Factors associated with stillbirths in Koulikoro Reference Health Centre, Mali, January 2019 to December 2020

KEYWORDS: Stillbirth, associated factors, case-control study, Mali

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RECEIVED
17/12/24

ACCEPTED
01/09/25

PUBLISHED
03/09/25

LINK

https://afenet-journal.org/factors-associated-with-stillbirths-in-koulikoro-reference-health-center-mali-january-2019-to-december-2020/

CITATION
Aliou Badara Ballo et al. Weekly disease surveillance system evaluation in Chimanimani District, Zimbabwe, 2023: A descriptive cross-sectional study. J Interval Epidemiol Public Health. 2025 Sep; 8(3): 69.
DOI: https://doi.org/10.37432/jieph-d-24-02051

ABSTRACT

Introduction: Stillbirth is still a major obstetrical public health problem. Stillbirth causes emotional trauma for the mother and her family. Despite the strategies put in place by Mali, stillbirth remains an alarming problem. The aim of this study was to investigate the factors associated with stillbirths at the Koulikoro Reference Health Centre, Mali, from January 2019 to December 2020. **Methods**: This is a sex-matched case-control study carried out in Koulikoro reference health centre. Data were collected from pregnant women's records and maternity registers. We performed conditional logistic regression using R software to identify factors associated with stillbirth. **Results**: Factors independently associated with stillbirth were: rural (aOR: 8.92; 95%CI: 2.88 – 27.58; p ≤ 0.001); multiparity (aOR: 4.72; 95%CI: 1.42 – 15.62; p = 0.011); preeclampsia/eclampsia (aOR: 9.44; 95%CI: 1.39 – 64.16; p = 0.021); Retroplacental hematoma (aOR: 136.49; 95%CI: 6.02 – 3090.62; p = 0.002); prolonged rupture of membranes (aOR: 4.72; 95%CI: 1.71 – 12.99; p = 0.002); Hemorrhage (aOR: 4.66; CI95%: 1.12 – 19.29; p = 0.033) and fetal weight less than 2500g (aOR: 12.34; 95%CI: 3.56 – 42.79; p ≤ 0.001). **Conclusion**: Fetal weight below 2500 grams was the factor most associated with stillbirth in our study. The improvement and use of quality obstetric care at all levels would reduce the number of stillbirths.

Introduction

Stillbirth is still an obstetrical problem of major public health importance, despite advances in health services to prevent or treat its causes[1]. Stillbirth causes emotional trauma for the mother who has lost her child, as well as for those around her[1]. Progress in reducing the stillbirth rate has been slow. Between 2000 and 2019, the stillbirth rate fell by just 2.3% per year, while the annual rate of decline was 2.9% for neonatal mortality and 4.3% for mortality among children aged between 1 and 59 months[2].

In the world, according to the World Health Organization (WHO), nearly 2 million children are stillborn every year – that's one infant every 16 seconds. In its new report entitled "A low-key tragedy: the global burden of stillbirth", the vast majority of stillbirths (84%) occur in low-income and lower-middle-income countries. In 2019, three out of four stillbirths took place in sub-Saharan Africa or South Asia[2]. In developing countries, rural areas pay a heavy price, with unskilled birth attendants making a major contribution to the care of pregnant women[3].

In Africa, particularly south of the Sahara, the rate is 21.7 stillbirths per 1,000 births, about seven times higher than the lowest rate observed in developed regions[4]. In Nigeria, 182,307 stillbirths were recorded in 2021, representing 10% of all stillbirths worldwide[5].

In Mali, according to the sixth version of the Demographic and Health Survey (EDSM-VI 2018), perinatal mortality is estimated at a rate of 38 per 1,000 births. This perinatal mortality is 41 per 1000 in rural areas compared with 28 per 1000 in urban areas[6]. In Koulikoro, the health situation is characterized by an increase in the proportion of stillbirths. This proportion has risen from 1.20% in 2019 to 5.14% in 2020, with almost half representing fresh stillbirths[7].

In 2014, the World Health Assembly endorsed a target of 12 stillbirths or fewer per 1,000 births in all countries by 2030[8]. With this in mind, Mali had already based its sectoral health and population policy on principles and strategies in which one of the major objectives is to reduce maternal and infant mortality and morbidity. Regarding maternal mortality, Mali plans to reduce the rate from 325 per 100,000 live births in 2018 to 240 per 100,000 live births in 2024. This reduction also applies to neonatal mortality, with the country planning to reduce it from 33 per 1.000 live births to 16 per 1.000 live births over the same period (2018 to 2024)[6].
Healthcare services during pregnancy, childbirth, and after childbirth are crucial for the survival and well-being of both mother and child. [6] This is why, in collaboration with its partners, the country has developed and implemented several plans, programs and strategies for maternal and child health. These include the strategic plan for reproductive health, the strategic plan for essential care in the community (SEC) and the prevention of mother-to-child transmission of HIV (PMTCT) program[6].

Despite these various strategies, plans and programs implemented by the country and its investments, stillbirths in Mali remain alarming and constitute a major challenge. We initiated this work to highlight the factors associated with the high number of stillbirths in the country. Findings from our study will generate evidence for policymakers and program managers to come up with interventions that are tailored to reducing stillbirths in order to reach the World Health Assembly's target of 12 stillbirths or fewer per 1,000 births by 2030[8].

Methods

Study setting

The study took place in Koulikoro reference health centre, which is located in Mali's second administrative region. The cercle of Koulikoro covers an area of 7,260 km², straddling the Niger River. It is bordered to the north by the cercle of Banamba, to the northwest by the cercle of Kolokani, to the south by the cercle of Dioïla and to the west by the cercle of Kati (Koulikoro health information system).

The cercle's population is estimated at 298,894. The total fertility rate is 6.6 and the average number of children per woman is 7 (Koulikoro health information system). The cercle has 11 private facilities, including one denominational, and 24 public facilities (one reference health center and 23 community health centers (Koulikoro health information system).

Study design: We conducted a matched case-control study with retrospective data collection from January 1, 2019, to December 31, 2020.

Study population: All live births and stillbirths recorded in the gyneco-obstetrics department of Koulikoro reference health center from January 2019 to December 2020.

Selection of cases and controls

A case was defined as a fetus whose mother was admitted in labor (gestational age greater than or equal to 28 weeks) with at least one vital sign (fetal heart rate, active fetal movements) present at the time of admission, who was born dead and was recorded by birth attendants as a new stillbirth in the gyneco-obstetrics department of Koulikoro reference health center from January 1, 2019 to December 31, 2020[9] or any fetus whose mother has been admitted in labor (gestational age greater than or equal to 28 weeks) without any vital signs (fetal heart rate, active fetal movements) present at the time of admission, who is declared dead at birth and has been registered by the birth attendants as a new stillbirth in the gyneco-obstetrics department of Koulikoro reference health center from January 1, 2019 to December 31, 2020[9]. A matched control was a live-born newborn with the same sex as the case and whose date of birth was closest to that of the[9] case.

Sample size

Sample size was calculated using Open Epi (23) software. We took 1 case for every 2 controls. For a two-tailed confidence level of 95%, a power of 80% and a coast-to-coast ratio of 2 according to Fleiss with continuity correction. The theoretical size is 323, divided into 108 cases and 215 controls.

***Sampling*:** We conducted a census of all stillbirth cases in the gyneco-obstetrics department of Koulikoro reference health center from January 1, 2019 to December 31, 2020. We then drew lots using Excel software after assigning a number to each case. For each stillbirth, we took 2 controls who were matched on sex.

Dependent variable: Our dependent variable is stillbirth (stillborn vs. live child), which is a qualitative variable.

Independent variables: Mother's age, occupation, marital status, residence, education level, preeclampsia/eclampsia, hemorrhage, severe anaemia, placenta previa, retroplacental hematoma, premature rupture of membranes, parity, mode of admission and fetal weight.

Data collection

Using a data extraction Excel file, trained investigators collected data (mothers' socio-demographic characteristics, use of care, mothers' clinical factors and fetal factors) from antenatal consultation registers, operating theatre registers, mothers' medical records and partograms.

Data measurement and analysis

Data were entered into Epi-Info 7.2. software, exported to Excel 2016 and then analysed with R 3.6.2 analysis software. We categorized the following variables: Fetal weight and maternal age. For the descriptive phase, we calculated frequencies, proportions and means ± standard deviation.

For the analytical phase, the proportions of the various risk factors according to case and control status were compared using the Chi-square test, and the crude association between the dependent variable (stillbirth) and the various independent variables was estimated using Odds Ratios and presented with their 95% confidence intervals. Variables for which the univariate analysis found an association with stillbirth at the threshold of p-value < 20% were retained for the multivariate analysis.

For this, we performed a conditional logistic regression with the creation of a matching variable, adopting the step-by-step top-down procedure using the Akaike information criterion (AIC) method in R software. The final model was made up of variables with a p-value < 0.05. Results are presented as adjusted odds ratios (aOR) with 95% CI and corresponding p-values.

Variables for which the Odds Ratio is >1 and statistically significant were considered as risk factors. Variables with adjusted Odds Ratios <1 and statistically significant were considered protective factors.

Ethical considerations

The protocol was validated by the teaching team of the Burkina-Faso Epidemiology and Field Laboratory Program (BFELTP). Permission to collect data from the health facility was obtained from the Director General of Health and the Chief Medical Officer of the health district (authorization letter number: 09899/MSDS/DGSP of June 8, 2021). The documents were processed in compliance

with confidentiality rules. Anonymity numbers were used for each woman, and data collection media were secured. Data was stored on a computer with a secure password. In addition, only one operator was responsible for data processing and entry.

Results

Sociodemographic characteristics of mothers in Koulikoro reference health centre from 2019 to 2020

During the two-year study period (2019 – 2020), we counted 122 stillbirths meeting our inclusion criteria. During the same period, Koulikoro reference health centre recorded 2694 deliveries at the maternity ward.

Pregnant women ranged in age from 15 to 45 years, with an average age of 27.87 ±7.27 years for cases. Controls ranged in age from 14 to 42, with an average of 24.50 ±6.65 years.
Among the mothers of the cases, 60 (55.56%) were aged between 15 and 30, compared with 159 (73.95%) of the controls. In addition, 48 (44.44%) of the cases were over 30, compared with 55 (25.58%) of the controls. In terms of working life, 90 (91.67%) of the cases' mothers were housewives, compared with 193 (89.77%) of the controls (P= 0.584).
Eighty-eight (81.48%) of the case mothers had no formal education, compared to 141 (65.58) of the control mothers. The difference was statistically significant (P= 0.002).

Regarding residence, 87 (80.56%) of case mothers lived in rural areas, while 123 (87.21%) of control mothers lived in urban areas (P< 0.001). The marital status of cases and control mothers was almost similar in our study; 108 (100%) of cases were married versus 211 (98.14%) of controls, p=0.404 (Table 1).

Socio-demographic and clinical risk factors for stillbirths in Koulikoro reference health center

After univariate analysis, women aged between 15 and 30 are less likely to give birth to a stillborn child than those over 30 (OR: 0.46; IC95%: 0.66-0.80, p = 0.006). Stillbirth was statistically related to parental residence. Rural origin was a risk factor (OR: 7.41; 95% CI: 3.85 – 14.22; p ≤0.001). Being referred from a health center to Koulikoro reference health center (OR: 4.13; IC95% :2.22- 7.70; p≤ 0.001); hypertension (OR: 3.09; IC95% :1.72-5.55; p≤ 0.001) and severe anemia (OR: 11.05; IC95%: 3.97-33.25; p ≤ 0.001) were significantly associated with stillbirth. Retroplacental hematoma (OR: 56; 95% CI: 7.61-411.58; p ≤0.001), placenta previa (OR: 10; 95% CI: 1.16-85.59; p =0.035), eclampsia (OR: 3.75; 95% CI: 1.58-8.84; p =0.002), hemorrhage (OR: 11.18; 95% CI: 4.69 – 26.64; ≤0.001) , prolonged rupture of membranes (OR: 2.80; 95% CI: 1.39-3.80; p =0.001), excessive uterine height (OR: 2.31; 95% CI: 1.09-4.93; p =0.027) were also significantly associated with stillbirth (Table 2).

Multivariate analysis of factors independently associated with stillbirths in Koulikoro reference health center

On multivariate analysis, stillbirth was associated with the following variables: rural residence (aOR: 8.92; IC95% : 2.88 – 27.58; p ≤ 0.001); multiparity (aOR: 4.72; 95% CI: 1.42 – 15.62; p = 0.011); Stillbirth risk was 9.44 times higher in mothers with a history of preeclampsia/eclampsia (aOR: 9.44; 95% CI: 1.39 – 64.16; p = 0.021); Retroplacental hematoma was significantly associated with stillbirth (aOR: 136.49; 95% CI: 6.02-3090.62; p = 0.002, Prolonged rupture of membranes (aOR: 4.72; 95% CI: 1.71 – 12.99; p = 0.002); Hemorrhage (aOR: 4.66; 95% CI 1.12 – 19.29; p =0.033); The probability of stillbirth was 12.34 times higher when fetal weight was less than 2500g compared to ≥ 2500g (aOR: 12.34, 95% CI: 3.56-42.79, p ≤ 0.001) Table 3.

Discussion

Stillbirths are a major global burden, but are often neglected by mother-child care programs. We conducted this matched case-control study at the maternity ward of Koulikoro reference health centre, Mali, over two years (2019 – 2020). It revealed that the mothers' sociodemographic and clinical (medical and obstetric) factors, namely rural residence, multiparity, preeclampsia/eclampsia, retro placental hematoma, premature rupture of the water sac, hemorrhage and fetal weight below 2500g, were independently associated with stillbirth. In our study, rural residence was a significant risk factor for stillbirths. Indeed, rural areas in low-income countries such as Mali are characterized by the following factors: financial and geographical

inaccessibility, low utilization of health services, particularly prenatal consultations, inadequate or sometimes lacking qualified personnel, inadequate equipment for monitoring labor and delivery, delays in the decision to consult, refer to a higher level and delays in management, difficulties in transporting parturients, illiteracy, etc. These results are similar to those of Bhusal in Nepal[10] and Ouahid in Morocco[11].

The association between pre-eclampsia/eclampsia and stillbirth was highlighted in our study. Pregnancy monitoring is an essential step in identifying danger signs in pregnant women, and in our study few women had recourse to the requisite antenatal care. Under these conditions, it would be very difficult to identify pregnant women with or at risk of preeclampsia. Hence the delay in identifying and managing these cases. This association leading to in-utero foetal death has been described in the literature and confirmed by a number of studies[12–15].

Prolonged rupture of membranes increased the probability of stillbirth in Koulikoro reference health center. Under physiological conditions, the membranes of the egg (chorion and amnion) rupture spontaneously during full dilation labor: this is called temptative rupture. Premature rupture occurs before the onset of labor (2 to 24 hours, depending on the definition adopted). After 24 hours, it is usually referred to as prolonged rupture. Ruptures occurring before term, i.e. before 37 completed weeks, pose real problems of prematurity and infection[16]. In our study, these were ruptures that occurred before term. These expose the fetus to intra-amniotic infection, resulting in fetal death in utero. In our study, this situation can be explained by pregnant women's financial constraints, distance from the center and delays in making the decision to consult. A similar study in Madagascar found that 14.05% of in utero fetal deaths were due to premature rupture of membranes[17]. In Suleiman's Nigerian study, stillbirth was associated with prolonged rupture of membranes[12].

There was a statistically significant association between birth weight and stillbirth. The association could be explained by the fact that the further the pregnancy is from term, the higher the prematurity and its corollary complications (low birth weight), and hence the stillbirth rate. Pregnant women's financial constraints and the lack of prenatal care to identify the various dangers facing pregnant women could also explain this low birth weight and its complications (stillbirth). This association has been demonstrated by Badimsuguru in Ghana, Yego in Kenya and Tashimanga in Zimbabwe[17–19].

In our study, around a third of mothers had experienced obstetric complications during pregnancy, including retroplacental hematoma (RPH). The latter is a significant risk factor for stillbirth. The magnitude of this risk and the width of the confidence interval are evidence that a small sample had this complication. Retroplacental hematoma has been described in the literature with its main risk factors: maternal age over 35, multiparity, hypertension, smoking, premature rupture of membranes and a history of retroplacental hematoma. Its consequences can lead to a reduction or even interruption of transplacental exchanges, resulting in asphyxia or even death in utero[20]. All these risk factors, apart from smoking and previous retroplacental hematoma, must have contributed to the occurrence of this complication, in addition to the shortage of qualified personnel among our pregnant women. This association with retroplacental hematoma has been confirmed by several studies, notably those by Egbe, Poudel and Chuwa[21–23].

Being multiparous was associated with stillbirth in our study. This result could be explained by the neglect of multiparous women in pregnancy monitoring following experience in this field. Our results are similar to those of Ouahid in Morocco, where primiparity was a protective factor as opposed to multiparity[24].

Haemorrhage was also a significant risk factor for stillbirth. This result could be explained by the fact that 69.44% of cases were referrals, often with very long delays (road conditions, distance, delay in decision-making). It has been shown that hemorrhage can be fatal for both mother and fetus if interventions are not initiated within minutes or hours. Our findings corroborate those of Yego[18] in Kenya, Sandjong[24] in Cameroon and Traoré in Mali[25]. In fact, haemorrhage mainly concerns haemorrhages in the second and third trimesters of pregnancy. These may be due to bleeding from the cervix as a result of ectropion, cervicitis, polyp or cervical cancer; or to bleeding from the endocervix

as a result of cervical changes due to uterine contractions. Or two major obstetric emergencies with a life-threatening impact on the mother and foetus: placenta previa and retroplacental haematoma. Alongside these are other causes such as uterine rupture and Benkiser hemorrhage[26].

Limitations

As our study took place in only one of Mali's 75 health districts, we felt that our results could not be generalised to the country's entire population. Another limitation was the small sample size for some of the rare risk factors, notably retroplacental hematoma, resulting in very wide confidence intervals.

Conclusion

Our study revealed that stillbirths were associated with unfavorable socio-demographic (rural residence), medical and obstetrical (pre-eclampsia/eclampsia, retroplacental hematoma, premature rupture of the water sac, hemorrhage, multiparity) conditions in pregnant women, as well as fetal factors (Fetal weight below 2500 grams). Improving access to quality care through the equitable distribution of qualified personnel, providing basic emergency obstetric and neonatal care in all community health centres, and focusing plans and policies on vulnerable women living in rural areas would significantly reduce stillbirths in Mali.

What is already known about the topic

- In developing countries, rural areas are the hardest hit.
- Three out of four stillbirths occur in sub-Saharan Africa or South Asia.
- Underweight, multiparity, pre-eclampsia/eclampsia, haemorrhage, etc. are among the main risk factors.

What this study adds

- This study highlighted the socio-demographic and clinical characteristics of pregnant women with a likelihood of stillbirth at the Koulikoro Reference Health Center.
- Premature rupture of the water sac at the Koulikoro Reference Health Center is a risk factor.

Competing Interest

The authors of this work declare no competing interests.

Consent to publish

Consent to publish this article was obtained from the country's health authorities and the Burkina-Faso Epidemiology and Field Laboratory Program (BFELTP).

Availability of data and materials

The study data are available in Excel format and can be consulted.

Funding

The authors did not receive any specific funding for this work

Acknowledgements

Our thanks to Ministère de la Santé et de l'Hygiène Publique du Mali; Programme de Formation en Epidémiologie et laboratoire de Terrain du Burkina Faso ; West African Health Organization; CDC – Atlanta; Université Ouaga I, Pr Joseph Ki Zerbo, Burkina Faso ; Université des Sciences, des Techniques et des Technologies de Bamako (USTTB) ; African Field Epidemiology Network (AFENET) and Staff of the Centre de Santé de Référence de Koulikoro, Mali.

Authors´ contributions

ABB, NT, JK, DB, PY, MD, YS participated in protocol development, data collection, analysis, interpretation and manuscript writing. MMK, BT, HK, NM contributed to data interpretation.

Tables & Figures

Table 1: Representation of mothers according to their sociodemographic characteristics in Koulikoro reference health centre from 2019 to 2020

Table 2: Sociodemographic and clinical risk factors for stillbirths in Koulikoro reference health center from 2019 to 2020

Table 3: Factors independently associated with stillbirth in Koulikoro reference health center from 2019 to 2020

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Table 1: Representation of mothers according to their sociodemographic characteristics in Koulikoro reference health center from 2019 to 2020

Characteristics of mothers	Case n (%)	Controls n (%)	P-value
Age (years)			
15-30	73 (67.59)	175 (80.93)	0.010
>30	35 (32.41)	40 (18.61)	
Profession			
Housewife	99 (91.67)	193 (89.77)	0.584
Non-housewife	9 (8.33)	22 (10.23)	
Education level			
No formal education	88 (81.48)	141 (65.58)	0.002
Formal education	20 (18.52)	74 (34.42)	
Residence			
Urban	21 (19.44)	123 (87.21)	< 0.001
Rural	87 (80.56)	92 (42.79)	
Marital status			
Single	0 (0.00)	2 (0.93)	0.404
Married	108 (100)	211 (98.14)	
Widow	0 (0.00)	2 (0.93)	
Admission mode			
Evacuated	75 (69.44)	102 (47.44)	< 0.001
Coming of its own accord	33 (30.56)	113 (52.56)	

Table 2: Sociodemographic and clinical risk factors for stillbirths in Koulikoro reference health center from 2019 to 2020

Variables	Case n (%)	Controls n (%)	OR (95% CI)	P-value
Age (years)				
>30	35 (32.41)	40 (18.61)	–	
15–30	73 (67.59)	174 (80.93)	0.46 (0.66–0.80)	0.006
Residence				
Urban	21 (19.44)	123 (87.21)	–	
Rural	87 (80.56)	92 (42.79)	7.41 (3.85–14.22)	≤ 0.001
Admission				
Not evacuated	33 (30.56)	113 (52.56)	–	
Evacuated/Referred	75 (69.44)	102 (47.44)	4.13 (2.22–7.70)	≤ 0.001
Severe anemia				
No	86 (20.37)	201 (97.67)	–	
Yes	22 (79.63)	5 (2.33)	11.05 (3.97–33.25)	≤ 0.001
Retroplacental hematoma				
No	81 (75.00)	213 (99.07)	–	
Yes	27 (25.00)	2 (0.93)	56 (7.61–411.58)	≤ 0.001
Placenta previa				
No	103 (93.37)	214 (99.53)	–	
Yes	5 (4.63)	1 (0.47)	10 (1.16–85.59)	0.035
Pre-eclampsia/eclampsia				
No	93 (86.11)	207 (96.28)	–	
Yes	15 (13.89)	8 (3.72)	3.75 (1.58–8.84)	0.002
Hemorrhage				
No	74 (68.52)	206 (95.81)	–	
Yes	34 (31.48)	9 (4.19)	11.18 (4.69–26.64)	≤ 0.001
Premature rupture of water sac				
No	62 (57.41)	82 (25.38)	–	
Yes	46 (42.59)	133 (41.17)	2.30 (1.39–3.80)	0.001

Table 3: Factors independently associated with stillbirth in Koulikoro reference health center from 2019 to 2020

Variables	aOR	CI (95%)	P-value
Residence			
Urban	1		
Rural	8.92	2.88 – 27.58	≤ 0.001
Parity			
Primipara/Nullipara	1		
Multipara	4.72	1.42 – 15.62	0.011
Pre-eclampsia/eclampsia			
No	1		
Yes	9.44	1.39 – 64.16	0.021
Retroplacental hematoma			
No	1		
Yes	136.49	6.02 – 3090.62	0.002
Premature rupture of the water sac			
No	1		
Yes	4.72	1.71 – 12.99	0.002
Hemorrhage			
No	1		
Yes	4.66	1.12 – 19.29	0.033
Fetal weight			
≥ 2500g	1		
< 2500g	12.34	3.56 – 42.79	≤ 0.001