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Factors Associated with Maternal Deaths in Cotonou Hospitals, Benin

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ABSTRACT

Background: Maternal mortality remains a major public health issue in Benin. This study aimed to determine the hospital-based maternal mortality ratio and factors associated with maternal deaths.
Subjects and Method: We conducted a case-control study over two years from 1st January 2020 to 31 December 2021 in four Cotonou hospitals. It included 264 maternal deaths (case) matched to 264 controls by delivery mode. The dependent variable was the status at discharge. Independent variables included socio-demographic characteristics, gyneco-obstetric information, medical and gynecologic history as well as type of complications. Univariate and multivariate analysis were performed to identify the factors associated with maternal deaths.
Results: The hospital-based maternal mortality ratio was 1403 deaths per 100,000 live births. Age superior than or equal to 30 years old (OR= 3.09; 95% CI= 1.52 to 6.41; p=0.002), admission by a referral from public health facility (OR=4.26; 95% CI= 2.60-7.10; p<0.001) or private health facility (OR= 4.52; 95% CI= 2.49-8.38 ; p<0.001); parity between 1 and 3 (OR=2.72; 95% CI= 1.27 to 6.15; p= 0.012), gestational age less than or equal to 31 weeks (OR=3.77; 95% CI= 2.13 to 6.84 ; p<0.001) and the occurrence of non-infectious (OR= 1.94; 95% CI= 1.27 to 2.97; p= 0.002) and fetal complications (OR= 1.98; 95% CI= 1.13 to 3.54; p=0.018) were the factors associated to maternal deaths.
Conclusion: Strengthening policies aiming to increase access to modern methods of contraception and safe abortion, improving the referral system, and implementing multifaceted contextualized interventions could contribute to reduce maternal mortality.

Keywords: maternal death, maternal mortality, associated factors, Benin.

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BACKGROUND

Maternal deaths remains a major problem for healthcare systems, particularly in low- and middle-income countries. In 2020, the number of maternal deaths was estimated at 287,000 worldwide with around 70% in sub-Saharan Africa. The maternal mortality ratio was estimated at 223 maternal deaths per 100,000 live births worldwide; this indicator was 545 maternal deaths per 100,000 live births in sub-Saharan Africa (World Health Organization, 2023).7.08% of deaths among women aged 15-49 were due to maternal death in 2019, while in Africa this same proportion was 12.66% (Institute for Health Metrics and Evaluation, 2023). In Benin, the 2017-2018 Demographic and Health Survey revealed a maternal mortality ratio of 391 maternal deaths per 100,000 live births (Ministère du Plan et du Développement- Institut National de la Statistique et de l'Analyse Économique (INSAE) Cotonou, 2019) and 19.93% of deaths of women aged from 15 to 49 years old recorded in the country in 2019 were due to maternal deaths (Institute for Health Metrics and Evaluation, 2023) .

The consequences of maternal death on the family are linked to mental health, financial stability, and the children's future (Lawrence et al., 2022; Pande et al., 2015). Occurrence of maternal death also has an impact on the mental health of providers (Stabnick et al., 2022). In order to effectively reduce maternal mortality, it is necessary to understand its factors associated. This will lead to evidence-informed decision-making regarding design and implementation of effective interventions. There is a knowledge gap on the topic in Benin and particularly on maternal deaths occured in Cotonou hospitals. This study aimed to determine the hospital-based maternal mortality ratio and factors associated with maternal deaths in this city.

SUBJECTS AND METHOD

1. Study Design

The study was conducted in Cotonou. Located in the south of Benin, Cotonou is the economic capital and largest city in Benin, with an estimated population of 852,361 in 2021 including 249,146 women of childbearing age. In the same year, the city had 30 health facilities offering maternity care, with a ratio of 3.0 midwives per 10,000 women of childbearing age. We included the health facilities that reported almost all maternal deaths during the study period. These were the National Teaching Hospital Hubert K. Maga, the Mother and Child Teaching Hospital *Lagune*, the District Hospital *Suru Lere* (public hospitals) and the District Hospital of *Mènontin* (private hospital). The first two hospitals are on the tertiary level and the last two on the peripheral level of the healthcare platform. They receive referrals from neighboring departments.

We conducted a case-control study to compare groups of pregnant women whose outcome was maternal death (cases) with groups of pregnant women whose outcome was alive at discharge (controls). This study covered a two-year period from 1st January 2020 to 31 December 2021.

2. Population and Sample

The study population consisted of the medical records of pregnant women admitted to the maternity wards of the selected hospitals during the study period.

For the cases, we included medical records of maternal deaths as defined by the World Health Organization. For controls, we included the medical records of women who gave birth without maternal deaths. Unusable medical records were excluded.

The minimum sample size was calculated using SCHWARTZ formula: $n= z^2 pq/i^2$ where n is the sample size; z=1.96; p

(prevalence of the phenomenon studied, corresponding here to the maternal mortality ratio) equal to 905 per 100,000 live births (Aboubakar et al., 2021) that is 0.905%; q (equal to 1-p) = 0.095 and i = 0.04. Thus, the minimum sample size was 207 cases and 207 controls.

For cases, we carried out an exhaustive census of all maternal deaths records over the study period, giving us a number of 157; 97; 15 and 7 maternal death medical records respectively for the Nationl Teaching Hospital Hubert K. Maga, the Mother and Child Teaching Hospital *Lagune*, the District Hospital *Suru Lere* and the District Hospital of *Mènontin* with a total of 276 cases. After excluding, medical records with many missing data, we included 264 cases. Controls were recruited by matching a case with a control who had given birth during the same period, according to delivery mode.

3. Study Variables

The dependent variable was the women's vital status at hospital discharge.

The independent variables were socio-demographic and gyneco-obstetric characteristics, medical and gyneco-obstetric history and type of complications.

4. Operational Definition of Variables

Women's vital status was dichotomous: death (case) and alive (control).

Age was ≤ 24; 25 to 29; ≥ 30 years.

Residence was rural or urban

Occupation was craftswomen, farmers, traders, housewives, executives and similar

Occupation of spouse was craftswomen, farmers, traders, housewives, executives and similar.

Marital status was union, single.

Gestation was 1; 2 to 3; ≥ 4.

Parity was 0; 1 to 3; ≥ 4.

Gestational age (weeks) was ≤ 31; 32 to 36; ≥ 37.

Number of antenatal care visits was 0; 1 to 3; ≥ 4.

Admission mode was self-admission, referal from public health facility, referal from private center.

Medical history was high blood pressure, diabetes, Human Immunodeficiency Virus (HIV).

Ggyneco-obstetric history was cesarean section, cystectomy, myomectomy

Type of complications (obstetric, infectious, non-infectious, featal): yes, no.

5. Study Instruments

Data were collected from medical records using a pre-tested questionnaire.

6. Data analysis

Data were analyzed using Stata 15. Variables were presented as proportions. We then performed univariate analyses between the dependent and independent variables. The Chi-square or Fisher's exact test was used for comparisons between dependent and independent variables. Variables considered significant were then entered into a logistic regression model. The association between death and the independent variables thus considered was studied by calculating adjusted odds ratios (aOR) and their 95% confidence intervals (95% CI).

7. Research ethics

We informed the hospitals authorities about the study and obtained their written authorization before data collection. Data were extracted anonymously from medical records. All data were processed and analyzed anonymously.

RESULTS

1. Hospital-based maternal mortality ratio

During the study period, a total of 344 maternal deaths were reported by the study hospitals at national level. The number of livebirths registered in the District Health Information software 2 for the same period

was 24,525 livebirths resulting in an hospital-based maternal mortality ratio of 1,397 deaths per 100,000 livebirths.

2. Sociodemographic characteristics

The study included 264 cases and 264 controls. Cases aged from 17 to 45 years, with an average age of 30.27 (+/- 6.49) years. Controls aged from 15 to 45 years, with a mean of 27.79 years (+/-6.05) years. Cases (82.20%) and controls (90.15%) were predominantly from urban areas. The majority of patients were traders (37.88% of cases and 31.82% of controls), while the majority of spouses were artisans (53.79% of case spouses and 36.36% of control spouses). The majority of cases and controls lived in union (48.11% and 31.06% respectively).

3. Factors associated to maternal death in univariate analysis

Socio-demographic factors associated to maternal deaths

Age, place of residence, patient's occupation, spouse's occupation and marital status were significantly associated with maternal death (Table 1).

Gyneco-obstetric factors associated with maternal deaths

Gestational age, gestity, parity, number of prenatal consultations and mode of admission were significantly associated with maternal deaths (Table 2).

Table 1. Socio-demographic factors associated with maternal death in study hospitals from 2020 to 2021, Cotonou

Independent Variables	Case (n=264) n (%)	Control (n=264) n (%)	p
Age (years)			<0.001
≤24	54 (20.45)	85 (32.20)	
25-29	51 (19.32)	83 (31.44)	
≥30	159 (60.23)	96 (36.36)	
Residence			<0.001
Rural	23 (8.71)	4 (1.52)	
Urban	217 (82.20)	238 (90.15)	
Not specified	24 (9.09)	22 (8.33)	
Women occupation			<0.001
Traders	100 (37.88)	84 (31.82)	
Craftswomen	71 (26.89)	68 (25.76)	
Executives and similar	28 (10.61)	58 (21.97)	
Housewives	27 (10.23)	17 (6.44)	
Students	18 (6.82)	21 (7.95)	
Farmers	1 (0.38)	0 (0.00)	
Others*	4 (1.52)	15 (5.68)	
Not specified	15 (5.68)	1 (0.38)	
Spouse occupation			<0.001
Craftsmen	142 (53.79)	96 (36.36)	
Executives and similar	36 (13.64)	76 (28.79)	
Farmers	6 (2.27)	1 (0.38)	
Students	6 (2.27)	7 (2.65)	
Traders	19 (7.20)	36 (13.64)	
Others**	10 (3.79)	31 (11.74)	
Not speciefied	45 (17.05)	17 (6.44)	
Marital status			<0.001
Union	127 (48.11)	82 (31.06)	
Single	5 (1.89)	33 (12.50)	
Not speciefied	132 (50.00)	149 (56.44)	

*cook, maintenance worker, pastry cook, farmer **maintenance worker, security guard, cook, vehicle driver

History associated with maternal death

Medical and gyneco-obstetric history were significantly associated with maternal death (Table 3).

Types of complications associated with maternal deaths

The occurrence of obstetrical, non-infectious and fetal complications were statistically associated with maternal deaths (Table 4).

Table 2. Gyneco-obstetric factors associated with maternal deaths in study hospitals from 2020 to 2021, Cotonou

Independent Variables	Case (n=264) n (%)	Control (n=264) n (%)	p
Gestity			<0.001
1	67 (25.38)	72 (27.27)	
2-3	68 (25.76)	115 (43.56)	
≥4	129 (48.86)	77 (29.17)	
Parity			<0.001
0	61 (23.11)	92 (34.85)	
1-3	122 (46.21)	138 (52.27)	
≥4	81 (30.68)	34 (12.88)	
Gestational age			<0.001
≤31	76 (28.79)	28 (10.61)	
32-36	58 (21.97)	66 (25.00)	
≥37	130 (49.24)	170 (64.39)	
Number of ANC* visits			<0.001
0	8 (3.03)	10 (3.79)	
1-3	31 (11.74)	50 (18.94)	
≥ 4	43 (16.29)	88 (33.33)	
Not specified	182 (68.94)	116 (43.94)	
Admission mode			<0.001
Self-entry	47 (17.80)	132 (50.00)	
Referal from public health facility	144 (54.55)	92 (34.85)	
Referal from private center	68 (25.76)	36 (13.64)	
Not speciefied	5 (1.89)	4 (1.52)	

*antenatal care

Table 3. Medical and gyneco-obstetric history associated with maternal death in study hospitals from 2020 to 2021, Cotonou

Independent Variables	Case (n=264) n (%)	Control (n=264) n (%)	p
Medical history			<0.001
High blood pressure	16 (6.06)	11 (4.17)	
Diabètes	1 (0.38)	1 (0.38)	
HIV	9 (3.41)	6 (2.27)	
None	146 (55.30)	212 (80.30)	
Not specified	73 (27.65)	15 (5.68)	
Others*	19 (7.20)	19 (7.20)	
Gyneco-obstetric history			<0.001
Cesarean section	37 (14.02)	57 (21.59)	
Cystectomy	0 (0,00)	1 (0.38)	
Myomectomy	3 (1.14)	3 (1.14)	
None	138 (52.27)	182 (68.94)	
Not specified	81 (30.68)	17 (6.44)	
Others**	5 (1.89)	4 (1.52)	

*haemoglobinopathy, asthma, gastric ulcer **breast nodule, abortion

4. Potential predictors of maternal deaths : multivariable analysis

Age superior than or equal to 30 years old, admission by a referral, parity between 1 and 3, gestational age less than or equal to 31 weeks, and the occurrence of non-infectious and fetal complications were identified as predictors of maternal death in multivariate analysis (Table 5).

Table 4. Type of complications associated with maternal deaths in study hospitals from 2020 to 2021, Cotonou

Independent Variables	Case (n=264)	Control (n=264)	p
	n (%)	n (%)	
Obstetrical complications			0.001
No	120 (45.45)	158 (59.85)	
Yes	144 (54.55)	106 (40.15)	
Infectious complications			0.400
No	215 (81.44)	223 (84.47)	
Yes	49 (18.56)	41 (15.53)	
Non-infectious complications			<0.001
No	138 (52.27)	187 (70.83)	
Yes	126 (47.73)	77 (29.17)	
Fetal complications			<0.001
No	196 (74.24)	234 (88.64)	
Yes	68 (25.76)	30 (11.36)	

Table 5. Predictors of maternal death in multivariate analysis in study hospitals from 2020 to 2021, Cotonou

Variables	Adjusted OR (95% CI)	p
Age		
≤24ans	1	
25-29ans	1.09 (0.58-2.09)	0.800
≥30ans	3.09 (1.52-6.41)	0.002
Admission mode		
Self-entry	1	
Referral from public health facility	4.26 (2.60-7.10)	<0.001
Referral from private center	4.52 (2.49-8.38)	<0.001
Gestity		
1	1	
2-3	0.25 (0.11 – 0.55)	<0.001
≥4	0,26 (0.10 – 0.70)	0.008
Parity		
0	1	
1-3	2.72 (1.27 – 6.15)	0.012
≥4	3.92 (1.42 – 11.2)	0.009
Gestational age		
≤31	3.77 (2.13-6.84)	<0.001
32-36	0.97 (0.58-1.61)	0.900
≥37	1	
Obstetrical complications		
No	1	
Yes	1.49 (0.97-2.30)	0.068
Non-infectious complications		
No	1	
Yes	1.94 (1.27-2.97)	0.002

Variables	Adjusted OR (95% CI)	p
Fetal complications		
No	1	
Yes	1.98 (1.13 – 3.54)	0.018

DISCUSSION

The hospital-based maternal mortality ratio in our study was 1,397 deaths per 100,000 livebirths. This ratio is higher than that found in studies carried out at the *Saint Jean de Dieu de Tanguieta* hospital in northern Benin (1173 deaths per 100,000 live births) and at the the Mother and Child Teaching Hospital *Lagune* (905 deaths per 100,000 live births) (Aboubakar et al., 2021; Atade et al., 2021). It is also higher than that observed in Senegal (794 deaths per 100,000 live births) (Thiam et al., 2017); it is close to that determined in Nigeria (1,359 deaths per 100,000 live births) (Ezegwui et al., 2013) but lower than the ratio of 5,369 deaths per 100,000 live births observed in Burkina Faso (Zamané et al., 2018). This may be explained by the fact that our study included four hospitals of which two are third-level hospitals and therefore referral centers for critical cases.

Age was associated with maternal death in our study. This result is similar to those of other studies such as the study carried out in six countries which noted that women aged over 35 years had a higher risk of death (Bauserman et al., 2020) and another one which revealed that the youngest women (13 to 19 years) and the oldest (40 to 49 years) had the highest risk of death (Horwood et al., 2020). The same conclusion was reached by Ouedraogo et al in Burkina-Faso (Ouédraogo et al., 2016). Age is a non-modifiable risk factor, but the decision to become pregnant during the high-risk age groups should be a woman's choice. Policies aiming to increase access to modern methods of contraception, to safe abortion and these aiming to increase women empowerement should be strengthened in order to fight this risk factor.

Referral from another health facility was associated with a poor prognosis. This is confirmed by results obtained in Madagascar, Nigeria and Kenya (Rafamatanantsoa JF et al., 2017; Ntoimo et al., 2018; Fawole et al., 2012; Dindi NP et al., 2020). Delayed referral due to a delay in the decision by the healthcare team or a delay in acceptance of this decision by the patient or her family and referral conditions (non-equipped ambulance, personal vehicle, motorcycle) are factors that could favour deterioration in the patient's condition before admission to the host hospital and thus worsen the patient's vital prognosis. The reorganization of the referral system between maternity wards could enable patients to have faster access to host maternity wards.

Our study identified high parity as a predictor of maternal death. This result is similar to those of two multicenter studies conducted in Nigeria (Ntoimo et al., 2018; Fawole et al., 2012). This result could be explained by decreasing use of maternal interventions by women as parity increases. Indeed, a multi-country study using Demographic and Health Survey data from ten countries including Benin reported that higher the parity is, less women used critical maternal interventions (Sonneveldt et al., 2013).

Gestational age less than or equal to 31 weeks and the occurrence of non-infectious and fetal complications have also been identified as predictors of poor prognosis. These results may be explained by challenges linked to the quality of maternity care. According to Benin Maternal/ Neonatal

Death Surveillance and Response Annual Reports of 2020 and 2021 (Ministère de la Santé du Bénin, 2021, 2022), maternal deaths reviews concluded that the majority of dysfunctions leading to the occurrence of maternal deaths were related to the care delivery platform. Design and implementation of multifaceted contextualized interventions aiming to improve the quality of care could help to eliminate these factors. The effective application of accountability, particularly in the implementation of recommendations of maternal death reviews should also help to improve the quality of care. In addition, the progressive implementation of a health insurance mechanism could help to improve the timely management of complications.

This study identified the factors associated with the occurrence of maternal deaths. Strengthening policies aiming to increase access to modern methods of contraception and safe abortion, improving the referral system, and implementing multifaceted, contextualized interventions could contribute to reduce maternal mortality.

AUTHOR CONTRIBUTION

GA, CS and BA designed the study. GA and CA collected and analyzed data respectively. GA wrote the first draft of the manuscript which has been critically reviewed by all co-authors.

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CONFLICT OF INTEREST

The authors have not stated any conflicts of interest.

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