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ORIGINAL ARTICLE

Epidemiological, clinical, and prognostic aspects of preterm birth over 10 years in Ouagadougou, Burkina Faso

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Abstract:
Background: Preterm birth is an emerging global public health problem. The aim was to determine the epidemiological, clinical, and prognostic aspects of preterm newborns delivered at a sanitary training centre in Ouagadougou, Burkina Faso and describe the mothers of preterm newborns, the circumstances of childbirth, and the clinical characteristics of preterm newborns in order to calculate and study mortality. Material and methods: This retrospective study includes all preterm newborns hospitalized in the neonatology unit of Clinique El Fateh-Suka over a 10-year period. Results: The frequency of preterm birth was 193 of 574 gestational age-specified newborns (33.6%). Insufficient antenatal consultation, premature rupture of membranes, and pathology during pregnancy comprised 58%, 64.9%, and 82.6% of preterm birth cases, respectively. The main pathologies associated with preterm birth included hemorrhagic and hematological disorders (42.5%), neonatal infections (23.3%), congenital malaria (21.8%), and intrauterine hypoxia and birth asphyxia (13.5%). The incidence of mortality was 21.2%, and the major causes of mortality included hemorrhagic and hematological disorders (46.3%), intrauterine hypoxia and birth asphyxia (22%), and neonatal infections (14.6%). These deaths were more frequent in the early neonatal period than late neonatal period (30.8% vs. 6.1%) (OR = 6.91; 95% CI [2.34–20.40]; P = 0.000). Conclusion: Preterm birth occurs frequently in our neonatology unit, and the involved complications are as expected. Providing high-quality antenatal consultations will reduce the incidence of preterm birth. An improved system of care for newborns would also greatly reduce preterm mortality.

Keywords: *Newborn, Premature, Diseases, Mortality*
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Introduction

The World Health Organization (WHO) defines preterm birth as any birth at < 37 weeks of amenorrhea (WA) or < 259 days from the first day of a woman's final menstrual period [1]. Of 15 million preterm births that occur worldwide each year, 1.1 million do not survive due to preterm birth-related complications, and many survivors will suffer from life-long disabilities, in particular learning, visual, and hearing disorders [2]. The estimated incidence of preterm birth is 9.6% of all births worldwide, and the phenomenon is of great interest in developed and developing countries. The highest preterm birth rates

have been reported in Africa (11.9%) and North America (10.6%), while the lowest is in Europe (6.2%); in addition, 11 of 12.9 million (85%) preterm births occurred in Africa and Asia [3]. Preterm birth contributes to 62% of neonatal mortality [4]. In Burkina Faso, few studies have been devoted to preterm birth [5,6]. Here, our aim was to determine the epidemiological, clinical, and prognostic aspects of preterm newborns who were delivered at a neonatology unit (NU) in Ouagadougou, Burkina Faso.

Material and Methods

Study site

Clinique El Fateh-Suka (CFS), a private health institution created in 1999, is located in Ouagadougou. The NU receives newborns from the maternity department of the institution, which averages 360 childbirths per year. The NU also receives newborns who are referred from other health centres in the city and surrounding areas of Burkina Faso. The NU staff includes three doctors (two pediatricians and a general practitioner) and seven nurses. It is equipped with eight incubators, nine cribs, a conventional phototherapy unit, and neonatal resuscitation materials.

Methods

This retrospective study was conducted using the clinical records of all hospitalized newborns who were treated between June 15, 1999 and June 14, 2009. Any newborn whose gestational age at birth was < 37 WA and was hospitalized during the study period was included. Any newborn who did not fulfill these criteria was excluded from the study. Gestational age was determined by obstetric ultrasound during the first quarter of pregnancy, when available, or by morphological and neurological maturation using the Farr and Amiel-Tison criteria [7,8]. Growth (birth weight for gestational age) was estimated according to the Lubchenco chart [9]. An individual case record form was designed for this study that allowed the collection of data on (i) the mother (age, number of pregnancies, parity, antenatal consultations [ANCs], prior history of twins and preterm birth, pathology during the pregnancy, pathological medical histories), (ii) childbirth (place, delivery, state of membranes), and (iii) newborn (gestational age, sex, birth weight, complementary examinations, diagnosis, modality of leaving the hospital [recovery, death, leaving against medical advice], period, time, and cause of death). Data were entered using Epi-infoTM 6.04d software (Center for Diseases Control and Prevention, Atlanta, GA, USA) and exported to SPSS 16.0 (IBM SPSS Inc., Chicago, IL, USA) for analysis. Insufficient variables and modalities were not analyzed. Frequency distributions were generated for all variables. The chi-squared test was used to compare proportions. To identify associations between categorical variables and assumed risk factors, the odds ratio (OR) and confidence interval at 95% [95% CI] were calculated. Statistical tests demonstrating $P < 0.05$ were considered statistically significant. The tenth edition of the International Classification of Diseases and Related Health Problems (ICD-10) was used to codify all diagnoses [10].

Definitions

Based on their ages, mothers were categorized into two groups: young (≤ 20 years) or reproductive-age (> 20 years). ANCs < 4 were considered low (or insufficient), and normal was considered ≥ 4. Intramural delivery refers to birth occurring within the CFS labor ward, and extramural delivery was defined as birth that required intervention outside the CFS. Preterm newborns were classified according to gestational age: moderate preterm (32–36 WA), very preterm (28–31 WA), or extremely preterm (< 28 WA). They were also classified according to their birth weight and gestational age into: Appropriate for gestational age (AGA), Small for gestational age (SGA) and Large for gestational age (LGA). We also distinguished between the early (0–6 completed days) and late (7–28 completed days) neonatal periods. Infections specific to the perinatal period (P35–P39) and certain infectious and parasitic diseases (A00–B99) were considered neonatal infections (NNI). Intrauterine hypoxia and birth asphyxia (P20–P21) were synonymous with neonatal cerebral injury. Anemia in preterm newborns was defined as < 150 g/L hemoglobin and hypoglycemia was defined as < 1.4 mmol/L blood glucose [11,12].

Results

General data

Over 10 years, 697 newborns were hospitalized. The gestational age of 574 newborns was determined, but not for the remaining 123 newborns. In total, 368 (64.1%) newborns were considered full term, 193 (33.6%) were preterm, and 13 (2.3%) were post-term. The ratios according to the whole number of newborns were 52.8%, 27.7% and 1.9%, respectively.

Maternal and childbirth data

According to their medical histories, 3 of 136 women (2.2%) had already given birth to a preterm newborn. Vaginal delivery was successful in 101 of 187 preterm newborns (54%), and caesarean section was required for the remaining 86 newborns (46%). Of 106 age-specified mothers, the average age was 28.46 ± 5.68 years (range: 16–41). Nine young mothers (8.5%) vs. 97 (91.5%) reproductive-age mothers were identified. The median number of pregnancies per woman was 2 (range: 1–6). Forty-six primigravida patients (23.8%) were identified vs. 147 multigravida patients (76.2%). Median parity was 2 (range: 1–6); 64 primiparous (33.2%) vs. 129 multiparous women (66.8%) were identified. The average number of ANCs per woman was 3 (range: 1–7), and 40 of 69 patients (58%) demonstrated low ANCs vs. 29 of 69 (42%) patients with of normal ANCs. During pregnancy, 17 of 123 women (13.8%) demonstrated no pathological conditions. On the other hand, a disorder was reported in 106 of 123 women (86.2%) during pregnancy and considered related either to urological or genital infection (34 mothers; 32.1%), arterial hypertension (24 mothers; 22.6 %), malaria (21 mothers; 19.8%), human immunodeficiency virus infection (8 mothers; 7.5%), cervical incompetence (7 mothers; 6.6%), or the threat of preterm birth (28 mothers; 26.4%). State of membranes was specified in 77 women of whom 50 (64.9%) demonstrated Premature rupture of membranes (PROM). We noted 147 cases of intramural delivery (82.6%) vs. 31 cases of extramural delivery (17.4%).

Data on preterm newborns

Epidemiology

Preterm delivery was spontaneous in 152 of 193 patients (78.8%). Among 41 induced causes (41 patients; 21.2%), arterial hypertension and complications (26 patients; 13.5%), hemorrhagic placenta praevia (9 patients; 4.7%), and acute or chronic fetal distress (6 patients; 3.1%) were diagnosed. There were 94 male (51.1 %) and 90 female (48.9%) preterm newborns, demonstrating a sex-ratio of 1.04:1. In addition, 46 of 193 newborns (23.8%) were twins. The average gestational age of the preterm newborns was 33.09 ± 2.59 WA (range: 25–36); moderate preterm newborns were more common (73.5%) than very preterm (24.9%) or extremely preterm newborns (1.6%). No risk factor associated with degree of preterm birth could be identified (data not shown). The average birth weight of the preterm newborns was 1891 ± 529.93 g (range: 640–2870). Based on their growth, moderate preterm and very preterm newborns were mostly appropriate for gestational age (AGA), except for extremely preterm newborns who exclusively were small for gestational age (SGA) (Table 1).

Table 1. Growth of preterm newborns hospitalized between June 15, 1999 and June 14, 2009 in Ouagadougou, Burkina Faso.

	Preterm			Total*
	Moderate preterm	Very preterm	Extremely preterm	
AGA†	74 (53.3)	35 (74.5)	0 (0.0)	109 (57.7)
SGA‡	64 (46.0)	11 (23.4)	3 (100.0)	78 (41.3)
LGA¶	1 (0.7)	1 (2.1)	0 (0.0)	2 (1.0)
Total	139 (74.5)	47 (24.9)	3 (1.6)	189 (100.0)

Birth weight was not specified in 4 preterm newborns, †AGA: Appropriate for Gestational Age, ‡SGA: Small for Gestational Age, ¶LGA: Large for Gestational Age

Morbidity

Hemorrhagic and hematological disorders (82 of 193 newborns; 42.5%) were the most frequent pathologies diagnosed in preterm newborns. In this group of diseases, hemorrhagic disease was Vitamin K insufficiency due and was found in 7 of 193 newborns (3.6%) while jaundice was found in 8 of 193 (4.1%). Among 102 preterm newborns with available and complete blood counts, the average hemoglobin level was 140 ± 2.98 g/L (range: 49–209) and 67 preterm newborns (65.7%) were diagnosed with anemia (range: 49–149). NNI of suspected or confirmed bacterial origin was encountered in 45 of 193 newborns (23.3%). Congenital malaria was associated with preterm birth in 42 of 193 newborns (21.8%), and Plasmodium falciparum was the only plasmodium species identified. Congenital malformations included congenital heart defect (3 patients), supernumerary fingers (2 patients), imperforate anus, small bowel atresia, Down's syndrome, congenital ectasia of the third ventricle, and untagged malformation syndrome (1 patient each). Among respiratory and cardiovascular disorders, respiratory distress was encountered in 5 of 193 newborns (2.6%).

Table 2. Pathologies diagnosed in 193 preterm newborns hospitalized between June 15, 1999 and June 14, 2009 in Ouagadougou, Burkina Faso.

Pathologies associated with preterm birth (ICD-10 code)	Frequency (%) *
Hemorrhagic and hematological disorders (P50–P61)	82 (42.5)
Neonatal infections (P35–P39 and A00–B99)	45 (23.3)
Congenital *P. falciparum* malaria (P37.3)	42 (21.8)
Intrauterine hypoxia and birth asphyxia (P20–P21)	26 (13.5)
Diarrhea and infectious colitis of unspecified origin (A09.9)	12 (6.2)
Congenital malformations and chromosomal abnormalities (Q00–Q99)	10 (5.2)
Respiratory and cardiovascular disorders (P20–P29)	10 (5.2)
Others pathologies	8 (4.2)
Other disorders originating in the perinatal period (P90–P96)	4 (2.1)
Diseases of the digestive system (P75–P78)	3 (1.5)
Lesions, trauma, poisoning (S00–T90 and P10–P15)	2 (1.0)

***Total exceeds 100% because some newborns were simultaneously diagnosed with multiple diseases.**

Hypoglycemia was diagnosed in 9 of 76 preterm cases (11.8%). The pathologies associated with preterm birth are presented in Table 2.

Hospital outcomes

The average length of stay in the hospital for the 193 preterm newborns was 10.06 ± 13.63 days (range: 0–92). One hundred and forty-five newborns (75.1%) were safely discharged home, 41 died (21.2%), and 7 left against medical advice (3.6%). All very preterm newborns died. Mortality was higher among extramural preterm newborns (10 of 29 newborns; 34.5%) than intramural preterm newborns (28 of 142; 19.7%), although this difference was not statistically significant. Mortality in the early neonatal period (37 of 120; 30.8%) was significantly higher than the late neonatal period (4 of 66; 6.1%) (OR = 6.91; 95% CI [2.34–20.40]; P = 0.000). The main causes of preterm death were hemorrhagic and hematological disorders (46.3%), intrauterine hypoxia and birth asphyxia (22%), and NNI (14.6%). The most lethal conditions were congenital malformations and chromosomal abnormalities (50%), intrauterine hypoxia and birth asphyxia (34.6%), hemorrhagic and hematological disorders (23.2%), and NNI (13.3%) (Table 3).

Discussion

The frequency of preterm birth in our study was higher than the rate of 15.9% observed 10 years ago at Yalgado University Teaching Hospital (UTH) in Ouagadougou [6]. This difference could be explained, in part, by the development of health insurance over the last decade. Indeed, rather than visit a public hospital and meet all financial costs out of pocket, patients with health insurance are moving toward private clinics where this form of payment is accepted. Therefore, many insured preterm newborns were referred to our NU, which was the only private NU in the city of Ouagadougou. Previously published data indicate lower rates of preterm birth elsewhere in Africa: 3.8% in Sudan,[13] 15.1% in Madagascar,[14] 16.4% in Zimbabwe,[15] and 19.9% in Nigeria [16]. Similar frequencies of 28.4% and 29.9%, respectively, were recorded in Central African Republic [17] and Mali [18]. The conditions that favor preterm birth in these countries are probably similar because in 2010 WHO ranked Central African Republic, Mali and Burkina Faso in the same group, where the rates of preterm birth are 10–15%.[2] The proportion of young mothers in our study was lower than other studies (range: 16.5–39.4%) [6,17] because of the mode of enrollment. However, we know that mother's age strongly influences the risk of preterm delivery [19], and risk is 4-fold higher in young pregnant women [5]. For similar reasons, the proportion of primigravida in our study was lower than the 36.4% previously reported in Ouagadougou [6] and 39.8% in Bangui, Central African Republic [17]. Despite this low percentage of primigravida among the preterm births included in this study, the first pregnancy was closely associated with young maternal age and influenced preterm birth. Indeed, primigravida demonstrates twice the risk of premature birth than multigravida [5]. One of

Table 3. Distribution of the 41 deaths according to cause and mortality among preterm newborns hospitalized from June 15, 1999 to June 14, 2009 in Ouagadougou, Burkina Faso.

Cause of death * (code ICD-10)	Number of cases	Number of deaths	PMR† (%)	Mortality rate (%)
Hemorrhagic and hematological disorders (P50–P61)	82	19	46.3	23.2
NNI (P35–P39 and A00–B99)	45	6	14.6	13.3
Congenital *Plasmodium falciparum* malaria (P35.3)	42	2	4.8	4.9
Intrauterine hypoxia and birth asphyxia (P20–P21)	26	9	22.0	34.6
Congenital malformations and chromosomal abnormalities (Q00–Q99)	10	5	12.2	50.0

**** Only the main diagnosis was taken into account. †PMR: proportional mortality rate.***

the essential purposes of ANCs is the prevention of preterm delivery, an insufficient ANC increases the risk of preterm delivery by > 9-fold [5]. However, 58% of women in our study had < 4 ANCs, which is the minimum number of recommended visits. This rate is high in comparison with 25% in Brazzaville, Republic of Congo [20] and 48% in Bangui, Central African Republic [17]; however, 66.6% of women in Lomé, Republic of Togo with low ANCs gave birth prematurely [19]. The retrospective nature of this study did not allowed us to determine why women did not attend ANCs although some of them were insured. Due to the lack of sufficient ANCs, we observed a high frequency of pathology among women who gave birth prematurely. Urological and genital infections, vascular and renal syndromes, PROM, threat of preterm birth, placenta praevia, and cervical and isthmian incompetence have also been reported [19]. The risk factors for preterm delivery are not unambiguous, although hospital data from some African countries report several maternal factors that are sometimes contradictory [13,15,16]. In fact, the socioeconomic and demographic factors, gynecological and obstetrical factors, and factors related to pregnancy and lifestyle that promote preterm birth have already been described by Papiernik, and risk can be calculated as the coefficient of risk of preterm birth [21]. Our experience shows that this is a rarely used tool; however, applying the coefficient of risk appears to help prevent preterm births, especially given the difficulties and huge economic impact of support in countries with limited resources.

Hemorrhagic and hematological disorders were the most frequent pathologies associated with preterm birth in this study, in addition to a high prevalence of anemia. Although we have not investigated etiologies of anemia among preterm because this retrospective study was not designed to answer this question. In the Republic of Côte d'Ivoire, authors reported a lower frequency of 25% of anemia in preterm newborns [22]. This difference is due to the cut-off value used to define anemia, which is lower in their study (< 13 g/dL). Nutritional deficiencies and blood loss by parasitic diseases endemic to the tropical areas are the general causes of anemia. In these countries, anemia can affect up to 68% of pregnant women [23]. If anti-anemic prophylaxis is insufficiently or not at all applied to pregnant woman, the newborn will begin life with a deficit hemoglobin reserve; this deficit will be exacerbated in preterm newborns because of immature hematopoietic function. According to a study carried out in the Republic of Côte d'Ivoire, 51.3% of mothers with anemic preterm newborns received no anti-malarial chemoprophylaxis or iron supplementation during pregnancy [24]. After birth, the causes of anemia in preterm newborns include blood loss due to sampling, shortened lifespan of red blood cells, iron deficiency, and inflammation [25]. The frequency of hemorrhagic disease in preterm newborns reported here was lower than the rate of 8% reported in Côte d'Ivoire, [22] perhaps due to the smaller sample size. NNIs are ubiquitous in studies conducted in sub-Saharan Africa, although they demonstrate different statistics by country. In Burkina Faso, the two previous studies conducted at Yalgado UTH reported NNI frequencies of 9.3% [6] and 35.9% [26]. Our findings were comparable to the reported results of 28.4% in Central African Republic,[17] but lower

than the rates of 30.3% and 53% observed in Côte d'Ivoire, [22,27] 33% in Mali, [18] 35.5% in Madagascar, [14] and 58% in Togo [28]. The diagnosis of bacterial NNI is mainly based on clinical examination in Africa [18,22,27,29,30] so the risk of over- or under diagnosis must be taken into account to explain differences in NNI frequencies. Preventing NNIs will reduce the incidence of preterm birth, in addition to morbidity and lethal burden. For example, screening and treating urinary tract bacterial infections in pregnant women would reduce the incidence of preterm birth between 20–55%, and the practice of kangaroo maternal care (KMC) would prevent infections by 51% in newborns [31]. Meta-analyses reveal that KMC reduces neonatal mortality in preterm newborns and effectively reduces severe morbidity from infection [32]. Stringently following the basic rules of asepsis and hygiene is also very important for controlling nosocomial infection, which could be responsible for 50% [33] or even 61–81% [34] of NNIs in developing countries.

The high incidence of malaria in this study attest to its well-established role in preterm birth [19,35]. In the absence of a vaccine, the effective prevention of malaria in pregnant women, particularly in malaria-endemic areas, will enable its prevention in newborns, especially preterm newborns.

The frequency of neonatal cerebral injury in this study is as high as 11.9%, similar to earlier findings in Ouagadougou [6] and the rate of 10.6% reported in Bangui, Central African Republic [17]; however, our rate is higher than the 7% reported in Abidjan, Republic of Côte d'Ivoire [22]. In newborns, including preterm, neonatal cerebral injury is associated with the lack of pregnancy monitoring, insufficient monitoring during work, poor delivery conditions, and resuscitation of the newborn in the birth ward [18,26].

With a frequency of 6.2%, diarrhea and infectious colitis rank fifth as a morbid entity associated with preterm birth in this study. Disorders related to the immaturity of the digestive system, on one hand, and those related to food substitutes for breast milk and possible nosocomial infections, on the other hand, could explain the development of diarrhea and colitis in preterm newborns. The absence of available data in the African medical literature has not encouraged a greater in-depth analysis of this condition.

Congenital malformations were found in 5.2% of preterm newborns in this study. To the best of our knowledge, they are less specifically discussed in the available African literature. In a recent American study on the relationship between congenital disorders and preterm birth, the observed frequency was 3%. According to this study, congenital disorders increase the risk of preterm birth 2-fold and significantly increase the degree of preterm birth by doubling and tripling the risks of moderate and extremely preterm birth, respectively [36].

Respiratory and cardiovascular disorders were observed at the same level as congenital malformations. Perhaps because our sample was small, we found a lower frequency of respiratory distress in preterm newborns in comparison with Central African Republic (11%) [17] and Côte d'Ivoire (16%) [22]. One of the main causes of respiratory distress in preterm newborns is Respiratory distress syndrome (RDS). However, this condition rarely occurs in black fetuses because of early pulmonary maturation, [37] which probably explains why respiratory distress is less frequently described in black Africans.

At a rate of 21.2%, preterm mortality was high in this study. Among the risk factors of death that are intrinsic to preterm birth, gestational age is crucial, and we found that mortality was inversely related to gestational age. This also agrees with studies that report preterm newborns born at < 32 WA die more quickly in 46.0–81.2% of cases [6,14,17]. Similarly, low birth weight negatively affects survival. Indeed, in this study, all very preterm newborns expired and we observed that most preterm newborns were at a high risk of death. In other words, our results are similar to the observations of other studies, where death occurs in 63.8–65.9% of preterm newborns who weigh < 1500 g at birth [6,17]. Among the environmental factors, the poor conditions associated with transporting preterm newborns from maternities to NU do not favor survival. In Ouagadougou, transport is provided by nonmedical ambulances, taxis, or private cars. Under these conditions, travel is fatal for 64% of premature newborns referred from outlying maternity wards to Yalgado UTH [6]. It is by these same modes of transport, sometimes even by motorcycle, that preterm newborns arrive at our NU; this probably also contributed to the death rate of 34.5%. At Lomé, Republic of Togo, the high death rate of newborns born out of the UTH is reportedly 66.7% [19]. In the context of developing countries where facilities are inadequate, the high mortality of preterm newborns grimly reflects the difficulty of their care, especially when they are very immature [6,14,17]. It is not surprising that the most common

complications are the deadliest, and a greater proportion of deaths among preterm newborns occur during the early neonatal period. The vulnerabilities of newborns in the first moments of life, in association with the inadequacies of care, are bad prognostic factors. In preterm newborns, this prognosis worsens because of the immaturity of the organs and visceral functions.

Due to the retrospective nature of the study, the exhaustive collection of data was not possible because some clinical records were incomplete. In addition, the NU of CFS does not receive all newborns, not only because of its limited capacity but also because of its private status which makes it financially inaccessible to people with low incomes and/or those lacking health insurance. This is also a hospital-based study whose data do not necessarily reflect the situation in the city of Ouagadougou. Despite these limitations, the long study period enabled us to obtain a large enough sample to determine the main epidemiological, clinical, and prognostic aspects of preterm newborns hospitalized at our NU.

Preterm birth remains an issue of grave concern in Burkina Faso. In this study, the preterm complications are as expected, and prognosis was characterized by high mortality. Preventive interventions aimed at increasing the ANC coverage rate and detecting and effectively treating diseases during pregnancy and PROM before childbirth will reduce the incidence of preterm birth. The survival of preterm newborns also requires more research because there is little or no medium- and long-term data available in Africa.

Conflict of interests

The authors have no conflict of interest to declare.

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