2 report the variables for mothers in terms of absolute and relative frequencies.

DISCUSSION

The prevalence found in our study was 2%, or 20 per 1,000 live births. The incidence of perinatal asphyxia reported in the literature ranges from three to six per 1,000 live births. Although at a first glance our study appears to have revealed a significantly discrepant finding, the difference may be explained by the use of a less rigorous set of criteria to diagnose infants with perinatal asphyxia. Other authors have used more stringent criteria, such as the guidelines published by the American College of Obstetricians and Gynecologists (ACOG) or the American Academy of Pediatrics (AAP), which use the Agar score combined with other parameters.

A study performed in the Brazilian northeastern city of Fortaleza using similar diagnostic criteria found a prevalence of 1.3%[11]. Although prevalence was higher in our study, we should remember that the HMIB is a tertiary hospital to which infants with malformations and preterm newborns with gestational ages below 32 weeks with increased risk of requiring resuscitation are referred. Higher risk subgroups of

Table 1. Variables pertaining to mothers, pregnancy, and occurrence of asphyxia in newborns seen at HMIB. Brasília (DF), January 2017 to June 2018.

	Asphyxia							
	Yes (Apgar 0 - 5)		No (Apgar 6 - 10)		Not reported		Total	
Mother age range	**n°**	**%**	**n°**	**%**	**n°**	**%**	**n°**	**%**
Less than 14 years	0	0.00	23	0.43	0	0.00	23	0.42
15-19 years	23	21.29	653	12.47	3	17.64	679	12.67
20-34 years	62	57.40	3602	68.83	9	52.94	3673	68.55
35 and above	23	21.29	955	18.24	5	29.51	983	18.34
Total	108	100	5233	100	17	100	5358	100
Number of prenatal care visits								
None	21	19.44	197	3.76	4	23.52	222	4.14
01/mar	29	26.85	300	5.73	1	5.88	330	6.16
04/jun	34	31.48	1129	21.57	2	11.76	1165	21.74
7 and above	24	22.22	3494	66.76	9	52.94	3527	65.83
Not reported	0	0.00	113	2.15	1	5.88	114	2.13
Total	108	100	5233	100	17	100	5358	100
Type of delivery								
Vaginal	63	58.33	2366	45.21	12	70.59	2441	45.56
Cesarean section	42	38.89	2787	53.26	5	29.41	2834	52.89
Not reported	3	2.78	80	1.53	0	0.00	83	1.55
Total	108	100	5233	100	17	100	5358	100

Source: Sinasc - Giass/Divep/SVS/SES-DF

Tabela 2. Distribuição das variáveis neonatais e a ocorrência de asfixia em RNs atendidos no HMIB. Brasília (DF), janeiro de 2017 a junho de 2018.

	Asphyxia							
	Yes	(Apgar 0 - 5)	No (Apgar 6 - 10)		Not reported		Total	
Gestational age	**n°**	**%**	**n°**	**%**	**n°**	**%**	**n°**	**%**
Less than 22 weeks	15	13.89	8	0.15	2	11.76	25	0.47
22-27 weeks	46	42.59	89	1.70	0	0.00	135	2.52
28-31 weeks	10	9.26	204	3.90	1	5.88	215	4.01
32-36 weeks	15	13.89	730	13.95	1	5.88	746	13.92
37-41 weeks	15	13.89	3857	73.71	12	70.59	3884	72.49
42 weeks and above	0	0.00	173	3.31	0	0.00	173	3.23
Not reported	7	6.48	172	3.29	1	5.88	180	3.36
Total	108	100	5233	100	17	100	5358	100
Birth weight								
1g to 999g	70	64.81	99	1.89	3	17.65	172	3.21
1000g to 1499g	5	4.63	128	2.45	2	11.76	135	2.52
1500g to 2499g	14	12.96	629	12.02	1	5.88	644	12.02
2500g to 2999g	8	7.41	1210	23.12	4	23.53	1222	22.81
3000g to 3999g	10	9.26	2912	55.65	6	35.29	2928	54.65
4000g and above	1	0.93	255	4.87	1	5.88	257	4.80
Total	108	100	5233	100	17	100	5358	100
Sex								
Male	54	50.00	2667	50.97	10	58.82	2731	50.97
Female	51	47.22	2563	48.98	6	35.29	2620	48.90
Not reported/blank	3	2.78	3	0.06	1	5.88	7	0.13
Total	108	100	5233	100	17	100	5358	100

Source: Sinasc - Giass/Divep/SVS/SES-DF

infants were not excluded, a factor that potentially increased the prevalence of asphyxia in our study.

Despite its limitations at diagnosing infants with asphyxia[3,4,6,10], the Apgar score is still an important, easy-to-use tool. Infants with an Apgar score below 7 at 5 minutes require additional attention, particularly in healthcare units with limited access to laboratory tests[6]. Cruz et al. found an association between low Apgar scores at 5 minutes and increased morbidity and mortality[10]. These findings supported the use of very low Apgar scores (< 6) at 5 minutes in our study to identify more severely affected newborns unable to improve despite neonatal resuscitation efforts. Infants in this situation are at greater risk of having asphyxia and ensuing associated disorders[10]. Therefore, Apgar scores at 5 minutes are the closest measure of asphyxiation in a study based on birth records.

The risk factors for perinatal asphyxia cited in the literature include lower maternal age, prematurity, low birth weight (< 2500g), history of stillbirth, primiparity, chance of preterm birth, complications, and poor quality prenatal care[6]. None of these independent variables were covered in our study due to data unavailability.

In terms of maternal age, Brazil has gone through profound changes in its population structure and in the incidence and prevalence of diseases[12]. Fertility rates have decreased across the board in the nation, with the exception of the adolescent population (10-19 years of age), in which high fertility rates have been observed, and among females in the upper limit of fertile age (35 years and above)[13]. The two exceptions cited above increase the chances of high risk pregnancies and the risk of maternal and fetal morbidity and mortality[14]. Similarly to Daripa et al.[2], most of the mothers included in our study were aged 20-34 years, a group known for having low risk pregnancies. In higher risk age ranges, 13% of the cases came from teenage pregnancies and 18.3% from mothers aged 35 years and above. We found a significant correlation between teenage pregnancy and perinatal asphyxia, as reported by Fiorelli and Krebs. However, it should be noted that a number of other factors might be at play in this correlation other than age, such as higher prevalence of drug use, inadequate prenatal care, and unfavorable socioeconomic conditions[15]. Interestingly, affluent women of advanced age seeking fertility treatment at high-end human reproduction clinics appear not to replicate the correlation generally seen between advanced maternal age and asphyxia[13].

Most of the newborns included in our study were born of cesarean sections (53%), as also described by Silva et. al[16]. The high proportion of patients undergoing cesarean sections in our study reflects Brazil's second position in the list of countries with more performed cesarean sections in the world. According to the WHO, proportions of cesarean sections greater than 10% in a population have not been associated with increased protection of mothers and newborns, the primary reason for performing cesarean sections in the first place[17]. However, this does not reflect the reality at HMIB, a referral center for high-risk pregnancies in which patients are more likely to undergo cesarean sections. In our study, therefore, cesarean sections were associated with protective effects against perinatal asphyxia (p = 0,004), similarly to Gupta et. al[7], where vaginal delivery was associated with perinatal asphyxia ($p < 0.001$).

The Program for the Humanization of Prenatal Care and Birth (PHPN) sets at six the minimum number of prenatal care visits[18]. More than 65.8% of the pregnant women included in our study attended at least seven prenatal care visits; a significant proportion of them (10.3%) attended fewer than four visits; and 40.2% simply did not go to any prenatal care visit. In our study, lower numbers of prenatal care visits were associated with perinatal asphyxia. According to Domingues et al., prenatal care may contribute to more favorable outcomes, as risk factors potentially tied to complications to mothers and newborns are controlled and diseases are diagnosed and treated in a timely manner[19].

Although apparently counterintuitive, Brazil offers good prenatal care coverage and meets international requirements in almost every region. However, broad coverage does not necessarily equate with quality prenatal care. Performance is below par in many regions of the country in areas such as start of prenatal care, number of prenatal care visits, and basic procedures required by the Ministry of Health, particularly in poorer regions[20].

In terms of newborn parameters, prematurity and asphyxia were significantly correlated (OR = 21.4), as reported by Campos et al. ($p < 0.001$)[11]. A strong association was observed between low birth weight and perinatal asphyxia (OR = 23.8), as described by Cunha et al. (OR = 11.2)[21] and Gudayu[22]. There is wide agreement in the literature about the correlations between these factors and increased prevalence of asphyxia. Sixty percent of low birth weight neonates suffer from perinatal asphyxia[5]. In our study, 83.2% of the newborns with asphyxia had low birth weight. Although Cunha et al. reported female sex as having a protective effect against asphyxia, we did not observe a correlation between asphyxia and newborn gender (OR=0.1)[21].

Many factors related to mothers or newborns may predispose infants to perinatal asphyxia. However, they cannot be analyzed in isolation, since the environment, socioeconomic factors, and the care provided to mothers and newborns (before, during, and after delivery) often play a more determining role in making infants more prone to this complication.

A limitation of our study lies on the fact that it was performed at a tertiary hospital located in an urban area in Brazil that does not reflect the reality of other centers in the country of even of the State in which it is located. Daripa et al. reported a higher prevalence of early neonatal death and sequelae associated with asphyxia in centers located in rural areas compared with healthcare units located in urban areas, possibly due to differences in access to prenatal care. In an analysis of the socioeconomic factors potentially affecting asphyxia, Almeida et al.[8] saw that high income nations had lower incidence of deaths connected to asphyxia, while the death rates for asphyxia in the Northeast and North regions of Brazil were two times higher than the national average. Therefore, the results observed in our study cannot be generalized.

Another significant limitation was the data missing in the records for variables analyzed in the study (items described as "not reported" or "blank"). Poor data collection impairs the implementation of effective policies in healthcare. Missing data (number of prenatal care visits and Apgar scores at 1 and 5 minutes) indicates that healthcare workers are not aware of the importance of recording patient data[2]. Silva et al. pointed out to the need of increasing the awareness of healthcare workers of the importance of proper record keeping and intensifying the inspection of patient records[16].

Our study did not exclude non-viable fetuses with extreme GA or BW, since we did not have access to individualized data to assess the progress of each newborn. However, the use of the Apgar score alone to diagnose infants with asphyxia was the greatest limitation of our study, since this is a method with relatively low specificity, sensitivity, and diagnostic power that may underestimate or overestimate the occurrence of perinatal asphyxia[3,6,10].

FINAL CONSIDERATIONS

The prevalence of perinatal asphyxia at HMIB was 2% between January 2017 and June 2018. Perinatal asphyxia is a significant cause of infant death. Survivors may develop neurologic sequelae that impair the quality of life of affected families. Nevertheless, many cases of perinatal asphyxia may be prevented through quality prenatal care and proper management of neonates in the delivery room. This study shed light on the need to offer training to healthcare teams (physicians, nurses, and nurse technicians) on neonatal resuscitation, in addition to providing the equipment required to perform proper health care.

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