# Risk Factors for Neonatal Mortality at the Yaounde Gynaeco-Obstetric and Pediatric Hospital, Cameroon

### Andreas Chiabi\*, MD; Vanessa Takou, MD; Evelyn Mah, MD; Seraphin Nguefack, MD; Hypolyte Siyou, MD; Virginie Takou, MD; Pierre-Fernand Tchokoteu, MD; Elie Mbonda, MD

Yaounde Gynaeco-Obstetric and Pediatric Hospital, Faculty of Medicine and Biomedical Sciences, University of Yaounde I, Cameroon

Received: Sep 18, 2013; Accepted: Mar 25, 2014; First Online Available: Jun 29, 2014

## **Abstract**

**Objective:** Neonatal mortality is a major health problem in sub-Saharan Africa and the risk factors are not well established. The objective of this study was to determine the risk factors for neonatal mortality at the Yaounde Gynaeco-Obstetric and Pediatric Hospital.

*Methods:* We conducted a retrospective and analytic case-control study from the medical records of newborns admitted at the neonatal unit of this hospital between 1st March 2003 and 31st December 2012. 850 subjects were enrolled; that is 425 cases and 425 controls.

*Findings:* The intra-hospital neonatal mortality rate was 9.83%. The main causes of neonatal mortality were in descending order: neonatal sepsis (60.2%), complications from prematurity (42.6%), birth asphyxia (37.4%), and congenital malformations (11.8%). The most prominent risk factors for neonatal mortality after multivariate analysis with logistic regression were: prolonged membrane rupture (OR: 3.8719, 95% CI: 2.3619-6.3471; *P*=0.0000), low birth weight (OR: 1.6240, 95% CI: 1.0108-2.6091; *P*=0.0450), Apgar score less than 7 at the 5th minute (OR: 6.8979, 95% CI: 4.0709-11.6883; *P*=0.0000), and congenital malformations (OR: 4.3307, 95% CI: 1.6120-11.6347; *P*=0.0037). Delivery by cesarean section (OR: 0.2644, 95% CI: 0.1478-0.4732; *P*=0.0000) and being born in this hospital (OR: 0.4409;95% CI: 0.2566-0.7576; *P*=0.0030) were protective.

*Conclusion:* Neonatal mortality was influenced by both maternal and neonatal factors. This could be reduced through sensitization of pregnant women on the need of good quality antenatal visits, and capacitating the health personnel on the adequate management of high risk neonates.

Iranian Journal of Pediatrics, Volume 24 (Number 4), August 2014, Pages: 393-400

Key Words: Neonatal Mortality; Hospital; Risk Factors; Cameroon

# **Introduction**

The World Health Organization (WHO) estimates that more than 3 million neonates worldwide die within the first months of life, with a similar number of stillbirths. During the first month of life, more than a quarter of these deaths occur during the first 24 hours of life, and 75% within the first week<sup>[1]</sup>. In 2010, the global neonatal mortality rate (NMR) was 23‰, and the highest rates of  $33\%_0$  and  $35\%_0$  were observed in South Asia and sub-Saharan Africa respectively<sup>[2]</sup>. However, the global NMR worldwide over the years has been:  $28\%_0$  in  $2006^{[3]}$ ,  $30\%_0$  in  $2007^{[4]}$ ,  $24\%_0$  in  $2009^{[5]}$  and  $23\%_0$  in  $2010^{[2]}$ . In Cameroon in 2011, the NMR was  $31\%_0$  and approximately one out of eight children died before reaching the age of five<sup>[6]</sup>.

\* Corresponding Author;

E-mail: andy\_chiabi@yahoo.co.uk

Address: Gynaeco-Obstetric and Pediatric Hospital/Faculty of Medicine and Biomedical Sciences, University of Yaounde I, Cameroon; P.O. Box 4362, Yaounde, Cameroon.

<sup>© 2014</sup> by Pediatrics Center of Excellence, Children's Medical Center, Tehran University of Medical Sciences, All rights reserved.

In Benin the NMR was 55.6‰ in 1991<sup>[35]</sup>. In Nigeria, the NMR ranged between 25.6/1000 live births and 72.4/1000 live births in out-born neonates, and 336.5/1000 live births for out-borns<sup>[36]</sup>. An early neonatal mortality rate of 68/1000 live births and 16/1000 live births in Kenya <sup>[41]</sup> and Ghana respectively.

Mortality in hospitalized neonates also vary from country to country: 13.1%, 28.3%, 26.5%, 34.2% in Burkina Faso, Togo, Ivory Coast, Guinea Conakry respectively <sup>[37,38,39,40]</sup>.

The objective of this study was to determine the socio-demographic, maternal, obstetric and neonatal risk factors associated with neonatal mortality in this setting, which will serve as a basis in proposing interventions to curb it.

at the 5th minute, birth weight, and pathologies presented during admission.

Data were entered and analyzed in the Epi-Info Version 3.5.3software, and the Fisher's exact test was used to compare proportions. The statistical significance level was P value <0.05. The Odds ratio (OR) with its confidence interval (CI) at 95% were used to assess the risk of an association. The factors significantly associated with neonatal mortality in the bivariate analysis further underwent multivariate analysis with logistic regression.

Ethical clearance was obtained from the Ethics Committee of the hospital, and the data were kept confidential.

## Subjects and Methods

It was a retrospective and analytic case-control study with data collected from medical records of newborns admitted in the neonatal unit (NNU) of the Yaounde Gynaeco-Obstetric and Pediatric Hospital (YGOPH) between 1<sup>st</sup> March 2003 and 31<sup>st</sup> December 2012 (9 years 10 months).

Enrolled in this study were all newborns admitted in the NNU of this hospital, and who died during hospitalization within 28 days of life. Newborns admitted in this unit and discharged alive after management were the controls. The cases and controls were matched for gestational age±2 weeks of amenorrhea. Excluded from the study were neonates admitted during the study period but who died or were discharged alive after 28 days of life, and also files with insufficient data.

Data extracted from these records were put on questionnaires. The variables collected were:

- For the mother: age, place of residence, marital status, level of education, occupation, gender, past prematurity, abortions history of and/or stillbirths, neonatal deaths, follow-up of pathologies pregnancy, during pregnancy, perinatal fever, time of rupture of membranes with respect to delivery, nature of the amniotic fluid, place of birth, gestational age and mode of delivery.

- For the newborn: the sibling rank, age at admission, the number of fetuses, sex, Apgar score

# **Findings**

*Study population:* During the study period, 7824 neonates were admitted to the NNU of the YGOPH. From this number, 769 died and 7,055 were discharged alive, giving an intra-hospital neonatal mortality of 9.83%. For the study, we selected 425 cases and 425 controls, who met up with our inclusion criteria giving a case-control ratio of 1:1.

Of the 425 neonates who died, 233 (54.8%) were males and 192 (45.2%) females, giving a sex ratio of 1.21, with no statistically significant difference (P=0.2). Most neonates who died, 397 (93.4%) were admitted during the early neonatal period ( $\leq$ 7 days), against 28 (6.6%) in the late neonatal period (>7 days) (P=0.08). Most deaths occurred in the early neonatal period, 307 (72.2%) against 118 (27.8%) in the late neonatal period. Amongst the 425 neonates who died, 77 (18.1%) died during the first 24 hours of life. The mean duration of hospitalization of the neonates who died was about 5 days (range 1- 27 days).

Half of these newborns, 221 (52%) had a low birth weight (<2500g) and 15 (3.5%) were macrosomic (> 4000 g). The mean gestational age of the newborns who died was 35 weeks of amenorrhea, with extremes of 22 and 44 weeks. Nearly half of the newborns, 205 (48.2%) who died were born at term (37 to 42 weeks of amenorrhea); 201 (47.3%) neonates came from the YGOPH, while 224 (52.7%) came from elsewhere (20% from other referral hospitals,

		n	(%)
Cov	Males	233	54.8
Sex	Females	192	45.2
Dariad of admission (days)	≤ 7	397	93.4
Period of admission (days)	> >7	28	6.6
	< 2500	221	52
Birth weight (g)	2500-4000	189	44.5
	≥4000	15	3.5
	< 37	200	47.1
Gestational age (weeks)	37-42	205	48.2
	≥42	20	4.7
Origin of the needed	YGOPH	201	47.3
origin of the neonates	Others*	224	52.7

#### **Table 1:** Characteristics of the dead neonates

\*other hospitals: 20%; peripheral health centers: 16.9%; home: 15.8%

16.9% from other health facilities, and 15.8% from home) (Table 1).

*Socio-demographic characteristics of the mothers:* Celibacy was a risk factor for neonatal death (OR: 1.65; 95%CI: 1.19-2.27; *P*=0.001) and being married was a protective factor (OR: 0.62; 95% CI: 0.45-0.86; *P*=0.002). Primary or secondary level of education was a risk factor (OR: 1.43; 95%CI: 1.01-2.02; *P*=0.03) (Table 2).

*Obstetrical characteristics:* Among the analyzed obstetrical factors, primiparity was the only risk factor (OR: 1.51; 95%CI: 1.14-2.01; *P*=0.002) (Table 3).

*Maternal illnesses:* Amongst the 127 (30.8%) mothers of dead neonates who had had at least one acute or chronic illness and/or pathology during pregnancy, the most common pathology encountered was malaria in 59 (46.5%) of the mothers. None of the maternal pathologies or disorders had a significant impact on neonatal mortality.

Maternal factors associated with labor and delivery: Perinatal fever (OR: 2.09; 95%CI: 1.28-3.43; P=0.002), prolonged rupture of membranes ( $\geq$  12 hours before delivery) (OR: 2.70; 95% CI: 1.99-3.64; P<0.001), meconium stained amniotic fluid (OR: 2.33; 95% CI: 1.59-3.43; P<0.001), delivery out of a hospital setting (OR: 2.17; 95%CI: 1.01-4.66; P=0.03) were significant risk factors associated with neonatal mortality; whereas cesarean section (OR: 0.31, 95% CI: 0.22-0.42; P< 0.001) was a protective factor (Table 4).

*Characteristics* associated with neonates: Provenance of the neonates from the YGOPH was a protective factor against neonatal mortality (OR: 0.35; 95%CI: 0.26-0.47: *P*<0.001). First borns (OR: 1.48, 95%CI: 1.12-1.96: *P*=0.003), Apgar score less than 7 at the 5th minute (OR: 3.66; 95%CI: 2.68-4.98; *P*<0.001), and low birth weight (<2500g) (OR: 1.43, 95%CI: 1.09-1.88; *P*=0.005) were risk factors (Table 5).

Table 2. Distribution of the neonat	es according to materna	l socio-demographic factors
<b>Table 2.</b> Distribution of the neonat	es accor unig to materna	1 socio-demographic factors

Parameter		Cases n (%)	Control n (%)	OR	CI 95%	<i>P.</i> value
Maternal age range	< 20	48 (53.3)	42 (46.7)	1.11	0.73 - 1.77	0.34
Place of residence	Rural	51 (54.8)	42 (45.2)	1.27	0.81 - 1.97	0.29
n <sup>a</sup> = 612 (93+519)	Urban Single	254 (48.9) 170 (57.4)	265 (51.1)			
Marital status	Others <sup>b</sup>	141 (45.0)	172 (55.0)	1.65	1.19 - 2.27	0.001
(311+298)	Married Others¢	141 (45.3) 170 (57.0)	170 (54.7) 128 (43.0)	0.62	0.45 - 0.86	0.002
Educational level na= 557 (352+205)	Primary/Secondary University	198 (56.3) 97 (47.3)	154 (43.7) 108 (52.7)	1.43	1.013 -2.02	0.026
<b>Occupation</b> n <sup>a</sup> = 660 (92+568)	Salaried Others <sup>d</sup>	42 (45.7) 295 (51.9)	50 (54.3) 273 (48.1)	0.78	0.50 - 1.21	0.2

<sup>a</sup>number of informative files, <sup>b</sup>not single (married, widow, divorced), <sup>c</sup>not married (single, widow, divorced), <sup>d</sup> (private sector, students, housewives, farmers, traders, unemployed); OR: Odds Ratio; CI: Confidence interval

Parameter		Cases n (%)	Control n (%)	OR	CI 95%	<i>P.</i> value
Parity nª=803 (346+457)	Primiparous Others	194 (56.1) 209 (45.7)	152 (43.9) 248 (54.3)	1.51	1.14 - 2.01	0.002
PH of prematurity n <sup>a</sup> = 802 (23+779)	Yes No	10 (43.5) 392 (50.3)	13 (56.5) 387 (49.7)	0.76	0.33 - 1.75	0.3
PH of still birth or miscarriage n <sup>a</sup> =802 (271+531)	Yes No	124 (45.8) 278 (52.4)	147 (54.2) 253 (47.6)	0.77	0.57 - 1.03	0.04
PH of neonatal death nª= 802 (48+754)	Yes No	24 (50.0) 378 (50.1)	24 (50.0) 376 (49.9)	0.99	0.55 - 1.78	0.5
No of antenatal consultations nª=411 (141+270)	< 4 ≥ 4	81 (57.4) 137 (50.7)	60 (42.6) 133 (49.3)	1.31	0.87 - 1.97	0.1
Pathologies during pregnancy nª=830 (260+570)	Yes No	127 (48.8) 285 (50.0)	133 (51.2) 285 (50.0)	0.95	0.71 - 1.28	0.4

Table 3: Distribution of neonates according to maternal obstetrical factors

anumber of informative files; PH: Past history; OR: Odds Ratio; CI: Confidence interval

*Neonatal pathologies on admission:* Neonatal sepsis (OR: 1.35; 95%CI: 1.02-1.77; *P*=0.02), neonatal asphyxia (OR: 3.25, 95%CI: 2.34-4.51; *P*<0.001), and congenital malformations (OR: 4.59; 95%CI: 2.41-8.75; *P*<0.001) were statistically associated with neonatal mortality (Table 6).

*Causes of neonatal deaths:* The main causes of neonatal deaths were: neonatal sepsis 256 (60.2%), complications from prematurity181 (42.6%), neonatal asphyxia 159(37.4%), and congenital malformations 50 (11.8%). The most common malformative syndromes (18%), congenital heart disease (12%), esophageal atresia (10%), laparoschisis (10%), and meningo-encephalocele (10%).

On multivariate analysis with logistic regression of the significant risk factors above, prolonged membrane rupture (OR: 3.87, 95%CI: 2.36-6.35; *P*<0.001), low birth weight (OR: 1.62, 95%CI: 1.01-2.61); *P*=0.04), Apgar score less than 7 at the 5th minute (OR: 6.90, 95%CI: 4.07-11.69; *P*<0.001), and congenital malformations (OR: 4.33, 95%CI: 1.61-11.63; *P*=0.004), persisted as the risk factors for neonatal mortality. Cesarean section (OR: 0.26, 95%CI: 0.15-0.47; *P*<0.001) and being born at the YGOPH (OR: 0.44; 95% CI: 0.26-0.76; *P*=0.003) remained protective factors.

## Discussion

The study matched 425 neonates who died in the NNU of the YGOPH, with 425 controls discharged alive from same unit after management. After multivariate analysis, prolonged rupture of the

#### **Table 4:** Distribution of factors associated with labor and delivery

Parameter		Cases n (%)	Controls n (%)	OR	CI 95%	P. value
Perinatal fever n <sup>a</sup> = 850 (77+773)	Yes	51 (66.2) 374 (48 4)	26 (33.8) 399 (51.6)	2.09	1.28 - 3.43	0.002
PROM n <sup>a</sup> = 850 (271+579)	Yes	180 (66.4) 245 (42.3)	91 (33.6) 334 (57.7)	2.70	1.99- 3.64	<0.001
Aspect of amniotic fluid n <sup>a</sup> = 850 (137+713)	d Stained Clear	92 (67.2) 333 (46 7)	45 (32.8)	2.33	1.59 - 3.43	< 0.001
Place of delivery n <sup>a</sup> = 846 (516+330)	Extra-hospital setting Hospital	21 (67.7) 401 (49.2)	10 (32.3) 414 (50.8)	2.17	1.01 - 4.66	0.03
Mode of delivery n <sup>a</sup> = 825 (260+ 790)	Caesarean section Vaginal	79 (30.4) 346 (58.6)	181 (69.6) 244 (41.4)	0.30 78	0.22 - 0.42	< 0.001

anumber of informative files; PROM: Prolonged rupture of membranes; OR: Odds Ratio; CI: Confidence interval

Parameter		Cases	Controls	OR	CI 95%	<i>P.</i> value
		n (%)	n (%)			
Provenance	YGOPH	206 (39.9)	310 (60.1)	0.25	0.26 0.47	<0.001
nª=846 (516+330)	Others	216 (65.5)	114 (34.5)	0.55	0.20 - 0.47	<0.001
Rank in the family	1	199 (55.6)	159 (44.4)	1 40	112 100	0.002
nª=804 (358+446)	>1	204 (45.7)	242 (54.3)	1.48	1.12 - 1.96	0.003
Type of pregnancy	Multiple	34 (51.5)	32 (8.5)	1.07	0 (5 17(	0.4
nª=850 (66+784)	Single	391 (49.9)	393 (50.1)	1.07	0.65 - 1.76	0.4
Sex	Male	233 (51.3)	221 (48.7)	1 1 2	0.05 1.47	0.2
nª= 850 (454+396)	Female	192 (48.5)	204 (51.5)	1.12	0.05 - 1.47	0.2
Gestational age (weeks)	<37	200 (50.3)	198 (49.7)	1.02	070 122	0 5
n <sup>a</sup> =850 (398+452)	≥37	225 (49.8)	227 (50.2)	1.02	0.78 - 1.33	0.5
Apgar score at 5 <sup>th</sup> minute	< 7	195 (70.9)	80 (29.1)	277	2 ( 0 4 0 0	-0.001
nª=850 (275+575)	≥7	230 (40)	345 (60)	3.00	2.68 - 4.98	<0.001
Birth weight (in grams)	<2500	221 (54.7)	183 (45.3)	1 42	1.00 1.00	0.005
nª=850 (404+446)	≥2500	204 (45.7)	242 (54.3)	1.43	1.09 - 1.88	0.005

Table 5: Distribution of factors associated with the neonate

OR: Odds Ratio; CI: Confidence interval

membranes, low birth weight, congenital malformations and a low Apgar score represented risk factors for neonatal deaths. It should be noted that this hospital is a mother and child referral hospital in Yaounde, the political capital of Cameroon. It receives patients from Yaounde and its environs as well as referrals from other parts of the country.

It is worth noting that the health care system in Cameroon has a pyramidal organization structure in three levels:

- A. Central level: with four 1<sup>st</sup> category hospitals and three central hospitals,
- B. Intermediary level: constituted of 10 regional hospitals (3<sup>rd</sup> category) in the 10 regions of Cameroon,
- C. Peripheral level: constituted of district hospitals (4<sup>th</sup> category); subdivisional health centers (5<sup>th</sup> category), integrated health centers (6<sup>th</sup>

category), and peripheral health posts (7<sup>th</sup> category).

In this study the intra-hospital neonatal mortality was 9.83%. Higher rates were noted in Zimbabwe (19.3%)<sup>[7]</sup>, Kenya (31.5%)<sup>[8]</sup>, and Mali (38.8%)<sup>[9]</sup>. This is in contrast to the low rates observed in some developed countries: 0.38% and 0.35% in England and the United States respectively<sup>[10,11]</sup>. This could be due to poverty and ignorance prevailing in these countries which limit access to antenatal, intra-partum and postnatal care. The male predominance amongst the dead neonates has also been described by several authors<sup>[12-14]</sup>. Other studies noted a female predominance but still without any statistically significant difference<sup>[8,15]</sup>. Most deaths (93.4%) occurred in neonates admitted during the early neonatal period with 72.2% in the first 24 hours.

Early neonatal deaths have also been noted to

Disorders		Cases n (%)	Control s n (%)	OR	CI 95%	Р
Prematurity	Yes	181 (49.7)	183 (50.3)	0.00	0.75 1.20	0 5
n <sup>a</sup> =850 (364+486)	No	244 (50.2)	242 (49.8)	0.90	0.75-1.29	0.5
Neonatal sepsis	Yes	256 (53.2)	225 (46.8)	1 25	102 177	0.02
n <sup>a</sup> =850 (481+369)	No	169 (45.8)	200 (54.2)	1.55	1.03 -1.77	0.02
Neonatal asphyxia	Yes	159 (70.7)	66 (29.3)	2.25	2 24 4 51	<0.001
n <sup>a</sup> =850 (225+625)	No	266 (42.6)	359 (57.4)	5.25	2.34-4.31	<0.001
<b>Congenital defects</b>	Yes	50 (80.6)	12 (19.4)	4 50	2 41 0 75	<0.001
n <sup>a</sup> =850 (62+788)	No	375 (47.6)	413 (52.4)	4.59	2.41-8.75	<0.001

## Table 6: Distribution of neonatal pathologies at admission

OR: Odds Ratio; CI: Confidence interval

www.SID.ir

be higher than deaths in the late neonatal period in other studies<sup>[8,9,12,13,16-21]</sup>. The early neonatal period is a delicate period because it is a period of transition between the intra-uterine and extrauterine environment. At this age, the neonate is fragile with a weak immune status and body systems not quite adapted to the extra uterine environment, and therefore very susceptible to infections which can be fatal.

The average stay in hospital for the neonates who died was 5 days. Other authors noted 2, 4 and 8 days<sup>[7,8,14]</sup>.

*Maternal factors associated with labor and delivery:* Prolonged rupture of membranes for more than 12 hours was strongly associated to the risk of death in our series. A similar finding has been noted by other authors<sup>[22,23]</sup>. Ruptured membranes for long periods expose the fetus to infections which can be a direct cause of death.

Cesarean section was a protective factor against neonatal deaths. The babies born by C-section are systematically sent to neonatology for observation. Most of the babies may not have any pathology compared to those born per vaginally and admitted in the unit due to ill health. Another explanation may be the fact that YGOPH being a referral hospital receives cases requiring emergency cesarean section with indications being generally life-saving for the fetus, and also has C-section kits ready to manage emergency cases without delay. A similar finding was noted in other studies<sup>[7,18]</sup>. The higher mortality in neonates born vaginally may also be related to the fact that neonates born through cesarean sections were routinely admitted at the NNU for monitoring for at least two days, while those born vaginally were only admitted at the NNU when they presented signs and/or symptoms of disease. Similarly Ribeiro et al in Brazil noted a similar finding but with low birth weight neonates, and they postulated that this association (high neonatal mortality from vaginal deliveries) could be due to poor neonatal care following vaginal deliveries, and an inappropriate choice of the mode of delivery<sup>[24]</sup>.

In this study, the number of prenatal visits did not statistically influence the risk of death, which goes to support the premise that it is the quality of these visits and not the number that influences pregnancy and eventually neonatal outcome. It is during these visits that malaria chemoprophylaxis, iron/folic acid supplements, tetanus vaccines are prescribed. Also routine investigations as urinalysis, vaginal smears, HIV serology, syphilis testing, obstetrical ultrasounds and blood pressure monitoring are done.

*Characteristics associated with neonates:* Most neonates who died came from other health facilities than those directly from the YGOPH maternity. Delivery in the YGOPH was a protective factor on the multivariate analysis with logistic regression. Other authors noted the same findings<sup>[16]</sup>. Transfer of neonates from one health facility or location to another in inappropriate conditions exposes the neonate to infections, hypothermia and delay in management, all factors which further reduce the chances of survival.

Low birth weight was a risk factor. This observation has also been noted by several authors<sup>[13,15,18,21]</sup>. These neonates are at higher risk of asphyxia, sepsis, hypothermia and feeding problems. Besides, common diseases tend to be more severe and long-lasting in these neonates than in those with normal birth weights<sup>[25]</sup>.

Other studies in Africa<sup>[7,13,19,20,26,27]</sup>, Iran<sup>[15]</sup>, Brazil<sup>[18]</sup>, and the Palestine<sup>[28]</sup>, also noted that low birth weight was a risk factor for neonatal mortality.

Prematurity is one of the main causes of low birth weight, but in this study it was not found to be a risk factor for neonatal deaths. A likely explanation for this could be due to the fact that the cases and controls were paired for gestational age plus or minus two weeks.

A low Apgar score <7 at the 5th minute was strongly associated with neonatal mortality. A low Apgar score has been shown to be correlated with neonatal mortality<sup>[29]</sup>. However the interpretation of the Apgar score has limitations especially in premature neonates, in whom the tone, color and reflexes partially depend on the physiological maturity of the newborn<sup>[29,30]</sup>. Our finding is similar to those of Eloundou<sup>[17]</sup>, and Chiabi et al<sup>[31]</sup>, whereas others noted that a low Apgar score at both the 1<sup>st</sup> and 5<sup>th</sup> minute was a risk factor for neonatal mortality<sup>[14]</sup>.

*Neonatal pathologies on admission:* Neonatal sepsis, birth asphyxia and congenital malformations were statistically associated with neonatal mortality. However the main causes of deaths in descending order were: neonatal sepsis, complications from prematurity, birth asphyxia

and congenital malformations. The same causes were noted by Lawn et al<sup>[32]</sup>.

The high mortality from congenital malformations despite the presence of a pediatric surgery unit at the YGOPH, could be explained by the frequent lack of antenatal diagnosis, lack of a well-equipped ambulance transport system during referral, the delay in surgical procedures, poverty, and an inadequate surgical, anesthetic and neonatal resuscitation platform<sup>[33]</sup>. Other authors also observed a significant association between malformations congenital and neonatal mortality<sup>[7,14,18,21,34]</sup>.

## **Conclusion**

This study noted that neonatal mortality was influenced by maternal factors (prolonged rupture of membranes for more than 12 hours, cesarean section) and neonatal factors (low birth weight, Apgar score <7 at the 5th minute, congenital malformations and place of delivery).

Sensitization of pregnant women, through information-education-communication, on the importance of antenatal care for early detection and appropriate management of high-risk pregnancies could help reduce neonatal mortality. The technical platform for proper management of congenital malformations in this setting should be improved, and as well as building capacity of health personnel to adequately manage high risk neonates with infections, prematurity, asphyxia and low birth weight.

#### Acknowledgment:

We wish to thank all the nursing staff of the neonatology unit for taking care of the neonates. Thanks also to Dr. L. Mbuagbaw and Mr F. Tchuisseu for assistance in the study design and data analysis.

#### **Authors Contribution:**

Concept / Design: A. Chiabi

Acquisition of Data: V. Takou, E. Mah, S. Nguefack, H. Siyou Data Analysis / Interpretation: A. Chiabi, V. Takou, E. Mah Manuscript Preparation: A. Chiabi, V. Takou, E. Mah Critical Revision of the Manuscript: P.F. Tchokoteu, E. Mbonda All authors read and approved the final version of the paper.

#### Conflict of Interest: None

- World Health Organization. Children: reducing mortality. Fact sheet N° 178. September 2012. Available at: http://www.who.int/mediacentre /factsheets/fs178/en/, Access date: October 4th, 2012).
- 2. Fonds des Nations Unies pour l'Enfance (UNICEF). La situation des enfants dans le monde 2012-Les enfants dans un monde urbain. New York (NY): UNICEF;2012.
- 3. Fonds des Nations Unies pour l'Enfance (UNICEF). La situation des enfants dans le monde 2008- La survie de l'enfant. New York (NY):UNICEF; 2007.
- 4. Fonds des Nations Unies pour l'Enfance (UNICEF). La situation des enfants dans le monde 2009. La santé maternelle et néonatale. New York (NY): UNICEF; 2008.
- 5. Fonds des Nations Unies pour l'Enfance (UNICEF). The state of world's children 2011 - Adolescence an age of opportunity. New York (NY): UNICEF; 2011.
- 6. Institut National de la Statistique (INS) et ICF Macro 2011. Enquête Démographique et de Santé et à Indicateurs Multiples EDS-MICS 2011.
- Kambarami RA, Matibe P, Pirie D. Risk factors for neonatal mortality: Harare Central Hospital Neonatal Unit-Zimbabwe. *Cent Afr J Med* 1999;45(7):169-73.
- 8. Simiyu DE. Morbidity and mortality of neonates admitted in general paediatric ward at Kenyatta national hospital. *East Afr Med J* 2003;80(12):611-6.
- 9. Sylla M, Folquet-Amorissani M, Oumar AA, et al. Morbidité et mortalité néonatales dans le service de réanimation pédiatrique de l'Hôpital Gabriel Touré. *Louvain Médical* 2009;128(4):141-4.
- 10. Joyce R, Webb R, Peacock JL. Associations between perinatal interventions and hospital stillbirth rates and neonatal mortality. *Arch Dis Child Fetal Neonatal Ed* 2004;89(1):F51-6.
- Hessol AN, Fuentes-Afflick E. Ethnic differences in neonatal and post neonatal mortality. *Pediatrics* 2005;115(1):e44-51.
- Tietche F, Kago I, Njimoke A, et al. Mortalité hospitalière des nouveau-nés eutrophiques à terme à Yaoundé (Cameroun): Aspects étiologiques. *Méd Afr Noire* 1998;45:193-5.
- 13. Tchokoteu FL. Mortalité néonatale à l'Hôpital Gynéco-Obstétrique et Pédiatrique de Yaoundé. Thèse de Méd. Faculté de Médecine et des Sciences Biomédicales-Université de Yaoundé I 2010.
- 14. Risso, SP, Nascimento LFC. Risk factors for neonatal death in neonatal intensive care unit according to survival analysis. *Rev Bras Ter Intensiva* 2010;22(1): 19-26.
- Chaman R, Naieni KH, Golestan B, et al. Neonatal mortality risk factors in a rural part of Iran: a nested case-control study. *Iran J Publ Health* 2009;38:48-52.
- Monebenimp F, Tchiro R, Nana AD. Morbidité et mortalité des naissances intra-hospitalières du Centre Hospitalier Universitaire de Yaoundé, Cameroun. Clin Mother Child Heath 2005;2:355-8.

- 17. Eloundou OE. Etiologies et facteurs aggravant la morbidité et la mortalité néonatales à l'Hôpital Gynéco-Obstétrique et Pédiatrique de Yaoundé (HGOPY). Thèse de Méd. Faculté de Médecine et des Sciences Biomédicales-Université de Yaoundé I 2006.
- 18. Zanini RR, Moares AB, Giugliani ER, et al. Contextual determinants of neonatal mortality using two analysis methods, Rio Grande do Sul, Brazil. *Rev Saúde Pública* 2011;45(1):79-89.
- Sidibé T, Sangho H, Doumbia S, et al. Mortalité néonatale dans le district de Kolokani (Mali). J Pédiatr Puériculture 2006;19(7):272-6.
- Lawoyin TO, Onadeko MO, Asekun-Olarinmoye EO. Neonatal mortality and perinatal risk factors in rural South Western Nigeria: a community-based prospective study. *West Afr J Med* 2010;29(1):19-23.
- 21. Adetola OA, Tongo OO, Orimadegun EA, et al. Neonatal mortality in an urban population in Ibadan, Nigeria. *Pediatr Neonatol* 2011;52(5):243-50.
- Boskabadi H, Maamouri G, Mafinejad S. Neonatal complications related with prolonged rupture of membranes. *Maced J Med Sci* 2011;4(1):93-8.
- 23. Chelo D, Monebenimp F, Npanguepko TFR, et al. Mortalité neonatal précoce et ses déterminants dans une maternité de niveau I à Yaoundé, Cameroun. *Pan Afr Med J* 2012;13:67.
- 24. Ribeiro AM, Guimarães MJ, Lima MC, et al. Risk factors for neonatal mortality among children with low birth weight. *Rev Saúde Pública* 2009;43(2):246-55.
- Saili A. Essential care of low birth weight neonates. Indian Pediatr 2008;45(1):13-5.
- 26. Chiabi A, Miaffo L, Mah E, et al. Facteurs de risque et pronostic hospitalier des nouveau-nés de faible poids de naissance (poids de naissance inférieure à 2500 grammes) à l'Hôpital Gynéco-Obstétrique et Pédiatrique de Yaoundé, Cameroun. J Pédiatr Puériculture 2011;24(3):125-32.
- 27. Chiabi A, Mah E, Ntsama Essomba MJ, et al. Facteurs associés à la survie des nouveau-nés de très faible poids de naissance à l'hôpital gynéco-obstétrique et pédiatrique de Yaoundé, Cameroun. Arch Pediatr 2014;21(2):142-6.
- 28. El Awour I, Abed Y, Ashour M. Determinants and risk factors of neonatal mortality in the Gaza Strip, occupied Palestinian territory: a case-control study. *Lancet* 2012;380(1):25-6.
- 29. American Academy of Pediatrics, Committee on Fetus and Newborn, American College of Obstetricians and

Gynecologists and Committee on Obstetric Practice. *Pediatrics* 2006;117(4):1444-7.

- 30. Hegyi T, Carbone T, Anwar M, et al. The Apgar score and its components in the preterm infant. *Pediatrics* 1998;101(1 Pt 1):77-81.
- 31. Chiabi A, Nguefack S, Mah E, et al. Risk factors for birth asphyxia in an urban health facility in Cameroon. *Iran J Child Neurol* 2013;7(3):46-54.
- 32. Lawn JE, Cousens S, Zupan J, et al. Neonatal survival 1. 4 million deaths: when? where? why?. *Lancet* 2005;365(9462):891-900.
- 33. Mouafo Tambo FF, Chiabi A, Ngowe Ngowe M, et al. Mortalité des urgences chirurgicales néonatales à l'Hôpital Gynéco-Obstétrique et Pédiatrique de Yaoundé. *Med Trop(Mars)* 2011;71(2):206-7.
- 34. Jehan I, Harris H, Salat S, et al. Neonatal mortality, risk factors and causes: a prospective populationbased cohort study in urban Pakistan. Bull World Health Organ 2009;87(2):130-8.
- 35. Alihonou E, Dan V, Ayivi B, et al. Mortalité néonatale au Centre National Hospitalier et Universitaire de Cotonou : Incidence, causes et moyens de lutte. Méd Afr Noire 1991;38:745-51.
- 36. Ogunlesi TA, Ogunfowora OB, Adekanmbi AF, et al. Neonatal mortality at Olabisi Onabanjo University Teaching hospital Sagamu. *Nig J Paediatr* 2006; 33(2):40-6.
- Djadou K-E, Azouma D, Yable G, et al. Mortalité néonatale au Centre Hospitalier Régional de Tsévié (Togo). Arch Pediatr 2006;13(8):1156.
- Nagalo K, Dao F, Tall FH, Ten years morbidity and mortality of newborns hospitalized at the Clinic El-Fateh Suka (Ouagadougou, Burkina Faso). *Pan Afr Med J* 2013;14:153.
- Mutombo T. Difficulté d'ameliorer le taux de mortalité néonatale en milieu rural. Méd Afr Noire 1997;44(12):658-60.
- 40. Diallo S, Kourouma S, Camara Y. Mortalité neonatale à l'institut de nutrition et de santé de l'enfant (INSE). *Méd Afr Noire* 1998;45:326-9.
- 41. Yego F, D'Este C, Byles J, et al. Risk factors for maternal mortality in a tertiary hospital in Kenya: a case control study *BMC Pregnancy Childbirth*. 2013; 10:3.
- 42. Engmann C, Walega P, Aborigo RA, et al. Stillbirths and early neonatal mortality in rural Northern Ghana. *Trop Med Int Health* 2012;17(3):272-82.