Risk factors of neonatal mortality in a referral hospital of Kisangani in Democratic Republic of Congo: a case-control study.

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RESUME

Introduction. La mortalité néonatale en République Démocratique du Congo est parmi les plus élevées en Afrique. Cette étude a été menée afin de déterminer la mortalité néonatale ainsi que les facteurs de risque associés.

Patients et méthodes. Cette étude cas-témoins a été réalisée dans l'Hôpital du Cinquantenaire de Kisangani (HCK) de mars 2013 à mars 2017. Les données socio-démographiques, cliniques et biologiques des nouveau-nés décédés ou cas, ont été comparées à celles des nouveau-nés sortis vivants de l'hôpital (témoins). Chaque cas a été apparié à 3 témoins de mêmes sexe et groupe d'âge gestationnel.

Résultats. Parmi les 612 nouveau-nés hospitalisés, dont 199 étaient prématurés, 169 étaient nés dans HCK (dont 20 sont décédés), et 443 référés d'autres hôpitaux (dont 126 décès). La mortalité hospitalière a été de 23,8% (146 cas). La prématurité a été la première cause de décès, suivie des infections et de l'asphyxie péripartale. En analyse bivariée, la mortalité était associée à la prématurité (*P* = 0,000001), aux infections (*P* = 0,01), au faible poids de naissance (*P* < 0,000001), à la référence d'un autre hôpital (*P* = 0,000005), à l'anémie (*P* = 0,000001), aux malformations congénitales (*P* = 0,000001), et aux causes chirurgicales (P = 0,000001).

Conclusion. Le taux de mortalité néonatale reste élevé et associé à des facteurs évitables. Le renforcement des capacités des ressources humaines et l'équipement des hôpitaux de Kisangani peut contribuer à réduire cette mortalité.

Mots-clés. *Nouveau-né, mortalité, facteurs de risque Kisangani, République Démocratique du Congo.*

SAMMARY

Introduction: The neonatal mortality in Democratic Republic of Congo is amongst the highest in Africa. This study aimed to determine the neonatal mortality and associated risk factors.

Methods. This case control study was conducted in *Hopital du Cinquatenaire de Kisangani* (HCK) from March 2013 to March 2017. Socio-demographic, clinical and biological data of dead newborn (cases) were compared to those of alive (controls). One case was matched to 3 controls with same sex and gestational age. Univariate and bivariate analysis were performed

Results. Of 612 newborns hospitalized, 199 were preterm, and 9 post term. One hundred and sixty-nine patients were born in HCK (20 died), and 443 referred from other hospitals (126 died). The hospital mortality rate was 23.8% (146 cases). Prematurity was the first cause of death (67.1% of all deaths), followed by neonatal infections and perinatal asphyxia. In bivariate analysis, the mortality was associated with prematurity (*P* = .000001; OR 7.3 :4.8 – 11.1), neonatal infection (*P* = .01; OR .6: .4 – .9), birthweight <2500 g (*P* < .000001; OR 7.7:5 – 12), reference from other hospitals (*P* = .000005; OR 2.9:1.7 – 5.2), anemia (*P* = .000001; OR 3.6: 2.4 – 5.4), congenital abnormalities (*P* = .000001; OR 8.7 :3.3 – 23), surgical causes (P = .000001; OR 34.1 :4.3 – 269.4).

Conclusion. The neonate mortality rate remains high and associated with avoidable factors. Improving hospital human and material resources, and networking newborn referral between hospitals of Kisangani can contribute to lower neonatal mortality.

Key words. *Newborn, mortality, risk factors, Kisangani Democratic Republic of Congo*

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INTRODUCTION

The reduction of global infant mortality depends on the capacity to reduce neonatal mortality. Worldwide, about 40 % of children under 5 years-old die during the first month of their life and most of them during the first week. [1-2]. Nearly 130 million of babies are born every year. Fourteen million of them die before being 28 days old. Up to 75% of neonate deaths happen within the first 24 hours. Therefore, efforts to achieve the 4th millennium development goal which aims to reduce the under-five mortality, must focus on the reduction of neonatal mortality [3].

Most of those deaths happen in Asian and sub-Saharan countries [3-4]. Among the main causes, three are most important: prematurity, neonatal infections and perinatal asphyxia [2]. Many countries are experiencing the decrease of neonatal mortality rate [1] but it remains high particularly in sub-saharan countries. European countries have the lowest rate, about 3%, followed by American with 5%, African with 28% and then Asian with 36% [3].

In Pakistan, Imtiaz found a neonatal mortality rate about 47.3 for one thousand alive births. Prematurity, caesarian section and obstetrical complications in intrapartum period were associated with neonatal deaths. Forty-five per cent happened during the first hour and 73% in the first 48 hours. Prematurity was the leading cause of mortality in 34% of cases, followed by asphyxia (21%) and infections (23%) [5]. A Kenyan survey on the survival of the newborns of less than 2000 grams in the national Kenyatta hospital revealed a death rate of 37.4%. The rate of survival was about 0%, 68 and 78% respectively among the newborns of less 1000grammes, of 1000 to 1499 grams, of 1500 to 1999 grams [6].

In Democratic Republic of Congo (RDC), the neonatal mortality is high: the national death rate is the 7th most elevated in the world and the 3rd most elevated in Africa [3, 7].

This survey aims to contribute to the reduction of neonatal mortality. The specific objectives were (i) to describe the epidemiological and clinical characteristics of the newborns hospitalized in *Hôpital du Cinquantenaire de Kisangani* (HCK) (ii) to determine the rate of neonatal mortality and (iii) risk factors associated with it.

PATIENTS AND METHOD

This case-control survey was conducted in the HCK, a secondary level hospital created since 2013 in Kisangani town. Data have been retrospectively collected from March 2013, when the hospital begun functioning, to March 2017. All children born in HCK then hospitalized as well as those born in other hospitals then referred to HCK were included. The premature were treated in the neonatal incubator and nourished by maternal or bottle formula milk if the former was unavailable. Neonatal infections, diagnosed on the basis of clinical signs and/or positive C reactive protein (CRP), were managed with the association of intravenous cefotaxime, amoxicilline and gentamicine.

There was no cooling device for asphyxiated newborn. The treatment was only medical: airways aspiration, respiratory assistance with ambu bag, oxygen, antibiotics, 10% glucose infusion with electrolytes (Na+, K+, Cl -, Ca++). Collected data concerned age, sex, residence, birthweight, gestational age, symptoms, diagnosis, days of hospitalization, delivery problems, biological exams (qualitative CRP, hematocrit, white blood cells count, calcemia, glycemia, blood slides for malaria), mode of birth delivery, and survival.

All well-being babies born at HCK with no pathologic history and no signs were excluded. Likewise, all asymptomatic babies born in HCK or referred from other hospitals with positive history related to sepsis, but who afterwards had negative CRP were declared as 'not infected' and released. In this study, they were excluded. Referred newborn, who arrived at HCK with no life signs were also excluded. The cohort was divided in two groups: data of dead newborns (cases) were compared to those of alive newborns (controls) in the purpose of determining the risk factors. Data of one dead newborn matched those of three alive on the criterion of sex and gestational age. Treatment of data were realized with Microsoft® Excel 2016 and analysis with Epi info™ 7. 2. 1. 0. Pearson's chi square at the confidence interval of 95% was used to determine difference in dochotomic data. Risk factors associated with neonatal death were assessed by odds ratio. Means of quantitative data were compared by Student t test.

This study had the agreement of Academic authorities of the Faculty of Medicine and Pharmacy of the University of Kisangani. Forms

used for data collection included neither names nor full recognizable address of parents and data were not accessible to people stranger to the study.

RESULTS

Characteristics of patients

Table 1. Socio-demographic data (N=612).

		n(%)
Age	0 – 7 days	551 (90 %)
	8 – 30 days	61 (10 %)
Gestational Age	Preterm	199 (32.52%)
	Term	404 (66.01%)
	Post-term	9 (1.47%)
Address	Makiso	366 (59. 8%)
	Kabondo	110 (17.97%)
	Tshopo	64 (10.46%)
	Mangobo	39 (6.37%)
	Kisangani	30 (4. 9%)
	Lubunga	3 (0.49%)
Hospital	HCK	169 (27.61%)
	From Other Hospitals	443 (72.39%)
Birthweight (N=612)	>4000g	20 (3.27%)
	2500-4000g	345 (56.37%)
	1500-2499g	131 (21.41%)
	1000-1499g	73 (11.93%)
	<1000g	43 (7.03%)
Diagnosis*	Infections	438 (71.57%)
	Prematurity	199 (32.52%)
	Perinatal asphyxia	142 (23.2%)
	Congenital abnormalities	20 (3.3%)
	Surgical causes	11 (1.8%)
Mortality	146/612 (23.86%)	
	Within first 24 hours	68/146 (46.5%)
	Within first 48hours	90/146 (61.6%)

(*): some newborns had co-morbidities (like infected preterm or infected asphyxiated newborns)

Age varied from 2 minutes to 30 days (mean 3, 1 ± 5 days; median: 1 day). The sex ratio F: M was of 0.87 (285/327). The majority of the newborns came from the township of Makiso.

The weight varied from 550 to 4700 g (mean 2573.5 ± 976.5 g; median 2800 g). Neonatal infections were the leading cause of hospitalization.

Almost half of all deaths occurred within the first 24 hours and 2 thirds in the first 48 hours. The hospitalization length was 10 ±14 days (variation from 10 minutes to 68 days, median 5 days).

Characteristics of newborns and type of maternity

Table 2: Newborn from HCK (Inborn) versus from other hospitals (outborn)

Features	Outborn	Inborn	P
Mean Birthweight (N=612)	2407.5 (999.2)* g	2978.6 (790.2)* g	**< .00001**
Mean Hospitalization duration (N=612)	10.7 (15.2)* days	6.9 (8.5)* days	**.0001**
Birthweight <2500 g (N = 246)	210 (85.37%)	36 (14.63%)	**< .00001**
Prematurity (N=199)	172 (86.43%)	27 (13.57%)	**< .00001**
Asphyxia (N=119)	79 (66.39%)	40 (33.61%)	**0.05**
Sepsis (N = 438)	339 (77.4%)	99 (22.6%)	**.00001**
Age at arrival : mean (N=612)	3,3 (5.3)*	2.5 (4)*	**.04**
Mortality (N=146)	126 (86.3%)	20 (13.7%)	**< .00001**

(*): standard deviations.

Newborn coming from other hospitals had lower birthweight than those born in HCK, and longer hospitalization duration. Deaths due to prematurity, sepsis and asphyxia were more important among outborn than inborn babies.

Risk factors

Among the main reasons of death, the prematurity came first (98 out of 146 deaths or 67.1%), followed by neonatal infections and asphyxia. Factors associated to mortality were age ≤7 days, prematurity, neonatal infection, low birthweight (less than 2500 gr), reference from other hospitals, anemia, obvious and life-threatening congenital malformations, surgical causes. There was no meaningful difference between the cases of death by sex ($P = 0.2$).

Table 3. Factor associated with hospital mortality

	Dead	Alive	OR (95% IC)	*P* value
Infection				
Yes	94	344	0.6(0.4-0.9)	**S**
No	52	122		
Prematurity				
Yes	98	101	7.3 (4.8-11.1)	**S**
No	48	365		
Perinatal asphyxia				
Yes	26	93	.8 (0.5-1.4)	N.S
No	120	373		
Anemia				
Yes	61	77	3.6 (2.4-5.4)	**S**
No	85	389		
Congenital abnormalities				
Yes	15	6	8.7 (3.3-23)	**S**
No	131	460		
Surgical Causes				
Yes	10	1	34.1 (4.3-269.4)	**S**†
No	136	465		
Age				
≤7 days	137	414	0.9-4.5)	**S**†
>7days	9	52		
Sex				
Female	64	221	0.8 (0.59-1.2)	N.S
Male	82	245		
Origin				
other hospitals	126	317	2.9 (1.7-5.2)	**S**
HCK	20	149		
Birthweight				
<2500 g	111	135	7.7 (5-12)	**S**
> 2500 g	35	331		

* WGA: weeks of gestational age; †: Mid-p exact;

DISCUSSION

Characteristics of patients

Newborns of 0 to 7 days represented 90%. The majority of the newborns came from the township of the Makiso, which is the urban center of Kisangani town. These results agree with those of other authors that found a predominance of 0 to 7 days-old neonates [8]. It is also during this period that most of the deaths occur [3]. The preponderance of the Makiso township is explicable by proximity, because the HCK is located in Makiso.

Seventy-two per cent of the newborns have been referred by other hospitals of the city. The reason is that, during the study period, HCK was more equipped than any other referral hospital in Kisangani, especially about pediatric devices. But many of them arrived in poor clinical statute because of low level healthcare in the origin hospital.

Newborn of less than 2500 g were 366 (59,8%). This reflects the burden of low birthweight in RDC noticed by other studies [9] and the high proportion of the premature in our sample.

About main neonatal diagnosis, infections were the most frequent, followed by prematurity and asphyxia. These data agree with those other studies [3, 5, 6].

The hospital mortality rate of 23.8% was close to 23.1% found in Ethiopia [17], higher than the 5.3% in Algeria [25], 8% in the Gabriel-Touré hospital [10], 9% and 13.1% in Burkina Faso [11, 15], 10% and 20% in Cameroon [16, 21], 14.2% in Nigeria [13] and 20% in Ivory Coast [18]. In Uganda, Musooko found a rate of 10.9% [26] The rate is lower than the 28.4% found in Bangui [12], 38% in many other African countries [3]. This situation might be explained by the fact that many newborn came from other hospitals in bad clinical state because, among those who were born in HCK, the mortality rate was 13.7%.

Risk factors

The prematurity was the most frequent mortality reason (67.1%), followed by neonatal infections and asphyxia. This preponderance was found by many other studies: Imtiaz found respectively in Pakistan 34%, 23% and 21% [5], Lawn found 28%, 26% and 23% [3]. But some studies found sepsis as the leading cause of newborn mortality [16,21, 22], and others incriminated asphyxia first [18-19, 27].

However, Kisito N found, in Burkina, the rates of hospital mortality of 23.5% among premature, 20.9% among asphyxiated and of 17.6% among infected neonates. Globally the 3 main reasons were found [25]. Rates observed in this study were higher. One reason is the hospital origin: 93.3% of the newborns have been referred because of the insufficiency of neonatal resuscitation conditions and the lack of incubator for warming the premature. Other surveys also found a higher rate of neonatal mortality among newborn referred from other hospitals [21,24,29].

Our results showed that nearly one newborn out of 3 referred from other hospitals died. Katamea found, in Lumbumbashi, DRC, similar facts: 37.5% of referred newborn died [29]. Infants of gestational age less than <37 weeks had a risk of death 7 times more elevated than term neonates; those with birthweight <2500g 4 times more elevated, those referred from other hospital 12 times more elevated.

GarcõÂa-Basteiro found, in Mozambique, that preterm delivery was associated with 5 times higher mortality compared to term babies [14]. The association between low birthweight and newborn mortality was confirmed by many surveys [15,16, 21]. Other risk factors were anemia, obvious congenital malformations, surgical reasons. Different studies have found similar results [3, 5, 8, 9, 16, 22, 27]. The proportion of anemia is to underline because it is associated to nearly half of the cases of death. The high proportion of preterm and low birthweight newborn can partially explain this high rate, like some author stated it [23].

Mortality is also high in case of congenital malformations requiring an urgent surgical management. This reflects local insufficiency in skilled human resources in anesthesia and resuscitation of the newborn. In Kisangani town there is neither a pediatric surgeon. This situation is observed in a lot of low-income countries [12].

Limits of our study

In this study we did not check up important data about birth order and birth spacing, maternal age and post-natal data like mode of feeding (breastfeeding versus formula). Data were recorded retrospectively and, for some newborn, maternal details about date of menstruation was the only one basis of gestational age determination. Therefore, biais could have occur about classifying newborn in term or preterm groups.

CONCLUSION

The mortality rate was high and significantly associated to avoidable factors. More interventions about training, neonatal equipment and networking newborn referral between hospitals of Kisangani can contribute to lower neonatal mortality.

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