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Part 3: Factors of death

Perinatal Asphyxia in a Hospital Setting in a Developing Country

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Keywords: Newborn; Neonatal resuscitation; Hypoxic-ischemic encephalopathy; Neonatal mortality.

Abbreviations: Ancs: Antenatal Care Visits; CHUP-CDG: Centre Hospitalier Universitaire Charles De Gaulle; HIE: Hypoxic-Ischemia Encephalopathy; LBW: Low Birth Weight; NU: Neonatal Unit; PNA: Perinatal Asphyxia; WA: Weeks of Amenorrhae.

Abstract

Background: Perinatal asphyxia is one of the three major causes of neonatal morbidity and mortality, along with prematurity and neonatal sepsis. The aim of the study was to identify the mortality risk factors associated with perinatal asphyxia in a hospital of a developing country, in order to reduce neonatal mortality linked with this major public health problem.

Methods: A retrospective cross-sectional study was conducted from 1 January 2019 to 31 October 2021 at the neonatology unit of the Centre Hospitalier Universitaire Pédiatrique Charles de Gaulle, Ouagadougou, Burkina Faso (West Africa). All newborns with an Apgar score of less than 7 at the 5th minute of birth were included. A bivariate followed by multivariate analysis along with logistic regression was used to identify the risk factors for death in asphyxiated newborns.

Results: The incidence of perinatal asphyxia was 22.3%, the case-fatality rate 29.9%, and the mortality rate 6.2%. The risk factors identified for death were the mother's occupation as a housewife (OR = 2.27; p = 0.01), low birth weight of the newborn (OR = 3.28; p = 0.01), and severe hypoxic-ischemic encephalopathy (OR = 2.21; p = 0.04).

Conclusion: The continuum of care through the triptych of "pregnancy monitoring-codified delivery management-postnatal care" must be strengthened and good quality care must be delivered to reduce the risk of perinatal asphyxia and related deaths.

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Introduction

Perinatal Asphyxia (PNA), the inability to initiate and maintain breathing at birth [1], is caused by an event in the ante-, pre- or immediate post-natal period. A cascade of metabolic reactions is triggered in response to the initial hypoxic-ischemia, leading to multi-visceral failure. The most significant concern regarding these lesions is the occurrence of Hypoxic-Ischaemic Encephalopathy (HIE) due to its high lethality and potential for long-term cerebral sequelae. The epidemiology of PNA in developed countries is completely different from that described in developing countries. For example, the incidence of neonatal deaths caused by PNA is low in the United States of America, where a rate of 9.8 per 100,000 NV is reported [2], whereas, in low-income countries, this rate can be as high as 30 to 40% [3]. In Burkina Faso, previous studies done about ten years ago reported variable mortality rates of PNA ranging from 10% [4] to 20.9% [5]. However, PNA's causes and prognostic factors are not well known in our context.

Hence, the aim of this study was, therefore, to identify the risk factors responsible for PNA-associated neonatal mortality in order to better understand the determinants of this condition in Burkina Faso and to propose strategies to reduce its incidence in the country. Ultimately, this research aimed to provide valuable information for decision-making regarding public health policies for the prevention of PNA in developing countries.

Material and Methods

A cross-sectional retrospective study was conducted in the Neonatology Unit (NU) of the Centre Hospitalier Universitaire Pédiatrique Charles De Gaulle (CHUP-CDG) in the city of Ouagadougou, the capital of Burkina Faso (West Africa). The NU provides around 530 hospital admissions a year. The staff includes six pediatricians, 40 nurses, care assistants, and ward assistants. The equipment includes neonatal resuscitation tables, radiant and closed incubators, oxygen delivered from a central unit, ventilation equipment (self-inflating balloons, masks, goggles), conventional and intensive phototherapy equipment, monitoring scopes, and electric mucus aspirators. Medicines (caffeine, anticonvulsants, antibiotics, etc.) are available from a hospital pharmacy that dispenses them individually by name. The Continuous Positive Airway Pressure (CPAP) and infant flow devices are not operational. Since the CHUP-CDG lacks a maternity ward, the newborns are typically admitted through transfer from the city's maternity wards. All newborns hospitalized from 1 January 2019 to 31 October 2021 PNA were included in this study.

The epidemiological, diagnostic, therapeutic, and outcomes aspects of PNA are described in detail in the first part of this study [6, Nagalo 2023, Part 1]. Maternal, obstetric, and neonatal factors assumpted to contribute to neonatal death were identified and analyzed (**Table 1**).

A bivariate logistic regression analysis was performed to check the correlation of each independent variable with the dependent variable. Variables with a p-value < 0.20 in the bivariate analysis were selected for multivariate logistic regression. Variables with an adjusted OR at 95% CI and *p-value* < 0.05 were retained as factors in death during PNA.

Table 1: Study variables during perinatal asphyxia, Ouagadougou, Burkina Faso, 2021.

Dependent variable	Independent variables
Neonatal death (Yes or No)	Maternal factors: age, occupation, chronic pathology
	Obstetrical factors: number of pregnancies, parity, pregnancy follow-up, pathology during pregnancy, mode of delivery
	Neonatal factors: means of transfer, sibling rank, term, birth weight, severity of HIE

Results

During the study period of 34 months, 1,599 newborns were hospitalized in the NU. Of these, 331 were hospitalized for PNA, giving an overall hospital frequency of 20.7%.

In 69.5% of cases, the newborns were discharged normally. There were 99 deaths, giving a case-fatality rate of 29.9% (99/331) and she specific mortality rate of 6.2% (99/1,599). During the same period, a total of 355 deaths were recorded, giving a proportional mortality rate of 27.9% (99/355). **Table 2** shows the maternal factors associated with death, such as maternal age, occupation, and the presence of pathologies before pregnancy.

Table 3 shows the maternal obstetrical factors associated with newborns' death, such as the number of deliveries, the presence or absence of pathologies during pregnancy or delivery, pregnancy follow-up, and mode of delivery.

Table 4 shows the neonatal factors associated with death, such as means of transfer and term of birth, birth weight, and severity of HIE.

Table 5 shows the results of the multivariate analysis of the factors involved in the death of asphyxiated newborns, such as the mother's occupation, birth weight, and the severity of HIE.

Table 2: Maternal factors associated with the death of asphyxiated newborns, Ouagadougou, 2021, Burkina Faso.

Maternal factor	Neonatal death		OR [95%IC]	*p-value*
	Yes	No		
Age (years)				
<20	36	12	0,751 [0,373-1,513]	0,422
20-35	73	169	1,047 [0,614-1,784]	0,867
>35	7	16	1,027 [0,409-2,580]	0,955
Occupation				
Housewife	73	129	2,242 [1,337-3,760]	0,002
Other	26	103		
Pathology prior to pregnancy				
Yes	5	31	0,345 [0,13-0,915]	0,026
No	94	201		

Table 3: Maternal obstetric factors associated with the death of asphyxiated newborns, Ouagadougou, 2021, Burkina Faso.

Maternal obstetrical factor	Neonatal death		OR [95%IC]	*p-value*
	Yes	No		
Parity				
Primiparous	36	109	0,645 [0,397-1,046]	0,075
Pauciparous	43	79	1,487 [0,919-2,406]	0,105
Multiparous	20	41	1,179 [0,650-2,139]	0,587
Large multiparous	0	3	0,698 [0,650-0,750]	0,256
Pathology during pregnancy				
Yes	13	23	1,374 [0,665-2,836]	0,389
No	86	209		
Pregnancy follow-up				
Poor (ANCs* <4)	50	97	1,42 [0,885-2,278]	0,145
Good (ANCs ≥4)	49	135		
Mode of delivery				
Vaginal	86	197	0,851 [0,429-1,688]	0,644
Cesarean section	13	35		

*ANCs: Antenatal Care Visits

Table 4: Neonatal factors associated with the death of asphyxiated newborns, Ouagadougou, 2021, Burkina Faso.

Neonatal factor	Neonatal death		OR [95%IC]	*p-value*
	Yes	No		
Means of transfer				
Other	65	180	1,811 [1,080-3,036]	0,023
Ambulance	34	52		
Sibling rank				
Other	63	123	0,645 [0,397-1,046]	0,075
First	36	109		
Term of birth (WA*)				
Premature (<37)	28	29	2,761 [1,537-4,957]	5.10^{-4}
Normal (≥37)	71	203		
Birth weight (g)				
LBW§ (<2,500)	27	23	3,408 [1,838-6,317]	5.10^{-5}
Normal (≥2,500)	72	209		
Severity of HIE†				
Mild (Sarnat stage 1)	41	150	0,386 [0,239-0,626]	9.10^{-5}
Moderate (Sarnat stage 2)	27	57	1,151 [0,675-1,964]	0,605
Severe (Sarnat stage 3)	31	25	3,775 [2,084-6,836]	5.10^{-6}

*WA: Weeks of Amenorrhoea; §LBW: Low Birth Weight, †HIE: Hypoxic-Ischaemic Encephalopathy

Discussion

Of the 11 risk factors that were significant in the univariate analysis, only three-the woman's occupation as a housewife, low birth weight of the newborn, and severe Sarnat stage 3 HIE remained statistically significant in the multivariate analysis.

This study showed that the housewife was twice as likely to give birth to an asphyxiated newborn as compared to a woman in another occupation. Similarly, many authors have reported a high frequency of asphyxiated newborns in housewives [7-12]

Table 5: Multivariate analysis of factors associated with the death of asphyxiated newborns, Ouagadougou, 2021, Burkina Faso.

Presumed cause of death	Neonatal death		OR [95%IC]	*p-value*
	Yes	No		
Occupation				
Housewife	73	129	2,265 [1,265-4,057]	0,006
Pathology prior to pregnancy				
Yes	5	31	0,546 [0,192-1,553]	0,257
Means of transfer				
Other than the ambulance	65	180	0,638 [0,358-1,137]	0,127
Sibling rank				
1er	36	109	0,922 [0,503-1,690]	0,793
Term of birth				
Premature	28	29	0,328 [0,272-1,545]	0,648
Birth weight				
LBW	27	23	3,278 [1,338-8,033]	0,009
Severity of HIE				
Mild	41	150	0,158 [0,077-0,322]	0,000
Moderate	27	57	0,453 [0,216-0,950]	0,036
Severe	31	25	2,210 [1,053-4,637]	0,036

but none of them have identified the occupation of the housewife as a risk factor for death from PNA. In our context, a housewife is responsible for housework and caring for children and other family members and the potential impact of physically demanding and stressful jobs, such as housework can increase the risk of complications during pregnancy and childbirth, which can indirectly contribute to the risk of PNA. It is therefore crucial for pregnant women who engaged in physical work to take the necessary precautions in order to prevent accidents and complications during pregnancy and childbirth.

This study showed that the mortality risk of LBW asphyxiated newborns is three times higher than normal weight asphyxiated newborns which confirms the findings from several previous authors [13-16]. LBW newborns, due to their immature systems, including the respiratory system are more vulnerable to complications during delivery and thereby, contributing to the risk of PNA and death. However, it is to be noted that, LBW alone is not a risk factor for death; its association with several other factors contributes to death from PNA. For example, LBW is often associated with prematurity and intra-uterine growth retardation, which increase the risk of PNA and death. Of course, not all LBW newborns will develop PNA, but it is essential to remember that there is a correlation between the two factors and that LBW newborns require closer monitoring and additional care to minimise the risks associated with PNA.

In this study, severe HIE was found a risk factor for death which confirms the findings reported by most authors [9,13,14,17-22]. Despite the greater frequency, fewer fatalities were observed in stages 1 and 2 as compared with stage 3 having a higher case-fatality rate. Stage 1 is associated with an excellent prognosis, comparable to a reference population with no encephalopathy; stage 3 is associated with a very unfavourable prognosis, with 100% death or serious sequelae, while stage 2 is associated with an intermediate prognosis, with 40-60% sequelae [23]. According to Farouk [20], the lack of robust protocols for the manage-

ment of HIE and the absence of controlled hypothermia are the risk factors for death. To reduce the frequency of PNA and its complications, it is necessary to build the capacity of healthcare providers in labour room and improve monitoring and newborn resuscitation. The introduction and use of controlled hypothermia would be an asset in our working conditions.

Limitations and constraints of the study

Owing to the retrospective nature of the study, the common challenges such as missing information and low response rate may give rise to certain biases that limit the scope and reliability of this study.

Conclusion

This study showed that perinatal asphyxia is common in our neonatal unit, with high mortality linked to several maternal and neonatal risk factors. The prognosis of the disease can be improved through enhanced equipment availability and the implementation of new therapeutic methods such as controlled hypothermia. Additionally, improving the quality of immediate ante-, per-, and post-natal care by maternity unit staff is a major challenge for the survival of newborns in our resource-limited countries.

Conflicts of interest

The authors declare no conflicts of interest regarding the publication of this paper.

Authors' contributions

KN designed the study, analyzed the data, and drafted the manuscript.

BK participated in designing the study and writing the manuscript.

SP participated in data collection, data entry, data analysis, and drafting of manuscript.

LT, SD, AB, MS, CK contributed to the drafting of the manuscript.

DY critiqued and revised the manuscript.

All the authors read and approved the final version of the manuscript.

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