

Evolution and Risk Factors of Maternal Mortality in Cameroon: A Case Control Study

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Abstract

Background: Maternal mortality is still high in sub-Saharan Africa, especially in Cameroon where more efforts to reduce maternal mortality and provide universal access to reproductive health should be made. This study aims to see the evolution of maternal mortality and identify associated risk factors in Laquintinie hospital in Cameroon. **Methods:** A manual review of records for 166 maternal deaths (cases) and 322 controls was undertaken using a standard audit form. The sample included pregnant women aged 16 - 46 years admitted at the maternity of Laquintinie Hospital in Douala, Cameroon from January 2017 to December 2022. Software SSPS 3 and Logistic regression analysis were used to analyze data. **Results:** One hundred and sixty-six (166) maternal deaths were identified during the study period for 14,114 live births, representing a maternal mortality ratio of 1176/100,000 live births. Factors significantly associated with maternal mortality included: young age (15 - 24 years) (aOR 0.11, 95% CI 0.00 - 0.76, p = 0.037), Alcohol intake (aOR 22.79, 95% CI 1.04 - 501.3, p = 0.047), Abortion or ectopic pregnancy (aOR 61.53, 95% CI 1.29 - 2927.3, p = 0.037), having no antenatal visits (aOR 388.3 95% CI 5.6 - 2675.9, p = 0.006), being admitted with hemorrhage (aOR 343.7, 95% CI 16.2 - 7276.0, p < 0.0001), being admitted with anemia (aOR 27,713.0, 95% CI 128.2 - 5,989,223.3, p < 0.0001), and being unbooked (aOR 0.00, 95% CI 0.00 - 0.18, p = 0.016). **Conclusion:** Despite slight decrease in maternal mortality, early diagnosis of pregnancy and good Antenatal care associated with maternal health education are important factors for reducing maternal mortality. Young women were the most affected. Singles, alcoholics, women with a no or only primary education level, and referred women represented the majority of deceased cases.

Keywords

Maternal Mortality, Ratio, Live Births, Risk Factors

1. Background

Maternal Mortality is the death of a woman while pregnant or within 42 days of termination of pregnancy, irrespective of the duration and site of the pregnancy, from any cause related to or aggravated by the pregnancy or its management, but not from accidental or incidental causes [1].

The maternal mortality ratio (MMR) is defined as “the ratio of the number of maternal deaths during a given period per 100,000 live births during the same time period”. The global MMR is 210 per 100,000 live births. The maternal mortality ratio in developing countries is 240 per 100,000 births versus 16 per 100,000 in developed countries. There are large disparities between countries, with few having extremely high maternal mortality ratios of 1000 or more per 100,000 live births. There are also large disparities within countries, between people with high and low incomes, and between people living in rural and urban areas [2].

Sub-Saharan Africa is the region of the world with high rates of maternal death [3] [4] and where about 25% of total births on the planet are registered each year.

According to the WHO, some facts have been observed; between 1990 and 2010, maternal mortality worldwide dropped by almost 50%; Every day, approximately 800 women die from preventable causes related to pregnancy and childbirth; 99% of all maternal deaths occur in developing countries; Maternal mortality is higher in women living in rural areas and among poorer communities; Young adolescents face a higher risk of complications and death as a result of pregnancy than older women; Skilled care before, during, and after childbirth can save the lives of women and newborn babies [5].

In Cameroon, in 2018, according to the Demographic and Maternal Health Survey (DMHS), the maternal mortality ratio went from 782 deaths per 100,000 live births in 2011 to 467 deaths per 100,000 live births in 2018 [6]. This ratio is heterogeneous according to the health structures; in 2015 at central hospital Yaoundé, this rate was estimated at 964 per 100,000 live births and 247 per 100,000 live births at the regional hospital in Bamenda [7]. From 2011 to 2016 a Study performed at Laquintinie Hospital recorded an MMR of 1638 per 100,000 live births [8].

The main direct causes of maternal death in developing countries include haemorrhage, sepsis, obstructed labour and hypertensive disorders [9]. The risk of death from haemorrhage is one in 1000 deliveries in developing countries, compared with one in 100,000 in developed countries, and accounts for one-third of the maternal deaths in Africa [10]. A retrospective study undertaken at a tertiary hospital in Nigeria in 2007 found that the most common risk factors for

maternal mortality were primiparity, haemorrhage, anaemia, eclampsia and malaria [11].

Many individual and socioeconomic factors have been associated with high maternal mortality. These include lack of education, parity, previous obstetric history, employment, socioeconomic status, and types of care-seeking behaviours during pregnancy. There is also evidence of an increased risk of death among young women [12]. In Nigeria, a cross-sectional survey revealed that the most common risk factors for maternal death were primigravidity (19%) and unbooked status (19%) [13]. Poverty has also been associated with adverse maternal outcomes, not directly, but as a contributor to maternal ability to access good health care centers [14] [15].

Antenatal care (ANC) is very important during pregnancy. International organizations recommend a minimum of four visits, the administration of two doses of tetanus toxoid, and folic acid supplementation during ANC attendance [16]. When women receive good care during the pre-partum period, they have been shown to be at lower risk of maternal morbidity and mortality since they have a higher likelihood of using a professional health facility during birth [17] [18].

The aim of this study is to identify risk factors associated with maternal mortality in Laquintinie hospital in Douala, Cameroon. To achieve this objective, we studied and analyzed four sets of determinants: socio-demographic, maternal history, obstetric, and hospital admission.

2. Methods

An unmatched case-control study of women who had been admitted at the maternity unit of Laquintinie Hospital between January 2017 and December 31, 2022, was conducted. Laquintinie Hospital is located in the Littoral region of Cameroon. As the largest regional hospital in Douala, it provides a range of curative, preventive, and rehabilitative health services to a population of about 3 million inhabitants. The maternity unit is made up of 05 birth rooms, each with a convertible bed, a pre-labour room with a capacity of five beds, and many rooms for postpartum. A functional operating theatre (with two immediate post-interventional treatment rooms with two beds each) is attached to this entire unit. The obstetrics and gynaecology department has a capacity of 80 beds and a filling rate of 80%. The cases ($n = 166$) were maternal deaths identified from a manual review of hospital records. The controls ($n = 332$) were selected in a ratio of 2 control per case. Controls were surviving women who were admitted immediately preceding and following cases.

2.1. Inclusion Criteria

All Cases registered as maternal deaths were selected retrospectively during the study period (January 1, 2017 to December 31, 2022). Abortion and ectopic pregnancy related deaths were included in the study. Trained staff collected informa-

tion using a standard audit form.

2.2. Exclusion Criteria

We excluded all the cases of deaths in women who were not pregnant or in the postpartum period. Also, there were cases with incomplete data, such as the absence of age, address, occupation, past history or any other important information.

2.3. Data Collection

Data was collected using a data collection form. Sociodemographic data included the mother's age, mother's marital status, mother's educational level, mother's occupation, religion, and residence. Data on maternal medical history included smoking, alcohol use, abortion, multiple gestation, gravidity, number of ANC visits, and stage of labour. Health system factors included mode of delivery, and referral from another facility (yes or no). Maternal clinical data during admission was also collected and included the diagnosis on admission (e.g., already death, eclampsia, dystocia, haemorrhage, anemia), pulse rate on admission (beats per minute/bpm), clinical cause of death. The primary cause of maternal death was extracted from the patient's medical record and post mortem records.

2.4. Statistical Analyses

Analyses were performed using the Statistical Package for Social Sciences version 26 software. The data was checked for obvious errors. Univariate logistic regression analysis was conducted for each potential risk factor. All variables with a p value < 0.2 in the univariate models were included in a multivariate model. Backward stepwise multiple logistic regression was undertaken separately for the four groups of risk factors in the framework adapted from the Delay Model, (individual and socio-demographic; maternal history; reproductive or obstetric; and admission). Variables were removed from the models where p-values ≥ 0.1 on the Likelihood Ratio Test. The variables in each of the final models were then included in a combined model and removed where p-values ≥ 0.1 in order to derive a final parsimonious model. Odds ratios (ORs), 95% confidence intervals and p-values are reported for all models. The reference group was the category with the lowest expected risk of death, or if there were few cases in this category, the group with the majority of respondents.

Assuming the probability of exposure in controls was 40% and the ratio of cases to controls was 1:2, with 80% power and a 5% level of significance, a sample of approximately 500 women (166 cases and 332 controls) was needed to detect an odds ratio of approximately 0.5 or 1.8.

Prior to our study, an ethical clearance was obtained from the Institutional review board of the University of Douala. Our study was conducted with strict compliance with the fundamental principles of medical research (principle of research safety and confidentiality).

3. Results

3.1. Trends in Maternal Mortality

A total of 166 maternal deaths against 14,114 live births were recorded from 2017 to 2022 giving a maternal mortality ratio of 1176 per 100,000 live births. **Table 1** shows the distribution of maternal deaths and live births from January 1st, 2017, to December 31st, 2022. We observed a decrease of numbers of deliveries in 2020 due to the corona virus impact on people (fear of hospitals) (**Figure 1**).

3.2. Association between Sociodemographic Variables and Maternal Mortality

The age group of 25 - 34 had the highest proportion of maternal mortality (50.6%). However, the age group of 15 - 24 remained significantly associated with maternal mortality after multivariate logistic regression (aOR 0.11, 95% CI 0.00 - 0.76, $p = 0.037$). Mother's occupation (Formal), also remained significantly associated with mortality after multivariate analysis (aOR 0.01, 95% CI 0.00 - 0.57, $p = 0.027$). Residence, religion, educational level, and marital status did not show any association with maternal mortality. **Table 2** below summarizes the distribution and association between sociodemographic variables and maternal mortality at the Laquintinie hospital.

Table 1. Distribution of maternal death at Laquintinie hospital from January 2017 to December 2022.

Variables	years							Total
	2017	2018	2019	2020	2021	2022		
Maternal Death	20	31	47	28	15	25	166	
Live births	2967	2545	2690	1693	2380	1839	14,114	
Maternal mortality ratio/100,000 live births	674	1218	1747	1693	630	1359	1176	

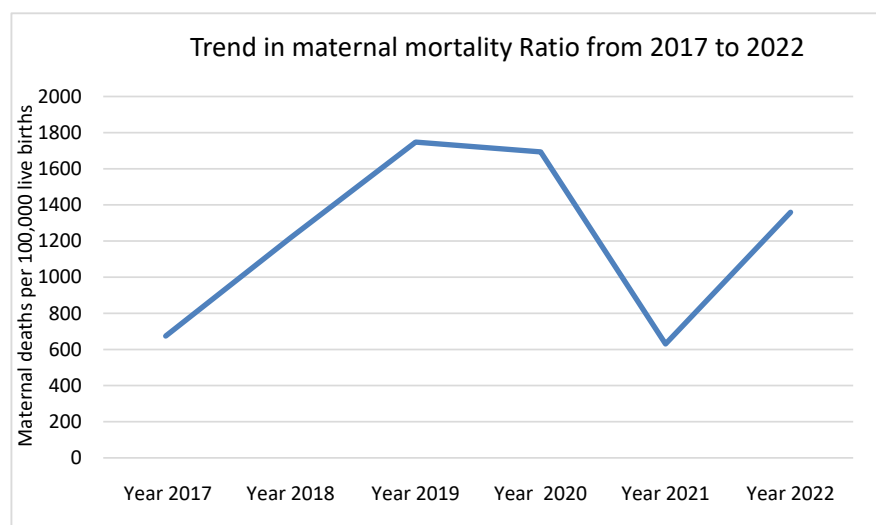


Figure 1. Trend in Maternal mortality ratio.

Table 2. Individual and Socio-demographic risk factors for maternal mortality in Laquintinie Hospital from January 2017 to December 2022.

	Case		Control		OR [95% CI]	p-value	Multivariate Logistic Regression	
	n	%	n	%			aOR [95% CI]	p-value
Age (years)								
15 - 24	23	13.9	104	31.4	0.20 [0.11 - 0.36]	<0.001	0.11 [0.00 - 0.76]	0.037
25 - 34	84	50.6	174	52.6	0.43 [0.28 - 0.68]	<0.001	0.42 [0.02 - 7.20]	0.546
35 - 45	59	35.5	53	16.0	Reference		Reference	
Marital status								
Married	63	38.0	102	30.7	1.38 [0.93 - 2.04]	0.107	14.25 [0.45 - 449.5]	0.131
Single	103	62.0	230	69.3	Reference		Reference	
Education								
None	20	12.0	7	2.1	5.66 [2.24 - 14.30]	<0.001	19.50 [0.28 - 1357.4]	0.170
Primary	33	19.9	49	14.8	1.33 [0.76 - 2.34]	0.316	1.05 [0.03 - 43.46]	0.980
Secondary	65	39.2	181	54.5	0.71 [0.45 - 1.11]	0.135	0.30 [0.02 - 5.23]	0.409
University	48	28.9	95	28.6	Reference		Reference	
Occupation								
Housewife	85	51.2	140	42.2	1.06 [0.70 - 1.60]	0.790	4.68 [0.44 - 49.92]	0.201
Formal	19	11.4	84	25.3	0.39 [0.22 - 0.71]	0.002	0.01 [0.00 - 0.57]	0.027
Informal	62	37.3	108	32.5	Reference		Reference	
Religion								
Christian	116	69.9	214	64.5	1.56 [0.85 - 2.87]	0.155	24.42 [0.50 - 1185.1]	0.107
Muslim	34	20.5	72	21.7	1.36 [0.67 - 2.73]	0.392	16.82 [0.29 - 987.0]	0.174
Other	16	9.6	46	13.9	Reference		Reference	
Residence								
Bepanda	26	15.7	34	10.2	2.09 [1.17 - 3.76]	0.013	2.17 [0.07 - 69.25]	0.661
Ndogpassi	42	25.3	74	22.3	1.55 [0.97 - 2.50]	0.068	0.98 [0.05 - 20.81]	0.989
Bonaberi	33	19.9	46	13.9	1.97 [1.16 - 3.34]	0.012	10.46 [0.60 - 183.0]	0.108
Others	65	39.2	178	53.6	Reference		Reference	

3.3. Association between Maternal Mortality and Factors of Maternal History, and Obstetric Characteristics

The association between maternal mortality and maternal history of prevailing conditions, and obstetric and reproductive factors are shown on **Table 3** below. Smoking was more common among cases compared to control (4.2% vs 3.3%) although the difference was not statistically significant (aOR: 1.31, 95% CI: 0.00 - 581). Alcohol consumption and abortion were more common amongst the cases (63.9% vs 41%, and 42.2% vs 8.7% respectively) and the differences were statistically significant (aOR: 22.79 95% CI: 1.04 - 501, $p = 0.047$ and aOR: 61.5 95% CI: 1.29 - 2927, $p = 0.037$ respectively). The proportion of cases that had no

ANC visits, and only 1 - 3 visits were significantly higher compared to that of the controls with the odds of maternal mortality 388 times higher amongst those without ANC (aOR: 388 95% CI: 5.6 - 26,752, $p = 0.006$) and 421 times higher amongst those with only 1 - 3 ANC (aOR: 421, 95% CI: 11.5 - 15,503, $p = 0.001$). The differences in the distribution of twin gestation, gravidity, and mode of delivery did not differ significantly between the cases and controls.

Table 3. Mother's history of prevailing conditions and obstetric characteristics associated with maternal mortality in Laquintinie Hospital from January 2017 to December 2022.

Variables	Case		Control		OR [95% CI]	p-value	Multivariate Logistic Regression	
	n	%	n	%			aOR [95% CI]	p-value
Smoking								
Yes	7	4.2	11	3.3	1.29 [0.49 - 3.38]	0.611	1.31 [0.00 - 581.2]	0.931
No	159	95.8	321	96.7	Reference		Reference	
Alcohol								
Yes	106	63.9	136	41.0	2.55 [1.73 - 3.74]	<0.001	22.79 [1.04 - 501.3]	0.047
No	60	36.1	196	59.0	Reference		Reference	
Abortion								
Yes	70	42.2	29	8.7	7.62 [4.67 - 12.44]	<0.001	61.53 [1.29 - 2927.3]	0.037
No	96	57.8	303	91.3	Reference		Reference	
Twins								
Yes	6	3.6	13	3.9	0.92 [0.34 - 2.47]	0.869	0.01 [0.00 - 2150]	0.600
No	160	96.4	319	96.1	Reference		Reference	
Gravida								
Primigravida	25	15.1	71	21.4	0.66 [0.35 - 1.24]	0.195	1.91 [0.02 - 198.89]	0.781
Multigravida	110	66.3	203	61.1	1.01 [0.62 - 1.66]	0.957	4.50 [0.12 - 164.93]	0.414
Grandmulti	31	18.7	58	15.5	Reference		Reference	
Mode of delivery								
Normal	88	53.0	196	59.0	0.37 [0.22 - 0.63]	<0.001	3.10 [0.09 - 111.5]	0.536
Caesarian	36	21.7	101	30.4	0.30 [0.17 - 0.54]	<0.001	6.54 [0.11 - 407.7]	0.373
Assisted	0	0.0	0	0.0	Undefined		Undefined	
Did not deliver	42	25.3	35	10.5	Reference		Reference	
Pregnancy stage								
Intrapartum	7	4.2	0	0.0	Undefined		Undefined	
Antepartum	39	23.5	0	0.0	Undefined		Undefined	
Puerperium	120	72.3	332	100.0	Reference		Reference	
Number of ANC visits								
None	19	11.4	8	2.4	17.94 [7.32 - 43.97]	<0.001	388.3 [5.6 - 26752.9]	0.006
1 to 3	111	66.9	52	15.7	16.13 [9.99 - 26.04]	<0.001	421.6 [11.5 - 15503.2]	0.001
Above 4	36	21.7	272	81.9	Reference		Reference	

3.4. Association between Maternal Admission Factors and Maternal Mortality

The proportion of death on arrival was higher amongst cases compared to controls (28.9% vs 0.0%). Eclampsia, severe preeclampsia, pulse rate ≥ 110 bpm had significantly higher proportions amongst cases than controls (eclampsia: 9% vs 2.1%; severe preeclampsia: 12.7 vs 4.2%; pulse rate ≥ 110 bpm: 28.8% vs 2.7%) although on multivariate analysis, they did not reach statistical significance (eclampsia: aOR: 23.7, 95% CI: 0.08 - 7184; severe preeclampsia: aOR: 14.5, 95% CI: 0.33 - 634.50; pulse rate < 110 bpm: aOR: 0.07 95% CI: 0.00 - 1.70). Admission from comorbid complications like being admitted with hemorrhage (aOR 343.7, 95% CI 16.2 - 7276.0, $p < 0.0001$), being admitted with anemia (aOR 27,713.0, 95% CI 128.2 - 5,989,223.3, $p < 0.0001$), and being referred (aOR 0.00, 95% CI 0.00 - 0.18, $p = 0.016$) were all statistically significant risk factors for maternal mortality (Table 4).

Table 4. Maternal admission factors associated with maternal mortality in Laquintinie hospital from January 2017 to December 2022.

Variables	Case		Control		OR [95% CI]	p-value	Multivariate Logistic Regression	
	n	%	n	%			aOR [95% CI]	p-value
Already death								
Yes	48	28.9	0	0.0	Undefined		Undefined	
No	118	71.1	332	100.0	Reference		Reference	
Eclampsia								
Yes	15	9.0	7	2.1	4.61 [1.84 - 11.55]	0.001	23.76 [0.08 - 7184.7]	0.277
No	151	91.0	325	97.9	Reference		Reference	
Dystocia								
Yes	5	3.0	12	3.6	0.83 [0.29 - 2.39]	0.727	1.46 [0.02 - 91.95]	0.858
No	161	97.0	320	96.4	Reference		Reference	
Haemorrhage								
Yes	118	71.1	45	13.6	15.68 [9.90 - 24.83]	<0.001	343.7 [16.2 - 7276.0]	<0.001
No	48	28.9	287	86.4	Reference		Reference	
Preeclampsia								
mild	0	0.0	27	8.1	Undefined		Undefined	
severe	21	12.7	14	4.2	3.01 [1.49 - 6.09]	0.002	14.50 [0.33 - 634.50]	0.166
no	145	87.3	291	87.7	Reference		Reference	
Anemia								
Yes	130	78.3	11	3.3	105.3 [52.1 - 213.3]	<0.001	27713.0 [128.2 - 5989223.3]	<0.001
No	36	21.7	321	96.7	Reference		Reference	
Pulse								
<110 bpm	118	71.1	323	97.3	0.07 [0.03 - 0.14]	<0.001	0.07 [0.00 - 1.70]	0.103
≥ 110 bpm	48	28.9	9	2.7	Reference		Reference	
Referral								
No	4	2.4	48	14.5	0.15 [0.05 - 0.41]	<0.001	0.00 [0.00 - 0.18]	0.016
Yes	162	97.6	284	85.5	Reference		Reference	

3.5. Multivariate Logistic Regression Analysis

Table 5 shows the multivariate analysis combining all factors from the previous models. Statistically significant risk factors for maternal mortality included: young age (15 - 24 years) (aOR 0.11, 95% CI 0.00 - 0.76, $p = 0.037$), Alcohol intake (aOR 22.79, 95% CI 1.04 - 501.3, $p = 0.047$), Abortion or ectopic pregnancy (aOR 61.53, 95% CI 1.29 - 2927.3, $p = 0.037$), having no antenatal visits (aOR 388.3 95% CI 5.6 - 2675.9, $p = 0.006$), being admitted with heamorrhage (aOR 343.7, 95% CI 16.2 - 7276.0, $p < 0.0001$), being admitted with anemia (aOR 27713.0, 95% CI 128.2 - 5,989,223.3, $p < 0.0001$), and being referred (aOR 0.00, 95% CI 0.00 - 0.18, $p = 0.016$).

Table 5. Multivariable model showing risk factors for maternal mortality in Laquintinie Hospital from January 2017 to December 2022.

Variables	Case		Control		Multivariate Logistic Regression	
	n	%	n	%	aOR [95% CI]	p-value
Age (years)						
15 - 24	23	13.9	104	31.4	0.11 [0.00 - 0.76]	0.037
25 - 34	84	50.6	174	52.6	0.42 [0.02 - 7.20]	0.546
35 - 45	59	35.5	53	16.0	Reference	
Occupation						
Housewife	85	51.2	140	42.2	4.68 [0.44 - 49.92]	0.201
Formal	19	11.4	84	25.3	0.01 [0.00 - 0.57]	0.027
Informal	62	37.3	108	32.5	Reference	
Alcohol						
Yes	106	63.9	136	41.0	22.79 [1.04 - 501.3]	0.047
No	60	36.1	196	59.0	Reference	
Abortion						
Yes	70	42.2	29	8.7	61.53 [1.29 - 2927.3]	0.037
No	96	57.8	303	91.3	Reference	
Number of ANC visits						
None	19	11.4	8	2.4	388.3 [5.6 - 26752.9]	0.006
1 to 3	111	66.9	52	15.7	421.6 [11.5 - 15503.2]	0.001
Above 4	36	21.7	272	81.9	Reference	
Haemorrhage						
Yes	118	71.1	45	13.6	343.7 [16.2 - 7276.0]	<0.001
No	48	28.9	287	86.4	Reference	
Anemia						
Yes	130	78.3	11	3.3	27713.0 [128.2 - 5989223.3]	<0.001
No	36	21.7	321	96.7	Reference	
Referral						
No	4	2.4	48	14.5	0.00 [0.00 - 0.18]	0.016
Yes	162	97.6	284	85.5	Reference	

4. Discussion

4.1. Summary of Main Findings

Our study set out to determine the MMR and to identify associated factors for maternal mortality at the Laquintinie Hospital of Douala, Cameroon. We found an MMR of 1176 maternal deaths per 100,000 live births. Factors associated with maternal mortality include: young maternal age (15 - 24 years), formal occupation, alcohol consumption, abortion, no ANC visits and 1 to 3 ANC visits compared to 4 visits, hemorrhage, anemia, and being referred.

4.2. Maternal Mortality Ratio

The maternal mortality ratio in our study was one thousand one hundred and seventy-six per one hundred thousand live births (1176/100,000). This is lower than the ratio founded by Essome *et al.* in the same hospital from January 2011 to December 31st, 2016, who had a ratio of 1638 maternal deaths per 100,000 live births [8]. The lower ratio could be explained by improvements in the structural and functional capacity of the hospital as well as the fact that many other hospitals in the city of Douala could now act as referral hospitals. However, the ratio of 1176 is far higher than the national ratio of 467 per 100,000 live births. This could be explained by the fact that Laquintinie hospital remain the first reference hospital in Douala and being a public hospital, they do not screen nor refer patients and as such, they continue to receive all types of referred patients from the entire region including poor and vulnerable patients as well as cases that are already in worst states.

4.3. Factors Associated with Maternal Mortality

Young mother's age between 16 to 24 years was significantly associated with maternal mortality. This is similar to WHO observations in many developing countries [2]. However, the age of 25 - 34 was the most representative. This finding is similar to that of Yego *et al.* in a study in Kenya [19]. The age group of 25 - 34 years is the most active reproductive age group and this could explain the high proportion. Maternal employment was found to be negatively associated with maternal mortality in our study. Maternal employment provides financial autonomy to the women and together with marital status, is effective determinants in the fight against maternal deaths [20] [21].

Over 60% of cases of maternal death in our study were unmarried women. Tiomela *et al.* working in a hospital in Yaoundé, another town in Cameroon, found similar findings [22]. About 65% of cases of maternal deaths came from areas with poor socio-economic status (Bepanda, Bonaberi, Ndogpassi). These areas coupled with the low socioeconomic status, lack basic health infrastructure hence health inequities are high among women in these areas. Low socioeconomic status could be linked with maternal mortality in various ways. Firstly, with low socioeconomic status, the women will not attend ANC or attend just a few, and secondly, their health literacy will be low. Low socioeconomic status

could therefore be an important determinant of maternal death. More so, poverty have been designated as a risk factor for maternal death [23].

Alcohol consumption is associated with 23-fold increased odds of maternal mortality. Alcohol has been reported by WHO as a risk factor for maternal mortality. This can be explained by negative behaviours associated with alcohol and socio-economic factors [2].

We found abortion or ectopic pregnancy to be significantly associated with maternal mortality with the odds of dying from abortion or ectopic pregnancy increased 61.5-folds. We included cases of maternal death following an abortion or an ectopic pregnancy in our study so as to be in conformity with the WHO definition [1] of maternal mortality. Surprisingly, abortions and ectopic pregnancies represented about 45% of maternal deaths in our study. This can be explained by the fact that abortion without medical indication is illegal in Cameroon. Most cases of abortions were induced criminal abortions who came consulting or were referred to Laquintinie hospital in critical or complicated states, or death on arrival.

The absence of antenatal visits or having only 1 - 3 antenatal visits were found to be risks factors in this study. This finding corroborates with those of other studies [24] [25]. Antenatal care is important in screening for pre-existing illnesses and complications in the early stages of pregnancy that could impact adversely during pregnancy and childbirth [26]. According to WHO recommendations, the qualitative follow-up of pregnancy includes among other things at least 4 prenatal consultations allowing education in behavioural change, the correction of nutritional deficiencies, the prevention, and treatment of infections [16]. Women who receive good care during the pre-partum period have been shown to be at less risk of maternal morbidity and mortality [17] [18].

Hemorrhage still remains a main cause of maternal mortality at the Laquintinie hospital, Douala, accounting for over 70% of cases. This result is similar to those found by Essome *et al.* [8] but higher than the 56.4% reported in 2009 at the Yaoundé University Hospital center [7]. Hemorrhage is reported in literature to be a leading cause of maternal mortality especially in developing countries. In a WHO review of 35,197 maternal deaths in Africa, hemorrhage was found to be the leading cause of death [5]. Anemia is often a consequence of bleeding, however, some cases of anemia in our study had no history of bleeding.

Almost all cases (95%) were referred patients. This rate is similar to the previously reported 92.1% rate at the Laquintinie hospital [8]. This finding is certainly due to the fact that the Laquintinie hospital remains the first referral hospital in Douala. This does not imply referral is a bad practice but rather delays associated with referred case particularly the second and third delays could be the main determinants of survival in referred cases. Our rate is higher than the 82% reported in another study in the University Hospital center in Yaoundé by Fomulu *et al.* [7]. The high rate in our study could be an indication that capacities of many other health facilities have to be improved in order to provide

timely and efficient care to these patients without necessarily referring them. It also implies that the Laquintinie hospital has to improve its preparedness in terms of structure and processes involved in the management of referred women with pregnancy related conditions.

5. Limitation of the Study

Since all those cases of maternal death have been presented at the hospital review and later at the regional review of maternal death cases, the patients files were well conserved. We did not face big difficulties for collecting data and carrying out this study.

6. Conclusion

This study highlights risk factors for mortality at Laquintinie hospital showing the importance of maternal education and amelioration of socio-economic level in preventing maternal mortality. Antenatal visits provide opportunities for the detection of risk factors for specific illnesses that may put a mother at risk during birth. This study also underlines the need to empower peripheral health structures in management of obstetrical emergencies, and training and recruitment of qualified personnel.

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Authors' Contributions

Boten designed the study, collected the data and wrote the manuscript. Mandeng, Mforteh, Dissack, Ngo dingom, Mbi, Takang, and Dobgima have read and corrected the manuscript. Essome directed the study, supervised the writing of the manuscript and validated the final version.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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Abbreviations

LB: Live births;

MDG: Millennium development goal;

MMR: Maternal mortality ratio;

ANC: Antenatal care;

NBU: Newborn unit;

WHO: World Health Organization;

HIV: Human immunodeficiency virus.

Appendix

Retrospective study on Evolution of maternal mortality at Laquintinie Hospital.

Name.....

1) Year:.....

Part 1: Socio-demographic characteristics.

2) Maternal Age..... () 2

3) Occupation

a = Housewife

b = Formal employment

c = Student

d = Seller

e = Hairdresser

f = Others(specify)..... () 3

4) Residence

a = Ndogpassi

b = Bepanda

c = Bonaberi

d = Others..... () 4

5) Marital Status

a = Single/Unmarried

b = Married

c = Divorced

d = Widow..... () 5

6) Education level

a = None

b = Primary school

c = Secondary school

d = University () 6

7) Religion

a = Christian

b = Muslim

c = Other (specify)..... () 7

Part 2: Past history and delivery

- 8) Gestity et parity:
 - a - Primigravida
 - b - Multigravida
 - c - Grandmultigravida..... () 8
- 9) Smoking:
 - a - Yes
 - b - No..... () 9
- 10) Drinking Alcohol:
 - a - Yes
 - b - No..... () 10
- 11) Abortion:
 - a - Yes
 - b -No..... () 11
- 12) Twin pregnancy:
 - a - Yes
 - b - No..... () 12
- 13) Mode of delivery:
 - a - Normal
 - b - Cesarean section
 - c - Assisted delivery
 - d - Did not deliver..... () 13
- 14) Pregnancy Stage:
 - a - Intrapartum
 - b - Antepartum
 - c - Postpartum..... () 14
- 15) Number of Antenatal consultations:
 - a - None
 - b - 1 - 3
 - c - Above 4..... () 15
- Part 3: Patient status at admission**
- 16) Alive
 - a - Yes
 - b - No..... () 16
- 17) Dystocia
 - a - Yes
 - b - No..... () 17
- 18) Pre-Eclampsia
 - a - Yes
 - b - No..... () 18
- 19) Eclampsia
 - a - Yes
 - b - No..... () 19
- 20) Haemorrhage
 - a - Yes

- b - No..... () 20
 21) Anemia
 a - Yes
 b - No..... () 21
 22) Pulse
 a - Less than 110 bpm
 b - Superior or Egal to 110 bpm..... () 22
 23) Referral
 a - Yes
 b - No..... () 23

COMPARISON: CHI-SQUARE TEST

Table A1. Sociodemographic risk factors.

Variables	Case		Control		X ²	p-value
	n	%	n	%		
Age					32.14	<0.001
15 - 24 years	23	13.9	104	31.4		
25 - 34 years	84	50.6	174	52.6		
35 - 45 years	59	35.5	53	16.0		
Marital status					2.61	0.106
Married	63	38.0	102	30.7		
Single	103	62.0	230	69.3		
Education					27.22	<0.001
None	20	12.0	7	2.1		
Primary	33	19.9	49	14.8		
Secondary	65	39.2	181	54.5		
University	48	28.9	95	28.6		
Occupation					13.03	0.001
Housewife	85	51.2	140	42.2		
Formal employment	19	11.4	84	25.3		
Informal employment	62	37.3	108	32.5		
Religion					2.15	0.342
Christian	116	69.9	214	64.5		
Muslim	34	20.5	72	21.7		
Other	16	9.6	46	13.9		
Residence					10.40	0.015
Bepanda	26	15.7	34	10.2		
Ndogpassi	42	25.3	74	22.3		
Bonaberi	33	19.9	46	13.9		
Others	65	39.2	178	53.6		

Table A2. Past history and delivery.

Variables	Case		Control		X ²	p-value
	n	%	n	%		
Smoking					0.26	0.611
Yes	7	4.2	11	3.3		
No	159	95.8	321	96.7		
Alcohol					23.22	<0.001
Yes	106	63.9	136	41.0		
No	60	36.1	196	59.0		
Abortion					77.67	<0.001
Yes	70	42.2	29	8.7		
No	96	57.8	303	91.3		
Twins					0.03	0.869
Yes	6	3.6	13	3.9		
No	160	96.4	319	96.1		
Gravida					2.85	0.241
Primigravida	25	15.1	71	21.4		
Multigravida	110	66.3	203	61.1		
Grandmultigravida	31	18.7	58	15.5		
Mode of delivery					19.36	<0.001
Normal	88	53.0	196	59.0		
Caesarian	36	21.7	101	30.4		
Assisted	0	0.0	0	0.0		
Did not deliver	42	25.3	35	10.5		
Pregnancy stage					101.36	<0.001
Intrapartum	7	4.2	0	0.0		
Antepartum	39	23.5	0	0.0		
Puerperium	120	72.3	332	100.0		
Number of ANC visits					170.25	<0.001
None	19	11.4	8	2.4		
1 to 3	111	66.9	52	15.7		
Above 4	36	21.7	272	81.9		

Table A3. State at admission.

Variables	Case		Control		X ²	p-value
	n	%	n	%		
Already death					106.24	<0.001
Yes	48	28.9	0	0.0		
No	118	71.1	332	100.0		
Eclampsia					12.58	<0.001
Yes	15	9.0	7	2.1		
No	151	91.0	325	97.9		
Dystocia					0.12	0.727
Yes	5	3.0	12	3.6		
No	161	97.0	320	96.4		
Haemorrhage					166.35	<0.001
Yes	118	71.1	45	13.6		
No	48	28.9	287	86.4		
Preeclampsia					24.70	<0.001
mild	0	0.0	27	8.1		
severe	21	12.7	14	4.2		
no	145	87.3	291	87.7		
Anemia					306.70	<0.001
Yes	130	78.3	11	3.3		
No	36	21.7	321	96.7		
Pulse					75.00	<0.001
<110 bpm	118	71.1	323	97.3		
≥110 bpm	48	28.9	9	2.7		
Referral					17.18	<0.001
No	4	2.4	48	14.5		
Yes	162	97.6	284	85.5		