

Prevalence and Causes of Neonatal Mortality at Chu-Mel, Cotonou in 2023

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Abstract

Introduction: Neonatal mortality represents a global health problem that has been at the core of programs developed by the World Health Organization (WHO) for more than 30 years. In our country, it represents a real scourge and remains high despite the efforts made by the Ministry of Health. The goal of this study was to investigate the prevalence and causes of neonatal mortality at CHU-MEL of Cotonou in 2023. **Material and Methods:** This was a cross-sectional and descriptive study with retrospective data collection, carried out in the neonatology unit of the Mother and Child Teaching Hospital of Lagune (CHU-MEL) in Cotonou over a period of six months from January 1, 2023 to June 30, 2023. All neonates, premature or full-term, born alive and who died during hospitalization in the unit were included. **Results:** 211 cases of neonatal deaths were recorded among the 2884 neonates hospitalized in the unit during the study period, representing a hospital prevalence of 7.31%. Early neonatal mortality represented 81.5% of cases. The average age at admission was 4.6 days \pm 5.3. The average weight of deceased neonates was 1609.08 \pm 798.35 g. The most frequent reasons for hospitalization were represented by prematurity (60.66%) and respiratory distress (23.22%), respectively. Prematurity was the leading cause of neonatal mortality (41.7%), followed by neonatal infections (29.4%) and perinatal asphyxia (10.9%). **Conclusion:** The prevalence of neonatal mortality in the neonatology unit of CHU-MEL is high. Efforts to improve the quality of perinatal care departments must be intensified to reduce this prevalence.

Keywords

Neonatal Mortality, Neonates, Prevalence, Causes, Cotonou (Benin)

1. Introduction

Neonatal mortality is defined as the number of children dying between 0 and 28

days of life per 1000 live births [1]. Out of 130 million annual births in the world, four millions neonates die before one month, 99% of them in poor countries [2] where neonatal mortality rates remain high at more than 45% on average compared to 4% in developed countries [3]. Among them, three quarters die in the first week of their life with a greater risk of death in the first 24 hours. Most causes of death are known [3] [4] and largely preventable or accessible to treatment [5] [6]. At the United Nations Summit dedicated to the adoption of the post-2015 development agenda, Benin made a commitment to work towards achieving 17 Sustainable Development Goals (SDGs) by 2030 and therefore to reduce the neonatal mortality rate to no more than 12 per 1000 live births as stipulated in target 3.2 of the Sustainable Development Goals [7]. Studies relating to neonatal mortality have been multiplied over the past two decades in Africa. In Benin, few studies on the subject have been carried out in recent years [8] [9]. That's the reason why we initiated this study with the aim of taking stock of neonatal mortality and its causes.

2. Material and Methods

The study took place in the neonatology unit of the Pediatric department of CHU-MEL. This was a cross-sectional and descriptive study with retrospective data collection, focusing on neonatal deaths occurring over a period of 6 months from January 1, 2023 to June 30, 2023 in the neonatology unit of CHU-MEL in Cotonou.

Our study population consisted of neonates hospitalized and deceased in the neonatology unit of CHU-MEL. Neonates, premature or full term, born alive and admitted to the neonatology unit of CHU-MEL and neonates who died during hospitalization between 0 and 28 days were included in our study. Neonates who died before admission and deaths occurring after transfer to another department were not included in our study. We carried out an exhaustive recruitment of all cases meeting the inclusion criteria of our study.

The dependent variable was neonatal death.

The independent variables were sociodemographic variables (In the neonate: age, sex, origin; In the mother: age, profession, area of residence, level of education, in the father: age, profession).

Variables related to the gestational history (medical health history of the mother, gynecological and obstetric history of the mother, gestation, parity, induced or spontaneous miscarriages, follow-up of pregnancy: number of ANC done, number of obstetric ultrasound done, ABO and Rhesus D blood groups of the mother, electrophoresis of the mother's hemoglobin, serologies, prophylaxis (iron/folic acid, LLIN, deworming, weight-for-height index: WHI), incidents occurring during pregnancy (infections, hypertension, etc.)

- Course of delivery: term, PROM (premature rupture of membranes), maternal fever, route of delivery, maneuvers.
- Condition of the child at birth: APGAR score, measurements.
- Clinical variables of the neonate (reason for admission, general condition,

- cardiovascular status, respiratory status, neurological status).
- Paraclinical variables (hemogram, CRP, blood culture, blood sugar, chest x-ray).
 - Variables linked to care (care of the neonate at birth: administration of vitamin K1, vaccination against hepatitis B, oxygen therapy, phototherapy, antibiotic therapy).
 - Variables linked to the evolution (length of hospital stay, age at death, cause of death).

The different data sources used were medical records of neonates; admission, hospitalization and death registers of neonates.

Data collection was carried out on the basis of a data collection sheet in the form of a pre-established processing sheet, developed for this purpose with KoBoToolbox tool. It was carried out by ourselves for two months from August to September 2023. Firstly, we exhaustively identified all neonates admitted to the department during the study period using admission registers. Secondly, we recorded all the deceased neonates using death registers. Finally, we completed the collection form using their medical records. After collection, we verified the completeness and accuracy of the data.

Data entry was carried out using KoBoCollect software. The data have been analyzed using SPSS software version 2021. During the data analysis, the quantitative variables were grouped into classes and presented as mean \pm standard deviation when the population is homogeneous and as median with extremes if the population is not homogeneous. As for qualitative variables, they are represented in number or percentage.

3. Results

3.1. Hospital Prevalence of Neonatal Mortality

From January 1, 2023 to June 30, 2023, 2884 neonates were hospitalized in the neonatology unit of CHU-MEL in Cotonou. We recorded 211 cases of death during this period, representing a hospital prevalence of 7.31%.

3.2. Sociodemographic Characteristics of Neonates

3.2.1. Age and Sex

In the 211 neonates included, 114 (54.03%) were female with a sex ratio of 0.9. The average age was 4.6 days \pm 5.3 with the extremes of one hour and 26 days.

3.2.2. Origin

Neonates transferred from the delivery room of CHU-MEL represented 60.2%.

3.2.3. Sociodemographic Characteristics of Mothers

The average age of the mothers was 27.3 years \pm 5.9 with the extremes of 15 years and 41 years. The most represented age group was 25 to 30 years old. The mothers of neonates were mainly workers (31.75%) and resellers (30.80%). In 75.4% of cases, the mothers lived in an urban area. In 52.1% of cases, the mothers were not in school. University level was in 10.4% of cases.

3.2.4. Sociodemographic Characteristics of Fathers

The average age of the fathers was 32.6 years \pm 5.6 with the extremes of 17 years and 63 years. The fathers of neonates were mainly workers (42.2%) and resellers (12.8%).

3.3. Clinical Characteristics of Neonates

3.3.1. Gestational History Data

The study revealed that 64.54% of mothers had less than 4 antenatal consultations.

3.3.2. Pathologies in Pregnancy

The majority of mothers had at least one pathology during pregnancy. The threat of premature delivery was found at 34.9% followed by preeclampsia (26.7%), hemorrhages (12.8%) and bacterial infections (10.5%).

3.3.3. Childbirth

The majority of mothers had given birth by vaginal delivery (72.5%).

3.3.4. Birth

Term of birth

The average term of birth in our study was 31.4 weeks \pm 2.2 with the extremes of 22.4 WA and 42.4 WA.

APGAR score and concept of resuscitation

The average score at the first minute was 6.2 \pm 1.8 in the neonates included in our study versus 6.8 \pm 1.9 at the fifth minute. Among the 211 neonates who died, 91 were resuscitated, *i.e.* 43.1%.

The distribution of deceased newborns according to their weight showed that 54.5% of them weighed less than 1500 g followed by those whose weight was between 1500 and 2500 g. For size, the average was 40.7 cm with extremes of 22 cm and 54 cm.

3.3.5. Reason for Admission

The most frequent reasons for admission in our study were prematurity (60.66%), respiratory distress (23.22%) and jaundice (3.79%), respectively. **Figure 1** shows the distribution of neonates according to the reason for admission.

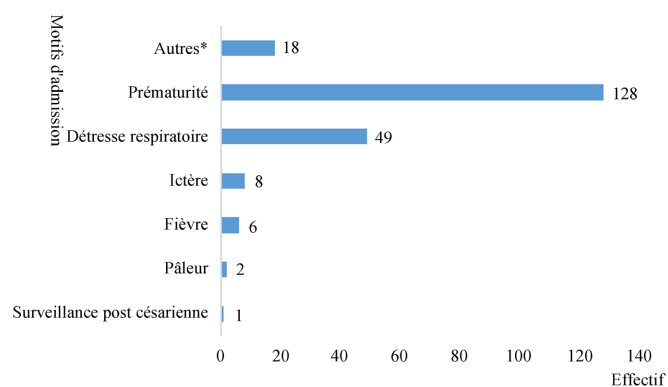


Figure 1. Répartition des nouveau-nés selon le motif d'admission, CHU-MEL, 2023.

3.3.6. Admission Time

Nearly half of neonates (47.4%) were admitted to the neonatology unit after the first hour of life (**Figure 2**).

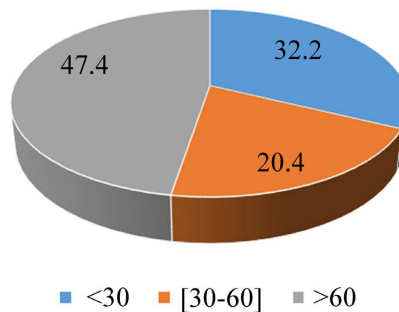


Figure 2. Distribution des nouveau-nés selon le délai d'admission, CHU-MEL, 2023.

3.4. Data Related to Death

3.4.1. Age at Death

The average age at death of neonates was 4.9 days \pm 5.3 with the extremes of one day and 27 days. We noted 173 deaths in neonates during the first seven days of life, representing an early neonatal mortality of 81.5%.

3.4.2. Length of Hospital Stay

The average length of hospital stay was 5.6 days \pm 4.3 with the extremes of 1 and 25 days. Neonates who died between the 2nd and 3rd day of hospitalization represented 35.1% of the total number, followed by deaths during the 1st day of hospitalization (33.2%).

Prematurity was the main cause of neonatal deaths (41.7%), followed by neonatal infections (29.4%). The main etiologies retained are presented in **Table 1** below:

Table 1. Etiologies of neonatal deaths, CHU-MEL, 2023.

Causes of death	Size	Percentage
Prematurity	88	41.7
Neonatal infections	62	29.4
Perinatal asphyxia	23	10.9
Neonatal respiratory distress	11	5.2
Bilirubin encephalopathy	8	3.8
Congenital malformation	6	2.8
Heart disease	6	2.8
Hemorrhagic disease of the neonate	2	0.9
Severe anemia	1	0.5
Severe dehydration	1	0.5
Hypoglycemia	1	0.5
Drug poisoning	1	0.5
Edema and ascites syndrome	1	0.5

4. Discussion

4.1. Prevalence

In view of the results, the neonatal mortality rate of 7.31% at the neonatology unit of CHU-MEL in Cotonou during the study period was relatively high with an early neonatal mortality of 81.5%. This was a hospital prevalence which did not constitute a good reflection of the prevalence of neonatal mortality in Benin. It was higher than that observed by Harir *et al.* at Sidi Bel Abbes gynecology-obstetrics hospital of wilaya in Algeria and by Randriamanga RL *et al.* at the hospital center of Soavinadrianain Madagascar where it had been reported 5.3% and 5.8%, respectively [10] [11]. Conversely, this rate was lower than the rates of Koum *et al.* in 2015 in Cameroon [12], by Nagalo *et al.* [13] in Burkina-Faso in 2013 and Vierin-Nzame *et al.* [14] in Gabon in 2009 which reported 20.3%, 13.1% and 14.3%, respectively.

The prevalence of our study, although high, still remains lower than that reported by Houssou M.*et al.* [8] in Benin in 2015 which was 18.7% and that of Noudamadjo *et al.* [9] in 2021 (16.8%) in Benin but in different regions. The fact that our prevalence is lower than that of other authors could be explained by the numerous advances in the care of neonates, which have improved in our country, especially the improvement of the technical platform with the acquisition of equipment such as non-invasive ventilation devices, resuscitation tables, radiant heaters, oxygen concentrators.

Our mortality rate, however, remains high compared to European studies where socio-economic conditions and access to care are better [1].

These variations between studies could be explained in part by the size of the sample, differences in terms of hospitalization criteria, the severity of cases admitted to each structure and the quality of antenatal care provided in these establishments.

Table 2 presents some neonatal mortality rates found in different studies.

Table 2. Neonatal mortality rates in different studies.

Authors	Country	Year	Mortality rate
Y.VierinNzame <i>et al.</i> [14]	Gabon	2010	14.3%
Manzar <i>et al.</i> [15]	Pakistan	2012	8.1%
Kisito Nagalo <i>et al.</i> [13]	Burkina Faso	2013	13.1%
Harir Noria <i>et al.</i> [10]	Algeria	2015	5.3%
Kedy Koum <i>et al.</i> [12]	Cameroon	2015	20.3%
Houssou <i>et al.</i> [8]	Benin	2015	18.7%
Mouahid <i>et al.</i> [16]	Morocco	2019	19%
Noudamadjo <i>et al.</i> [9]	Benin	2021	16.8%
Randriamana RL <i>et al.</i> [11]	Madagascar	2022	5.8%
Our study	Benin	2023	7.31%

4.2. Sociodemographic Characteristics

4.2.1. Sex of Neonates

Female gender was the most represented in our study (54.03%) with a sex ratio of 0.9. This result is similar to that observed by Chelo *et al.* [17] who reported a sex ratio of 0.91. A male predominance was found by Houssou [8] (sex ratio = 1.2) in 2015, Noudamadjo [9] (sex ratio = 1.23) in 2021, all in Benin and Nagalo (sex ratio of 1.2) in Burkina Faso [13].

4.2.2. Age at Admission of Neonates

The average age at admission of neonates in our study was 4.6 ± 5.3 days, which is similar to those reported in Morocco by El Hakioui in 2020 (6.5 days) [18] and Chabli in 2021 (4.8 days) [19]. It was nevertheless higher than the age of 2 days reported in Burkina Faso by Nagalo *et al.* [13] and Barro *et al.* [20]. Neonates whose age was less than or equal to 7 days of life were the most represented in our study as well as in the data found in the literature [12] [18] [19]. This high concentration of neonates in the early neonatal period is explained by the fact that many admissions were neonatal emergencies.

On the other hand, in studies carried out in developed countries, the age of neonates at admission was higher. This may be due to the prolonged stay in maternity wards of neonates at risk of complications [21].

4.2.3. Clinical Characteristics of Neonates

Maternal medical history and follow-up of the pregnancy:

Neonatal deaths occurred in 62.6% of cases among multiparous women. That is consistent with the study conducted by Manzar *et al.* in Pakistan who found a frequency of 70.1% among multiparous women [15]. In Sudan, a study reported a significant association between multiparity and low attendance at antenatal care services. Thus, multiparous women tend to rely on their experience of previous pregnancies and do not feel the need for prenatal checks, believing that they already know what to expect during pregnancy or childbirth [22].

The follow-up of pregnancies makes it possible to detect high-risk pregnancies and monitor their progress. The health of the child during the first months of life depends largely on the conditions of the pregnancy [23]. In our study, only 35.54% of mothers had followed up their pregnancy with at least 4 antenatal consultations. The distribution of deceased neonates according to the implementation of the different prophylaxes by the mothers revealed that anti-malaria prophylaxis was effective in 46.9% of mothers for the intermittent preventive treatment IPT and 67.3% for LLIN. Mothers who received a deworming medication during pregnancy represented 42.7% of mothers and 73.9% of them were vaccinated against tetanus during pregnancy. The low socio-economic level of parents and the absence of health coverage could explain these worrying results despite the numerous reforms in terms of pregnancy follow-up (new recommendations of WHO), and the legal provisions making antenatal consultations compulsory and systematic in the Republic of Benin.

In Africa, several studies have also demonstrated the importance of antenatal consultations: mothers who did not have any consultation had a higher probability of losing their child before the 8th day; this risk decreases when the woman comes for consultation [24]-[26]. For example, in Nigeria, the study carried out by Akinyemi *et al.* found that a good follow-up of the pregnancy reduced the risk of neonatal death by 30% [27].

The threat of premature birth (34.9%), preeclampsia (26.7%) and hemorrhages (12.8%) were the most common pregnancy pathologies in our study. Koum *et al.* [12] reported in their study that malaria was the main disease in mothers, while Harir *et al.* [10] found genital infections (49.39%) and high blood pressure (26.82%). During our study, hemorrhage was found in 12.8% of mothers whose neonates were included, which is similar to the results of Sidibé *et al.* (9.2%) in 2006 in Mali [28].

These results show the multitude of pathologies that can occur during pregnancy and consequently, the importance of antenatal consultations in the fight against neonatal mortality.

4.2.4. Mode of Delivery

The course of childbirth plays an important role in the survival of the neonate. Several factors come into play and the presentation of the fetus comes first. A delivery that is too long or too laborious can have significant consequences on the condition of the neonate at birth.

The rate of cesarean deliveries was 26.5%. This rate is higher than the rate of 10 to 15% recommended by WHO [28]. It is close to that found by Koum *et al.* [12] which is 24.3% but remains significantly lower than the result of Nagalo *et al.* [13] in Burkina Faso (42.8%). Some studies prove that delivery by cesarean section is a protective factor against neonatal mortality [29] [30]. The vaginal route seems to expose people to a greater risk of dystocia, a source of intrauterine hypoxia and asphyxia at birth and therefore of death if adequate neonatal resuscitation care is not applied [13]. In contrast, Akinyemi [27] reported that neonates born by cesarean section have significantly twice the risk of death. This could be explained by the fact that the indications for cesarean sections were either maternal rescue or acute fetal distress which exposes one to the risk of iatrogenic prematurity, neonatal asphyxia and therefore increases the risk of neonatal death.

4.2.5. Term and Birth Weight

The average term of birth in our study was 31.4 weeks \pm 2.2 with the extremes of 22.4 weeks of amenorrhea and 42.4 weeks of amenorrhea. It is lower than that of Nagalo *et al.* [13] who reported a gestational age of 37.4 \pm 3.53 WA with the extremes of 25 weeks and 43 weeks. This discrepancy could be explained by the fact that in the neonatology unit of CHU-MEL, even non-viable neonates (<25 WA) are hospitalized while the smallest term in the study Nagalo was 25 WA.

Premature infants were the most represented in our study population with a rate of 77.77%. This result is close to that of Harir *et al.* [10] in Algeria (89%) but

is significantly higher than those of El Hakioui [18] in Morocco, Yenan *et al.* [30] in Ivory Coast and Cissé *et al.* [31] in Senegal who reported 26%, 30% and 47.3%, respectively. This could be explained on the one hand by the fact that our study is carried out in a neonatology unit of a referral hospital which receives more premature neonates and on the other hand, by the fact that nowadays, the risk of premature birth increases due to current lifestyle and stress which arise from social and professional pressures. As for the average term at birth, recruitment of neonates less than 25 WA in our study could also explain this difference. The average birth weight in our study was 1609.08 ± 798.35 g with the extremes of 250 and 3710 g. The majority of neonates had a birth weight lower than 2500 g (80.6%) and this result is similar to that of Harir *et al.* [10] (84.27%). However, it is higher than that found by Yenan [30] in Ivory Coast (60.21%). This disparity could be explained by the predominance of premature neonates in our study while Yenan observed more full-term neonates in his study.

The predominance of neonatal mortality among low birth weight neonates is due to their vulnerability during the first hours and days of their life, especially if they are premature. However, low birth weight is not only due to prematurity, but also to in utero growth retardation or a combination of both factors [13]. This is why it is necessary to pay increased attention to the prevention of low birth weight, in order to provide them with additional nutrition, warmth and care, which could significantly reduce neonatal deaths [6].

4.2.6. Causes of Death

The causes of neonatal death are often difficult to analyze because several causes can be associated. The absence of a death certificate and systematic autopsy in many countries often makes it difficult to find the main cause of death [19]. The predominant causes in our study were: prematurity (41.7%), neonatal infections (29.4%) and perinatal asphyxia (10.9%).

Globally, the causes of neonatal deaths vary by region. The main causes of neonatal mortality in developing countries are infectious diseases in 36% of cases (including sepsis, pneumonia, tetanus and diarrhea), premature births with its related complications (27%) and neonatal asphyxia (23%). The remaining 7% of deaths were linked to a congenital anomaly [4]. The causes also vary depending on the time of occurrence of death during the neonatal period. Neonatal infections especially predominate towards the end of the neonatal period. That is to say beyond the first week. Deaths due to prematurity and perinatal asphyxia are highest during the early neonatal period [32].

Prematurity is as much a risk factor for mortality as it is a direct cause of neonatal mortality. According to the International Classification of Diseases, the cause of death is attributed to prematurity when death is the result of complications specific to prematurity or when it occurs in a very preterm baby. For example, if a moderately preterm infant develops an infection and dies, the death should be attributed to the infection while prematurity acts as a risk factor [6].

Compared to international data, our prematurity mortality rate (41.7%) was

close to those of Barro *et al.* [20] in Burkina Faso and Kingwengwe *et al.* [33] in the Democratic Republic of Congo which found rates of 42.8% and 44%, respectively. This high rate of death could be explained by the fact that premature neonates are fragile with immaturity of vital functions causing multiple complications that are difficult to manage in our context. Neonatology units in countries with limited resources like ours do not have a technical platform adapted to the care of premature babies with the unavailability of exogenous surfactant and the absence of parenteral nutrition.

At the neonatology unit of CHU-MEL, the acquisition and use of devices for non-invasive ventilation such as nasal CPAP have contributed to improving the management of respiratory distress in premature babies.

4.2.7. Neonatal Infections

In countries with high neonatal mortality rates, approximately half of all neonatal deaths are due to infections and most of these deaths are preventable or treatable [34]. In our work, neonatal infection was the second leading cause of death in neonates (29.4%), all locations included (respiratory, neuro-meningeal, systemic, etc.). This result is similar to that found by Lahmini *et al.* in Morocco [35] between 2012-2016 (32.2%) and Dare *et al.* in Ghana [36] between 2004-2012 (29%). Other authors have noted higher rates. Vierin Nzame *et al.* in their study in Gabon [14], indicated that 38.46% of deaths in neonates were associated with neonatal infections. Koum reported that they were responsible for 54.9% of deaths [12]. On the other hand, countries with low neonatal mortality rates generally have lower proportions of mortality from neonatal infection [34]. The risk of a child dying from a neonatal infection is eleven times greater in countries with very high mortality than in those with very low mortality [2].

These high frequencies in our context could be explained by poor follow-up of pregnancies which prevents screening and management of risk factors for maternal-fetal infection and the lack of asepsis in the management of neonates.

4.2.8. Perinatal Asphyxia

Perinatal asphyxia is the third leading cause of neonatal mortality in developing countries [4]. We recorded 10.9% of neonatal deaths due to this pathology. This is consistent with the results of Kalondji *et al.* [37] in the DRC (10.3%) and Chabli [19] in Morocco (12.3%). Other authors have found higher rates: Ongoiba [38] in Morocco in 2010 (22.6%), Barro *et al.* [20] in 2016 (20.81%) and Nagalo *et al.* [13] in 2013 (20.9%) in Burkina Faso. The high rate of deaths from perinatal asphyxia could be explained by poor monitoring of labor. Indeed, good monitoring of labor by the partograph makes it possible to detect anomalies in order to initiate the necessary actions in time. The inadequacy of resuscitation in the delivery room and the absence of an adequate technical platform for the management of cases of asphyxia in neonatology could also be at the origin of the high rates.

The incidence of perinatal asphyxia must be reduced to lower the resulting morbidity and mortality. This requires the implementation of preventive measures

such as the adequate monitoring of parturients during labor, the evacuation and transfer of parturients at risk from peripheral hospitals, the provision of means of resuscitation of neonates in a state of asphyxia emergency in peripheral hospitals, raising awareness of health professionals on the importance of multidisciplinary collaboration in general, especially obstetric and pediatric management.

5. Conclusion

Neonatal mortality remains a real public health problem today. It is an indicator of the state of health of the entire population. The neonatal mortality rate at CHU-MEL in 2023 was high and mainly affected the early neonatal period.

Obstetric and pediatric collaboration, improving the quality of management and especially in the first week of life, need to be strengthened to have a significant impact on neonatal mortality in our countries with limited resources.

Conflicts of Interest

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

References

- [1] Champion, V., Serfaty, A. and Gold, F. (2011) Mortinatalité et mortalité néonatale. *EMC—Pédiatrie—Maladies Infectieuses*, **6**, 1-10. [https://doi.org/10.1016/s1637-5017\(11\)72496-6](https://doi.org/10.1016/s1637-5017(11)72496-6)
- [2] Lawn, J.E., Cousens, S. and Zupan, J. (2005) 4 Million Neonatal Deaths: When? Where? Why? *The Lancet*, **365**, 891-900. [https://doi.org/10.1016/s0140-6736\(05\)71048-5](https://doi.org/10.1016/s0140-6736(05)71048-5)
- [3] WHO (2008) World Health Statistics 2011. http://iris.who.int/bitstream/handle/10665/44552/9789241564199_eng.pdf?sequence=1
- [4] Nguyen Ngoc, N.T., *et al.* (2006) Causes of Stillbirths and Early Neonatal Deaths: Data from 7993 Pregnancies in Six Developing Countries. *Bulletin of the World Health Organization*, **84**, 699-705. <https://doi.org/10.2471/blt.05.027300>
- [5] Labie, D. (2005) Le scandale des 4 millions de morts néonatales chaque année: Bilan et actions possibles. *Médecine Sciences*, **21**, 768-772. <https://doi.org/10.1051/medsci/2005218-9768>
- [6] Lawn, J., Kerber, K., Enweronu-Laryea, C. and Masee Bateman, O. (2009) Newborn Survival in Low Resource Settings—Are We Delivering? *BJOG: An International Journal of Obstetrics & Gynaecology*, **116**, 49-59. <https://doi.org/10.1111/j.1471-0528.2009.02328.x>
- [7] (2019) Rapport national de spatialisation des cibles prioritaires des Objectifs de Développement Durable au Bénin. p. 75.
- [8] Houssou, M., Ahanhanzo Hessou, Y.G., Sawadogo, B., Antara, S., Mckenzie, A., Sawadogo, M., *et al.* (2020) Neonatal Mortality and Risk Factors in the University Hospital of the Mother and Child Lagoon in Cotonou, Benin, 2015-2016. *Journal of Interventional Epidemiology and Public Health*, **3**, Article No. 6. <https://doi.org/10.37432/jieph.2020.3.3.26>
- [9] Noudamadjo, A., Kpanidja, G., Mohamed, F., Zinvokpodo, K., Ahodegnon, R., Agossou, J., *et al.* (2021) Neonatal Morbidity and Mortality from 2010 to 2016 in the

- Neonatal Care Unit of the University Teaching Hospital of Parakou/Benin. *Open Journal of Pediatrics*, **11**, 215-224.
- [10] Noria, H., Sarah, O. and Asmaa, O. (2015) Facteurs de risques de mortalité néonatale dans l'hôpital de gynécologie-obstétrique de la wilaya de Sidi Bel Abbes, Algérie. *Pan African Medical Journal*, **20**, Article No. 387. <https://doi.org/10.11604/pamj.2015.20.387.5032>
- [11] Randriamanga, R.L., Tsifiregna, R.L., Mioramalala, S.A., Andriannirina, Z.Z. and Robinson, A.L. (2022) Facteurs de risque de décès néonataux au Centre Hospitalier de Soavinadriana. *Revue Malgache de Pédiatrie*, **5**, 37-42.
- [12] Kedy Koum, D., Exhenry, C., Penda, C., Nzima Nzima, V. and Pfister, R.E. (2014) Morbidité et mortalité néonatale dans un hôpital de district urbain à ressources limitées à Douala, Cameroun. *Archives de Pédiatrie*, **21**, 147-156. <https://doi.org/10.1016/j.arcped.2013.11.014>
- [13] Nagalo, K., Dao, F., Tall, F.H. and Yé, D. (2013) Morbidité et mortalité des nouveau-nés hospitalisés sur 10 années à la Clinique El Fateh-Suka (Ouagadougou, Burkina Faso). *Pan African Medical Journal*, **14**, Article No. 153. <https://doi.org/10.11604/pamj.2013.14.153.2022>
- [14] Vierin Nzame, Y., Maladjou Kondjo, J., Gahouma, D., Imboua, L., Mongi, P. and Moussavou, A. (2010) Enquête sur la mortalité néonatale à Libreville et Owendo. *Archives de Pédiatrie*, **17**, 179-180. <https://doi.org/10.1016/j.arcped.2009.11.002>
- [15] Manzar, N., Manzar, B., Yaqoob, A., Ahmed, M. and Kumar, J. (2012) The Study of Etiological and Demographic Characteristics of Neonatal Mortality and Morbidity—A Consecutive Case Series Study from Pakistan. *BMC Pediatrics*, **12**, Article No. 131. <https://doi.org/10.1186/1471-2431-12-131>
- [16] Mouahid, S., Chafii, H., Mouhaddach, O., Jaouhar, S. and Jawad, B. (2019) Study of Risk Factors of Neonatal Mortality in the Neonatology Unit at Pagnon Mother-Child Hospital in Meknes (Morocco). *EWASH & TI Journal*, **3**, 75-80.
- [17] Chelo, D., Monebenimp, F., Npanguepko, F. and Tietche, F. (2012) Mortalité néonatale précoce et ses déterminants dans une maternité de niveau I à Yaoundé. *Pan African Medical Journal*, **13**, Article No. 67.
- [18] El hakioui, A. (2020) Profil épidémiologique des nouveau-nés hospitalisés au service des Urgences Pédiatriques. Thèse de médecine, Maroc No. 115.
- [19] Chabli, S. (2020) La mortalité néonatale aux urgences Pédiatriques. Thèse de médecine, Faculté de médecine et de pharmacie de Marrakech, No. 176.
- [20] Barro, B., Kalmogho, A., Traore, T., Ouermi, S., Ouattara, I., Kombassere, O., et al. (2019) Morbidité et Mortalité néonatales au Centre Hospitalier Universitaire Sourô Sanou Bobo-Dioulasso (Burkina Faso). *Revue Africaine et Malgache pour la Recherche Scientifique*, **2**, 82-89.
- [21] Kedy, D.C., Essomba, N.E., Ngaba, G.P., Sintat, S., Ndombo, P.K. and Coppieters, Y. (2015) Morbidité et facteurs de risque de mortalité néonatale dans un hôpital de référence de Douala. *Pan African Medical Journal*, **20**, Article No. 258. <https://doi.org/10.11604/pamj.2015.20.258.5648>
- [22] Daguët, F. (2002) Un siècle de fécondité française. INSEE-Résultats société, p. 8.
- [23] Mustafa, M.H. and Mukhtar, A.M. (2015) Factors Associated with Antenatal and Delivery Care in Sudan: Analysis of the 2010 Sudan Household Survey. *BMC Health Services Research*, **15**, Article No. 452. <https://doi.org/10.1186/s12913-015-1128-1>
- [24] Chalumeau, M., Salanave, B. and Bouvier, C.M. (2002) Identification des facteurs de risque de mortalité périnatale en Afrique de l'Ouest: CPN ou surveillance de

l'accouchement? *Journal of Gynecology and Human Reproduction*, **31**, 63-49.

- [25] Akpadza, K., Baeta, S., Adjagba, K. and Hodonou, S. (1996) La mortalité périnatale au centre hospitalier régional de Sokodé (Togo). *Revue Française de Gynécologie et d'Obstétrique*, **91**, 247-250.
- [26] Andrianaina, B. (2004) Facteurs de mortalité néonatale précoce au centre hospitalier universitaire de gynécologie obstétrique (CHUA-GHGO) de Befelatanana. Thèse médicale, Institut National de Santé Publique et Communautaire.
- [27] Akinyemi, J.O., Bamgboye, E.A. and Ayeni, O. (2015) Trends in Neonatal Mortality in Nigeria and Effects of Bio-Demographic and Maternal Characteristics. *BMC Pediatrics*, **15**, Article No. 36. <https://doi.org/10.1186/s12887-015-0349-0>
- [28] Sidibé, T., Sangho, H., Doumbia, S., Sylla, M., Keita, M., Keita, H., *et al.* (2006) Mortalité néonatale dans le district sanitaire de Kolokani (Mali). *Journal de Pédiatrie et de Puériculture*, **19**, 272-276. <https://doi.org/10.1016/j.jpp.2006.08.004>
- [29] Organisation Mondiale de la Santé (OMS) (1985) Appropriate Technology for Birth. *The Lancet*, **2**, 436-437.
- [30] Yenan, J., Plo, J. and Asse, V. (2013) Morbidité et mortalité néonatales au service de pédiatrie du CHU de Bouaké. *Revue Africaine d'Anesthésiologie et de Médecine d'Urgence*, **18**, 52-57.
- [31] Cissé, C.T., Yacoubou, Y., Ndiaye, O., Diop-Mbengue, R. and Moreau, J. (2006) Évolution de la mortalité néonatale précoce entre 1994 et 2003 au CHU de Dakar. *Journal de Gynécologie Obstétrique et Biologie de la Reproduction*, **35**, 46-52. [https://doi.org/10.1016/s0368-2315\(06\)76371-2](https://doi.org/10.1016/s0368-2315(06)76371-2)
- [32] Lawn, J.E., Blencowe, H., Oza, S., You, D., Lee, A.C., Waiswa, P., *et al.* (2014) Every Newborn: Progress, Priorities, and Potential Beyond Survival. *The Lancet*, **384**, 189-205. [https://doi.org/10.1016/s0140-6736\(14\)60496-7](https://doi.org/10.1016/s0140-6736(14)60496-7)
- [33] Abdala kingwengwe, A., Shindano Mwamba, E., Mishika Lukusa, P., Nyenga Munganza, A., Katamea, T., Assumani, N., *et al.* (2019) Morbi-mortalité néonatale à l'hôpital général de référence de Kindu Etat de lieux et perspectives. *Médecine d'Afrique Noire*, **66**, 569-578.
- [34] UNICEF & WHO (2017) Levels & Trends in Child Mortality. Report.
- [35] Lahmini, W. and Bourrous, M. (2020) Mortality at the Pediatric Emergency Unit of the Mohammed VI Teaching Hospital of Marrakech. *BMC Emergency Medicine*, **20**, Article No. 57. <https://doi.org/10.1186/s12873-020-00352-9>
- [36] Dare, S., Oduro, A.R., Owusu-Agyei, S., Mackay, D.F., Gruer, L., Manyeh, A.K., *et al.* (2021) Neonatal Mortality Rates, Characteristics, and Risk Factors for Neonatal Deaths in Ghana: Analyses of Data from Two Health and Demographic Surveillance Systems. *Global Health Action*, **14**, Article ID: 1938871. <https://doi.org/10.1080/16549716.2021.1938871>
- [37] Kalondji, D.C., Mbayo, P.M., Kembo, L.N., Ngombe, M.I., Ngimbi, S.L., Nkulu, H.K., *et al.* (2018) Fréquence et causes de la mortalité neonatal précoce à Kamima, République Démocratique du Congo. *Revue de l'infirmier Congolais*, **2**, 90-94.
- [38] Ongoiba, O. (2010) La mortalité neonatal au CHU Hassan II de Fès (Etude retrospective à propos de 235 cas). These de Medicine, Maroc. N84.