Scientific Research Publishing

Open Journal of Pediatrics, 2021, 11, 816-831
https://www.scirp.org/journal/ojped
ISSN Online: 2160-8776
ISSN Print: 2160-8741

Risk Factors for Birth Asphyxia in Togo: A Case-Control Study

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How to cite this paper: Agbeko, F., Kétévi, A.A., Fiawoo, M., Tata, B.B.-L., Abalo, K.E., Takassi, E.O., Douaguibe, B., Akolly, D.A.E., Batalia, H.D., Djomaleu, R.A., Kérékou, R.B., Hemou, M., Pakoudjare, M., Nzonou, M., Sewu, E.K., Talboussouma, S., Saka, B., Azoumah, D.K., Djadou, E.K., Douti, K.N., Gbadoe, A.D. and Atakouma, Y.D. (2021) Risk Factors for Birth Asphyxia in Togo: A Case-Control Study. *Open Journal of Pediatrics*, **11**, 816-831.
https://doi.org/10.4236/ojped.2021.114077

Received: September 14, 2021
Accepted: December 19, 2021
Published: December 22, 2021

Abstract

Background: Birth Asphyxia (BA) is one of the leading causes of neonatal death in developing countries. In Togo, 30.55% of neonatal deaths were related to BA and caused by several risk factors. The purpose of this piece of work is to analyse the antepartum, intrapartum, and foetal risk factors of BA. **Methods:** This is a case control study, conducted from 1st December 2019 to 28th February 2020 in obstetrics wards and at neonatal intensive care of paediatric ward at the Sylvanus Olympio university teaching hospital (CHU-SO) in Lomé, Togo. Neonates diagnosed with BA (Apgar score < 7 at 5th minute) were considered as "cases" (N = 200) while neonates born either with normal vaginal delivery or by cesarean section having no abnormality were considered as "control" (N = 200). **Results:** The prevalence rate of BA was 9.13%. Age (p = 0.0391), gravidity (p = 0.0040), type of facility for prenatal follow-up

(p < 0.0001), use of Long-lasting impregnated mosquito nets (LLIN) (p < 0.0001), notion of maternal fever (p < 0.0001) and chronic pathology (p < 0.0001) were related to occurrence of BA. Significant antepartum risk factors observed were age < 25 years (OR = 1.15; CI 95% [0.66 - 1.98], p = 0.0391), primigravidity (OR = 1.82; 95% CI [0.86 - 3.85], 0.0040), prenatal follow-up in a private one (OR = 1.62; CI95% [1.03 - 12.55], p < 0.0001), non-use of LLIN (OR = 2.50; CI 95% [1.61 - 3.88], p < 0.0001), maternal fever (OR = 3.73; CI 95% [2.33 - 5.97], p < 0.0001) and existence of maternal chronic pathology (OR = 36.0, 95% [4.94 - 262.60], p < 0.0001). Significant intrapartum risk factors were PRM (OR = 7.89; CI 95% [2.62 - 14.02], p < 0.0001), abnormal AF (OR = 5.40; CI 95% [2.57 - 11.38],], p < 0.0001), long labour (OR = 2.11; CI 95% [1.34 - 3.34],], p = 0.0004), use of oxytocin (OR = 2.14; CI 95% [1.38 - 3.32], p = 0.0003), and spontaneous vaginal (OR = 1.76; CI 95% [1.14 - 2.72,], p = 0.0008]). Significant Foetal risk factors were male gender (OR = 1.55; CI 95% [1.03 - 2.33], p = 0.0423), preterm babies (OR = 8.83; CI 95% [3.79 - 20.60], p < 0.0001) and baby birth weight < 2500 gr (OR = 2.96; CI 95% [1.82 - 4.79], p < 0.0001). The Sarnat score had shown anoxo-ischemic encephalopathy stage III (19.00%), corresponding to 87.80% of case fatality rate (p < 0.0001). **Conclusion:** Various risk factors lead to BA in Lomé. Early identification of high-risk cases with improved antenatal and perinatal care can decrease the high mortality of BA in Togo.

Keywords

Birth Asphyxia, Neonate, Risk Factor, Togo

1. Background

Birth asphyxia (BA) is defined according to recommendations for the clinical practice of Obstetrical and Neonatal Emergency Care (ONEC) in Africa, as the absence of crying and maintenance of normal respiration in the newborn in the immediate aftermath of birth [1]. Globally 2.5 million children died in the first month of life in 2018 [2] [3]. There are approximately 7000 newborn deaths every day, amounting to 47% of all childhood deaths under the age of 5-years, up from 40% in 1990 [2] [3] [4]. The decline in neonatal mortality from 1990 to 2018 has been slower than that of post-neonatal under-5 mortality [2] [3]. The Sub-Saharan Africa region had the highest neonatal mortality rate in 2018 at 28 deaths per 1000 live births [2] [3]. The causes of the majority of all neonatal deaths (75%) occur during the first week of life, and about 1 million newborns die within the first 24 hours [3]. Preterm birth, intrapartum-related complications (birth asphyxia or lack of breathing at birth), infections and birth defects cause most neonatal deaths in 2017 [2] [3] [4].

In Togo, BA account for 30.56% of neonatal death in 2018 [5]. Unless progress is accelerated, more than 60 countries will be unable to reach the United Nations Sustainable Development Goals (SDGs) of ending preventable newborn deaths by 2030 [4]. Also, half of them, including Togo, will be unable to reach the target

of 12 neonatal deaths per 1000 live births by 2050 [4]. Moreover, BA represents a social and family tragedy, causing not only death, but also serious neurological sequels such as cerebral palsy, mental retardation, and epilepsy [6]. The occurrence of asphyxia can be linked to antepartum, peripartum, and foetal risk factors [7]. In resource-limited countries, reduction of BA should be achieved by anticipating the need for resuscitation through rigorous identification of risk factors for asphyxia during childbirth [8]. Several studies have been conducted in different government facilities in Togo, but to the best of our knowledge, the analysis by risk factors has not been documented yet. These factors are accessible for preventive care. In addition, their identification also makes it possible to plan optimal management during the perinatal period and to limit morbidity and mortality caused by the complications. The objective of this piece of work is to analyse the antepartum, intrapartum and foetal risk factors for BA at the Sylvanus Olympio University Teaching Hospital (CHU-SO).

2. Methodology

The Sylvanus Olympio University Teaching Hospital is the national referral centre in Togo, located in the capital city of Lomé. The current work was a case control study, conducted in obstetrics wards and at neonatal Intensive and premature care units of paediatric ward, from 1st December 2019 to 28th February 2020. The cases were newborns delivered in the obstetrics wards after a term greater than or equal to twenty-eight (28) weeks of amenorrhea who presented asphyxia at birth. The diagnosis of asphyxia was made on the basis of one of the following criteria: Apgar ≤ 7 at the 5th minute and/or; the notion of resuscitation having lasted at least 10 minutes and/or; the presence of signs of early encephalopathy. For the controls, they were represented by newborns delivered directly after the birth of the cases and who showed no signs of asphyxia. For each case included, one control was recruited. When two BA cases are consecutive, we took as controls the two newborns following these two with an Apgar score greater than 7. All newborns with Apgar < 7 but with a clinically detectable congenital defect and neonates born at home/others facilities were excluded. The recruitment method was exhaustive in our study. In total, during our study period, our sample consisted of 200 newborns with Apgar < 7 and another 200 newborns without Apgar < 7 who were controls. A pre-tested survey form was used for data collection. Data on the condition of the newborn are collected from the birth examination. The demographic factors of both the mother and neonate were noted and questions regarding possible risk factors were asked from the mother. Some parameters were obtained from obstetrical and ANC records. The parameters studied were frequency, sociodemographic characteristics (maternal age, education level, marital status), antepartum factors (gestational term, gravidity, parity, ANC follow-up, use of long-lasting insecticidal nets, presence of fever in the third trimester of pregnancy, presence of chronic pathology in the mother), intrapartum parameters (reason for admission, presen-

tation of the foetus, appearance of the amniotic fluid, duration of labour), foetal factors (sex of the newborn, birth weight, term) and prognosis (Sarnat score, duration of resuscitation, outcomes of BA). Sarnat's classification [9] into minor (I), moderate (II) and severe (III) neonatal encephalopathy are the most widely used. The collection was carried out on a daily basis by the principal investigator, who was on duty from Monday to Friday between 8 am and 5 pm, assisted by the three medical students on nights and weekends. The investigators were all briefed on perinatal asphyxia and how to complete the survey form. All data were entered into software Epidata 3.1 and analysed through R Studio version 3.4.2. The statistical analysis included a comparative analysis and a conditional regression. The matched Student's test and the Mac Nemar test were the statistical tests used. A univariate and multivariate conditional logistic regression was performed to look for factors associated with BA. The dependent variable was the BA coded 1 for cases and 0 for controls. The association between each explanatory variable and the dependent variable was estimated using the Odds Ratio (OR) and its 95% confidence interval. Multivariate analysis estimated the adjusted Odds Ratio (ORa) and its 95% confidence interval for each selected variable. The ethical issues have been validated by the management of the CHU SO and permission to conduct the study was granted.

3. Results

The prevalence rate of BA was 9.13% (200/2191) during the period of the study at CHU SO.

3.1. Antepartum Risk Factors

The mean age of mothers was 26.95 ± 6.10 years for cases and 27.78 ± 5.71 years for controls, with no significant difference ($p = 0.1585$). Age ($p = 0.0391$), gravidity ($p = 0.0040$), parity ($p = 0.0428$), type of facility for prenatal follow-up ($p < 0.0001$), use of LLINs ($p < 0.0001$), notion of fever in the 3rd trimester of pregnancy ($p < 0.0001$) and presence of maternal chronic pathology ($p < 0.0001$) were related to occurrence of antepartum BA. Age less than 25 years was a risk factor for the occurrence of BA (OR = 1.15; 95% CI [0.66 - 1.98]) (**Table 1**). Others antepartum risk factors observed were: Primigravidity (OR = 1.82; 95% CI [0.86 - 3.85]), primiparity (OR = 1.48; 95% CI [1.02 - 2.18]), prenatal follow-up in a government primary facility (OR = 4.62; 95% CI [2.26 - 9.36]) or in a private one (OR = 1.62; 95% CI [1.03 - 12.55]), non-use of LLINs (OR = 2.50; 95% CI [1.61 - 3.88]), presence of fever in the 3rd trimester of pregnancy (OR = 3.73; CI 95% [2.33 - 5.97] and existence of maternal chronic pathology (OR = 36.0, 95% [4.94 - 262.60]) (**Table 1**).

3.2. Intrapartum Risk Factors

Risk factors associated with the occurrence of intrapartum BA were prolonged rupture of membranes ≥ 12 hours (OR = 7.89; CI 95% [2.62 - 14.02]), abnormal

Table 1. Antepartum risk factors for BA in CHU SO.

	Case (N = 200)		Control (N = 200)		OR	CI 95%	p-value
	n	%	n	%			
Age							0.0391
<25	75	37.50	57	28.50	1.15	[0.66 - 1.98]	
[25 - 30[	64	32.00	55	27.50	1.00		
≥30	61	30.50	88	44.00	0.59	[0.35 - 0.99]	
Gravidity							0.0040
Multigravidity	84	42.00	50	25.00	1.00		
Paucigravidity	96	48.00	130	65.00	0.70	[0.36 - 0,89]	
Primigravidity	20	10.00	20	10.00	1.82	[0.86 - 3.85]	
Parity							0.0428
<2	90	45.00	70	35.00	1.48	[1.02 - 2.18]	
≥2	110	55.00	130	65.00	1.00		
Number of ANC							0.9999
<4	197	98.50	197	98.50			
≥4	3	1.50	3	1.50			
Type of facility for ANC							<0.0001
Private	52	26.00	23	11.50	1.62	[1.03 - 2.55]	
Public tertiary/secondary	52	26.00	83	41.50	1.00		
Public primary	96	48.00	94	47.00	4.62	[2.26 - 9.36]	
IPT							0.8597
No	17	8.50	15	7.50			
Yes	183	91.50	185	92.50			
LLIN							
No	124	62.00	82	41.00	2.50	[1.61 - 3.88]	<0.0001
Yes	76	38.00	118	59.000	1.00		
Fever in 3rd trimester							<0.0001
No	96	48.00	154	7.00	1.00		
Yes	104	52.00	46	23.00	3.73	[2.33 - 5.97]	
Maternal chronic pathology							<0.0001
No	163	81.50	199	99.50	1.00		
Yes	37	18.50	1	0.50	36.0	[4.94 - 262.60]	

ANC: antenatal care; LLIN: Long-lasting impregnated mosquito nets; IPT: intermittent preventive treatment.

amniotic fluid (OR = 5.40; CI 95% [2.57 - 11.38]), labour duration ≥ 12 hours (OR = 2.11; CI 95% [1.34 - 3.34]), use of oxytocin (OR = 2.14; CI 95% [1.38 - 3.32]), spontaneous vaginal mode (OR = 1.76; CI 95% [1.14 - 2.72]) and operative vaginal mode (OR = 8.36; CI 95% [1.97 - 15.36]) (Table 2).

3.3. Foetal Risk Factors

Significant Foetal risk factors were male gender (OR = 1.55; CI 95% [1.03 - 2.33]), preterm babies (OR = 8.83; CI 95% [3.79 - 20.60]), post term neonates (OR = 1.38; CI 95% [0.58 - 3.26]), baby birth weight < 2500 gr (OR = 2.96; CI 95% [1.82 - 4.79]) or ≥3999 gr (OR = 3.00; CI 95% [0.31 - 28.84]) (Table 3).

Table 2. Intrapartum risk factors for BA in CHU SO.

	Case (N = 200)		Control (N = 200)		p-value	OR	CI 95%
	n	%	n	%			
Referred mother					0.1002		
Yes	135	67.50	119	59.50			
No	65	32.50	81	40.50			
Type of presentation					0.2148		
Cephalic	151	75.50	162	81.00			
Breech	49	24.50	38	19.00			
PRM (hour)					<0.0001		
<12	9	4.50	176	88.00		1.00	
≥12	191	95.50	24	12.00		7.89	[2.62 - 14.02]
Amniotic fluid					<0.0001		
Normal	97	48.50	140	70.00		1.00	
Abnormal	103	51.50	60	30.00		5.40	[2.57 - 11.38]
Labour duration (hour)					0.0004		
<12	121	60.50	155	77.50		1.00	
≥12	79	39.50	45	22.50		2.11	[1.34 - 3.34]
Use of Oxytocin					0.0003		
No	50	25.00	86	43.00		1.00	
Yes	150	75.00	114	57.00		2.14	[1.38 - 3.32]
Delivery mode					0.0008		
Spontaneous vaginal	130	65.00	110	55.00		1.76	[1.14 - 2.72]
Caesarean	58	29.00	89	44.50		1.00	
Operative vaginal	12	6.00	1	0.50		8.36	[1.97 - 15.36]

PRM: Prolonged rupture of membranes IPT: intermittent preventive treatment.

Table 3. Foetal risk factors for BA in CHU SO.

	Case (N = 200)		Control (N = 200)		p-value	OR	CI 95%
	N	%	n	%			
Gender					0.0423		
Male	110	55.00	89	44.50		1.55	[1.03 - 2.33]
Female	90	45.00	111	55.50		1.00	
Gestational term					<0.0001		
Preterm	56	28.00	10	5.00		8.83	[3.79 - 20.60]
Normal	131	65.50	178	89.00		1.00	
Post term	13	6.50	12	6.00		1.38	[0.58 - 3.26]
Birth weight (gr)					<0.0001		
<2500	71	35.50	28	14.00		2.96	[1.82 - 4.79]
[2500 - 3999[	125	62.50	170	85.00		1.00	
≥3999	4	2.00	2	1.00		3.00	[0.31 - 28.84]

3.4. Multivariate Analysis

In multivariate analysis, only the presence of fever in the third trimester ($p < 0.0001$; OR = 3.38; 95% CI [1.93 - 5.89]), abnormal amniotic fluid ($p < 0.0001$; OR = 2.33; 95% CI [2.13 - 5.32]), long labour ($p = 0.0232$; OR = 2.06; 95% CI [1.13 - 3.77]), prematurity ($p < 0.0001$; OR = 6.83, 95% CI [3.82 - 8.23]) and post gestational term ($p < 0.0001$; OR = 1.50; 95%; CI [0.86 - 1.99]) were statistically associated with BA (Table 4).

3.5. Aetiologies and Outcomes of BA

PRM (n = 66; 33.00%), maternal infection (n = 81; 40.50%), cervical dystocia (n = 61; 30.50%) and prolonged labour (n = 61; 30.50%), twin pregnancy (n = 47; 23.5%) were the main aetiologies of BA at CHU SO.

Newborns with an Apgar score between 4 and 7 were the most represented 95.50% at the 5th minute. At 10th minute, N = 4, 2.00% 1 - 3; 4 - 7, N = 47, 23.50%: 8 - 10 N = 149, 74.50%. The evolution has been marked by HIE with Sarnat I (42.50%), Sarnat II (38.50%) and Sarnat III (19.00%). BA cases had a significant hospitalization duration (3.17 ± 2.70 days vs 1.86 ± 0.78 days, $p < 0.0001$). One-fifth (20.50%) of BA cases had died. A Sarnat III score was correlated with a high case fatality rate (87.80% vs. 1.26%, $p < 0.0001$) (Table 5)

4. Discussion

The incidence of BA is high at CHU SO in Lomé (9.13%), varying from 4 to 20% in developing countries: Benin in 2017 (4.50%) [10], Niger (4.85%) in 2019 [11], Chad in 2018 (5.1%) [12], Cameroon in 2013 (8.00%) [13], Nigeria in 2011

Table 4. Multivariate analysis of risk factors for BA.

	OR	CI 95%	p-value	ORa	CI 95%	p-value
Age			0.2523			
<25	1.36	[0.86 - 1.87]				
[25 - 30[	1.00					
≥30	0.36	[0.25 - 0.68]				
Gravidity			0.4523			
Multigravidity	1.00					
Paucigravidity	1.06	[0.39 - 2.87]	0.9203			
Primigravidity	3.40	[0.96 - 12.01]	0.0572			
Parity			0.6656			
≥2	1.00					
<2	1.17	[0.58 - 2.34]				
Fever in 3rd trimester			0.0001			<0.0001
No	1.00			1.00		
Yes	3.22	[1.78 - 5.83]		3.38	[1.93 - 5.89]	
Amniotic fluid			<0.0001			<0.0001
Normal	1.00			1.00		
Abnormal	3.36	[2.22 - 6.36]		2.33	[2.13 - 5.32]	<0.0001
labor duration (hour)			0.0232			0.0181
<12	1.00			1.00		
≥12	2.10	[1.10 - 3.97]		2.06	[1.13 - 3.77]	
Gender			0.0813			
Male	1.00					
Female	0.61	[0.36 - 1.06]				
Gestational term			<0.0001			<0.0001
Premature	7.03	[4.82 - 17.63]		6.83	[3.82 - 8.23]	
Normal	1.00			1.00		
Post term	1.24	[0.70 - 2.86]		1.50	[0.86 - 1.99]	

Table 5. Sarnat stage for BA cases in CHU SO.

	Alive (N = 159)		Dead (N = 41)		p-value
	n	%	n	%	
Sarnat I	85	53.46	0	0.00	
Sarnat II	72	45.28	5	12.20	<0.0001
Sarnat III	2	1.26	36	87.80	

(12.60%) [14], Madagascar in 2019 (18%) [15], Burkina Faso in 2015 (19.80%) [16]. The disparities between these different rates can be explained by the size of the study sample, the differences in the study frameworks, and above all by the criteria used to define the BA. On the other hand, in developed and emerging countries, in which living conditions are better, the incidence is significantly lower (France 0.27% in 2016 [17], South Africa 0.50% in 2013 [18]). However, in developing countries, the criteria for defining asphyxia are based on a combination of clinical indicators such as the absence of screaming, the concept of resuscitation and the Apgar score [8]. These criteria are more effective in our countries where the scarcity of qualitative human resources often explains the difficulties in identifying cases based on a more scientific approach. This could also contribute to the overestimation of the number of cases of perinatal asphyxia.

Regarding the antepartum factors, previous studies have also reported that young maternal age (18 - 25 years) and primigravidity are main risk factors for developing BA: biological immaturity, inadequate prenatal care, low weight before pregnancy, cephalo-pelvic disproportion and prolonged labour, first experience of childbirth, ignorance of early dangerous symptoms, [12] [19] [20] [21] [22]. In contrast, Rehana *et al.* in India [23] found that the risk of BA increased with maternal age > 35 years. The follow-up of antenatal consultations outside government secondary/tertiary facilities, the non-use of LLINs, the presence of fever in the 3rd trimester of pregnancy, the presence of a chronic maternal pathology were the other antepartum factors corroborated by several authors [7] [13]. Lack of pregnancy follow-up [9] [10] [16] [24] [25], eclampsia and pre-eclampsia, maternal anaemia and haemorrhage, and multiparty were also reported as other factors [7] [12]. Good pregnancy monitoring do not affect the number of ANCs but their quality and regularity [2] [3] [4]: it ensures prevention, early detection and treatment of obstetric complications and preparation for delivery [2] [3] [4].

The main intrapartum risk factors significantly associated with the occurrence of BA in our study were: abnormal AF, PRM ≥ 12 hours, long labour ≥ 12 hours, the use of oxytocin, vaginal delivery and instrumental delivery (suction cup, forceps) [8] [10]. Unregular antenatal care and referral, situations delay adequate management and allow the occurrence of complication during delivery which are represented mainly by foetal asphyxia [26]. This result underscores the importance of having qualified personnel and adequate equipment in peripheral health facilities to deal with emergency obstetric and neonatal care. Abnormalities (meconium, staining, fetid) in amniotic fluid (51.50%), a diagnostic criterion for BA, were observed by Ouédraogo in 71.80% of cases in Burkina Faso in 2015 [16]. Hypoxia leads to an increase in intestinal peristalsis and relaxation of the anal sphincter by sympathetic stimulation with emission of meconium [17] [27]. Similarly, a 12-hour PRM ≥ was a risk factor for hypoxia in Benin. PRM could lead to exposure to infections that could cause BA.

Caesarean section appeared to be a protective factor against BA [11]. In most

cases, indications for emergency Caesarean section were in themselves BA-causing pathologies [28] [29]. However, studies conducted in Togo [28] and Cameroon [29] on the impact of Caesarean section on perinatal prognosis showed an increased risk of BA and death. The explanation given was that Caesarean section requires increased doses of anaesthetics and morphine, which cause foetal distress secondary to anaesthesia [7] [24] [28].

Male sex, prematurity, weight less than 2500 grams and weight greater than 3999 grams were the factors significantly associated with the occurrence of BA at the CHU SO, as confirmed by african authors especially [10] [11] [13] [15] [24] [25]. Sexual hormones, particularly oestrogens, are thought to protect female newborns more effectively against anoxo-ischaemic lesions [30]. Low birth weight newborns have poor tolerance for labour and vaginal delivery and therefore require frequent resuscitation at birth [31]. Then, premature newborns often face multiple morbidities including immaturity of an organ or system, especially pulmonary immaturity leading to respiratory failure [19]. Finally, excessive weight leads to shoulder dystocia during labour, which is responsible for BA [1].

The prognosis is essentially based on neuroradiological evaluation and monitoring [27] which is characterised by anoxo-ischemic encephalopathy (Sarnat classification). In our study, anoxo-ischemic encephalopathy was present in all cases (42.50% were at stage I; 38.50% at stage II and 19.00% at stage III of the Sarnat classification). Okoko *et al.* had also had 100% of newborns with anoxic-ischemic encephalopathy in 2016 in Congo Brazzaville [32]. Weaker results were found by Thiam *et al.* in 2017 in Senegal [25], *i.e.* 80.40%, of which 95 (77.20%) were at stage I, 27 (22.00%) at stage II and 01 (0.80%) at stage III of the Sarnat classification. In 2019, Kamaye *et al.* in Niger [11] found that 80.00% of asphyxiated neonates had stage 1 Sarnat and that transfontanel ultrasound was pathological in 4.00% of them. The radiological elements of prognosis are essentially amplitude electroencephalogram and magnetic resonance imaging, which are not commonly performed in a context of limited resources [17] [27]. Post-natal neurological evaluation is fundamental because the importance and duration of neurological signs are the best long-term prognostic criteria. The high case fatality rate (20.50% in our study) was also reported in the African data, with a percentage varying from 21% to 34.00% [13] [16] [21] [26]. The higher the Sarnat score is, the greater the lethality is. This BA-related mortality is attributable, among other things, to the lack of qualified providers for adequate care and to the absence of effective means of care such as respiratory assistance, parenteral nutrition and therapeutic hypothermia, whose beneficial effects are well known [33]. Lack of ANC, late referral during labour, aversion to caesarean deliveries inevitably increases the risk of BA and stresses the fact that a properly trained person in neonatal resuscitation preferably a paediatrician should be present at every delivery especially the high risk ones. Presence of working resuscitation equipment e.g. suction, proper size ambu bags, endotracheal tubes, neonatal laryngoscopes and oxygen supply should be made mandatory. Implementation of a Neonatal Resuscitation Program in developing countries has

been particularly challenging [12]. In this study, resuscitation using warm, drying, clearing the airway, and stimulating and oxygen was performed.

5. Limitations

The results observed in the Gynaecology-Obstetrics and Paediatrics departments of the CHU-SO of Lomé cannot be extrapolated to the entire population of Togo, because this hospital is not the only one that receives parturient. It is a referral centre, therefore receiving obstetric complications. It would be interesting to study the risk factors for BA in health facilities in the rural areas of Togo, particularly in primary and intermediate level centres. In addition, it is important to acknowledge the limitations of the Apgar score. The Apgar score is an expression of the physiological situation of the newborn for a limited time and includes subjective components. The impossibility of assigning biological markers of foetal metabolic acidosis (scalp and cord Ph, base deficiency, lactate) is objective measures necessary for the diagnosis of BA. The evaluation of Sarnat updated with the electroencephalogram could bring more in-depth measures. Finally, the long-term outcome of newborns with BA (notably anoxischemic encephalopathy) has not been determined in our work, which a subsequent cohort study could extend.

6. Conclusion

The BA contributes significantly to the 7000 newborns that die each day worldwide. This study identified antepartum risk factors (age < 25 years, primigravidity, ANC follow-up in private facilities, presence of maternal fever, presence of chronic pathology), intrapartum factors (abnormal AF, PRM, long labour, use of oxytocin, vaginal delivery) and foetal factors (male, prematurity, low weight). Improving the geographical and financial accessibility of antenatal care, rigorous monitoring of labour during delivery, and strengthening the training of private sector maternity care workers and neonatal resuscitation technicians seem to be crucial for reducing morbidity and mortality.

Declarations

Ethics Approval and Consent to Participate

This study was approved by the head of the gynaecology-obstetric department of the Sylvanus Olympio University Hospital (Ref N˚126/2019/GYN/CHUSO). We obtained consent from patients that participated in the study. For each respondent, the objectives and benefits of participating in the survey and its conduct were clearly stated, as well as their right to interrupt the interview without justification. An informed consent form signed after the verbal explanation was made by the investigating officer in the language understood by the participant.

Authors' Contributions

FYA and MF contributed to the development of the protocol, edited the manu-

script, AAK and BD develop the survey protocol and coordinated the field activities. BBT, ST and KEA collected, analyzed the data and wrote the manuscript. DAEA, HDB, RAD and RBK supervised the field activities (acquisition and collation of data). EKS, MH and MP and MN analyzed the data, DKA, EKD and KND provided technical validation of the protocol and BS contributed to the development of the manuscript. BS, ADG, EOT and YDA provided technical input and edited the manuscript. All authors approved the final version of the manuscript.

Acknowledgements

The authors acknowledge particularly all the medical students of University of Lomé who have contributed to data collection, Doctor Banguilane Douaguibe Doctor Ameyo Ayoko Ketevi, Mr. Koffitse Essèboe Sewu., Doctor Kokouvi Evenyo Abalo.

Conflicts of Interest

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

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Abbreviations

AF	Amniotic fluid
BA	Birth Asphyxia
ANC	Antenatal care
CHU SO	Centre hospitalier universitaire Sylvanus Olympio (Sylvanys Olympio University Teaching Hospital)
HIE	Hypoxo-ischemic encephalopathy
LLIN	Long-lasting impregnated mosquito nets
PRM	Prolonged rupture of membranes
SDG	Sustainable Development Goals (SDGs)
IPT	intermittent preventive treatment
WHO	World Health Organization

Annexe: Fiche D'Enquete

EPIDEMIOLOGIE

MERE

ETAT CIVIL

Age: ……ans

Niveau d'étude: analphabète □ primaire □ secondaire 1 □ secondaire 2 □ Etude supérieure □

Profession: couturière □ coiffeuse □ revendeuses □ ménagère □ fonctionnaire □

autres: préciser ……

Statut Matrimonial: célibataire □ mariée □ veuve □ divorcée □ concubinage □

SUIVI CPN

Antécédents d'avortement: Oui □ Non □

Antécédents de mort née: Oui □ Non □

Gestité: Parité:

CPN: Oui □ nombre:….. (<4 □ ≥4 □) Non □

Lieu de CPN: CHU □ CHR □ CMS □ Privée □ Maison d'accouchement □ Autres: ……

TPI: Oui □ non □ Usage du MILDA: Oui □ Non □

Supplémentation FAF: Oui □ Non □

Notion de fièvre durant la grossesse: Oui □ Non □

Pathologies maternelles: Oui □ Non □

Si oui: Diabète □ HTA □ Hémoglobinopathie □ asthme □ épilepsie □

Autres: à préciser ……. □

Suivi de la pathologie maternelle: Oui □ Non □

ACCOUCHEMENT

Référée (mère): □ Evacuée: □ Admise: □

Lieu d'accouchement: CHU □ CHR: □ CMS: □ Privée: □ Accouchement à domicile □

Autres:……..

Accoucheur: Médecin □ Sage-femme: □ Accoucheuse état: □ accoucheuse □

Assistant: infirmier:

Terme de grossesse: ……SA…… Jour(s)

Présentation: céphalique □ siège □ (complétée □ décomplétée □) face □

front □ Epaule □

Score de Manning: Favorable □ défavorable □

Fièvre au cours de l'accouchement: Oui □ Non □

Mode d'accouchement: voie basse □ césarienne □ Épisiotomie (voie basse) □ forceps □ ventouse □

LA: Clair □ Méconial □ teinté □ purée de pois □ hématique □ autres: □

Durée de travail: ……heures (<12h □ ≥12 □)

RPM □: oui □: ……heures (<12h □ ≥12 □) non □

Médicaments utilisés: Ocytocique □ Antispasmodiques □ Diazépam □

Autre:……

Anomalie pendant l'accouchement: Oui □ Préciser: …… Non □

Type d'anesthésie (césarienne): général □ Rachis □

Etiologies de l'asphyxie: (pour les cas)

MATERNELLES

BGR: □ Eclampsie/preeclampsie: □ Gémellité: □ infection maternelle: □ Diabète: □
Anémie: □ Travail prolongé: □ hémorragies antépartum □ dystocie cervicale □
Autres:……..

FŒTALES

Présentation: (siège: □ face □ front □ épaule □); Poids: □

ANNEXIELLES

Placenta prævia: □ HRP: □ Anomalies du cordon: □ RPM: □ Hypertonie utérine: □ Hypotonie □

IATROGENES

Utilisation d'Ocytocine: □ utilisation de diazépam □

NOUVEAU NE

Sexe: M □ F □ Poids: ……, ……gs (en gramme)
Taille: …….
PC: ……. Notion de malformation □: A préciser……
Prématuré □ A terme □ Post terme □
APGAR: 1ère minute: 5ème minute: 10ème minute:
Cri immédiat: oui □ non □
Réanimation: oui □ Durée: ……. Non □
Si Oui: Aspiration □ Oxygène □ Ventilation □
Intubation □ Médications □ Préciser…….
Statut clinique du NNé: Hypotrophie □ RCUI □ Normal □
Complications: Détresse respiratoire □ apnée □ convulsions □ choc □
Succion faible □ Abolition des réflexes archaïques □,
diminution des réflexes archaïques □, hypotonie □ hypertonie □,
léthargie □ irritabilité □ coma incapable de téter □
Encéphalopathie anoxoischemique □ si oui, préciser: sarnat 1 □ sarnat 2 □
sarnat 3 □
Autres: à préciser ……□
Durée de séjour: ……jours (convertir les heures en jours)
Pronostic hospitalier: vivant □ DCD □ Séquelles □…à préciser: ……