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Factors Associated with Post-Cesarean Maternal Mortality in the Dassa-Glazoué Health Zone, Benin, from 2020 To 2024

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Abstract

Introduction: Cesarean section provides enhanced safety in high-risk pregnancies, thereby preventing numerous deaths; however, it also exposes women to an increased risk of postoperative complications and even death. **Objective:** To investigate factors associated with post-cesarean maternal mortality in the Dassa-Glazoué health zone (Zone Hospital and Abbraccio Hospital). **Methods:** This was a retrospective cross-sectional analytical study conducted from January 1, 2020, to December 31, 2024. All women who delivered by cesarean section were included. Incomplete or unusable medical records, as well as records of women who underwent cesarean delivery elsewhere and were subsequently referred, were excluded. The sampling exhaustive was used. Data were collected using *KoboCollect* from June 18 to July 20, 2025, and analyzed with Epi Info version 7. Frequency measures and bivariate analyses were performed to identify associated factors. Chi-square (χ^2) and Fisher's exact tests were applied as appropriate. Text processing was carried out using Microsoft Word 2016, and tables and graphs were produced using Microsoft Excel 2016. **Results:** A total of 2771 women were included, among whom 20 post-cesarean maternal deaths were recorded, corresponding to a frequency of 0.72%. A total of 10,924 live births were registered, yielding a post-cesarean maternal mortality ratio of 183 per 100,000 live births. The mean age of the deceased women was 29.95 ± 6.62 years, with extremes ranging from 19 to 44 years. The main factors significantly associated with post-cesarean maternal mortality were age

($p = 0.015$), eclampsia ($p = 0.030$), anemia ($p < 0.001$), hemorrhage ($p = 0.016$), hypertension ($p < 0.001$), and certain indications for cesarean section. **Conclusion:** Strengthening emergency obstetric care is essential, particularly through raising awareness about the importance of early referral and timely hospital care.

Keywords

Maternal Mortality, Post-Cesarean Complications, Dassa-Glazoué Health Zone (Benin), 2020-2024

1. Introduction

Precarious socio-economic, environmental, and health conditions expose women to serious complications of pregnancy and childbirth that may result in death [1]. In 2023, an estimated 260,000 women died during or after childbirth, 70% of whom were in sub-Saharan Africa [2]. These largely preventable deaths highlight the need to strengthen the quality of obstetric care. Among the interventions aimed at reducing these risks, cesarean section is frequently performed in response to complications occurring during pregnancy or labor in order to prevent maternal and neonatal deaths [3] [4].

However, cesarean delivery may be followed by postoperative complications that constitute a significant risk factor for maternal mortality, particularly among women from disadvantaged backgrounds where access to quality healthcare remains limited [5]. In 2022, the Dassa-Glazoué health zone recorded a cesarean section rate of 9.3% and a maternal mortality ratio of 17.2 per 100,000 live births [6]; however, no study has specifically addressed post-cesarean maternal mortality in this setting. This study aims to investigate the factors associated with post-cesarean maternal mortality in the Dassa-Glazoué health zone from 2020 to 2024.

2. Methods

This was a retrospective cross-sectional analytical study conducted over a five-year period, from January 1, 2020, to December 31, 2024. The study population consisted of all women who delivered by cesarean section in the two hospitals of the Dassa-Glazoué health zone (the Zone Hospital and Abbraccio Hospital) during the study period. All women who underwent cesarean delivery between January 1, 2020, and December 31, 2024, were included. Exclusion criteria comprised incomplete or unusable medical records of women who delivered by cesarean section, as well as records of women who had undergone cesarean delivery elsewhere and were subsequently referred to one of the two hospitals in the health zone. The sampling exhaustive was used and consisted of a census of all medical records of women who delivered by cesarean section and met the selection criteria. The sample size corresponded to the total number of eligible records included in the study. The dependent variable was post-cesarean maternal death, defined as the death of

a woman during cesarean delivery or within 42 days following the procedure due to complications related to surgery or obstetric conditions [7] [8]. Independent variables included sociodemographic characteristics; gynecological and obstetric characteristics; medical history and comorbidities; complications during pregnancy; characteristics of the cesarean section; and factors related to patient management. A digital questionnaire developed using *KoboCollect* and configured on a smartphone was used for data collection. Data were collected from June 18 to July 20, 2025, and analyzed using Epi Info version 7. Frequency measures, bivariate and multivariate analyses were used to describe the data and identify associated and confounding factors. Qualitative variables were expressed as proportions, while quantitative variables were described using means and standard deviations. Text processing was performed using Microsoft Word 2016, and tables and graphs were produced using Microsoft Excel 2016. Comparisons of qualitative variables were conducted using the Chi-square test or Fisher's exact test, depending on the expected cell counts. The level of statistical significance was set at less than 5% for all analyses. Prior approval was obtained from the Research Protocol Review Committee of the National School for the Training of Senior Technicians in Public Health and Epidemiological Surveillance (ENATSE), the Local Ethics Committee for Biomedical Research of the University of Parakou (CLERB-UP), and the authorities of the Dassa-Glazoué health zone. Informed consent and confidentiality of participants were strictly respected.

3. Results

3.1. Post-Cesarean Maternal Mortality Rate

A total of 2771 women who delivered by cesarean section were included in the study, among whom 20 post-cesarean maternal deaths were recorded, corresponding to a frequency of 0.72%. A total of 10,924 live births were recorded, yielding a post-cesarean maternal mortality ratio of 183 per 100,000 live births.

3.2. Profile of Women Who Died Following Cesarean Section

3.2.1. Sociodemographic Characteristics

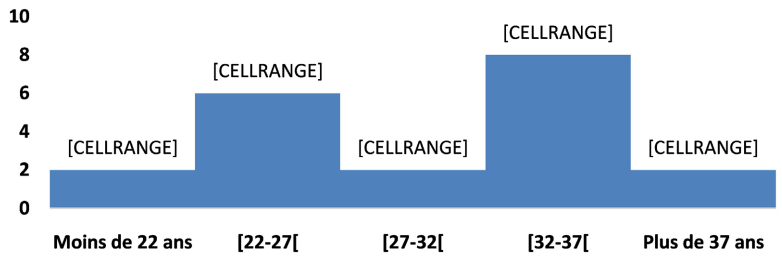

Figure 1. Distribution of women who died following cesarean section in the Dassa-Glazoué health zone from 2020 to 2024 according to age group.

The mean age of the women who died following cesarean section was 29.95 ± 6.62 years, with a range from 19 to 44 years. The most represented age group was 32 -

37 years (40%). Of the 20 post-cesarean maternal deaths recorded, 11 women (55%) resided in urban areas and 9 women (45%) lived in rural areas. Most of the women (90%) were homemakers, while 5% were farmers (Figure 1).

3.2.2. Gynecological and Obstetric History

- Gravidity and Parity

The mean gravidity of the women was 3.02 ± 2.11. Paucigravidae accounted for 50.52%, primigravidae for 30.31%, multigravidae for 20.21%, and grand multigravidae for 13.24%.

The mean parity was 1.87 ± 1.97. Nulliparous women represented 32.44%, pauciparous women 27.54%, primiparous women 21.26%, multiparous women 12.99%, and grand multiparous women 5.77%.

3.3. Medical History

Malaria (0.20%) and arterial hypertension (2.5%) were the medical antecedents reported among the women who died.

3.4. Indications for Cesarean Section among Deceased Women

The indications for cesarean section included an unfavorable Bishop score (0.3%), arterial hypertension (1.24%), pre-rupture syndrome (1.06%), dystocic presentation (0.74%), obstetric emergencies (1.20%), severe preeclampsia (0.88%), dynamic dystocia (0.71%), and maternal rescue indications (4.89%).

3.5. Maternal Outcome

This section includes postoperative status, the nature of the postpartum course, complications, causes of death, and length of hospital stay.

All women included in the study were alive at discharge from the operating room. The mean length of hospital stay was 3.43 ± 1.93 days. The causes of death were anemia (30%), hemorrhage (35%), hypertension and related complications (30%), septic shock (10%), hypovolemic shock (10%), and uterine rupture (5%) (Table 1).

Table 1. Distribution of women who delivered by cesarean section in the Dassa-Glazoué health zone from 2020 to 2024 according to the nature of the postpartum course, complications, and causes of death.

	Number	Percentage (%)
Nature of post-partum outcomes	(N = 2771)	
Simple	2410	86.97
Complicated	341	12.31
Maternal death	20	0.72
Complications	(n = 341)	
Anemia	165	48.39
Hemorragea	47	13.79

Continued

HBP and complications	81	23.75
Endometritis	02	0.59
Infectious syndrome	10	2.93
Parietal suppuration	01	0.29
Other	35	10.26
Death causes	(n* = 24)	
Hemorrhage	06	25
HBP and complications	07	29.2
Septic shock	06	25
Hypovolemic shock	02	8.33
Uterine rupture	02	8.33
Hemorrhage	01	4.14

n: complications's numbers, n*: number of death causes.

3.6. Factors Associated with Maternal Mortality

Association between post-cesarean maternal mortality and sociodemographic characteristics

A statistically significant association was found between age (p = 0.015) and the occurrence of post-cesarean maternal deaths. These women have a significantly lower risk of death, with a prevalence ratio (PR) of 0.26. Being between 17 and 24 years old appears to be a significant protective factor against mortality (Table 2).

Table 2. Association between post-cesarean maternal mortality and the sociodemographic characteristics of women who delivered by cesarean section in the Dassa-Glazoué health zone from 2020 to 2024.

		Death						
	N	Yes		No		RP	$IC_{95\%}$	p-value
		N	%	N	%			
Age (years old)								
Under 17	85	00	0.00	85	100	-	-	-
[17-24]	960	04	0.42	956	99.58	**0.26**	**[0.08-0.84]**	**0.015**
[24-31]	980	06	0.61	974	99.9	0.38	[0.14-1.07]	0.057
[31-38]	564	09	1.60	555	98.40	01		
Over 38	182	01	0.55	181	99.45	0.34	[0.04-2.7]	0.285
Place of residence								
Urban	1947	11	0.56	1936	99.44	0.5	[0.20-1.18]	0.100
Rural	780	09	1.15	771	98.85	01		

Continued

Socio Professional occupation								
Housewife	1111	18	1.62	1093	98.38	1.6	[0.22-11.89]	0.639
Civil servant	235	00	0.00	235	100	-	-	-
Craftwoman	517	00	0.00	517	100	-	-	-
Seller	425	00	0.00	425	100	-	-	-
Student/Apprentice	319	00	0.00	319	100	-	-	-
Farmer	97	01	1.03	97	98.97	01		

PR* = Prevalence report, CI = Confidence Interval.**

3.7. Relationship between Post-Cesarean Maternal Mortality and Complications during Pregnancy

Pregnancy-related complications such as eclampsia (p = 0.030), hemorrhage (p = 0.016), anemia (p < 0.0001), and arterial hypertension (p < 0.0001) were statistically associated with the occurrence of post-cesarean maternal deaths (as shown in Table 3).

Table 3. Association between post-cesarean maternal mortality and complications during pregnancy among women who delivered by cesarean section in the Dassa-Glazoué health zone from 2020 to 2024.

	Death							
	N	Yes		No		RP	$IC_{95\%}$	p-value
		N	%	N	%			
Preeclampsia								
Yes	182	01	0.55	181	99.45	0.75	[0.10 - 5.56]	0.776
No	2589	19	0.73	2570	99.27	01		
Eclampsia								
Yes	69	02	2.90	67	97.10	**4.35**	**[1.3 - 18.38]**	**0.030**
No	2702	18	0.67	2684	99.33	01		
Hemorrhage								
Yes	118	03	2.54	115	97.46	**3.97**	**[1.18 - 13.35]**	**0.016**
No	2653	17	0.64	2636	99.36	01		
Uterine rupture								
Yes	30	01	3.33	29	96.67	4.1	[0.66 - 34.77]	0.089
No	2741	19	0.69	2722	99.31	01		
Edema								
Yes	284	04	1.41	280	98.59	2.72	[0.89 - 8.29]	0.066
No	2487	13	0.52	2474	99.48	01		
Placenta previa								
Yes	71	01	1.41	70	98.59	02	[0.27 - 14.75]	0.488
No	2700	19	0.70	2681	99.30	01		

Continued

Anemia								
Yes	495	13	2.63	482	97.37	**8.54**	**[3.42 - 21.29]**	**<0.001**
No	2276	07	0.10	2269	99.69	01		
Hypertension								
Yes	239	06	2.51	233	97.49	**23.84**	**[9.25 - 61.49]**	**<0.001**
No	2532	14	0.55	2518	99.45	01		
Septicemia								
Yes	07	00	0.00	07	100	-	-	-
No	2764	20	0.72	2744	99.27	01		
Malaria								
Yes	98	00	0.00	98	100	-	-	-
No	2673	20	0.75	2673	99.25	01		

3.8. Relationship between Post-Cesarean Maternal Mortality and Indications for Cesarean Section

An unfavorable Bishop score ($p < 0.001$), acute fetal distress ($p < 0.001$), and arterial hypertension ($p = 0.024$) were statistically associated with the occurrence of post-cesarean maternal deaths (see Table 4).

Table 4. Association between post-cesarean maternal mortality and indications for cesarean section among women who delivered by cesarean section in the Dassa-Glazoué health zone from 2020 to 2024.

		Death						
	N	Yes		No		RP	$IC_{95\%}$	p-value
		N	%	N	%			
Prophylactic cesarean	115	00	0.00	115	100	-	-	-
Pre-rupture syndrome	94	01	1.06	93	98.94	0.22	[0.03 - 1.69]	0.104
Scarred uterus	296	00	0.00	296	100	-	-	-
Unfavorable Bishop score	435	01	0.23	434	99.77	**0.05**	**[0.01 - 0.37]**	**<0.001**
Abnormal fetal presentation	135	01	0.74	134	99.23	0.15	[0.02 - 1.18]	0.035
Bone dystocia	206	00	0.0	206	111	-	-	-
Post-term pregnancy	113	00	0.0	113	100	-	-	-
Fetal macrosomia	229	00	0.0	229	100	-	-	-
Obstetric emergency	166	02	1.20	164	98.80	0.25	[0.06 - 1.12]	0.048
Genital infection	62	00	0.00	62	100	-	-	-
Severe preeclampsia	114	01	0.88	113	99.12	0.18	[0.02 - 1.40]	0.061
Dynamic dystocia	141	01	0.71	140	99.29	0.15	[0.02 - 1.13]	0.030
Acute fetal distress	315	01	0.32	314	99.68	**0.06**	**[0.01 - 0.50]**	**<0.001**
Cephalopelvic disproportion	227	00	0.00	227	100	-	-	-
HBP	242	03	1.24	239	98.76	**0.25**	**[0.07 - 0.92]**	**0.024**
Intrauterine growth restriction	12	00	0.00	12	100	-	-	-
Maternal-fetal rescue	184	09	4.89	175	95.11	01		

3.9. Relationship between Post-Cesarean Maternal Mortality and Management-Related Factors

Following cesarean delivery, the majority of patients received antibiotics (77.44%), and 13.06% of women were transfused with blood. No statistically significant association was found between medical treatment, availability of care, and the occurrence of post-cesarean maternal deaths.

3.10. Multivariate Analysis of Factors Associated with Post-Caesarean Mortality in the Dassa-Glazoué Health Zone from 2020 to 2024

After multivariate analysis, it seems that the age group 17 - 24 years, an unfavorable Bishop score, and fetal distress appeared to be protective factors against maternal mortality (Table 5).

Table 5. Multivariate analysis of factors associated with post-caesarean mortality in the Dassa-Glazoué Health Zone from 2020 to 2024.

factors associated	aOR	IC 95 %	P-value
age 17 - 24 years old	**0.29**	**[0.09 - 0.91]**	**0.034**
Rural residence	1.58	[0.92 - 2.71]	0.092
Eclampsia	3.21	[1.01 - 10.23]	0.048
Hemorragea	2.87	[1.04 - 7.10]	0.041
Anemia	6.74	[2.53 - 17.94]	<0.001
HBP	11.62	[4.21 - 32.05]	<0.001
Obstetric emergency	1.89	[0.96 - 3.71]	0.064
Maternal-fetal rescue	4.38	[1.72 - 11.16]	0.002
Unfavorable Bishop score	**0.21**	**[0.05 - 0.88]**	**0.032**
Acute fetal distress	**0.28**	**[0.09 - 0.91]**	**0.034**

aOR: adjusted, CI = Confidence Interval.

4. Discussion

4.1. Post-Cesarean Maternal Mortality Rate

The post-cesarean maternal mortality ratio was 183 per 100,000 live births. This rate is close to the 185 per 100,000 live births reported in Benin by Mongbo *et al.* in 2016 [9]. In Nigeria, studies conducted over 5- and 10-year periods reported maternal mortality ratios of 624.1 and 908.6 per 100,000 live births, respectively. The differences can be attributed to the retrospective design of these studies [10] [11]. Our result is higher than that reported in Ethiopia in 2015 by Galeto *et al.*, where the post-cesarean maternal mortality ratio was 136 per 100,000 live births [12]. This may be explained by the fact that their study was based on secondary data from an evaluation survey. Balde *et al.* in Guinea reported a mortality ratio of 409.97 per 100,000 live births, which reflects the inclusion of both cesarean and

laparotomy procedures in a combined retrospective and prospective study [5].

4.2. Factors Associated with Post-Cesarean Maternal Mortality

✓ **Age**

The mean age of the women was 26.56 ± 6.62 years, ranging from 12 to 48 years. The most represented age group was 24 - 31 years (35.37%). Age between 17 and 24 years appeared as a significant protective factor against maternal mortality ($p = 0.015$). This finding is consistent with the study by Estaves-Pereira *et al.* (2016) in Brazil, which suggests that advanced maternal age (≥35 years) is associated with post-cesarean maternal mortality ($p = 0.018$).

✓ **Gravidity and Parity**

Primigravidae accounted for 30.31% of post-cesarean maternal deaths, with a relative risk of 0.15 ($p = 0.005$) [13]. This finding aligns with studies by Bishop *et al.* and Holmer *et al.*, which identified gravidity as a characteristic of women who died after cesarean section [7] [14]. Conversely, Poorolajal *et al.* reported that increasing gravidity overall increased maternal mortality risk [15].

Extremes of gravidity, including primigravidae and grand multigravidae, represent vulnerable profiles. Nulliparous women (32.44%) had a 0.12-fold risk of death compared to women who had previously delivered. Symonds *et al.* found similar results, highlighting that both nulliparity and grand multiparity are associated with post-cesarean maternal mortality [16]. Mongbo *et al.* and Kinenkinda *et al.* reported similar findings in Benin and the Congo, respectively [8] [17].

✓ **History of Malaria**

A history of malaria was associated with maternal mortality, representing 35.5% of all prior conditions. The risk of death among women with a malaria history during pregnancy was 0.2 ($p = 0.017$). Unger *et al.* have shown that malaria negatively impacts pregnancy outcomes and increases the risk of severe anemia [18].

✓ **Eclampsia, Hemorrhage, Anemia, and Hypertension During Pregnancy**

Hemorrhage during pregnancy occurred in 4.3% of women, similar to the 5.5% reported by Bishop *et al.* in 2019 [7]. These women had a 3.97-fold increased risk of death after cesarean section ($p = 0.016$). Bishop *et al.* also found that women with obstetric hemorrhage were 5.87 times more likely to die post-cesarean. In Ethiopia, Endeshaw *et al.* (2024) reported an 11.8-fold higher risk associated with hemorrhage [16]; the difference may be explained by their cohort study design, which evaluated mortality within seven days post-cesarean.

Eclampsia was identified as another risk factor for post-cesarean maternal mortality ($p = 0.030$), consistent with findings by Yego *et al.* (2014, $p < 0.001$) [18].

Anemia during pregnancy was also a significant factor, with affected women having an 8.54-fold higher risk of death after cesarean section ($p < 0.001$). This is consistent with Daru *et al.*, who reported a 1.86-fold increase in maternal mortality due to anemia, though their study considered only severe anemia [19].

Hypertension during pregnancy was another risk factor for maternal death post-cesarean ($p < 0.001$), in line with studies by Martinez-Garrido *et al.* (Mexico, 2024) and Ozuba *et al.* (Nigeria, 2002) [20] [21].

4.3. Indications for Cesarean Section

Women with an unfavorable Bishop score ($p < 0.001$), acute fetal distress ($p < 0.001$), or hypertension ($p = 0.024$) as the indication for cesarean had post-cesarean maternal death risks of 0.05, 0.06, and 0.25, respectively, compared with other indications. This aligns with findings from Andriamady *et al.* in Madagascar, which reported that indications such as hemorrhagic placenta previa or fetal distress were associated with maternal mortality [22].

Conversely, Mengesha *et al.* in Ethiopia (2017) found that preeclampsia or obstructed labor could worsen maternal prognosis, leading to death [23]. Thus, the indication for cesarean appears to strongly influence maternal outcomes.

5. Conclusions

The post-cesarean maternal mortality rate remains high, reflecting challenges in obstetric care. In the Dassa-Glazoué health zone between 2020 and 2024, seven women per 1000 cesarean deliveries died. Deceased women were predominantly in their thirties, homemakers, primiparous or pauciparous, primigravidae, and resided in urban areas.

The main factors associated with maternal mortality were age, gravidity, parity, mode of admission, malaria history, eclampsia, hemorrhage, anemia, hypertension during pregnancy, and the indication for cesarean section. These findings confirm that post-cesarean maternal mortality is multifactorial, arising from both individual and organizational determinants.

Authors' Contributions

All authors participated in the study design, implementation, manuscript writing, and revision.

Conflicts of Interest

The authors declare no conflicts of interest related to this research.

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