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Factors associated with very early neonatal mortality in Burkina Faso: A matched case–control study

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ABSTRACT

Objective: To identify the risk factors associated with very early neonatal death in Burkina Faso. *Methods:* A matched case–control study including newborns born between May 2009 and April 2010. Cases comprised newborns that died within 24 hours of birth, whereas controls were those of a similar birth weight to the cases who survived the first 24 hours. Potential risk factors related to mothers, neonates, and healthcare provision were assessed from medical records and via interviews. Conditional logistic regression was used to estimate odds ratios. *Results:* Data from 470 cases and 470 controls were analyzed. Multivariate analysis showed that Apgar score at 4–7 or 1–3 (aOR 6.27; 95% CI, 3.10–12.68 and aOR 72.26; 95% CI, 14.07–371.26, respectively); bradycardia at the last heart sound recorded before delivery (aOR 5.72; 95% CI, 1.42–23.03); inadequacy or lack of prenatal care (aOR 2.39; 95% CI, 1.15–4.97); resuscitation of newborns (aOR 2.07; 95% CI, 1.01–4.27); and referral of the newborn (aOR 5.29; 95% CI, 1.44–19.43) were associated with increased odds of neonatal mortality. However, being a primigravid mother (aOR 0.51; 95% CI, 0.29–0.89) was associated with decreased odds of neonatal mortality. *Conclusion:* Very early neonatal mortality is closely related to the condition of the newborn at birth, the monitoring of the pregnancy, and medical procedures.

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1. Introduction

Globally, almost four million newborns die every year during the neonatal period; among them, over two-thirds die in the first week of their life [1]. Low-resource countries are the most affected as they concentrate over 98% of neonatal deaths. Sixteen of the 20 countries with the highest neonatal mortality rates in the world are located in Sub-Saharan Africa [2,3].

Burkina Faso is a Sub-Saharan African country exhibiting high mortality rates. Poor and stagnating neonatal health indicators in the country for several years have led to the adoption and implementation of a policy to subsidize obstetric and neonatal emergency care to accelerate progress toward achieving Millennium Development Goal 4 (MDG 4). Despite these efforts, the mortality rate in newborns remains extremely high.

Several studies have found that low birth weight, the mother's age, socioeconomic status, the history of the mother, and the childbirth conditions are the major risk factors for neonatal mortality most commonly encountered [3–7]. However, these studies focused on mortality in the overall neonatal period or the late neonatal period especially, whereas the most vulnerable period for the newborn is the first 24 hours after birth. Approximately 25%–50% of neonatal deaths occur during this period [3]. Except for the weight of the newborn at birth and specific causes of death that are associated with the mortality of newborns throughout the early neonatal period [8–10], we did not find any study that specifically addressed factors related to mortality in the first 24 hours of life. This period is of great interest in the orientation of neonatal mortality reduction strategies as it is spent mostly in hospital and possible changes in medical procedures have the potential to impact its burden.

Through this research we aimed to understand why in the same context of morbidity and with similar birth weights, some newborns survive better than others during the first 24 hours of their life. The aim of the present study was to identify the main factors associated with very early neonatal mortality in Burkina Faso, taking into account the effect of the weight of the newborn at birth and morbidity.

2. Materials and methods

2.1. Study design

We conducted a matched case–control study based on the weight of the newborn at birth, the cause of death of the deceased newborn, and

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medical center. The study was part of the emergency obstetric and neonatal care (EmONC) needs assessment conducted from May 2009 to April 2010 in Burkina Faso. The needs assessment was conducted in every health facility that was providing patient care at the moment of the survey, disregarding their type and location. All neonates who died within 24 hours in a 12-month period preceding the study were identified. For each case of a deceased newborn, we individually assigned a control newborn who survived the first 24 hours after birth. Matching was done where the difference in weight was no greater than 100 g between the case and the control. Each control newborn was selected from the same neonatology hospital or childbirth facility as the case newborn and was born in the same research period. In the absence of a control newborn with these criteria in the same health facility, a control newborn was selected from the nearest facility.

2.2. Data collection

We collected data on each case and control following the same process. Data on a case and its corresponding control was collected using a single questionnaire. We used a standardized paper questionnaire to collect data. This questionnaire was adapted by the national research team in close collaboration with key persons during a workshop, and was validated by a steering and monitoring committee. The data were collected by health workers previously trained on interviewing. The information was extracted from the hospital records in the neonatal unit, records of mothers in the maternity ward, as well as birth registers. The available data from public and private health facilities throughout the country were extracted and a second mission was carried out in these facilities for additional data. The same sources were reused along with telephone and/or face-to-face interviews with one of the parents or the health worker who was present during the birth.

2.3. Data analysis

The collected data were double-entered using CSPro (US Census Bureau). Data cleaning and consistency checks were carried out after exportation into Stata version 12.1 software (StataCorp LP, College Station, TX, USA). We initially conducted a multidimensional analysis, including an analysis by principal component and multicomponent analysis to identify correlated factors and then select those that most informed the variable and were relevant. The relevant factors were those considered most important for the monitoring of pregnant women and newborns. Moreover, the quantitative variables whose log-linearity was not verified were re-coded based on their clinical relevance. The retained variables were studied in univariate analysis at the 10% threshold. We used a conditional logistic regression model and adopted a manual backward stepwise selection strategy at a 5% significance threshold to identify significantly associated variables. The statistical analysis of the data was performed with SAS software, version 9.3 (SAS Institute Inc, Cary, NC, USA).

2.4. Ethical considerations

Approval for the study was granted by the Ethics Committee for Health Research. We were also granted permission by the managers of health facilities to extract data from registers. Confidentiality was assured by the anonymity of the women on the collection sheets.

3. Results

Data for a total of 470 deceased newborns and 470 control newborns who survived after the first 24 hours of birth were analyzed. The characteristics of the cases and controls are described in Table 1. The mean age of the mothers was 24 years. Most of them lived with a partner. Household activities were the first occupations of mothers (93% for

cases vs 90% for controls) and rural area was the main place of residence (62.1% vs 59.5%). The median number of pregnancies was three and two for cases and controls, respectively. The newborns were predominantly male among cases and female among controls. The median number of prenatal care visits received was two for cases and three for controls. Most births took place in a health facility (96.9% for cases vs 97.4% for controls) and a partograph was used to monitor 56.6% of deliveries for cases and 48.5% for controls.

3.1. Univariate analysis of factors associated with very early neonatal mortality

At the threshold of 10%, our univariate analysis (Table 2) showed two variables related to maternal factors: age of the mother and gravidity. These were significantly associated with mortality of the newborn within the first 24 hours of birth (P=0.022; P=0.005, respectively). Three variables related to neonatal factors were significantly associated: newborn sex (P=0.006), the last heart sound recorded before delivery (P=0.005), and the condition of the newborn defined by Apgar score (P<0.001). Six variables associated with health care services were significantly associated factors: use of the partograph (P=0.038); qualification of the health worker who performed the delivery (P=0.018); number of prenatal care visits during the pregnancy (P<0.001); referral of the newborn to a higher level health structure (P<0.001); release of the respiratory tract (P=0.002); and resuscitation of the newborn (P<0.001).

3.2. Multivariate analysis of factors associated with very early neonatal mortality

The variables found to be associated with a risk for very early neonatal death in the multivariate analysis are summarized in Table 3. Children born with an Apgar score of 4–7 or 1–3 presented, respectively, aOR 6.27 (95% CI, 3.10–12.68) and aOR 72.26 (95% CI, 14.07–371.26) times more risk of death compared with newborns born with a score of 8–10. Bradycardia and barely perceptible last fetal heart sound recorded before delivery were also risk factors (aOR 5.72; 95% CI, 1.42–23.03 and aOR 2.95; 95% CI, 1.25–6.93, respectively). A single prenatal consultation or the failure to monitor the pregnancy (aOR 2.39; 95% CI, 1.15–4.97) led to a high risk of newborn death. Newborns transferred to external reference centers (aOR 5.29; 95% CI, 1.44–19.43) and those resuscitated (aOR 2.07; 95% CI, 1.01–4.27) were at high risk of death. However, newborns transferred to an internal reference center tended to be protected, although the result was not significant (aOR 0.48; 95% CI, 0.15–1.54). Being a primigravid mother reduced the risk of early neonatal mortality (aOR 0.51; 95% CI, 0.29–0.89) compared with being a multiparous mother.

4. Discussion

The present study found six factors that were significantly associated with early neonatal mortality. Among them, several are also mentioned in other studies in specific populations [11] or in investigation of mortality after 24 hours [7,12]. Our multivariate analysis confirmed the relevance of the Apgar score in predicting very early neonatal mortality. This near-certain death at a very low Apgar score is due to the inability of the newborn to respond effectively to external aggression. Fawole et al. [13] in Nigeria showed that newborns with an Apgar of 6 or less faced over 400 times the risk of death. Also, Moster et al. [14] showed that the risk of neonatal death was increased among newborns with a low Apgar score. Despite the major importance of this score, it is still disregarded by some health workers in Burkina Faso [15]. The Apgar score also serves to evaluate and guide the need for newborn resuscitation [16]. Faced with a low score, resuscitation should improve the condition of the newborn. Unlike the results of Chabernaud et al. [17] achieved in a high-resource country, we found that resuscitated