REVIEW ARTICLE

Risk factors for maternal mortality at two national reference maternity hospitals in Djibouti City, 2019-2023

DOI: 10.29063/ajrh2025/v29i9.15

Arbahim H. Yacoub[1], Sanae Elomrani[2], Ali A. Abdoulkader[3] Arbahim M. Mohamed[4], Ahmed Boudak[5] and Rachid Bezad[6]*

Epidemiology Research Team at the FMPH.Quality and Risk Management at the direction of University Hospital of Djibouti[1]; National School of Public Health, Rabat[2]; Epidemiology and Preventive Medicine, WHO Djibouti[3]; CHU-Dar El Hanan University Hospital Center of Djibouti[4]; University Hospital of Djibouti, UNFPA[5]; Orangers maternity hospital, IbnSina University Hospital,Rabat-Mohamed V University, Rabat Moroco[6]

***For Correspondence:** Email: *yacoubabi89@gmail.com*

Abstract

Maternal mortality is a global public health challenge, particularly in developing countries. Objective:To analyze the risk factors associated with maternal death in hospitals at the level 3 maternity hospitals of Djibouti City. A case-control analytical study from January 1, 2019, to December 31,2023, in Dar El Hanan maternity hospital and the Cheiko Hospital maternity.All maternal deaths that occurred in these periods in two maternity wards were included.A descriptive analysis is performed,thenconditional logistic regression univariate and multivariate analysis was used to assess factors associated with maternal mortality. The analysis focused, on a total of 515 women,103 cases, and 412 controls selected. The main causes of maternal death are hemorrhagic shock (26.2%); preeclampsia and its complications (20.4%) and then malaria(17.5%).After multivariate logistic regression analyses, we identified several factors associated with in-hospital mortality, such as, the level of education (woman not in school) with OR: 51.4 [6.75;114.8] and p<0.001;clinical status at admission with OR:4.12 [1.86;9.39]and p<0001;presence of thrombocytopenia with OR:2.97[1.21;7.30] and p:0.017; patientrequiring transfusions with OR:3.47 [1.55,7.93] and p<0.003;also the extreme,lengthofstay(LOS)≤24HwithOR:2.98[0.96,9.5]and LOS>14d OR:2.05[0.45,9.25] ,andp:0.012. The factors identified by this study show the need to strengthen preventive strategies during pregnancy(prenatal follow-ups,early detection of anemia and malaria as well as high-risk pregnancies);improve care during childbirth and the perinatal period. *(Afr J Reprod Health 2025; 29 [9]: 159-174).*

Keywords: Risk factors, maternal mortality, reference motherhood, pregnant woman, preventive strategy, maternal morbidity, high-risk pregnancy

Résumé

La mortalité maternelle est un défi mondial de santé publique, en particulier dans les pays en développement. Objectif : Analyser les facteurs de risque associés à la mortalité maternelle dans les maternités de niveau 3 de la ville de Djibouti. Étude analytique cas-témoins menée du 1er janvier 2019 au 31 décembre 2023 à la maternité Dar El Hanan et à la maternité de l'hôpital Cheiko. Tous les décès maternels survenus durant ces périodes dans les deux maternités ont été inclus. Une analyse descriptive a été réalisée, puis une analyse de régression logistique conditionnelle univariée et multivariée a été utilisée pour évaluer les facteurs associés à la mortalité maternelle. L'analyse a porté sur un total de 515 femmes, 103 cas et 412 témoins sélectionnés. Les principales causes de décès maternels sont le choc hémorragique (26,2 %) ; prééclampsie et ses complications (20,4 %) puis paludisme (17,5 %). Après des analyses de régression logistique multivariée, nous avons identifié plusieurs facteurs associés à la mortalité hospitalière, tels que le niveau d'éducation (femme non scolarisée) avec OR : 51,4 [6,75 ; 114,8] et p < 0,001 ; l'état clinique à l'admission avec OR : 4,12 [1,86 ; 9,39] et p < 0,001 ; la présence de thrombocytopénie avec OR : 2,97 [1,21 ; 7,30] et p : 0,017 ; patient nécessitant des transfusions avec OR : 3,47 [1,55, 7,93] et p < 0,003 ; également la durée de séjour les extrêmes (DS) ≤ 24 h avec OR : 2,98 [0,96, 9,5] et LOS > 14 j OR : 2,05 [0,45, 9,25] et p : 0,012. Les facteurs identifiés par cette étude soulignent la nécessité de renforcer les stratégies de prévention pendant la grossesse (suivi prénatal, dépistage précoce de l'anémie et du paludisme, ainsi que des grossesses à risque) et d'améliorer la prise en charge lors de l'accouchement et de la période périnatale. *(Afr J Reprod Health 2025; 29 [9]: 159-174).*

Mots-clés: Facteurs de risque, mortalité maternelle, maternité de référence, femme enceinte, stratégie de prévention, morbidité maternelle, grossesse à risque.

Introduction

Pregnancy is a period of fulfillment and happiness for all families, the occurrence of a mother's death is a shock, an unbearable tragedy for the family as well as for the whole society.Maternal mortality is a global public health problem, in 2020 nearly 800

women die every day from preventable causes related to pregnancy or childbirth.[1] But this scourge affects developing countries more, according to the WHO, at the global level, the maternal mortalityratio in 2020 is estimated at 233 per 100,000 live births (CI = [202; 235]).[2]

However, in recent decades, we have seen significant progress in the regression of the maternal mortality ratio at the global level, with a reduction of 34.3% between 2000 and 2020, an average rate of reduction of 2.9% per year.[1-3]

In addition, there is a marked disparity between developed and developing countries and between regions, the risk of maternal mortality in sub-Saharan Africa is 1 in 40, in Central and South Asia 1 in 340, in Latin America and the Caribbean 1 in 580 compared to the developed regions which are for example in Europe and North America 1/5100 and then in Australia and New Zealand. Zeeland, the risk of maternal mortality is at 1/16000. For example, in 2020, the sub-Saharan regions recorded the highest maternal mortality ratio at 545 per 100,000NV, in North Africa at 103 per 100,000NV and in the Australia region; New Zealand the maternal mortality Ratio is at 4 per 100,000NV.[1-4]Also a systematic analysis of data carried out in 2015 by Global Burden shows that geographical disparities widened between 1990 and 2015 and that in 2015, 24 countries still had a maternal mortality rate above 400 per 100,000 NV, as well as a significant correlation between access to quality maternal health care and maternal mortality Ratio[5].Disparities exist between and within countries. In the United States a study shows that the maternal mortality rate for non-Hispanic black women is 3 to 4 times higher than that of white women.[6-7]

Maternal mortality remains a topical problem because of its prevalence in developing countries, particularly in Africa, where socio-economic, environmental and health conditions expose women to complications during pregnancy and childbirth.

At the level of the East Africa region, despite considerable progress recorded in recent decades, the Maternal mortality ratio figures are still high. In Ethiopia with 267 per 100,000Live Births and in Eretria at 322 per 100,000Live Births, as well as in Djibouti with the MMR at 234 per 100,000Live Births.[8]

Reducing the maternal mortality rate is a priority for United Nations system agencies.Initially, theMillennium Development Goalswere agreed within the framework of the WHO in the early 2000s, and then in 2015 theSustainable Development Goals.

Djibouti has committed to these two challenges launched in 2000 and then relaunched in 2015, which aimed to reach seventy-five per 100,000 Live Births by 2015 and then by 2030. Djibouti has not met the targets set by the sustenableDevelopment Goalsbut a considerable reduction of 45.7% in 20 years has been observed, ranging from 512 per 100,000 Live Birthsin 2000 to 234 per 100,000 Live Birthsin 2020. At the national level, no scientific study has been published on maternal mortality, but it is a priority issue for the Ministry of Health, a national strategy for the acceleration of the reduction of maternal and neonatal mortality 2022-2026 has been developed. This strategy is based on five lines of action which include: Improving access to health care (geographical, financial, health education); The strengthening of the quality maternal and neonatalcare services at the three levels of the health pyramid; Improving governance; The integration of the social determinants of health, global health; The improvement of the information system for maternal and neonatal services, with the surveillance of maternal and neonatal mortality .

At the hospital level, also the rate is not decreasing, at the third-level reference maternity unit (Dar El Hanan), the rate of intra-hospital maternal deaths was 280 per 100,000 Live Birthsin 2020, then in

2021 at 266 per 100,000Live Birthsand in 2022 this Ratiowas at 261 per 100,000Live Births. And at the reference maternity ward of the Cheikho Hospital, the Maternal Mortality Ratiowas, in 2020, 164.6 per 100,000Live Births, then in 2021 at 123 per 100,000Live Birthsand this intra-hospital MMR was in 2022 at 154 per 100,000Live Births.

This analytical work on the issue of risk factors for maternal death within the hospital at the level of two reference maternity hospitals in Djibouti (Dar El Hanan maternity hospital and the Cheikho Hospital maternity) is the first of its kind at the national level. The objective of this study is to analyze the risk factors associated with maternal death in hospitals at the level 3 maternity wards of Djibouti City.

Methods

Type of study

This is a retrospective study, case-control from January 1, 2019, to December 31, 2023, at the levels of two national reference maternity hospitals in Djibouti. This study was conductedin Dar El Hanan Maternity Hospital and Cheiko Hospital Maternity Hospital over the five years (January 1, 2019, to December 31, 2023).

These two maternity hospitals manage an average of 11500 annual deliveries, which represents more than two-thirds of the annual expected delivery in Djibouti City. The two maternity wards take care of all obstetric and neonatal complications in the five regions of the interior of the country.

Study population and sampling

The data were obtained at the Dar El Hanan national reference maternity hospital and the maternity ward of Cheiko Hospital, in Djibouti, over a period of 5 years, between January 1, 2019, and December 31, 2023. A case-control study design was adopted. The cases included all maternal deaths recorded in the two maternity wards.

Women who died in the intra- or postpartum ward of a direct or indirect obstetric cause were included in the study (Cas). Women who died in the ward for an objectively non-obstetric cause (accidental or incidental) were not included.

Controls included women discharged alive after hospitalization due to vaginal birth or caesarean section, abortion, spontaneous termination of pregnancy, and medical termination. They were selected by simple random sampling matched to the case period. We selected four controls for one maternal death case.

Data were collected from patients' medical records, maternal death registers from two maternity wards, internal clinical audit minutes (PV) for cases. According to forms prepared in advance. The data collected was done with the Epi info software, version 7.2.5.0.

Listing sociodemographic, obstetric, and intrapartum exposures. Sociodemographic exposures included: maternal age [years] then classified by age group [≤18 years; 19-24 years old; 25-30 years old; 31-36 years old; ≥37 years old], the patient's profession, the level of education [not in school; Primary level; Secondary level; high school/university level]; marital status [single, married, widowed/divorced]; the spouse's profession; mother's place of residence [Djibouti City; Inland regions/Border localities]. Obstetrical and clinical exposures included: mode of admission [Direct; Simple reference; Transfer by ambulance], prenatal consultations by class [Pregnancy well monitored: ANC: ≥3; Male pregnancy followed: ANC ≤2; Pregnancy not followed: ANC: 0] and parity [nulliparous, primiparous, second; Third; ≥fourth]. Maternal clinical status at admission[Good General statut; Statut poor/ Altered (Unconscious), as well as intrapartum exposures including mode of delivery [vaginal delivery, caesarean section; abortion/PNO].

Also, clinical exposures, anaemia by degree of severity [severe anaemia defined by an Hb level < 7g/dl; moderate anaemia defined as a level of 7 ≤ Hb< 10 g/dl; mild anemia corresponds to a level of 10 ≤ Hb< 11g/dl]. The presence of thrombocytopenia [Yes: Platelet≤150,000/mm3; No: Wafer>150.000/mm3]. The length of stay in hospital [≤2H; ≤24H; 24H-72H]; 4-7 days; 8-14 days; >14j]; the use of blood transfusions and derivatives; ventillatory support have been studied for cases and controls. Figure 1

CD-11 definition of maternal death

Maternal deaths: "Maternal death is the death of a pregnant woman or death occurring within 42 days of the termination of pregnancy, related to pregnancy or its management, regardless of the gestational age of the fetus and the position of the baby. Maternal death is not related to accidental or fortuitous causes."[9]

Direct obstetric deaths: Deaths resulting from obstetrics complication of pregnancy (pregnancy, labor, and postpartum), and from interventions, omissions, incorrect treatments, or a chain of events resulting from any of the above events.

Indirect obstetric deaths: Deaths resulting from disease or condition that developed during pregnancy and were not due to direct obstetric causes but were aggravated by the effects of pregnancy.

Accidental or accidental maternal deaths: Deaths that occur during pregnancy or in the aftermath of childbirth but whose causes are unrelated to it

Data analysis

The analysis of the data collected will be done using Excel, Epi Info 7.2.5.0 software: EBM SPSS Statistics 20. In all statistical tests, the significance threshold will be set at risk α= 5% with a 95% confidence interval (CI). The analysis of the data collected will be conducted using the R software version 4.2.2. A descriptive analysis will be conductedof all the data collected. Quantitative variables will be described through the meaning with its standard deviation and qualitative variables through absolute and relative frequencies. For bivariate comparative analysis, the Chi2 test or the Fisher's exact test will be performed according to the conditions of applicability. These tests will be used to look for associations between maternal death and the different explanatory factors with a significance threshold $p < 0.05$. Then, we performed multivariate logistic regression analyses, variables that had a P-value < 0.2 were introduced into the logistic regression model. The Backward automated Step-by-Step selection procedure was used for the selection of the final model. Then, to evaluate the quality of the model's fit, we will perform the Homer Lemeshow test. This process will allow us to obtain the adjusted odds ratios with the 95% confidence intervals.

Results

During the period of our study (2019-2023), we identified 103 cases of maternal deaths out of 52487 live births, which is what makes the intra-hospital maternal mortality ratioin the two maternity wards at 196.2 per 100,000NV. Of the 67487 women admitted, we obtained, after random selection, 412 controls matched to obstetric complications and period of admission in relation to maternal deaths. In total, 515 maternal files were analyzed. The distribution of the study sample by establishment was 87 cases and 337 controls at the Dar El Hananmaternity, and 16 cases and 75 controls at the Cheikho hospital maternity.

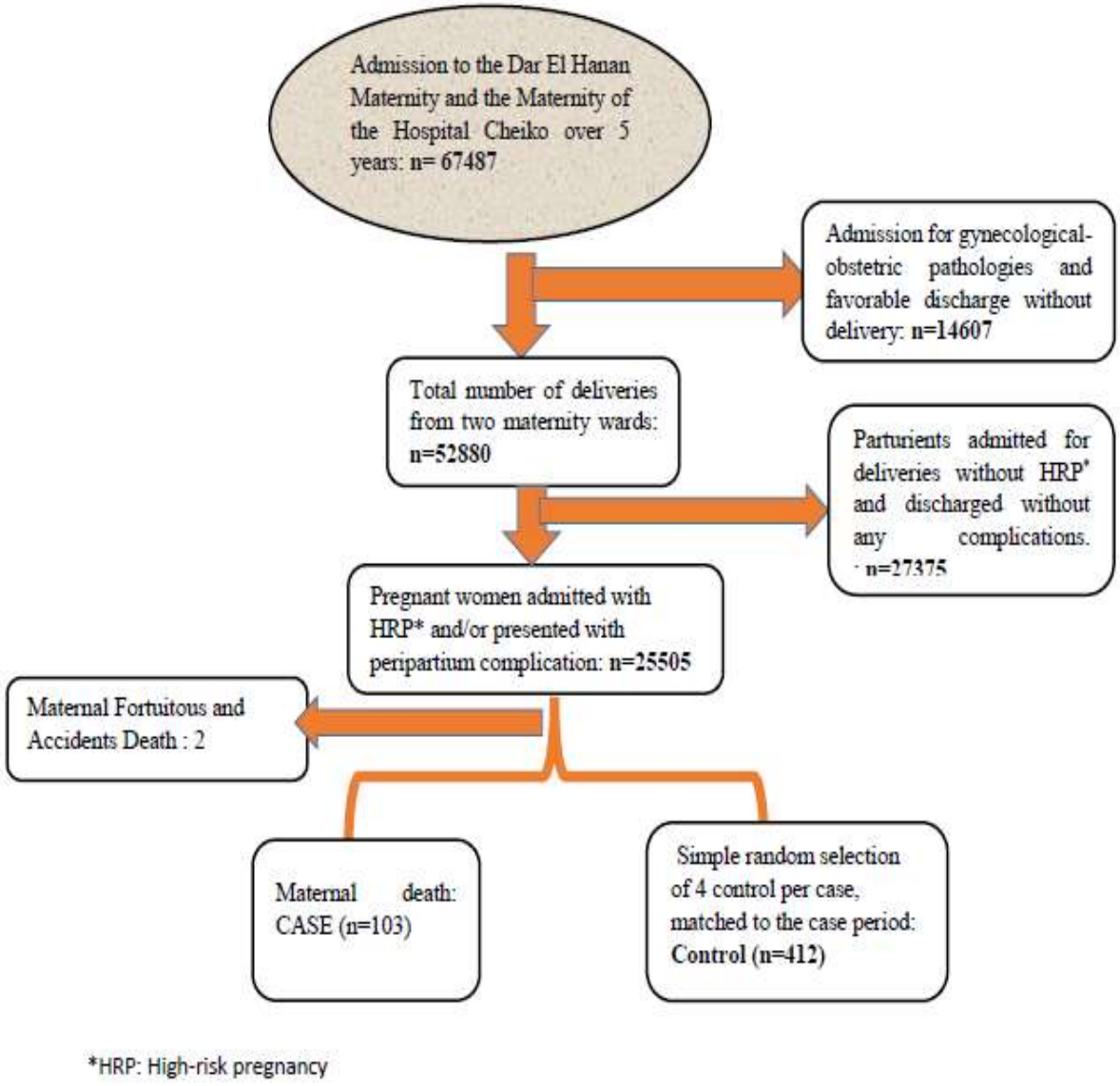

Figure 1: Study Population Flow Diagram

Table 1: Description and analysis of the characteristics of the cases and controls

Variables	Case (n=103) n(%)	Control (n=412) n(%)	OR	P-value
Age				
Mean ±SD	28.7 ±6,36	29.4±6,20		
Age group				P*: 0.311
≤18 years old	6 (5.8)	15 (3.6)	1.38 [0.44; 3.86]	
[19-24 years old]	24 (23.3)	82 (19.9)	---	
[25-30 years old]	38 (36.9)	134 (32.5)	0.97 [0.54; 1.75]	
[31-36 years old]	22 (21.4)	127 (30.8)	0.59 [0.31; 1.13]	
≥37 years old	13 (12.6)	54 (13.1)	0.83 [0.38; 1.75]	
Marital Status				P**:0.160
Single	2 (1.9)	3 (0.7)	----	
Bride	100 (97.1)	408 (99.0)	0.36 [0.05; 3.13]	
Widowed/Divorced	1 (1.0)	1 (0.2)	1.41 [0.03; 76.8]	
Patient's profession				P*<0.001
No	95 (92.2)	308 (74.8)	4 [1.8; 8.51]	
Yes	8 (7.8)	104 (25.2)	0.25 [0.11; 0.51]	
Level of patient education				P**:<0.001
Elementary level	2 (1.9)	55 (13.3)		
Middle school level	2 (1.9)	32 (7.8)	1.71 [0.17; 17.1]	
High School/University Level	1 (1.0)	72 (17.5)	0.41 [0.01; 5.17]	
Not in school	98 (95.1)	253 (61.4)	9.90 [3.00; 65.9]	
Spouse's occupation				P*<0.001
No	79 (76.7)	181 (43.9)	4.2 [2.55; 6.9]	
Yes	24 (23.3)	231 (56.1)	0.24 [0.14; 0.39]	
Patient's place of residence				P*<0.001
Djib-ville	70 (67.9)	360 (87.4)	---	
Region-Interior/Borders	33 (32.05)	52 (12.6)	3.26 [1.95; 5.40]	
Parity Frequency				P*:0.014
Nulliparous	41 (39.8)	111 (26.9)	1.95 [1.03; 3.89]	
Primipart	19 (18.4)	76 (18.4)	1.33 [0.63; 2.86]	
Second part	15 (14.6)	80 (19.4)	---	
Third party	16 (15.5)	47 (11.4)	1.81 [0.81; 4.05]	
Multipare (≥ 4p)	12 (11.7)	98 (23.8)	0.66 [0.28; 1.49]	
Admission procedure				P**<0.001
Direct	68 (66,02)	367 (89.08)	---	
Reference	1 (0.97)	14 (3.34)	0.44 [0.02; 2.24]	
Transfer	34 (33.01)	31(7.52)	5.89 [3.39; 10.3]	
Clinical Status at Admission				P*< 0.000
Good	27 (23.3)	301 (73.1)	0, 13 [0.08; 0,13]	
Poor/ Altered (Unconscious)	76 (73.78)	111 (26.7)	7.57 [4.69; 12.6]	

Anemia Class				P*<0.001
Normal	43 (41.75)	228 (55.3)	---	
Moderate anemia	21 (20.38)	109 (26.45)	1.02 [0.57; 1.80]	
Severe anemia	39 (37.86)	75 (18.2)	2.75 [1.65; 4.57]	
Thrombocytopenia				P*<0.001
No	72 (69.9)	366 (88.8)	---	
Yes	31 (30.1)	46 (11.2)	3.42 [2.02; 5.75]	
Pregnancy Follow-up Class in ANC				P**<0.001
Pregnancy Well followed	3 (2.9)	35 (8.5)		
Poorly monitored pregnancy	89 (86.4)	260 (63.1)	3.81 [1.32; 16.7]	
Pregnancy Not followed up	11 (10.7)	117 (28.4)	1.06 [0.30; 5.13]	
Modality of delivery				P*<0.001
Terminated pregnancy (abortion/ PNO)	25(24)	10(2)	---	
Caesarean section	47(46)	221(54)	0,53[0.24; 1.2]	
Vaginal	31(30)	181(44)	0.43[0.18 ; 0.97]	
Necessity for Blood and Derivatives Transfusion				P*<0.001
No	55 (53.4)	311 (75.5)	---	
Yes	48 (46.6)	101 (24.5)	2.68 [1.71; 4.20]	
Length of hospital stays				P**<0.001
≤2H	9 (8.7)	1 (0.2)	38.7 [4.75; 321]	
≤24H	19 (18.4)	33 (8.0)	2.46 [1.18; 5.12]	
[24H-72H]	23 (22.3)	99 (24.0)	---	
[4-7d]	29 (28.2)	169 (41.0)	0.74 [0.40; 1.36]	
[8-14 d]	11 (10.7)	96 (23.3)	0.50 [0.22; 1.06]	
>14 days	12 (11.7)	14 (3.4)	3.65 [1.47; 9.07]	
Ventillatory Assist Patient				P*<0.001
No	48 (46.6)	396 (96.1)	---	
Yes	55 (53.4)	16 (3.9)	27.8 [15.1; 54.0]	

ANC: **Antenatal Care Service**;PNO: **pregnancy no out Outcome With Maternal death** ;P*-value: **TEST khi2 pearson**; P**-value: **Fisher's Exact Test**

Descriptive analysis of population characteristics

The mean age of the case group is 28.7 years [±6,36] and the control group is 29.4 [±6,20] with a median age of 30 years. Most admission modalities were spontaneous, direct admissions to the maternity ward in both groups, 66% of cases and 89.1% of controls, and admissions by transfers from the regions were 33% for cases and 7.5% for controls. (Table 1).

Most of our study populations were in a marriage situation (97% cases and 99% controls).

Also, most of the women were not in professional employment, 92.2% of cases and 74.8% of controls. Also, the spouses of women were not in employment in 76.6% of the cases and 43.9% of the controls.

Regarding women's educational attainment, most women were not in school, 95.1% forcases and 61.4% for Controls. The most frequent parities among women are nulliparous with 39.8% for cases and 26.8% for controls.

Descriptive analysis of the causes of maternal death

Of the deaths recorded, twenty-five occurred during pregnancy and the remaining seventy-eight during labour, delivery and in the immediate postpartum period. Among maternal deaths in hospitals, the four leading causes of maternal death are: first, hemorrhagic shock (26.2%); in second place, pre-eclampsia, and its complications (20.4%) and then malaria (17.5%), in fourth place came sepsis (11.7%), (Tables 2). Intra-hospital maternal deaths were classified by type of cause by the in-hospital audit committees, 61.2% were direct causes, 38.8% were indirect causes. (Tables 2). Finally, we have classified these causes of death according to the model of three delays (WHO), the third delay represents (57.3%) of the cases, the first delay represents (23.3%); then the second lag (19.4%), (Tables 2).

Risk factors associated with maternal mortality

In univariate analysis (Tables 1), patients admitted by medical evacuation from inland and border regions were 33.2% of cases and 7.52% of controls; This difference was significantly associated with maternal mortality with (p<0.001). The occupations of women and spouses were significantly associated with care (p<0.001).

Table 2: Causes of maternal mortality

Variables	N (%)
Period of death	**n(%)**
Pregnant	25(24.2)
Peripartum	2(1.9)
Postpartum	76(73.8)
Class of Causes	**n(%)**
Causes Direct	63(61.2)
Causes Indirect	40(38.8)
Deaths according to model of 3 WHO delays	**n(%)**
First Delay	24(23.3)
Second delay	20(19.4)
Third delay	59(57.3)
Cause of Maternal Death	**n(%)**
Haemorrhagic shock	27(26,2)
Pre-eclampsia and its complications	21(20,4)
Malaria	18 (17,5)
Sepsis	12(11,7)
Thromboembolism	8(7,8)
Heart disease	5(4,9)
HydroElectrolitic Disorder	4(3,9)
Anaemia	2(1,9)
Immunosuppression (HIV)	2(1,9)
Suicide	1(1,0)
Gestational Diabetes	1(1,0)
Spinalanaesthesia	1(1,0)
Intestinal obstruction	1(1,0)

In both groups, most women were not in school, i.e., 95.1% for the Cas and 61.4% for the Controls, the low enrolment in school of women is significantly associated with maternal mortality with p<0.002.

Nulliparous women have twice the risk of death than other parities, with p:0.014.Multiparity (≥ 4parities) represent 11.7% among cases and 23.8% among controls, with p: 0.014, it is a protective factor.

Then, for the factors concerning the prenatal follow-up of the pregnancy, poorly monitored pregnancies represent 86.4% among cases and 63.1% among controls, a difference significantly associated with maternal mortality (p<0.001).

Tables 3: Risk factors associated with maternal mortality

Variables	Or.adjusted	95% adjusted ci	Adjusted p-value
Patient instruction level			0.001
Elementary level	—	—	
Middle school level	2.46	0.06, 98.2	
High school/university level	0.00	0.00, 23,285	
Not in school	51.4	6.75, 114,8	
Clinical status at admission			<0.001
Good	—	—	
Poor/altered	4.12	1.86, 9.39	
Thromnbopenie			0.017
No	—	—	
Yes	2.97	1.21, 7.30	
Pregnancy follow-up			0.3
Pregnancy well monitored	—	—	
Poorly monitored pregnancy	3.28	0.56, 64.1	
Pregnancy not followed	0.53	0.07, 11.5	
Transfusion requirements (blood and blood derivatives)			0.003
No	—	—	
Yes	3.47	1.55, 7.93	
Hospital length of stay			0.012
≤2h	109	0.00, 150	
≤24h	2.98	0.96, 9.50	
[24h-72h]	—	—	
[4-7d]	0.34	0.12, 0.91	
[8-14 d]	0.18	0.04, 0.65	
>14 days	2.05	0.45, 9.25	
Patient on ventilator assistance			<0.001
No	—	—	
Yes	26.9	10.7, 75.5	
Modalities of delivery			<0.001
Terminated pregnancy (abortion/pno)	—	—	
Caesarean section	0.03	0.01, 0.18	
Vaginal	0.02	0.00, 0.13	

Pno: **pregnancy with no out outcome with maternal death ;** or = **adjusted odds ratio;** ci = **adjusted confidence interval;** p-value**:wald's khi2 test**

Patients admitted in an altered clinical condition have significant differences (p<0.001), i.e., these women have a 4.12 times greater risk of death. In addition, women with severe anemia are 2.75 times more likely to die, severe anemia is significantly associated with maternal deaths (P<0.001). Secondly, thrombocytopenia factors are also significantly associated with maternal death with (p<0.001). However, the modality of delivery is a protective factor in relation to maternal mortality with P<0.001.

In the context of care provided during the course of care, those who required transfusions of blood products and derivatives have a 2.7 times greater risk of maternal death (p<0.001). Then, patients who required ventillatory support were significantly associated with maternal deaths, (p<0.001).

Extreme lengths of stay are also significantly associated with maternal deaths, with short lengths of stay (≤2H) with p<0.001.and long lengths of stay (>14) with p<0.001.

In multivariate analysis (Table 3), the risk factors related to maternal mortality that were identified are educational attainment, out-of-school women have risks significantly associated with maternal mortality, with an OR: 51.4 [6.75; 114.8] and p<0.001. Altered clinical status at admission was a risk factor associated with maternal mortality, with an OR: 4.12 [1.86; 9.39] and (p<0.001).

Women with thrombocytopenia had a 3-fold increased risk of mortality with an OR: 2.97[1.21; 7.30] Thrombocytopenia is a risk factor associated with maternal mortality with p-value: 0.017.

Intra-hospital vaginal and upper delivery were protective factors for maternal mortality, with an OR of 0.02 [0.0 to 0.13] and 0.03 [0.01 to 0.18] and p<0.001, respectively.

Transfusion is significantly associated with maternal mortality, a factor in the need for transfusion OR: 3.47[1.55; 7.93] p-value: 0.003; ventilatory support is a risk factor for maternal mortality with OR: 26.9[10.7; 75.5] and p<0.001. Finally, the length of stay in hospital was significantly related to maternal death, which is a risk factor for maternal mortality, with extreme length of stay, length of stay (LOS)≤ 24 hours with OR: 2.98 [0.96, 9.50] and LOS>14d OR: 2.05 [0.45, 9.25], and p: 0.012; Modalities of delivery by caesarean section or vaginal delivery are significantly associated with maternal mortality, it is a protective factor of mortality, respectively OR: 0.03[0.01; 0.18] and OR: 0.02[0.00; 0.13] and p<0.001. (Table 3).

Discussion

This analytical study on maternal mortality in two level 3 maternity wards between 2019 and 2023 identified an in-hospital maternal mortality rate (MMR) of 196.2 per 100,000 live births, which is still high compared to the SDG targets at the national level. The analysis of the different factors associated with maternal death highlights several clinical, sociodemographic and systemic aspects of maternal mortality.

Sociodemographic risk factors

The average age of the women who died was 28.7 years, which is like the average age of the control group of 29.7 years. Indeed, this study did not highlight a significant relationship between age and the risk of maternal mortality, similar results were demonstrated in an analytical study carried out in Iran.[10] However, several literature highlights the significant correlations between extreme age and the occurrence of maternal morbidity and mortality.[11-12] A striking factor in our study is the association between the geographical origin of patients and the risk of maternal mortality. Indeed, in univariate analysis, women from inland regions and border localities have a significantly higher risk of death with an OR=3.26[1.95; 5.40] and p<001, but which does not stand out in multivariate

analysis. These differences in risks were mainly related to difficulties in accessing prenatal care and emergency obstetric care, as well as low levels of education and geographical distances from health facilities, similar results are observed in several articles and scientific journals.[13]Also an American study demonstrates the differences in the level of vulnerability in maternal health by geographical area.[14-15]

The majority of transfer admissions were mothers evacuated from interiors regions or border localities, they have a risk of death 5.9 times higher than direct admissions OR=5.89[3.39; 10.3] and p<001 in univariate. These are found in the literature and are often explained by a delay in the use of care, by difficulties in accessing care, by the decision-making of transfers to the appropriate levels of care, as is the case of the results of a study carried out in a community hospital in Bangui, Central Africa in 2009.[16]Then in 2025 an analytical study in the same hospital.[17-18-19] Similar results are also found on the high risks of mortality by evacuated mothers.[20-21]

In addition, sociodemographic and economic factors are major factors that increase the risk of maternalmortality, such as not being in school,womenwithout professions. In our study, out-of-school women had 51.4 times mortality with OR: 51.4[6.75; 114.8] and p <0.001, it was a risk factor significantly associated with maternal mortality. Also, women without a profession have more risks related to maternal mortality, which is significant in univariate (p <001). Several results in the literature demonstrate the correlation between the level of maternal education and maternal morbidity and mortality.[22-23] This result highlights the importance of health education for mothers in reducing maternal mortality, due to a better understanding of warning signs, risk factors and better access to care, as well as better access to maternal mortality.[24-25] Astudycarried out in Tanzaniahighlighted the correlation between maternal morbidity and mortality and the level of education, prenatalfollow-up, as well as neonatalmorbidity.[26]

Clinical and obstetrical risk factors

Clinical status at admission is also a major predictor of maternal death. Patients admitted in an altered clinical condition have a 4.12[1.86; 9.39] times higher risk of death (p<0.001), highlighting the need for early detection of obstetric complications, expanding preventive obstetric care at the national level. [17-27]

Other biological factors have been identified as significantly associated with maternal mortality, including severe anaemia with OR: 2.75[1.65; 4.57]; p<0.001), only in univariate, also Thrombocytopenia has been identified as a risk factor for maternal mortality OR: 2,97[1.21 ; 7.30] and p-value:0.017. These risk factors underscore the importance of rigorous prenatal follow-up to anticipate and treat these complications before they become fatal. Similar results are observed in the literature.[28-29]

Nullipart women have 1.95 [1.03; 3.89], twice the risk of maternal mortality, then poorly monitored pregnancyhave 3.81 [1.32; 16.7] almost four times as much maternal mortality, were associated with mortality. A study carried out in Niger between 2008-2010 on the risk factors for maternal death in hospitals shows that these factors were significantly associated with maternal mortality, early pregnancies aged 14-19 years (p-value: 0.00000178), high multiparity (7+ children) (p-value: 0.00000124), primiparity (p-value: 0.000016), and the 3rd trimester of pregnancy (p-value: 0.0054).[30] Also concordant results in thissense in the literature.[31-32] In addition, a studycarried out in Tanzaniademonstrates the correlation between low prenatalfollow-up, no schooling and the occurrence of perinatal morbidities.[26]

Finally, hospital care is also a key determinant of maternal mortality, in our study the length of hospital stay was identified as a risk factor related to maternal death, with a high risk for patients who stayed less than 24 hours in hospital, Length of stay(DS)≤ 24H with OR:2.98 [0.96, 9.50] and p:0.012 . Mainly due to admission too late, with an altered clinical condition on admission. Conversely, patients with a prolonged stay (>14 days) are also at significant risk DS>14j OR: 2.05 [0.45, 9.25] and p:0,012associated with maternal mortality, which may reflect serious complications requiring prolonged intensive care. Several scientific studies confirm the result of this study on the correlation between length of stay and maternal mortality.[33-35]
Vaginal delivery and intra-hospital caesarean section were protective factors for maternal mortality, with an OR of 0.02 [0.0; 0.13] and OR: 0.03 [0.01; 0.18] and p<0.001 respectively; These can be explained by the benefits of early use of peripartium care in level 3 maternity wards in women who survived high-risk pregnancy, and identical results have been observed in the literature.[36-37]

The main causes of maternal death identified in our study are hemorrhagic shock (26.2%), pre-eclampsia and its complications (20.4%) and malaria (17.5%), followed in fourth place by sepsis (11.7%). These results corroborate the trends observed in other studies of the literature, where hemorrhage and preeclampsia, and hypertensive disorders of pregnancy remain the leading causes of maternal mortality.[38-39,40-41-4-42-43-44]

In our study, in particular, the cause of maternal mortality related to malaria is in third place ahead of sepsis. This is justified by the period of our study which coincides with the COVID-19 period from March 18, 2020, to 2023. This health crisis has had an impact on the preventive measures usually put in place by the Ministry of Health during the peak periods of the malaria epidemic nationwide. Also the impacts of covid-19 on pregnancy follow-up and maternal health care are reported in the literature by Chmielewska B, Barratt I et al.[45]
Analysis according to the WHO's model of the three delays allowed us to identify that the third delay, relating to the quality of hospital care, is the most predominant (57.3%), followed by the first delay (23.3%) and the second delay (19.4%).These results indicate the importance of improving the quality of intra-hospital care, training health personnel and strengthening the capacities of hospital structures to optimize the management of obstetric emergencies. Similar results have been demonstrated in the literature on the impact of improving the quality of care on maternal mortality.[46]
.

Limitations of the study

As it is limited to the reference hospital setting, in the two maternity wards, this study does not cover women who gave birth at home, and deaths at home. However, our study is representative of the population of Djibouti City, as these two maternity hospitals perform on average more than two-thirds, or 71% of the expected annual delivery in Djibouti City. The retrospective nature of our studies did not allow us to study all the determinants of maternal mortality.

Conclusion

During the study period from 2019 to 2023, maternal mortality was recorded at 196.2 per 100,000 live births. Our research analyzed 515 patients admitted to two level-3 reference maternity wards. Several risk factors were identified as significantly associated with maternal mortality, including education level, clinical status at admission, thrombocytopenia, blood transfusion and derivatives, ventilatory support in intensive care, and length of hospital stay.

Furthermore, this study demonstrated that medical evacuation (transfer), inadequate prenatal follow-up, severe anemia, and nulliparity increased the risk of maternal mortality.There is a need for strengthen interventions to mitigate factors such as the level of education, the clinical condition at admission to level 3 maternity, and maternal intensive care.It isalsonecessary to ensureevidence-basedintrapartum interventions to improve the quality and safety of obstetric care..

Declaration of conflicting interests

The authors declare that they have no conflict of interest regarding the subject of this study or the results that will emerge from it

Authorization and anonymity

Authorization to consult the archives was obtained in advance before data collection commenced. Anonymity and confidentiality were been strictly maintained throughout the data collection period. Additionally, authorization from the ethics committee was secured beforehand with reference (184/2024 CERB.

References

1.WHO. Trends in maternal mortality 2000 to 2020: estimates by Who, UNICEF, Unfpa, World Bank Group and UNDESA/Population Division. Geneva: World Health Organization; 2023. Licence: CCBY-NC-SA3.0IGO.

2. WHO.Maternal Mortality. [cited April 2025].Available: https://www.who.int/news-room/fact-sheets/detail/Maternal-mortality.

3. WBG.Maternal mortality ratio (modeled estimate, per 100,000 live births) 2023.World Bank Open Data. [Cited September 2024].Available: https://data.worldbank.org

4. SaucedoM,Aouba A, Benbassa A, Bouvier-Colle MH, Charbonneau P, Chassard D, Cohen H, Deneux-Tharaux C, Favrin S, Fillette D, Le Guern V, Leroux S, Levy G, Mercier F, Puech F and Simon A.Épidémiologie de la mortalité maternelle en France, 2007–2009.Journal de Gynécologie Obstétrique et Biologie de la Reproduction(Paris)2013Nov;42(7):613-27.[Frenc]

5. Kassebaum NJ, Steiner C,Murray C J L, Lopez AD,and Lozano R.GBD2015 Maternal Mortality Collaborators. Global, regional, and national levels of maternal mortality, 1990-2015: a systematic analysis for the Global Burden of Disease Study 2015. Lancet.2016Oct8;388(10053):1775-1812.doi:10.1016/ S01 40-6736(16)314702.Erratumin:Lancet.2017Jan 7 ; 389 (10064) .

6. Small MJ, Allen TK, and Brown HL.Global disparities in maternal morbidity and mortality. Seminars in Perinatology.2017 aoûg ;41(5):318-22.DOI:10.1053/j.semperi.2017.04.009.

7. Bingham D, Jones DK and Howell EA. Quality Improvement Approach to Eliminate Disparities inPerinatalMorbidityandMortality.ObstetGynecolClinNorthAm.2019 juin ;46(2):227-38.doi:10.1016/j.ogc.2019.01.006.

8. Berhan Y and Berhan A..Review of maternal mortality in Ethiopia: a story of the past 30 years. Ethiop J Health Sci. 2014 sept ;24 Suppl(0 Suppl):3-14.Doi:10.4314.

9. OMS.Classification internationale des maladies onzième révis International Classification of Diseases for Mortality and Morbidity Statistics (ICD-11).Genève2022.. Licence :CC BY-ND 3.0 IGO.available: https://icdcdn.who.int/icd11referenceguide/en/refguide.pdf.

10. Shekari M, Shirzadfardjahromi M, Ranjbar A, Mehrnoush V, Darsareh F and Roozbeh N. Advanced maternal age and adverse obstetrical and neonatal outcomes of singleton pregnancies. Gynecology and Obstetrics Clinical Medicine. 2022dec ;2 (4) :175 -80 .10.1016/ j.

11. Lisonkova S, Potts J, Muraca GM, Razaz N, Sabr Y, Chan WSand Kramer S.M. Maternal age and severe maternal morbidity: A population-based retrospective cohort study. PLoS Med. 2017 May;14(5):e1002307.doi:10.1371/journal.pmed.

12. Nyongesa P, Ekhaguere OA, Marete I, Tenge C, Kemoi M, Bann CM, Bucher SL, Patel AB, Hibberd PL, Naqvi

F, Saleem S, Goldenberg RL, Goudar SS, Derman RJ, Krebs NF, Garces A, Chomba E, Carlo WA, Mwenechanya M, Lokangaka A, Tshefu AK, Bauserman M, KosoThomas M, Moore JL, McClure EM, Liechty EA and Esamai F. Maternal age extremes and adverse pregnancy outcomes in low-resourced settings. Front Glob Womens Health. 2023;4:1201037.

13. Mehta A, Spitz J, Sharma S, Bonomo J, Brewer LC, Mehta LS, and Sharma G. Addressing Social Determinants of Health in Maternal Cardiovascular Health. Canadian Journal of Cardiology. 2024 Jun 1;40(6):1031-42.doi:10.1016/j.cjca.2024.02.010
14. Murosko DC, Radack JBarreto A, Passarella M, Formanowski B, McGann C, Nelin T, Paul K, Pen MM,Salazar E G,Burris HH,Handley SC,Williams DM and Lorch S A.County-Level Structural Vulnerabilities in Maternal Health and Geographic Variation in Infant Mortality. The Journal of Pediatrics. janv 2025;276:114274.
15. Nosy AMN and Razakamanana MV. Determinants de l'acces aux soins des meres et enfants a madagascar : cas du district de manandriana. Revue Internationale de la Recherche Scientifique (Revue-IRS). 29 avr 2024;2(2):686-700. doi 10.5281/zenodo.11088224
16. Sépou A, Goddot M, Ngbalé R, Gaunéfet C, Domande-Modanga Z, Fandema E, and Baligross, S. Evolution of the frequency and problems associated with sanitary referrals to the gynecology and obstetric service of the « Hopital Communautaire de Bangui ». clinics Mother and Child Health .2009;6:1007–12.
17. Wongo GR de LK, Gbekere TBCSK, Dondo-Fongbia JP, Koirokpi A, Matoulou-M S,Deguene H,Manirakiza A,Ngbale NR, and Sepou A. Analysis of Patient Evacuations at the Centre Hospitalier Universitaire Communautaire (CHUC), Central African Republic. Open Journal of Obstetrics and Gynecology. 6 janv 2025;15(1):55-66.
18. Mehrnoush V, Ranjbar A, Banihashemi F, Darsareh F, Shekari M and Shirzadfardjahromi M. Urban-rural differences in the pregnancy-related adverse outcome. Gynecology and Obstetrics Clinical Medicine. 2023 mars 1;3(1):51-5.
19. Straneo M, Beňová L, van den Akker T, Abeid MS, Ayebare E, Dossou JP,Handing G,Kandeya B,Pembe AB and Hanson C. Mixed vulnerabilities: the biological risk of high parity is aggravated by emergency referral in Benin, Malawi, Tanzania and Uganda. International Journal for Equity in Health. 2025;24(1).
20. Samaké A, Traoré SO, Keita M, Diallo M, Konate M, Diarra L, Maiga M, Traoré OM, Traoré MA, Diakité N, Sangaré RT. Kamissoko A, Coulibaly F, Dao S Z, Traore MS, Sima M, Traoré M and Dolo A. Les Évacuations Sanitaires Obstétricales dans un Hôpital de Deuxième Niveau de Référence du District de Bamako. The Journal of Medicine and Biomedical Sciences. 8 sept 2020 [cited 2025 fev 19]. Available from: http://hsd-fmsb.org/index.php/hsd/article/view/2299. [French]
21. Diarra M. Etude des facteurs associés aux décès maternels dans le Centre de Santé de Référence de la Commune VI du district de Bamako de janvier 2013 au 31 décembre 2018. Université des Sciences, des Techniques et des Technologies de Bamako; 2020 [cited 2023 sept12]. available: https://www.bibliosante.ml/handle/123456789/4063. [French]
22. Cantarutti A, Franchi M, Monzio Compagnoni M, Merlino L and Corrao G. Mother's education and the risk of several neonatal outcomes: an evidence from an Italian population-based study. BMC Pregnancy Childbirth. 12 juill 2017;17(1):221.
23. Sarma UC and Kakoty SD. 17.Maternal Mortality: An Equity Issue. Indian Journal of Public Health. déc 2017;61(4):231.
24. Tasuku Okui. Sociodemographic characteristics of maternal mortality in Japan: An analysis of national data from 2010 to 2022. European Journal of Obstetrics & Gynecology and Reproductive Biology305(2025) 17-22. Available: https://pdf.sciencedirectassets.com/271236/1-s2.0-
25. Kusuma D, Cohen J, McConnell M and Berman P. Can cash transfers improve determinants of maternal mortality? Evidence from the household and community programs in Indonesia. Social Science & Medicine. 1 août 2016;163:10-20.
26. Kamala BA, Mgaya AH, Ngarina MM and Kidanto HL. Predictors of low birth weight and 24-hour perinatal outcomes at Muhimbili national hospital in Dar es

Salaam, Tanzania: afive-year retrospective analysis of obstetric records. Pan African Medical Journal. 2018;29.

27. Ouédraogo AM, Ouédraogo HG, Baguiya A, Millogo T, Somé A and Kouanda S. A case–control study of risk factors for maternal mortality in Burkina Faso in 2014. International Journal of Gynecology & Obstetrics. 1 nov 2016;135:S79-83.
28. Kangalgil M, Sahinler A, Kırkbir IB and Ozcelik AO. Associations of maternal characteristics and dietary factors with anemia and iron-deficiency in pregnancy. Journal of Gynecology Obstetrics and Human Reproduction. 1 oct 2021;50(8):102137.
29. Parks S, Hoffman MK, Goudar SS, Patel A, Saleem S, Ali SA, GoldenbergeRL, Hibberdf PL, Mooreg J, Wallaceg D, McClureg EMand Dermanh RJ. Maternal anaemia and maternal, fetal, and neonatal outcomes in a prospective cohort study in India and Pakistan. BJOG. mai 2019;126(6):737-43.
30. Alkassoum I, Djibo I, Hama Y, Abdoulwahabou AM and AmadouO.Risk factors for in-hospital maternal mortality in the region of Maradi, Niger (2008-2010: A retrospective study of 7 regional maternity units. Med Sante Trop. 1 févr 2018;28(1):86-91.
31. Merriam AA, Metz TD, Allshouse AA, Silver RM, Haas DM, Grobman WA, Simhan H N , WapnerR J , Wing D, Mercer BM, Parry S and ReddyU M . Maternal Morbidity Risk Factors in Nulliparas. Am J Perinatol. mai 2024;41(S 01):e1878-84.
32. CR. AdJOby, SV. KoffI, R. Kouakou-kouraogo, YP. Akobé, NBC. Houphouet-Mwandji, M. Gadji, OPJ. Loba and ND. effohN'drin. Facteurs de risque et pronostic materno-fœtal de l'hematome retro placentaire au chu d'angrea propos de 102 cas. journal de la sago (Gynécologie – Obstétrique et Santé de la Reproduction). 11 févr 2025 [cité 18 févr 2025]. Avaible: https://www.jsago.org/index.php/jsago/article/view/198
33. Gessessew A, Barnabas GA, Prata N and Weidert K. Task shifting and sharing in Tigray, Ethiopia, to achieve comprehensive emergency obstetric care. International Journal of Gynecology & Obstetrics. 1 avr 2011;113(1):28-31.
34. Thomas TK, Umeokonkwo CD, Sesay HW, Adewuyi P, Babalola OJ, Wachekwa I and Amo-Addae MP. Maternal mortality review in a major tertiary referral hospital in Liberia, 2018–2021. Heliyon. 30 mars 2024;10(6):e28001.
35. Ikeda S, Shibanuma A, Silwal R and Jimba M. Factors associated with the length of stay at health facilities after childbirth among mothers and newborns in Dhading, Nepal: a cross-sectional study. BMJ Open. 1 mai 2021;11(5):e042058.
36. Marian-Pavlenco A, Siritanu I, Ribac T and Friptu V. Cesarean delivery in a tertiary institution of the Republic of Moldova: analysis using the Robson classification. AJOG Global Reports. 1 nov 2024;4(4):100408.
37. Engjom HM, Morken NH, Hoydahl E, Norheim of and Klungsoyr K. Increased risk of peripartum perinatal mortality in unplanned births outside an institution: a retrospective population-based study. American Journal of Obstetrics & Gynecology. 1 août 2017;217(2):210.e1-210.e12.
38. Wolfson C,Angelson JT, Atlas R, Burd I, Chin P, Downey C,FaheyJ,Hoffman S,Johnson C,JonesM,Jones-Beatty K and Kasirsky J. Severe maternal morbidity contributed by obstetric hemorrhage:Maryland, 2020-2022. American Journal of Obstetrics and Gynecology MFM. 2025;7(2).
39. Krakowiak P, Morton CH, McCain C, Sun D, Mathur D, Butwick AJ, MBBS MS, Gupta N,Nijagal, M A. , Williams A,Seacrist M ,Shields L E, Reyes C,Klassen M,Yznaga E and Main E K. Pregnancy-Related Mortality in California due to Obstetric Hemorrhage. Obstet Gynecol. 2025 Feb 13 .
40. Filippi V, Chou D, Ronsmans C, Graham W and Say L. Levels and Causes of Maternal Mortality and Morbidity. In:Black RE, Laxminarayan R, Temmerman M, Walker N, éditeurs. Reproductive, Maternal, Newborn, and Child Health: Disease Control Priorities, Third Edition (Volume 2). Washington (DC): The International Bank for Reconstruction and Development/TheWorldBank;2016[cited2025feb].Available from: http://www.ncbi.nlm.nih.gov/books/NBK361917/
41. Diallo A, Michalek IM, Bah IK, Diallo IA, Sy T, Roth-

Kleiner M and Desseauve D. Maternal mortality risk indicators: Case-control study at a referral hospital in Guinea. European Journal of Obstetrics & Gynecology and Reproductive Biology. 1 août 2020;251:254-7.

42. Saucedo M and Deneux-Tharaux C.Mortalité Maternelle, Fréquence, causes, profil des femmes et évitabilité des décès en France 2013–2015. Gynécologie Obstétrique Fertilité & Sénologie. 1 janv 2021;49(1):9-26.
43. Sak M.E, Evsen M.S, Soydinc H.E, Turgut A, Ozler A, Sak S, Celik Y. and Gul T.Risk factors for maternal mortality in eclampsia: analysis of 167 eclamptic cases. European Review for Medical and Pharmacological Sciences. (16: 1399-1403):2012
44. Ahmed SS. Etude de la mortalité maternelle à la maternité de DAR EL HANAN : à propos de 91 cas. [Faculté de Médecine Djibouti(FMD)]: Universite de Djibouti; 2018. [French]
45. Chmielewska B, Barratt I, Townsend R, Kalafat E, van der Meulen J, Gurol-Urganci I, O'Brien P, Morris E,Draycott T,Thangaratinam S, Le Doare K,LadhaniS,vonDadelszen P, Magee L and Khalil A . Effects of the COVID-19 pandemic on maternal and perinatal outcomes: a systematic review and meta-analysis. Lancet Glob Health. 2021 Jun ;9(6):e759-72.
46. Srofenyoh EK, Kassebaum NJ, Goodman DM, Olufolabi AJ and Owen MD. Measuring the impact of a quality improvement collaboration to decrease maternal mortality in a Ghanaian regional hospital. International Journal of Gynecology & Obstetrics. 2016 Aug 1;134(2):181-5.