International Journal of Latest Research in Science and Technology **ISSN (Online):2278-5299**
Volume 5, Issue 3: Page No 43-49, May-June 2016
https://www.mnkpublication.com/journal/ijlrst/index.php

FACTORS ASSOCIATED WITH EARLY NEONATAL MORBIDITY AND MORTALITY IN AN URBAN DISTRICT HOSPITAL IN DOUALA, CAMEROON.

[1]Dr Essomba Noel Emmanuel, [2]Dr Kedy Koum Danielle Christiane, [3]Dr Moby Hervé, [4]Dr Halle Marie Patrice, [5]Dr Ngaba Guy Pascal, [6]Dr Nguedjam Mbianda Manuela, [7]Pr Coppieters Yves

[1]Assistant Professor, University of Douala-Cameroon; noelesso@yahoo.fr;
[2]Senior Lecturer, University of Douala- Cameroun; dckedykoum@yahoo.fr
[3]Senior Lecturer, University of Douala- Cameroun; demobs@yahoo.com
[4]Senior lecturer, University of Douala- Cameroon, patricehalle@yahoo.fr
[5]Senior lecturer, University of Douala- Cameroon; pascalnagaba1974@gmail.com;
[6]Assistant, University of Douala - Cameroon; manuelanguedjam@yahoo.fr
[7]Professor, Ecole de Santé Publique de Bruxelles- Belgium; yves.coppieters@ulb.ac.be;

Corresponding author :
Dr Essomba Noel Emmanuel, University of Douala Cameroun, Department of Public health, PO Box 106 Douala Cameroon ; noelesso@yahoo.fr, tel : 00237 677551808.

Abstract – Background:
Mortality in newborns remains high in black Africa, despite the Millennium Development Goals. The aim of this study was to determine the factors associated to early neonatal mortality in Douala- Cameroon.
Methods:
A cross sectional and analytical survey, has been conducted from May 2013 to January 2014. A pretest questionnaire was to collect the different variable of the survey. The tests of chi square and Fisher have been used for the associations of variables. The multivariate regression has permitted to analyze the associated factors.
Results:
Of 269 new borns admitted, 75.4% were born at the maternity of Bonassama, 51.5% was baby boys, 66.1% had an gestational age ≥ 37SA. The most frequent exit diagnoses were the neonatal infection 79.1%, the jaunisse 41.6%, the prematurity 33.4%. The early neonatal mortality rate has been estimated to 12.6%. The main causes of early neonatal mortality were the prematurity 41.1%, the neonatal infection 32.3%, the birth asphyxia 26.4%. The factors associated with early neonatal mortality were among others, the prematurity (OR = 21,3; 95% IC(1.49 - 304.24), P <0.0001), the birth asphyxia (OR=17.87; 95% IC(2.02 - 158.18), P <0.0001), respiration distress (OR=130.37 ; 95% IC(9.28 - 1832.51), P <0.0001).
Conclusion:
The early neonatal mortality is strongly associated to prematurity. The prevention of risk factors should reduce the neonatal mortality. The hold in charge of the newborn must be organized since the community until the different levels of the sanitary pyramid to give a better luck of survival to newborn.

Key words: neonatal mortality; neonatal morbidity; factors.

1) BACKGROUND

According to the World Health Organization (WHO), four million newborn children die each year during the first four weeks of their lives [1]. Of these, 75% die prematurely during the first week of life [2]. In addition to being a serious public health problem, neonatal mortality is a real threat to global development because, among children under 5 years old, it represents approximately forty per cent of deaths. This mortality rate has grown in Cameroon over time. In 2004 it was estimated at 29% [3, 4]. In 2011, the Demographic and Health Survey (DHS) reported the rate of infant mortality to be 62%, 31% in the neonatal period and 31% in the post-natal period [5].

A decrease in neonatal mortality is imperative for the achievement of the Millennium Development Goals (MDG), in which the fourth goal aims at reducing by two-thirds the mortality rate of children under the age of 5 years between 1990 and 2015 [6]. If we want to significantly reduce overall neonatal mortality, it is important to determine the factors associated with early neonatal mortality which represent the primary causes of this mortality in our community. This can be achieved via interventions at various levels of the health system [7].

Publication History
Manuscript Received : 3 May 2016
Manuscript Accepted : 5 June 2016
Revision Received : 15 June 2016
Manuscript Published : 30 June 2016

Factors associated with neonatal mortality are diverse even within the same population. They depend on socio-demographic conditions and the organization of the health system in a population [8]. Debelew et al. recommend well-coordinated interventions in all the stages following pregnancies, even at the community level, as a solution for the reduction of mortality [9].

Little published work addresses the problem of early neonatal mortality risk factors in the context of a district hospital in Cameroon, receiving more than 70% of patients [10]. To achieve the MDG4, Cameroon began a strategy of obstetric and neonatal emergency care. To contribute to and support the implementation of this policy, it seems appropriate to highlight the factors associated with early neonatal morbidity-mortality in our context.

METHODS

Type of study

We carried out a cross sectional analytic study with a study duration of 4 months, from the 1st of January 2014 to the 30th of April 2014. It was both retrospective and prospective with data collected from the medical records of patients hospitalized between May 2013 and April 2014. Retrospective data was collected from May 2013 to the 31st of December 2013 and prospective data from January 2014 to April 2014.

Site of the study

The Bonassama district hospital (BDH) is located in the Bonassama health district in the city of Douala, which is the economic capital of Cameroon. This district has a surface area of about 55km^2 and a population of about 302,068. In 2011, there were 1,710 deliveries in this hospital, approximately 26% of the 6,684 deliveries in the district as a whole. It is the only health facility in the district that has a neonatology unit which was opened in November 2009. The unit has 3 rooms (an intensive care room with 8 beds, a Kangaroo room with 2 beds, and a hospitalization ward with 5 beds). The neonatology unit hospitalizes about 300 newborns annually, with an occupation rate of 108%.

To facilitate the management of newborns, the hospital has a medical laboratory for investigations such as full blood counts, CRP, blood culture, urine culture, total and conjugated billirubin, blood glucose levels, calcium and other electrolytes. There is a standard x-ray unit, but ultrasounds, CT scans and Magnetic Resonance Imaging (MRI) are not available in the hospital.

Infrastructure and management of the Neonatology unit

The unit manages both preterm and term newborns. It consists of 2 incubators, 2 phototherapy machines and an aspirator. The material for manual ventilation, oxygen administration, umbilical catheterization, nasogastric feeding and intravenous fluids administration is available.

However, mechanical ventilation, positive expiratory pressure systems, and parenteral nutrition are unavailable. The Kangaroo method was introduced in 2012 for the management of low birth weight newborns who meet the criteria for this method. The unit is headed by a paediatrician neonatologist, 2 general medical practitioners and a team of nurses with an average ratio of one nurse to 7 newborns.

Study population and sampling

The study population was composed of newborns aged 0-6 days hospitalized in the neonatology unit of the district hospital in Bonassama, irrespective of where they were born. Medical records of all newborns aged 0-6 days with a complete medical history were included in the study. After obtaining informed consent from parents we also included in the study all newborns aged 0-6 days admitted to the neonatal unit at the time of the study. We included both those born in the maternity unit at the Bonassama district hospital (BDH) and those coming from elsewhere, accompanied by the mother's pregnancy booklet. Hence the study was both retrospective and prospective. Consecutive sampling has been chosen to conduct this study. As such, all folders and newborns fulfilling the predefined criteria were systematically included. The minimum sample size (47 patients) was calculated taking into consideration the prevalence of neonatal mortality in Cameroon [5].

2) Data collection

- Retrospective phase

Data from patient files were collected on an individual form designed on the basis of the data provided by the literature on this subject. Records were available thanks to the ongoing archiving policy in the BDH.

- Prospective phase

For this phase, data was collected following an interview with the mother or accompanying relative/guardian, monitoring of the consultation, the maternal folder and then the physical examination of the newborn. During this collection, two types of variables were taken into account. These were dependent variables which corresponded to the morbid state of the patient or to the death of the patient. The independent variables are listed in table 1.

Table 1: **Independent variables of the study**

Variables	Definition and terms	Measurement
General data of the newborn.	Age, sex, place of transfer, reason for transfer.	Patient's hospital file and hospital registers.
Socio-demographic data of the mother.	Age of the mother, marital status, profession, school level, place of residence, religion.	Patient's hospital file and hospital registers.
Maternal history.	Number of antenatal consultations (NAC); serological assessment: TPHA/VDRL, HIV, hepatitis B, toxoplasmosis, rubella, Cytomegalovirus, albuminuria, glycosuria, obstetric ultrasound, tetanus prophylaxis, anemia prophylaxis, malaria prophylaxis, diabetes, HBP, late toxicosis, peripartum fever, premature rupture of membranes > 12 hours, documented urinary tract infection, documented genital tract infection.	Mother's medical records.
Data relative to the delivery and adaptation of the newborn.	Gestational Age, place, multiple pregnancies, mode of delivery, aspect of the amniotic fluid, newborn first cry, Apgar score, resuscitation, birth weight.	Maternal medical records.
Data from the physical examination and diagnosis of the newborn.	Temperature on admission, blood glucose level, respiratory distress, convulsion, asphyxia, neonatal jaundice, congenital malformations, neonatal tetanus.	Direct observation for prospective cases and Medical records for retrospective cases.
Data relative to the treatment and clinical evolution.	Antibiotic treatment and duration, outcome on discharge, age at death, time of death, cause of death.	Direct observation in prospective File in retrospective.

Diagnostic criteria

Newborns were diagnosed as being premature using the mother's last menstrual period and/or the Ballard score. The Ballard score was the most frequently used method. Very few mothers had received a first trimester ultrasound scan.

The diagnosis of neonatal infection was made after questioning for maternal risk factors, examining the newborn for symptoms and signs of infection (refusal to feed, vomiting, digestive intolerance, cold extremities, petechiae, prolonged capillary refill time, fever, hypothermia, lethargy, convulsions) and laboratory investigations, in particular the C Reactive Protein (CRP). A CRP greater than 24mg/l was considered positive. Other bacteriology examinations such as heamoculture, urine culture and cerebrospinal fluid analysis were carried out only on the few patients that could afford them.

Respiratory distress was diagnosed based on signs such as polypnea, apnea, with or without central cyanosis. Respiratory distress was noted independently as it could also be a sign of a probable infection.

Neonatal jaundice was diagnosed clinically and confirmed by measuring serum levels of both total and conjugated billirubin.

Neonatal asphyxia was diagnosed solely on physical examination (no cry and spontaneous respiration at birth, apgar score less than 3 at 5 minutes and signs of encephalopathy during the first 48 hours of life.

Statistical analysis

Data were recorded and processed using Epi Info 7 and Excel 2007 software packages. The data was then analyzed using the XL Stat 7.5.2 software. The quantitative variables were presented on average ± standard deviation, the qualitative variables in numbers and percentages were reported in brackets. In bivariate analysis, the comparison between qualitative variables was performed using the Chi 2 test and the Fisher exact test was used in the case of dichotomous variables. Differences were considered significant for $p<0.05$. In multivariate analysis, logistic regression was carried out to establish the relationship between the dependent variable and the outcome variables. The variables selected for the logistic regression model were those with a tendency for significance. Thus, all variables related to death with $p<0.2$ have been retained [11]. The Odds Ratio and its 95% interval of confidence were determined to quantify the association between death and the various explanatory variables of the model.

Ethical issues

The study was submitted to and received the approval of the National Ethics Committee. The authorization of the Director of Bonassama hospital was also obtained for the recruitment of patients in this facility. The consent of the parents was obtained after explaining the purpose of the study. The information obtained was kept confidential.

RESULTS

General characteristics: newborns and mothers

The study recruited newborns hospitalized in the neonatology unit of the BDH from the 1st of May 2013 to the 30th of April 2014, with a total sample size of 269 newborns. The male gender was predominant among newborns admitted, 139 (51.5%) of cases. Over three quarter of the newborns, 203 (75.4%), were admitted from the maternity ward of the BDH. More than half of the infants, 173 (64.3%), were admitted within 24 hours following birth. The majority of the mothers of the infants, 214 (79.5%), were aged between 21 and 34 years and 53.3% were married. 219 (81.4%) resided in the district. More than half, (67.3%), had a secondary level of education. Only 191 (71.0%) had attended at least 4 antenatal consultations (ANC) and 75 (27.8%) had their first pregnancy. Caesarean section was carried out in 55 (20.4%) cases. The average weight at admission was 2734.18 ± 811.36g. Sixty two percent of the children were of a weight greater than or equal to 2500g. More than half, 178(66.1%), of the newborns admitted were born at term, 68 (23.2%) were near term preterm and 23 (8.5%) were very premature and extremely premature. The early neonatal mortality rate was 12.6%. The main diagnoses on discharge were neonatal infection, 213 (79.1%) cases; neonatal jaundice, 112 (41.6%) cases; prematurity, 90 (33.4%) cases (Table 2).

Table 2: Distribution of infants according to diagnosis on discharge

	Effective Number	Percentage (%)
Neonatal infection	213	79.1
Neonatal jaundice	112	41.6
Preterm birth	90	33.4
Respiratory distress	84	31.2
Low birth weight	53	19.7
Neonatal asphyxia	48	17.8
Hypoglycemia	20	7.4
Malformation	1	0.3

Mortality and factors associated with early neonatal mortality

The early neonatal mortality rate was 12.6%. The average age of the deceased patients was 3 ± 2 days with a minimum of 0 and a maximum of 6 days with a predominance of deaths within 72 hours following birth for 28.9%. The male gender predominated in 18 (52.9%) cases and the female gender in 16 (47.05%). (P = 0.9)

The results showed no maternal factors associated with early neonatal mortality. Similarly, no maternal history was associated with this mortality. This was also the case for factors related to childbirth. Neonatal factors related to neonatal mortality were, low weight at birth ($P<0.05$), hypothermia ($P<0.05$), Apgar's score at 1 minute <7 ($P<0,05$), Apgar's score at 5 minutes<5 ($p = 0.03$), the absence of immediate cry at birth ($P<0.05$), resuscitation at birth ($P<0.05$) (table 3).

Table 3: **Neonatal factors associated with early mortality**

		Deceased (%)	Non deceased (%)	P
Gender	Female	16 (47.06)	114 (48.5)	
	Male	18 (52.9)	121 (51.4)	0.9
Birth weight	< 1000g	2 (5.8)	3 (1.2)	
	1000-1499g	9 (26.4)	3 (4.4)	
	1500-2499g	11 (32.3)	74 (31.4)	
	≥ 2500g	12 (35.2)	155 (65.9)	< 0.0001
Temperature	Hyperthermia	1(2.9)	55(23.4)	
	Hypothermia	16(47.06)	34(14.4)	
	Normothermia	17(50)	146(62.1)	< 0.0001
Apgar 1	Apgar 1 < 7	20(58.8)	33(14.04)	
	Apgar 1 ≥7	14(41.1)	202(85.9)	< 0.0001
Apgar 5	Apgar 5 < 5	3(8.8)	3(1.2)	
	Apgar 5 ≥ 5	31(91.1)	232(98.7)	0.03
Immediate cry	No	24(70.5)	59(25.1)	
	Yes	10(29.4)	176(74.8)	< 0.0001
Resuscitation	No	14(41.1)	189(80.4)	
	Yes	20(58.82)	46(19.57)	< 0.0001

Diseases associated with early neonatal mortality

The main conditions associated with early neonatal mortality were: prematurity (P<0.05), neonatal asphyxia (P<0.05), low birth weight (P<0.05) and respiratory distress (P<0.05) (table 4).

Table 4: Diseases associated with early neonatal mortality

	Deceased	Non deceased	P
Early neonatal infection	30(88.2)	183(77.8)	0.2
Preterm birth	22(64.7)	68(28.9)	< 0.0001
Neonatal asphyxia	19(55.8)	29(12.3)	< 0.0001
Malformations	0(0)	1(0.4)	0.2
Low birth weight	13(38.2)	40(17.02)	0.007
Neonatal jaundice	15(44.1)	97(41.2)	0.8
Acute respiratory distress syndrome	33(97.06)	51(21.7)	<0.05
Hypoglycemia	4(11.7)	16(6.8)	0.4

Using multivariate regression for variables presenting a p<0.2, it was noted that preterm birth [95% CI, 1.49-304.2, OR = 21.3, P = 0.02], neonatal asphyxia [95% CI, 2.02 – 158.18, OR= 17.87, P = 0.01], acute respiratory distress syndrome [95% CI, 9.28-1832.51, 0R = 130.3 P = 0.0003] remained significantly associated with neonatal mortality (table 5).

Table 5: Multivariate regression associated with Predictors of neonatal mortality

		Deceased	Non deceased	OR	CI at 95% of OR	p
Preterm birth	No					
	Yes	22 (64.7)	68 (28.9)	21.3	1.4 – 304.2	0.02
Neonatal asphyxia	No	Ref				
	Yes	19 (55.8)	29 (12.3)	17.8	2.02 – 158.1	0.01
ARDS*	No	Ref				
	Yes	33 (97.06)	51 (21.7)	130.3	9.2 – 1832.5	0.0003

*ARDS: Acute Respiratory Distress Syndrome

DISCUSSION

Limitations of the study

For the retrospective cases, the data collection was not exhaustive due to missing information in some clinical records and accuracy of the records. For the prospective cases, the absence of maternal medical records for some transferred newborns from primary level facilities and incomplete data were harmful. Despite these limitations, we could identify the main characteristics of morbidity and neonatal mortality at an early stage.

Profiles of newborns and mothers

The majority of the admitted infants were male, 52.3%. Kouéta et al. in 2008 in Burkina Faso also reported a male predominance up to 55.2% [12].This predominance would be considered remarkable in the majority of neonatal services [13].Most admitted infants were born in the maternity ward of the BDH, 203 (75.4%). In the study by Kedy Koum et al. in Cameroon in 2014, 71.0% of the infants were born in the maternity ward of the BDH [14]. Bonassama district is separated from the rest of the city of Douala by the Wouri Bridge. This isolation encourages the use of local health structures. In this study, the rate of caesarean section was 20.4%. The World Health Organization (WHO) recommends a rate of caesarean section of 10 to 15% [13]. The increase in the rates of caesarean section is justified by many transfers of high-risk pregnancies from other centers and hospitals in the health district.

The number of antenatal consultations (ANC) ≥ 4 was 191 (71.0%). This reflects the need to educate more mothers that it is in their interest and that of their child to attend all of the ANCs. Concerning the level of education of mothers, 159 (59.1%) were educated to a secondary level. The 2011 DHS data reported the same configuration. In 2011, the majority of the women had an incomplete secondary level of education, i.e. 65% [14]. In this series, the average admission weight was 2734 ± 811g with a predominance of eutrophic newborns ≥ 2500g to 66.1%. Nagalo et al. in 2013 in Burkina Faso recorded an average weight of 2632 ±753.44g [15]. Dai et al. reported that there was an interaction of protection between the level of education of the mother and the number of prenatal care visits to reduce the risk of low birth weight [16]. The early neonatal mortality rate was 12.6%. This rate is significantly lower than that reported in Nigeria, which was 48.4% [17].

Neonatal morbidity

On the basis of these results we may note that diseases of the newborn are actually the same across sub-Saharan Africa where only their order of frequency varies according to the studies. In the present study, three conditions predominate: neonatal infection (79.1%), neonatal jaundice (41.6%) and prematurity (33.4%). According to the WHO, the main neonatal diseases are preterm birth (29.0%), asphyxia (23.0%), and neonatal infection (25.0%) [18]. The study conducted by Nagalo et al. in 2013 in Burkina Faso also found, respectively, neonatal infection (23.5%), preterm birth (17.8%) and congenital malaria (15.1%) [15].

The prevalence of early neonatal infection was high in our context. Kedy Koum et al. in Cameroon in 2014 had reported early neonatal infection at 76.8% [12]. For some authors, morbidity was dominated by neonatal infections at 47.9%, low birth weight (premature infants or small for gestational age) at 22.2% and neonatal asphyxia at 13.5% [19]. Neonatal infection was the leading cause of morbidity in this series. The diagnosis was made on anamnestic, clinical and paraclinical arguments, by the determination of the C

Reactive Protein (CRP).The analysis of cerebrospinal fluid (CSF), blood culture and urinalysis could only be carried out at the expense of the parents. As a result, these lab tests were rarely carried out and, consequently, the determination of the bacterial cause was difficult. In addition, a lack of hygiene at childbirth in the maternity wards of developing countries and neonatology departments is known to be responsible for nosocomial infections yet it is poorly documented [20]. Due to the non-specificity of identifying signs in neonatal infection and financial circumstances which do not always allow us to confirm the diagnosis, it is quite possible that there is a diagnosis by excess of neonatal infections.

Jaundice was the 2nd cause of early neonatal morbidity (41.6% of the newborns hospitalized). Jaundice is not easily identified with the naked eye early enough for timely treatment and high levels of bilirubin are considered responsible for mental handicap in emerging countries [20]. The diagnosis and treatment are simple and effective but require minimal infrastructure which is not always available at the level of regional hospitals which should be equipped with it. The early departure of children after the birth does not facilitate the diagnosis and management of neonatal jaundice.

Prematurity occupied the 3rd rank in this study at 33.4%. It was found to be in second place with 17.1% of cases by Nagalo et al. in Burkina Faso in 2013 [15]. The presence of 3 functional incubators at the BDH increases its capacity to accommodate preterm infants transferring from other centers. In the study conducted by Kokeb et al., prematurity was the main cause [21].

Concerning acute respiratory distress syndrome, the prevalence obtained in our study was 31.2%. Respiratory distress was systematically identified independently of its cause. The study led by Kedy Koum et al. in 2014 in the BDH [12], had reported 2.3 % and had widely underestimated the prevalence ofacute respiratory distress syndrome because the diagnosis was often hidden by its causal pathology. Forae et al. recorded 28.2% in Nigeria [17]. The treatment of acute respiratory distress syndrome in newborns is difficult in our context. In fact, the only available neonatal respiratory support, including in tertiary level neonatology units, is oxygen therapy. Positive end-expiratory pressure and mechanical ventilation are not yet available for newborns. In the light of the frequency of respiratory distress in newborns it is essential to implement, at least in reference hospitals, a breathing assistance device.

Factors related to neonatal mortality.

The rate of early neonatal mortality in this series was 12.6%. Diouf et al. found a higher rate, at 27.4% of admissions in Senegal [22]. Charles et al. in 2014 reported 11% in Nigeria [23]. The average age of the onset of death was 3±2 days in this series. The majority of the deaths occurred within 72 hours after birth, the same observation was made by other authors, with nearly two-thirds (63.0%) of the early deaths occurred in the first three days of life [24]. In the study by Imtiaz et al., most of the deaths occurred within 48 hours after birth [25], while, in that by Chelo et al. in 2013 in Cameroon, all deaths were recorded within 24 hours following birth [26].

The predominant sex of the deceased newborns was male at 52.9%.Cisseet al. in 1997 in Senegal showed a predominance of male deaths at 56.5% [27].This gender predominance was also found in the study by Hoanet al. at 52.1% cases [28]. Peacock et al. in the United Kingdom revealed that males have a higher neonatal mortality rate than females [24]. However, there was no significant difference in male/female mortality in our series ($p = 0.9$).

In our study, the reported causes of death were dominated by prematurity (41.1%) followed by neonatal sepsis (32.3%) and neonatal asphyxia (26.4%). Ngoc et al. in 2006 identified prematurity followed by asphyxia and neonatal sepsis to be primary causes in a study conducted in 6 developing countries [29].The majority of the deaths were made up of premature infants. Those whose gestational age ranged from 28-31weeks were the most at risk (26.4%). The prevalence of prematurity among deceased infants had been found in the study conducted by Hoan et al. in 2000 in Vietnam [28], as well as in the study by Charles in 2014 in Nigeria [23]. Premature infants, due to their overall immaturity and the numerous pathologies to which they are subject, have an increased mortality risk demonstrated by these different studies.

In this study, infants with a weight <2500g (64.7%) were more at risk of death. The study led by Chen et al. at the University Hospital of Dakar in 1996 presented similar results [22]. More recently, Sylva et al. in Brazil arrived at the same conclusion [30].

However, in the context of this study, it should be noted that the practice of the Kangaroo method and the presence of incubators at the BDH increased the transfer rate of newborns with low birth weight and therefore increased the rate of early neonatal mortality in this hospital.

Hypothermia was also a risk factor associated with early neonatal mortality in this study. Hypothermia was also identified by Kedy Koum et al. in 2014 in the BDH [12]. Whether premature or not, unsafe transfers and late support of newborns aggravates the risk of hypothermia. Hypothermia has been clearly demonstrated as associated with neonatal mortality in many studies conducted in developing countries [31, 32, 33]. As in our series, Kouéta et al. in 2008 in Burkina Faso found that resuscitation at birth was a factor associated with neonatal mortality [12]. Chelo et al. in Cameroon found Apgar at 5 minutes <7 to be a risk factor [26]. No maternal factors were significantly associated with neonatal deaths in our study. In the study by Chelo et al., the age of the mother ≤ 19 years was a factor associated with early neonatal mortality [26]. Osorno et al. in Mexico in 2009 identified the premature rupture of the membranes as a significant factor [32]. Owais et al. in 2013 in Bangladesh found that maternal malnutrition increased the risk of early death, which was not the case in our study [33].

CONCLUSION

Factors associated with early neonatal mortality at the BDH were: low birth weight, hypothermia, Apgar score at 1 minute <7 and at 5 minutes <5, the absence of immediate cry at birth, resuscitation at birth, prematurity or preterm birth, neonatal asphyxia, acute respiratory distress syndrome. The causes of early death were prematurity, neonatal infection, neonatal asphyxia. To reduce neonatal mortality and, therefore, infant mortality; maternal and newborn support must be organized from within the community and at different levels of the health system. Early neonatal mortality is associated with

several avoidable factors. The improvement of the quality of basic obstetric and neonatal emergency care should reduce this mortality. The decentralization of the management of the newborn is a realistic option, due to the number of newborn children requiring a level of coverage significantly exceeding the accommodation capacity of tertiary level hospitals. This decentralization will increase the chances of survival of the newborns whose support would be made available close to its place of birth.

Declarations:

List of abbreviations

1- WHO: World Health Organization
2- DHS: Demographic and Health Survey
3- MDG: Millennium Development Goals
4- BDH: Bonassama district hospital
5- MRI: Magnetic Resonance Imaging
6- CRP: Proteine C reactive
7- ANC: antenatal consultations
8- ARDS: Acute Respiratory Distress Syndrome
9- CSF: cerebrospinal fluid

Ethics approval and consent to participate

The study was submitted to and received the approval of the National Ethics Committee of Cameroon. The authorization of the Director of Bonassama hospital was also obtained for the recruitment of patients in this facility. The consent of the parents was obtained after explaining the purpose of the study. The information obtained was kept confidential.

Consent for publication

"Not applicable" in this section.

Availability of data and materials

Strobe

Competing interests

The authors reported no conflict of interest.

Authors' contributions:

ENE and KKDC designed the study. HMP, NGP and NMM undertook the data collection. CY and ENE undertook the statistical analysis. All the authors drafted the manuscript. All have approved the submitted version of the manuscript.

Acknowledgements

We want to thank the director of the Bonassama district hospital and the staff of the pediatric department of this hospital. The department of public health of the Douala University for its guidance during this work.

REFERENCES

[1] Yamey G, Horváth H, Schmidt L, Myers J, Brindis CD. Reducing the global burden of Preterm Birth through knowledge transfer and exchange: a research agenda for engaging effectively with policymakers. Reprod Health. 2016;13(1):26-31.

[2] Wechselberger K, Schmid A, Posod A, Höck M, Neubauer V, Fischer-Colbrie R, et al. Secretoneurin Serum Levels in Healthy TermNeonates and Neonates with Hypoxic-Ischaemic Encephalopathy.Neonatology. 2016 Mar 12;110(1):14-20.

[3] Institut National de la Statistique du Cameroun (INS). Enquête Démographique et de Santé Cameroun 2004. Yaoundé, INS 2005. [cited 2014 Jun 16]; Available from: http://minsante-cdnss.cm/sites/minsante cdnss.cm/files/biblio/2011/eds2004partie1.pdf

[4] Suleiman MB, Mokuolu OA. Perinatal Mortality in a North western Nigerian City: A Wake up Call. Front Pediatr. 2014;2:105.

[5] Quamruzzaman A, Mendoza Rodríguez JM, Heymann J, Kaufman JS, Nandi A. Are tuition-free primary education policie sassociated with lower infant and neonatal mortality in low- and middle-income countries? Soc Sci Med. 2014;120C:153-159.

[6] Sodemann M, Nielsen J, Veirum J, Jakobsen MS, Biai S, Aaby P. Hypothermia of newborns is associated with excess mortality in the first 2 months of life in Guinea-Bissau, West Africa. Trop Med Int Health. 2008;13(8):980–6.

[7] Duong HH, Mirea L, Shah PS, Yang J, Lee SK, Sankaran K. Pneumothorax in neonates: Trends, predictors and outcomes. J Neonatal Perinatal Med. 2014;7(1):29-38.

[8] Organisation Mondiale de la Santé (OMS). La mortalité néonatale baisse

[9] , Afework MF, Yalew AW. Determinants and causes of neonatal mortality trop lentement, surtout en Afrique. Genève, OMS, 2014.

[10] Debelew GT in jimma zone, south west ethiopia: a multi level analysis of prospective follow up study. PLoS One. 2014;9(9):e107184.

[11] Chichom-Mefire A, Mbarga-Essim NT, Monono ME, Ngowe MN. Compliance of district hospitals in the Center Region of Cameroon with WHO/IATSIC guidelines for the care of the injured: a cross-sectional analysis. World J Surg. 2014;38(10):2525-33.

[12] Zaidi AK, Thaver D, Ali SA, Khan TA. Pathogens associated with sepsis in newborns and young infants in developing countries. Pediatr Infect Dis J. 2009;28(1):S10–S18.

[13] Kouéta F, Yé D, Dao L, Néboua D, Sawadogo A. Morbidité et mortalité néonatales de 2002 à 2006 au Centre hospitalier universitaire pédiatrique Charles de Gaulle de Ouagadougou (Burkina Faso). Cah Détudes Rech Francoph Santé. 2008 Feb 18;17(4):187–91.

[14] Organisation Mondiale de la Santé (OMS). Soins locaux du cordon ombilical à la naissance. Genève, OMS 2013.

[15] Kedy Koum D, Exhenry C, Penda CI, NzimaNzima V, Pfister RE. Morbidité et mortalité néonatale dans un hôpital de district urbain à ressources limitées à Douala, Cameroun. Arch Pédiatrie. 2014;21(2):147–56.

[16] Nagalo K, Dao F, Tall FH, Ye D. Morbidité et mortalité des nouveau-nés hospitalisés sur 10 années à la clinique el fateh-suka (ouagadougou, burkinafaso). Pan Afr Med J, 2013. 14: 153.

[17] Dai L, Hu W, Luo X, Shen Y. Interaction of prenatal care and level of maternal education on the risk of neonatal low birth weight. Zhonghua Liu Xing Bing Xue ZaZhi. 2014;35(5):533-6.

[18] Forae GD, Uchendu OJ, Igbe AP. An audit of paediatric mortality patterns in a Nigerian teaching hospital. Niger Med J. 2014;55(2):130-3.

[19] Sylla M, Folquet-Amorissani M, Oumar AA, Dicko FT, Sidibé T, Moyo L, et al. Morbidité et mortalité néonatales dans le service de réanimation pédiatrique de l'hôpital de Gabriel Toure. Louvain Méd. 2009;128(4):141–4.

[20] Charles NC, Chuku A, Anazodo NM. Childhoodmortality in federal medical centre umuahia, South eastern Nigeria. Oman Med J. 2014;29(5):320-4.

[21] Bezzaoucha A, El Kebboub A, Aliche A. Évolution de la mortalité néonatale au CHU de Blida (Algérie) de 1999 à 2006. Bull Société Pathol Exot. 2010;103(1):29–36.

[22] Kokeb M, Desta T. Institution Based Prospective Cross-Sectional Study on Patterns of Neonatal Morbidity at Gondar University Hospital Neonatal Unit, North-West Ethiopia. Ethiop J Health Sci. 2016;26(1):73-9.

[23] Diouf S, Faye PM, Mouba JF, Sarr M. Neonatal healthindicators in a Senegalese rural district.ArchPediatr. 2012;19(4):435-6.

[24] Charles NC, Chuku A, Anazodo NM. Childhood mortality in federal medical centre umuahia, South eastern Nigeria. Oman Med J. 2014;29(5):320-4.

[25] Peacock JL, Marston L, Marlow N, Calvert SA, Greenough A. Neonatal and infant outcome in boys and girls born very prematurely. PediatrRes. 2012;71(3):305-10.

[26] Imtiaz S, Drohlia MF, Nasir K, Hussain M, Ahmad A. Morbidity and mortality associated with Plasmodium vivax and Plasmodium falciparum infection in a tertiary care kidney hospital. Saudi J Kidney Dis Transpl. 2015;26(6):1169-76.

[27] Chelo D, Monebenimp F, Npanguepko FRT, Tietche F. Mortalité néonatale précoce et ses déterminants dans une maternité de niveau I à Yaoundé, Cameroun. Pan Afr Med J 2012; 13:67.

[28] Cisse CT, Ngoma SI, Martin SL, Tall-Diaw C, Diadhiou F. Surveillance épidémiologique de la mortalité néonatale précoce au CHU de Dakar (Sénégal). Cah Détudes Rech Francoph Santé. 1997;7(2):109–12.

[29] Hoan PT, Bao TV, Phong DN, others. Mortalité néonatale précoce à l, hôpital de gynécologie-obstétrique de Hanoï, Vietnam. Bull Soc Pathol Exot. 2000;93(1):62–5.

[30] Ngoc NTN, Merialdi M, Abdel-Aleem H, Carroli G, Purwar M, Zavaleta N, et al. Causes of still births and early neonatal deaths: data from 7993 pregnancies in six developing countries. Bull World Health Organ. 2006;84(9):699–705.

[31] Silva SM, Mattos LC, Macedo LF, Araújo TS. Perinatal morbidity and mortality in pregnancies that progressed with ruptured membranes at a public hospital in Northern Brazil. Rev Bras Ginecol Obstet. 2014;36(10):442-8.

[32] Mathur NB, Krishnamurthy S, Mishra TK. Evaluation of WHO classification of hypothermia in sick extramural neonates as predictor of fatality. J Trop Pediatr. 2005;51(6):341–5.

[33] Osorno Covarrubias L, Watty Cáceres C, Alonzo Vázquez F, Dávila Velázquez J, Echeverría Eguiluz M. Confounding effect of prematurity in the neonatal death associated with obstetric maternal morbidity. Ginecol Obstet Mex. 2009;77(6):277-81.

[34] Owais A, Faruque ASG, Das SK, Ahmed S, Rahman S, Stein AD. Maternal and Antenatal Risk Factors for Still births and Neonatal Mortality in Rural Bangladesh: A Case-Control Study. PloS One. 2013;8(11):e80164.