



# Factors Associated with Maternal Deaths in the Donga Department, Benin, from 2020 to 2024

Mavlyson Kolawolé Zinvokpodo<sup>1</sup>, Badirou Aguemon<sup>1</sup>, Georgia Barikissou Damien<sup>2</sup>, Rousseau Christel Segbegnon Zinvokpodo<sup>3</sup>, Ignace Coovi Nonwanou Tokpanoude<sup>1</sup>, Josué Gildas Nical Kenet Tchilamessi Nounon<sup>4</sup>

<sup>1</sup>Faculty of Health Sciences (FSS), University of Abomey-Calavi, Cotonou, Benin

<sup>2</sup>Training and Research Center for Population Studies, University of Abomey-Calavi, Cotonou, Benin

<sup>3</sup>Departmental Health Directorate of Ouémé, Adjohoun-Bonou-Dangbo Health Zone, Adjohoun, Benin

<sup>4</sup>Research and Innovation Collective in Statistics, Work and Application on Software (CRISTAL-ENSPD), Parakou, University of Parakou, Benin

Email: kolawolezin@gmail.com

**How to cite this paper:** Zinvokpodo, M.K., Aguemon, B., Damien, G.B., Zinvokpodo, R.C.S., Tokpanoude, I.C.N., Nounon, J.G.N.K.T. (2025) Factors Associated with Maternal Deaths in the Donga Department, Benin, from 2020 to 2024. *Open Access Library Journal*, 12: e14035.

<https://doi.org/10.4236/oalib.1114035>

**Received:** July 28, 2025

**Accepted:** September 23, 2025

**Published:** September 26, 2025

Copyright © 2025 by author(s) and Open Access Library Inc.

This work is licensed under the Creative Commons Attribution International License (CC BY 4.0).

<http://creativecommons.org/licenses/by/4.0/>



Open Access

## Abstract

**Introduction:** maternal deaths remain a major public health issue in Benin, particularly in the Donga department despite notable efforts. The study aimed to identify factors associated with maternal deaths in order to improve decision-making. **Methods:** A case-control study was conducted in the Djougou-Copargo-Ouaké and Bassila health zones from January 2020 to December 2024. A total of 143 cases (maternal deaths) and 286 controls (women who gave birth without a fatal outcome) were included. Data were collected from birth registers, medical records, referral forms, and maternal death surveillance forms. Statistical analysis was performed using Epi Info software. Multivariate logistic regression was used to identify factors significantly associated with maternal deaths. **Results:** The maternal mortality ratio was 95.01 deaths per 100,000 live births. Factors significantly associated with the increase of maternal deaths were marital status (OR = 2.23;  $p = 0.007$ ), history of cesarean section (OR = 1.65;  $p = 0.027$ ), high multigravidity (OR = 2.01;  $p = 0.014$ ), and high multiparity (OR = 2.23;  $p = 0.021$ ). Management-related factors, such as a consultation delay of more than 3 days (OR = 4.06;  $p = 0.048$ ), absence of a referral form (OR = 2.72;  $p = 0.001$ ), absence of venous access upon arrival (OR = 2.23;  $p = 0.023$ ), and late referral to a specialized service (OR = 3.32;  $p = 0.001$ ) were also identified as major determinants. **Conclusion:** Reducing maternal deaths in the Donga department requires strengthening the referral system, improving obstetric care, better preparedness of peripheral health facilities, and addressing community awareness, transport, road conditions, and other structural barriers to minimize preventable delays.

## Subject Areas

Women's Health

## Keywords

Maternal Deaths, Benin, Cesarean Section, High Parity, Referral System, Delays in Care

---

## 1. Introduction

Maternal deaths remain a major public health challenge, particularly in low- and middle-income countries. According to the World Health Organization (WHO), approximately 800 women die every day from complications related to pregnancy or childbirth, equivalent to one woman every two minutes [1]. Maternal mortality remains a major public health issue in Sub-Saharan Africa (SSA), where most countries are unlikely to meet the Sustainable Development Goal (SDG) target of fewer than 70 maternal deaths per 100,000 live births by 2030. According to Adegoke *et al.*, even with a 30% increase in public health expenditures, only a few countries, such as Botswana, Namibia, and South Africa are projected to meet this target, while others may continue to record more than 200 maternal deaths per 100,000 live births by 2030 [2]. In 2020, this number was estimated to be 287,000 maternal deaths worldwide. Sub-Saharan Africa is the most affected region, accounting for about 70% of maternal deaths. In West and Central Africa, the maternal mortality ratio is estimated at 724 per 100,000 live births, the highest among all global regions [3].

In Benin, according to the Demographic and Health Survey (DHS) data, the maternal mortality ratio is estimated at 391 maternal deaths per 100,000 live births for the past seven years [4]. This means that each year, approximately 1600 women die from complications related to pregnancy or childbirth. The Beninese government is not standing idly by in the face of this concerning situation. According to the MICS 2021-2022 survey, 80.8% of births in Benin are attended by skilled health personnel [5]. To further increase this coverage and significantly reduce the maternal mortality ratio, the United Nations Population Fund (UNFPA) has pledged to support the government's efforts by strengthening various aspects of the health system [6]. Moreover, on Wednesday, October 20, 2021, the Beninese Parliament adopted a new legal amendment to the 2003 law on Sexual and Reproductive Health (SRH), which represents an essential step towards preventing avoidable maternal deaths and disabilities suffered by women, girls, and their families due to unsafe abortions [7].

Regarding preventable deaths, the majority of maternal deaths are caused by severe hemorrhage (27%), infections during childbirth (11%), high blood pressure during pregnancy (14%), or complications resulting from unsafe abortions (8%) [7]. In 28% of cases, these deaths are partly due to pre-existing conditions such as

malaria or HIV/AIDS [8]. Additionally, female genital mutilation can also lead to fatal complications during childbirth. Maternal mortality is not only the consequence of biomedical complications during pregnancy and childbirth, but also the result of structural social, economic, and systemic inequalities. According to Souza *et al.* (2024) [9], maternal health outcomes are shaped by a wide spectrum of distal and proximal determinants, including health system characteristics, social conditions, and individual risk factors, which together define the trajectory from high to low maternal mortality [10]. Maternal mortality is the result of a complex interaction between biomedical, social, economic, and systemic factors. According to a global analysis by Souza *et al.* (2023), maternal health and survival are influenced by a wide range of distal and proximal determinants, which include super-determinants such as social inequality, health system capacity, and access to quality care before, during, and after pregnancy. This multifactorial nature requires a broad approach to understanding and addressing maternal deaths.

It is within this context that the present study was undertaken, with the aim of investigating the factors associated with maternal deaths in the Donga Department to improve the health of mothers and their children.

## 2. Study Setting and Methodology

This study was conducted in the Donga Department, located in the North-West of Benin. The department comprises four municipalities: Djougou, Ouaké, Copargo, and Bassila, which are organized into two health zones: the Djougou-Ouaké-Copargo (DCO) health zone and the Bassila health zone. The public healthcare facilities range from health facilities to health zone hospitals, as well as a few private health facilities. The Direction Départementale de la Santé (DDS) coordinates all health activities in the region.

A case-control study was carried out in the Donga Department, Benin, from January 1, 2020, to December 31, 2024. The study area included the Djougou-Copargo-Ouaké and Bassila health zones. A total of 143 cases (maternal deaths) and 286 controls (women who gave birth without a fatal outcome) were included, respecting a 1:2 ratio. To minimize selection bias and ensure comparability between cases and controls, matching was carried out on the basis of predefined key criteria. Controls were selected from the same healthcare facilities where the maternal deaths occurred, so that both groups were exposed to similar healthcare environments. They were also matched in time, with deliveries or terminations taking place during the same period—or as close as possible to that of the corresponding maternal deaths. In addition, demographic characteristics such as age, parity and place of residence were taken into account to refine comparability. Among these characteristics, age was the dominant criterion, followed by place of residence. Cases included all women who died from confirmed maternal causes, according to the WHO definition [11], within public health facilities in the Donga area during the study period and with a complete medical record. Controls were women who gave birth or completed their pregnancy without a fatal outcome in

the same facility and during the same period; they were matched to cases by place (same health facility) and time (same month of delivery) to minimize selection bias. For each maternal death identified in the Donga Department between 2020 and 2024, two controls were selected according to matching criteria (same health facility, similar time period, and comparable demographic characteristics). Systematic random sampling was then applied to diversify and fairly distribute the controls across the selected health facilities. This approach ensured a representative control sample that was comparable to the maternal death cases. Data were extracted from delivery registers, referral forms, and medical records using a standardized form designed to collect sociodemographic information, medical and obstetric history, and details of care received. The dependent variable was binary qualitative (1 if maternal death occurred, 0 otherwise). Statistical analysis was performed using Epi Info version 7.2.6.0. After bivariate analysis, variables with a p-value < 0.05 were included in a logistic regression model to identify factors associated with maternal death. Although matching was performed during the selection of controls (based on age and facility), a standard (unconditional) multivariate logistic regression model was used. This choice was made because the matching was partial and not strict for all cases, and because unmatched cases and controls were also included in the final analysis. Conditional logistic regression was not used due to the variability in matching parameters and to preserve statistical power.

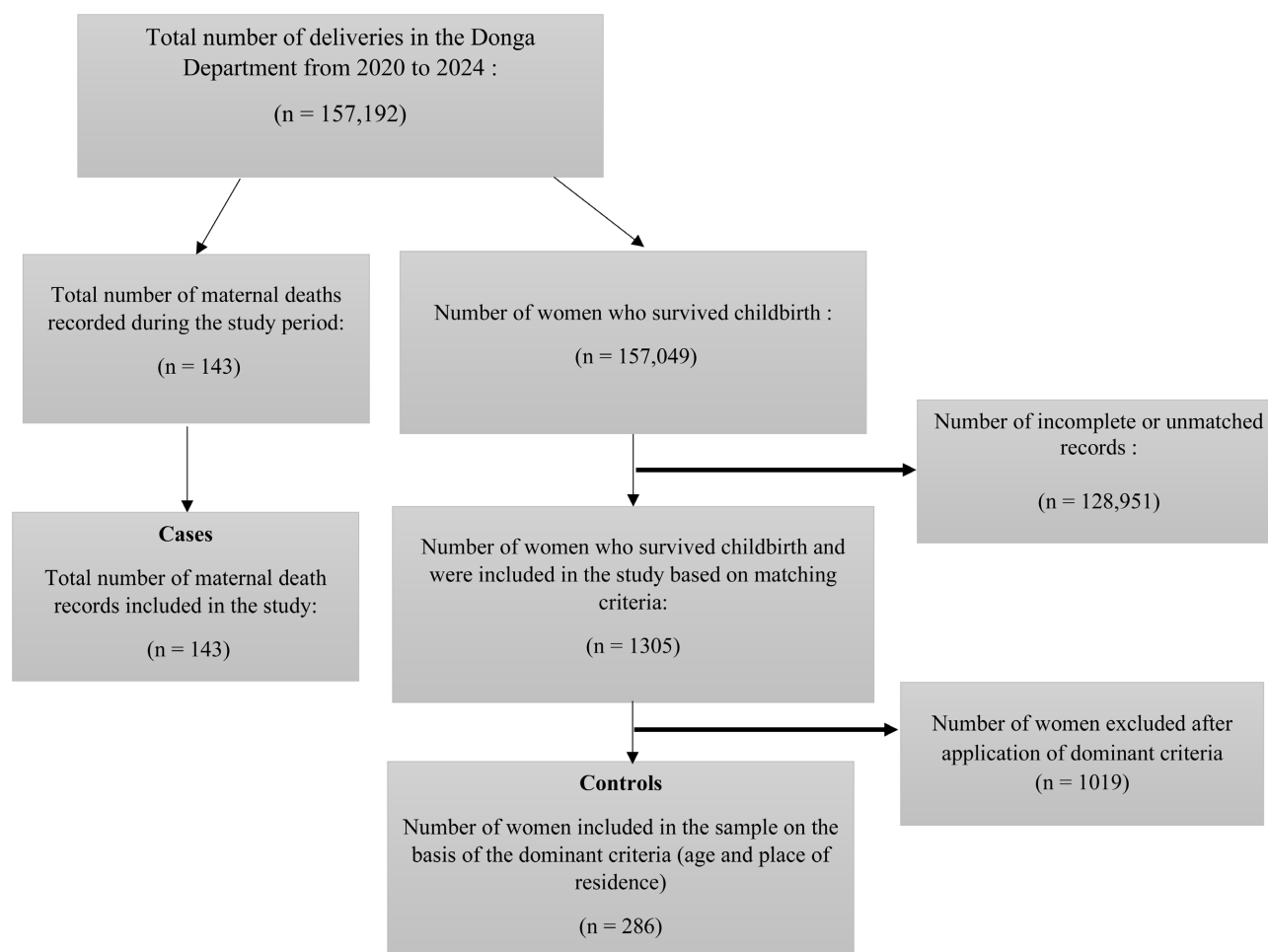
Records with incomplete data on key exposure or outcome variables were excluded from the analysis. Out of 143 maternal deaths and 1305 potential controls, 1019 control records were excluded for not meeting matching criteria or due to missing essential data.

Variables included in the multivariate model were selected based on a p-value threshold < 0.05 in bivariate analysis and their conceptual relevance as potential confounding factors (e.g., gravidity, parity, previous cesarean, marital status). Model fit was assessed using the Hosmer-Lemeshow goodness-of-fit test, and multicollinearity was checked using the Variance Inflation Factor (VIF), ensuring all VIF values were <2.

Several key clinical and organizational concepts were considered in this study to assess the timeliness and effectiveness of maternal care. Consultation delay refers to any delay exceeding the expected time for initiating a medical consultation or intervention, potentially compromising the quality of care and patient satisfaction. Such delays are typically measured in minutes or hours relative to the scheduled consultation time [12]. Vital distress is defined as a severe and acute dysfunction of one or more vital systems respiratory, circulatory, or neurological posing an immediate or imminent threat to the patient's life. It requires prompt recognition of clinical signs and emergency intervention [13]. An altered general condition describes a clinical state marked by a significant reduction in functional capacity, commonly identified by the triad of asthenia (extreme fatigue), anorexia (loss of appetite), and substantial weight loss. This condition often signals a serious

underlying pathology and reflects a deterioration in the overall health status [14]. Lastly, a timely referral refers to the process of transferring a patient to an appropriate level of care or specialized service within a clinically acceptable timeframe, before the onset of severe complications. This approach ensures appropriate and effective care and is guided by clinical and organizational standards to avoid detrimental delays [15]. The study adhered to ethical principles of confidentiality and anonymity and received approval from the Direction Départementale de la Santé (DDS) [16].

**Figure 1** shows the flow chart for this study.



**Figure 1.** Flow diagram.

### 3. Results

#### 3.1. Epidemiology of Maternal Deaths

A total of 150516 live births were recorded in the Donga Department. Over the same period, 143 maternal deaths were documented. The maternal mortality ratio in the Donga Department from 2020 to 2024 was 95.05 deaths per 100,000 live births.

**Table 1** below provides a summary of live births, maternal deaths, and the maternal

mortality ratio per 100,000 live births, by health zone and by year:

**Table 1.** Distribution of the Maternal mortality ratio in the Donga Department from 2020 to 2024.

Year	DCO			BASSILA			Total		RMM
	Births	Deaths	RMM	Births	Deaths	RMM	Births	Births	
2020	20,904	24	114.81	5628	13	230.99	26,532	37	139.45
2021	22,220	24	108.01	6057	6	99.06	28,277	30	106.09
2022	24,214	28	115.64	6855	5	72.94	31,069	33	106.22
2023	25,013	16	63.97	7045	5	70.97	32,058	21	65.51
2024	25,158	16	63.6	7422	6	80.84	32,580	22	67.53
<b>Total</b>	<b>117,509</b>	<b>108</b>	<b>91.91</b>	<b>33,007</b>	<b>35</b>	<b>106.04</b>	<b>150,516</b>	<b>143</b>	<b>95.01</b>

### 3.2. Bivariate Analysis

#### Relationship between maternal deaths and socio-demographic characteristics

The bivariate analysis shows a significant association only between marital status and maternal death ( $p = 0.001$ ). **Table 2** shows the association between women's sociodemographic characteristics and the occurrence of maternal deaths in the Donga Department during the study period.

**Table 2.** Association between sociodemographic characteristics and maternal deaths.

Variables	Maternal Death		Total	OR	IC95%	p
	Cases	Controls				
<b>Age group (years)</b>						0.194
[14 - 20[	10	18	28	1.224	0.546 - 2.745	
[20 - 35[	103	227	330	1		
≥35	30	41	71	1.613	0.954 - 2.727	
<b>Occupation</b>						0.135
Craftswoman	16	18	34	1.665	0.817 - 3.393	
Trader	12	46	58	0.489	0.248 - 0.961	
Student	2	6	8	0.562	0.103 - 3.055	
Civil servant	2	8	10	0.466	0.086 - 2.521	
Housewife	110	206	316	1		
Other	1	2	3	0.935	0.081 - 10.729	
<b>Place of residence</b>						0.876
Rural	107	212	319	0.968	0.613 - 1.529	
Urban	36	74	110	1		
<b>Marital status</b>						0.001**

## Continued

Single	10	3	13	7.091	1.924 - 26.198
Married	133	283	416	1	
<b>Type of household</b>					0.54
Monogamous	48	111	159	1	
Polygamous	85	172	257	1.136	0.747 - 1.726
<b>Total</b>	143	286	429	-	

\*\* : significant at the 5% level; \* : significant at the 10% level.

### 3.3. Relationship between Maternal Deaths and Hospital Admission Conditions

The analysis revealed a statistically significant association between consultation delay and maternal death ( $p = 0.001$ ). **Table 3** illustrates the relationship between hospital admission conditions and the occurrence of maternal deaths, highlighting variables with statistically significant associations.

**Table 3.** Relationship between maternal death and hospital admission conditions.

Variables	Maternal Death		Total	OR	IC 95%	p
	Cases	Controls				
<b>Consultation delay (hours)</b>						0.001**
<3	128	203	331	1		
≥3	7	5	12	2.12	0.720 - 6.250	
Not specified	8	78	86	0.16	0.080 - 0.360	
<b>Mode of admission</b>						0.205
Referred/Evacuated	93	187	280	1		
Self-referred	50	93	143	1.082	0.708 - 1.653	
Transferred	0	6	6			
<b>Type of transportation</b>						0.37
Medicalized	66	142	208	1		
Non-medicalized	27	45	72	1.299	0.768 - 2.197	
<b>Total</b>	143	286	429			

\*\* : significant at the 5% level; \* : significant at the 10% level.

### 3.4. Referral to a Specialized Service and Maternal Death

Bivariate analysis revealed a significant association between a condition requiring referral to a specialized service and maternal death, with a p-value of 0.047. Similarly, timely referral to a specialized service was associated with maternal death ( $p = 0.001$ ). **Table 4** presents the association between the need for referral to a

specialized service, the timeliness of such referral, and the occurrence of maternal deaths.

**Table 4.** Association between referral to a specialized service and maternal death.

Variables	Maternal Death		Total	OR	IC95%	p
	Cases	Controls				
<b>Condition requiring referral to specialized care</b>						0.047**
No	13	46	59	1	–	
Yes	130	240	370	1.917	0.999 - 3.677	
<b>If yes:</b>						0.001**
Referred on time	111	240	351	1	–	
Not referred on time	19	0	19	–	–	
<b>Total</b>	143	286	429	–	–	

\*\* : significant at the 5% level; \* : significant at the 10% level.

### 3.5. Relationship between the Patient's Obstetric and Medical History and Maternal Deaths

The analysis showed a significant association between maternal deaths and antenatal care attendance ( $p = 0.045$ ), gravidity ( $p = 0.001$ ), and parity ( $p = 0.002$ ). **Table 5** summarizes the association between patients' obstetric and medical history and the occurrence of maternal deaths, with a focus on antenatal care attendance, cesarean section history, gravidity, and parity.

**Table 5.** Association between obstetric and medical history and maternal deaths.

Variables	Maternal Death		Total	OR	IC95%	p
	Cases	Controls				
<b>Antenatal Care (ANC)</b>						0.045**
No	53	64	117	1		
Yes	76	124	200	0.74	0.466 - 1.175	
<b>Medical History</b>						0.871
No	67	162	229	1		
Yes	76	124	200	1.482	0.990 - 2.218	
<b>Cesarean Section</b>						0.050*
<b>No</b>	124	265	389	1		
Yes	19	21	40	2.014	1.001 - 4.051	
<b>Gravidity</b>						0.001**
<b>Primigravida (1)</b>	24	67	91	1		
Multigravida (2 - 4)	27	98	125	0.766	0.423 - 1.387	

## Continued

Grand multigravida ( $\geq 5$ )	87	121	208	2.01	1.186 - 3.407	
<b>Parity</b>						0.002**
<b>Nulliparous (0)</b>	24	53	77	1		
Primiparous (1)	16	54	70	0.653	0.313 - 1.364	
Multiparous (2 - 4)	47	103	150	1.036	0.585 - 1.837	
<b>Grand multiparous (<math>\geq 5</math>)</b>	51	76	127	1.849	1.006 - 3.401	

\*\* : significant at the 5% level; \* : significant at the 10% level.

### 3.6. Relationship between Clinical Condition at Admission and Maternal Deaths

The general condition of patients at admission was significantly associated with maternal death ( $p = 0.001$ ). The level of consciousness at admission also showed a significant association with maternal Deaths ( $p = 0.001$ ). The presence of vital distress was statistically associated with maternal death ( $p = 0.001$ ). **Table 6** highlights the relationship between patients' clinical condition at admission (general condition, level of consciousness, vital signs distress, initial assessment delay) and the occurrence of maternal deaths.

**Table 6.** Relationship between clinical condition at admission and maternal deaths.

Variables	Maternal Death		Total	OR	IC95%	p
	Cases	Controls				
<b>General condition</b>						0.001**
Deteriorated	77	54	131	5.511	3.585 - 8.480	
Good	60	232	292	1		
<b>Level of consciousness</b>						0.001**
Altered	41	10	51	11.644	5.610 - 24.183	
Good	61	218	279	1		
<b>Vital distress</b>						0.001**
No	88	262	350	1		
Yes	55	24	79	6.836	4.082 - 11.454	
<b>Initial assessment delay (min)</b>						0.063
$\leq 15$	108	222	330	1		
$> 15$	10	7	17	2.944	1.074 - 8.077	

\*\* : significant at the 5% level; \* : significant at the 10% level.

### 3.7. Multivariate Analysis

The multivariate analysis highlighted several factors associated with maternal death. Single women had a 2.2 times higher risk of death compared to married

women (OR = 2.226; 95% CI: 1.649 - 3.004;  $p = 0.007$ ). A delay of more than three days between symptom onset and hospital arrival increased the risk of maternal death fourfold compared to timely management within one hour (OR = 4.055; 95% CI: 3.004 - 5.474;  $p = 0.048$ ).

The absence of a referral form at admission also doubled the risk of death (OR = 2.717; 95% CI: 2.012 - 3.663;  $p = 0.001$ ), as did the lack of intravenous access upon arrival (OR = 2.227; 95% CI: 1.647 - 3.003;  $p = 0.023$ ). Failure to refer patients to a higher-level facility in a timely manner tripled the risk of death (OR = 3.322; 95% CI: 2.456 - 4.484;  $p = 0.001$ ).

Women with a history of cesarean section had a 1.6 times higher risk of death (OR = 1.649; 95% CI: 1.221 - 2.226;  $p = 0.027$ ), as did women with high gravidity (OR = 2.014; 95% CI: 1.492 - 2.718;  $p = 0.014$ ) or high parity (OR = 2.226; 95% CI: 1.649 - 3.004;  $p = 0.021$ ).

Finally, a deteriorated general condition at admission (OR = 4.482; 95% CI: 3.320 - 6.050;  $p = 0.027$ ) and a referral-to-arrival delay greater than or equal to 3 hours (OR = 3.32; 95% CI: 2.460 - 4.482;  $p = 0.012$ ) respectively increased the risk by factors of 4.48 and 3.32.

**Table 7** summarizes the results of the multivariate analysis of factors associated with maternal deaths in the Donga Department from 2020 to 2024.

**Table 7.** Multivariate analysis of factors associated with maternal deaths in the Donga Department from 2020 to 2024.

Variable	OR	IC95%	P-value
<b>Marital status</b>			0.007**
Married	1	-	
Single	2.226	1.649 - 3.004	
<b>Symptom-onset to arrival delay (days)</b>			0.048**
<3	1		
≥3	4.055	3.004 - 5.474	
<b>Referral form</b>			0.001**
Available	1	-	
Not available	2.717	2.012 - 3.663	
<b>Intravenous access</b>			0.023**
Performed	1	-	
Not performed	2.227	1.647 - 3.003	
<b>Referral</b>			0.001**
Timely referral	1	-	
Untimely referral	3.322	2.456 - 4.484	
<b>Cesarean section</b>			0.027**
No	1	-	

**Continued**

Yes	1.649	1.221 - 2.226	
<b>Gravidity</b>			0.014**
Primigravida	1	-	
Grand multigravida	2.014	1.492 - 2.718	
<b>Parity</b>			0.021**
Primiparous	1	-	
Grand multiparous	2.226	1.649 - 3.004	
<b>General condition</b>			0.027**
Good	1	-	
Deteriorated	4.482	3.320 - 6.050	
<b>Vital distress</b>			0.106
Absent	1	-	
Present	7.389	5.474 - 9.974	
<b>Referral-to-arrival delay (hours)</b>			0.012**
<3	1	-	
≥3	3.32	2.460 - 4.482	

\*\* : significant at the 5% level; \* : significant at the 10% level.

## 4. Discussion

### 4.1. Maternal Mortality Ratio

Our study revealed a maternal mortality ratio of 95.01 deaths per 100,000 live births in the Donga Department between 2020 and 2024. Nationally, Benin has recorded fluctuating MMRs over the years. In 2014, the MMR was estimated at 347 deaths per 100,000 live births [17]. More recently, in 2017-2018, this ratio was 397 deaths per 100,000 live births [18]. According to a study by Ouédraogo *et al.* in Burkina Faso, maternal deaths were estimated at 453 per 100,000 NV [19].

Although the MMR in Donga is lower than both national and regional averages, it remains above the Sustainable Development Goal (SDG) target of 70 deaths per 100,000 live births by 2030. Continued efforts are therefore essential to further reduce maternal deaths. This could include strengthening antenatal care, improving access to emergency obstetric services, providing continuous training for healthcare personnel, and raising community awareness of danger signs during pregnancy. The high level of maternal deaths observed in our study aligns with the broader regional challenge of underinvestment in public health systems. Adegoke *et al.* In 2024, it was demonstrated that unless public health expenditures (PHE) increase significantly by at least 30% most SSA countries will fall short of the SDG target for maternal mortality [2].

## 4.2. Factors Associated with Maternal Deaths in the Donga Department

- **Marital Status**

In Donga, married women had a significantly higher risk of maternal death (OR = 2.23;  $p = 0.007$ ). This observation, though surprising given the theoretically expected support role of a spouse, echoes the findings by Atade *et al.*, where 80.5% of deceased women were also married [20]. This result is consistent with findings from other studies that highlighted how marital status can affect maternal deaths, especially in contexts where decision-making is strongly influenced by the husband or extended family [21] [22].

- **Surgical History**

This finding is consistent with previous studies indicating that a scarred uterus due to previous cesarean sections or other surgical interventions is a major risk factor for obstetric complications and maternal deaths [23] [24].

- **High Gravidity and High Parity**

High gravidity (OR = 2.01;  $p = 0.014$ ) and high parity (OR = 2.23;  $p = 0.021$ ) were also associated with maternal death in Donga. These findings align with global evidence showing that grand multiparity significantly increases maternal health risks. For example, a study in Niger and Togo reported elevated maternal deaths in high-parity pregnancies [25], and research from Tanzania demonstrated that grand multiparous women face higher odds of postpartum hemorrhage and other adverse outcomes [26].

- **Delays in Care (First and Second)**

A delay of more than three days between symptom onset and admission increased the risk of death in Donga by over four times (OR = 4.06;  $p = 0.048$ ). Similarly, Atade *et al.* found that a delay of more than five days significantly increased the risk of maternal death ( $p = 0.003$ ). These findings underline how the “first delay” (late decision to seek care) and the “second delay” (barriers to reaching a facility) remain unresolved despite awareness campaigns.

One critical reason families fail to address these delays is the persistence of deep-rooted socio-cultural norms that often place decision-making power in the hands of male partners or elders, causing hesitation and consultation within the family before seeking care. Moreover, financial constraints, limited autonomy of women, lack of transport, and poor road infrastructure further exacerbate the second delay, particularly in rural settings. Addressing these barriers requires not just health education but also empowerment initiatives, community mobilization, and improved local transport systems.

A recent 2023 study in southwestern Nigeria reported that over 60% of obstetric referrals experienced significant delays, reflecting systemic gaps between primary and higher-level care that likely exacerbate maternal mortality risks in similar West African settings [26].

The fact that many maternal deaths in our study were associated with poor general condition on admission and delays in care reflects systemic weaknesses. As

Souza *et al.* in 2023 argue, avoidable maternal deaths are not only the result of clinical complications but also the tangible consequences of underlying social inequalities and dysfunctional health systems [27].

- **Referral Form and Intravenous Access at Admission**

The absence of a referral form (OR = 0.37;  $p = 0.001$ ) and the absence of intravenous access at admission (OR = 0.45;  $p = 0.023$ ) were identified as predictive factors for death in Donga. In Tanguiéta, these factors contributed to the “third delay,” which was strongly associated with maternal deaths (OR = 11.3;  $p < 0.001$ ) [5]. This finding also aligns with Aguèmon *et al.*, who identified the lack of medical assistance during evacuation as a factor associated with maternal death [26]. The absence of a referral form often reflects poor communication between facilities, while a lack of IV access indicates poor preparedness for critical cases or a lack of basic equipment/logistics at peripheral centers.

- **Referral to a Specialized Service**

In Donga, untimely referral to a specialized service also tripled the risk of death (OR = 0.30;  $p = 0.001$ ). This finding is consistent with Tanguiéta, where poor triage and non-medical referrals were common. It highlights the need to strengthen inter-level coordination, train peripheral care providers, and standardize obstetric referral criteria.

- **Clinical Condition at Admission**

Initial clinical parameters such as a deteriorated general condition (OR = 4.48;  $p = 0.027$ ), altered consciousness (OR = 3.67;  $p = 0.052$ ), and vital distress (OR = 7.39;  $p = 0.106$ ) significantly increased the risk of death. In Tanguiéta, most women were admitted in critical condition (collapse, unconsciousness, or hemorrhagic shock), reflecting delayed emergency care. These clinical factors often reflect the culmination of multiple delays (diagnosis, transport, and management).

Our findings confirm that maternal deaths often result from preventable complications that could be effectively addressed with timely and quality care. Souza *et al.* In 2023, emphasize that the health system represents a critical opportunity to interrupt the chain of events that may lead to maternal death, especially for women presenting pregnancy-related complications [10].

Reducing maternal mortality in a sustainable manner requires going beyond clinical responses. As highlighted by Souza *et al.* In 2023, expanding the health system’s ecosystem to address broader ecosocial forces and inequalities is essential to improve maternal health and well-being [10].

## 5. Limitations

This study has several limitations that should be acknowledged, as a case-control study relied on existing medical records, which may have been incomplete or inconsistent.

The quality and completeness of medical records used in this study may have affected the depth of analysis. This issue is consistent with findings from similar contexts, such as in Burkina Faso, where maternal death audits often lack key

clinical information and fail to follow recommended national protocols [27].

## 6. Conclusions

This study identified several factors associated with maternal deaths in the Donga Department. The results show that individual characteristics such as marital status, surgical history, high gravidity, and high parity influence the risk of death. Moreover, delays in care particularly prolonged delays between symptom onset and arrival at a healthcare facility as well as the absence of essential measures (referral form, intravenous access, timely specialized referral) emerged as major aggravating factors. Clinical condition at admission, notably a deteriorated general state and altered consciousness, also constitutes a strong marker of severity.

These findings highlight the urgent need to strengthen the capacities of healthcare facilities, ensure an effective referral system, and improve the early identification of high-risk pregnancies in the community. Targeted interventions should be developed to enhance the accessibility, quality, and continuity of obstetric care. Simultaneously, continuous training for healthcare personnel and community awareness are essential to break the cycle of preventable delays.

## Conflicts of Interest

The authors declare no conflicts of interest.

## References

- [1] Organisation mondiale de la Santé (2023) Mortalité maternelle. <https://www.who.int/fr/news-room/fact-sheets/detail/maternal-mortality>
- [2] Adegoke, Y., Mbonigaba, J. and George, G. (2025) Sustainable Development Goals (SDGs), Public Health Expenditures, and Maternal and Child Mortality in Selected African Countries: Forecasting Modelling. *International Journal of Environmental Research and Public Health*, **22**, Article 482. <https://doi.org/10.3390/ijerph22040482>
- [3] UNICEF (2023) Niveau et évolution de la mortalité infanto-juvénile en Afrique de l'Ouest et du Centre. UNICEF.
- [4] Institut National de la Statistique et de l'Analyse Économique (INSAE) (2018) Cinquième Enquête Démographique et de Santé au Bénin (EDSB-V) 2017-2018. [https://instad.bj/images/docs/insae-statistiques/sociales/Sante/Enqu%C3%AAt%C3%A9%20D%C3%A9mographique%20et%20de%20Sant%C3%A9%20au%20B%C3%A9nin%20\(EDSB\)%20de%202017-2018.pdf](https://instad.bj/images/docs/insae-statistiques/sociales/Sante/Enqu%C3%AAt%C3%A9%20D%C3%A9mographique%20et%20de%20Sant%C3%A9%20au%20B%C3%A9nin%20(EDSB)%20de%202017-2018.pdf)
- [5] Fonds des Nations Unies pour la population (UNFPA) (2023) Lutte contre la mortalité maternelle et infantile: Des sage-femmes compétentes pour des familles épanouies.
- [6] Füchtner, C. (2021) La FIGO salue la nouvelle loi béninoise pour lutter contre les décès maternels et les incapacités évitables en améliorant l'accès à l'avortement sécurisé. Fédération internationale de gynécologie et d'obstétrique. <https://www.figo.org/fr/resources/figo-statements/figo-welcomes-benins-new-law-address-preventable-maternal-deaths-and-disability-improving-access>
- [7] Institut national d'études démographiques (INED) (2014) La mortalité maternelle dans le monde. [https://www.ined.fr/fichier/s\\_rubrique/263/fichier.fiche.peda.mortalite.mater-nelle.monde.fr.pdf](https://www.ined.fr/fichier/s_rubrique/263/fichier.fiche.peda.mortalite.mater-nelle.monde.fr.pdf)

- [8] Organisation mondiale de la Santé (2023) Réduire la mortalité maternelle et infantile. Malteser International.  
<https://www.malteser-international.org/fr/qui-sommes-nous/champs-daction/sante/mortalite-maternelle.html>
- [9] Souza, J.P., Day, L.T., Rezende-Gomes, A.C., Zhang, J., Mori, R., Baguiya, A., *et al.* (2024) A Global Analysis of the Determinants of Maternal Health and Transitions in Maternal Mortality. *The Lancet Global Health*, **12**, e306-e316.  
[https://doi.org/10.1016/s2214-109x\(23\)00468-0](https://doi.org/10.1016/s2214-109x(23)00468-0)
- [10] Catala, I. (2025) Quand le planning opératoire a du retard, les patients trinquent. Le Quotidien du Médecin.  
<http://www.lequotidiendumedecin.fr/hopital/quand-le-planning-operatoire-du-retard-les-patients-trinquent>
- [11] digiSchool (2023) Les détresses vitales.  
<https://www.digischool.fr/cours/les-detresses-vitales>
- [12] Cardin-Changizi, P. (2021) Altération de l'état général (AEG): Signes, quelles causes?  
<https://sante.journaldesfemmes.fr/fiches-sante-du-quotidien/2768485-alteration-de-l-etat-general-aeg-signes-causes-risques-traitement/>
- [13] Fouda Atangana, B.D., Cesarine, M.M., Avahoun, V. and Paraiso, M.N. (2025) Facteurs associés aux hémorragies du post-partum à la maternité du Centre Hospitalier Départemental du Zou-Collines au Bénin en 2024. *Journal of Epidemiology and Population Health*, **73**, Article 202916. <https://doi.org/10.1016/j.jepth.2025.202916>
- [14] Direction Départementale de la Santé du Borgou (DDS B) (2025) Autorisation de recherche.
- [15] Seidou, A. (2018) Plan opérationnel de réduction de la mortalité maternelle et néonatale au Bénin PO-RMMN 2018-2022. Direction de la santé de la mère et de l'enfant.
- [16] Toffa, A. (2020) Accélérer la réduction de la mortalité maternelle au Bénin. Management Sciences for Health.  
<https://msh.org/resources/accelerer-la-reduction-de-la-mortalite-maternelle-au-benin/>
- [17] Ouédraogo, C., Ouattara, T., Akotionga, M., Thieba, B., Lankoande, J. and Kone, B. (2001) La mortalité maternelle au Burkina Faso: évolution et stratégie nationale de lutte. *Médecine d'Afrique Noire*, **11**, 452-456.
- [18] Atade, S.R., Hounkponou, A.F.M.N., Obossou, A.A.A. and Gabkika, B.M. (2024) Facteurs associés aux décès maternels à l'Hôpital de Zone Saint Jean de Dieu de Tanguiéta de 2015 à 2019. <https://www.researchgate.net/publication/354308068>
- [19] Kassebaum, N.J., Bertozzi-Villa, A., Coggeshall, M.S., Shackelford, K.A., Steiner, C., Heuton, K.R., *et al.* (2014) Global, Regional, and National Levels and Causes of Maternal Mortality during 1990-2013: A Systematic Analysis for the Global Burden of Disease Study 2013. *The Lancet*, **384**, 980-1004.
- [20] Say, L., Chou, D., Gemmill, A., Tunçalp, Ö., Moller, A., Daniels, J., *et al.* (2014) Global Causes of Maternal Death: A WHO Systematic Analysis. *The Lancet Global Health*, **2**, e323-e333. [https://doi.org/10.1016/s2214-109x\(14\)70227-x](https://doi.org/10.1016/s2214-109x(14)70227-x)
- [21] Organisation mondiale de la Santé (2015) WHO Recommendations on Health Promotion Interventions for Maternal and Newborn Health 2015. OMS.  
<https://www.who.int/publications/i/item/9789241508742>
- [22] Lukacz, E.S., Lawrence, J.M., Contreras, R., Nager, C.W. and Luber, K.M. (2006) Parity, Mode of Delivery, and Pelvic Floor Disorders. *Obstetrics & Gynecology*, **107**,

- 1253-1260. <https://doi.org/10.1097/01.aog.0000218096.54169.34>
- [23] Ndiaye, K., Portillo, E., Ouedraogo, D., Mobley, A. and Babalola, S. (2018) High-Risk Advanced Maternal Age and High Parity Pregnancy: Tackling a Neglected Need through Formative Research and Action. *Global Health: Science and Practice*, **6**, 372-383. <https://doi.org/10.9745/ghsp-d-17-00417>
- [24] Dasa, T.T., Okunlola, M.A. and Dessie, Y. (2022) Effect of Grand Multiparity on Adverse Maternal Outcomes: A Prospective Cohort Study. *Frontiers in Public Health*, **10**, Article 959633. <https://doi.org/10.3389/fpubh.2022.959633>
- [25] Olawade, D.B., Wada, O.Z., Ojo, I.O., Odetayo, A., Joel-Medewase, V.I. and David-Olawade, A.C. (2023) Determinants of Maternal Mortality in South-Western Nigeria: Midwives' Perceptions. *Midwifery*, **127**, Article 103840. <https://doi.org/10.1016/j.midw.2023.103840>
- [26] Aguémon, T., Denakpo, J., Adisso, S., Mampassi, E. and de Souza, J. (2012) Mortalités maternelle et périnatale liées aux références obstétricales à la C.U.G.O. du CNHU-HKM de Cotonou.
- [27] Congo, B., Méda, C.Z., Millogo, T., Sanon/Ouédraogo, D., Ouédraogo, C.M.R. and Kouanda, S. (2022) Evaluation of the Quality of Maternal Death Review Cycles in Burkina Faso. *International Journal of Gynecology & Obstetrics*, **158**, 21-28. <https://doi.org/10.1002/ijgo.14071>