

**DETERMINANTS OF MATERNAL MORTALITY DURING CHILD BIRTH
AMONG MOTHERS DELIVERING AT YOPOUGON TEACHING HOSPITAL**

By

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of Science in Medical Statistics.*

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DECLARATION

STUDENT

I declare that this thesis is my original work and has not been presented for a degree or any award in any other University.

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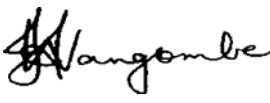
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DEDICATION

I dedicate this work to Almighty GOD, my grandmother, my mother, my father, my wife and children, my brothers and sisters.

TABLE OF CONTENTS

DECLARATION.....	ii
ACKNOWLEDGEMENT	iii
DEDICATION.....	iv
LIST OF FIGURES	vii
LIST OF TABLES	viii
ABBREVIATIONS	ix
ABSTRACT.....	x
CHAPTER ONE.....	1
INTRODUCTION.....	1
1.1 Background of the study	1
1.3 Problem statement.....	1
1.4 Justification	2
1.5 Overall objective	2
1.6 Specific objectives.....	2
CHAPTER TWO.....	3
LITERATURE REVIEW.....	3
2.1 Epidemiology of Maternal Mortality	3
2.2 Causes of Maternal Mortality.....	3
2.3 Prevention of Maternal Deaths.....	4
2.4 Risk Factors for Maternal Mortality	5
2.5 Strategies to Reduce Maternal Mortality	6
2.6 Maternal mortality indicators	7
2.7 Maternal mortality in Ivory Coast.....	9

CHAPTER THREE.....	10
METHODOLOGY.....	10
3.1 Study design.....	10
3.2 Study area.....	10
3.3 Study population	10
3.3.1 Inclusion criteria	10
3.4 Determination of Sample size	11
3.5 Sampling method.....	11
3.6 Data collection and analysis	12
3.7 Ethical Considerations.....	12
CHAPTER FOUR.....	13
RESULTS.....	13
4.1 Characteristics of the mothers	13
4.2 Determinants of maternal deaths during delivery	15
DISCUSSION	18
CONCLUSION	20

LIST OF FIGURES

Figure 1: Distribution of mothers' age by survival status	13
Figure 2: Distribution of Gravida by survival status of the mother	14
Figure 3: Distribution of ANC attendance by survival status of the mother	14

LIST OF TABLES

Table 1: Summary of the mothers' education and delivery history 15

Table 2: Determinants of maternal death during child delivery 16

ABBREVIATIONS

ANC	antennal care
ARR	Annual Rate of Reduction
JPMS	Journal of pioneering Medical Sciences
WHO	World Health Organization
UN	United Nations
MDG	Millennium Development Goals
MM	Maternal Mortality
MMR	Maternal Mortality Rate
SDMR	Surveillance of Maternal Deaths and Retaliation
RCI	Republic of Côte d'Ivoire
WHO	World Health Organization

ABSTRACT

Background of the study: In Côte d'Ivoire, mother and child health is a major concern as maternal mortality persists at a high level.

Objective: The main objective of the study was to establish factors contributing to maternal mortality during child birth among mothers delivered at Yopougon teaching hospital between January 2015 and July 2017.

Methodology: This was a case control study conducted using secondary data from 216 mothers who delivered at Yopougon teaching hospital between January 2015 and July 2017. The cases included mothers who died during child birth and the controls include mothers who went through a successful delivery process. Patient information (education level, age, gravida status, ANC attendance, time of delivery and delivery complications presented during birth) was collected from the hospital records. Univariate analysis was done to describe the data; appropriate descriptive statistics depending on type of data and distribution were reported. Numerous binary logistic regression models were fitted to determine factors extensively linked to the risk of a mother dying during child birth.

Results: The education level of the mother (OR=0.05, $p<0.001$), time of delivery (daytime/night shift) (OR=0.12, $p<0.001$) and number of ANC visits attended (OR=0.05, $p<0.001$) were found to have a significant effect on the odd of a mother dying during child birth. Among the complications of child delivery reported, hemorrhage (OR=3.25, $p<0.05$) was significantly associated with maternal mortality. A mother presenting with hemorrhage was 3.2 times more probable to die during child birth than a mother with Eclampsia. Delivery time also played a role in maternal mortality risk: a mother who delivered during the day was 88% less likely to die than who delivered during the day. Though not statistically significant, a mother who has been pregnant before (multigravida) less likely to die during child birth.

compared to one who is carrying her first pregnancy; also not statistical significant, mother older than 24 years was 13% more likely to die during child birth compared to a mother aged 24 years or younger.

Conclusion: The study findings demonstrated and emphasized the need to improve the literacy levels of women in Ivory Coast especially of matters of reproductive health and reinforce ANC attendance among expectant women. This will improve awareness level of mothers on their health enabling them to know when and where to seek medical attention in case of complications that would put the mother at risk. The staff roster need also to be adjusted to allow better performance mainly for night duty staff. Sensitization of potential risky mother (primigravida, older than 24 years) to deliver in a referral facility as first contact point.

CHAPTER ONE

INTRODUCTION

1.1 Background of the study

According to W.H.O, maternal mortality (MM) is the death that occurs in women when they are pregnant, it may occur within 42 days of extinction of pregnancy (WHO, 2013). Direct maternal deaths may include death due to obstetric causes (Khan *et al*, 2006) while indirect maternal deaths come as a result of previous existing diseases that developed during pregnancy. Subsidiary causes of maternal death may include suicide. The decline of maternal mortality is a global health priority and a target in the UN Millennium Development Goals (MDG) outline and a key concern of the Global Strategy for Women's and Children's Health launched by the UN Secretary-General in September, 2010 (UN, 2010; UNMDG, 2013).

In Africa, Côte d'Ivoire has made relatively slow progress in improving maternal mortality from 74.5/1000 in 1990 to 64.5/1000 deaths in 2015, this represents a decrease of 13.4% in 25 years with an annual rate of 0.6% versus 44% globally (WHO, 2015).

Several factors are involved in maternal mortality: socio-cultural factors such as education, marital status, ethnicity, race and religion; biological factors such as age, parity and birth spacing; economic factors such as wealth index, income, and women's and husbands' occupations and access to health care.

1.3 Problem statement

Maternal mortality (MM) is a major millennium goal which is not fulfilled by most of sub-Saharan Africa countries. MM is defined as a gold indicator in the 2015 WHO core 100 health indicators. The multisector nature of the determinants of MM means that the studies carried out in other places are not necessarily generalizable in RCI

1.4 Justification

Studies have been done to evaluate factors influencing the maternal mortality in Ivory Coast, particularly in Abidjan. From the results of these studies, health programs have been implemented to reduce the mortality rate. Until now the rate of mortality remains high. This situation leads to suppose a gap in the result of previous studies.

This study sought to address this gap by using a multiple logistic regression analysis of the accrued data. The findings of this study will aid in health program implementation and will also be used to initiate further research.

1.5 Overall objective

To determine factors contributing to maternal mortality during child birth among mothers delivered in referral hospitals in Abidjan (Ivory Coast)

1.6 Specific objectives

1. To describe the socio-demographics and clinical characteristics of mothers attending each referral hospital.
2. To assess association between mother's characteristics and maternal mortality during child birth

CHAPTER TWO

LITERATURE REVIEW

2.1 Epidemiology of Maternal Mortality

According to W.H.O, the rate of maternal mortality is unacceptably very high with close to 800 women die from pregnancy around the world every day (WHO, 2014). According to a UNICEF report, over the past 25 years, the rate of maternal mortality rate (MMR) has decreased by almost 44% to an estimated 216 live births in 2015, from an MMR of 385 in 1990 (UNICEF, 2015). The yearly number of maternal deaths reduced by 43% from 532 000 (UI 496 000 to 590 000) in 1990 to an estimated 303 000 (UI 291 000 to 349 000) in 2015. Third world countries accounted for 99% of the World maternal deaths in 2015, with many African Countries accounting for close to 66% followed by Southern Asia with approximately 66 000 (WHO, 2015).Nigeria in Africa and India in Asia were estimated to account for over 1/3 of all maternal deaths globally in 2015. In this year, over 58 000 maternal deaths that represents (19%) were recorded in Nigeria while 45 000 maternal deaths that represents approximately (15%) were recorded in India.

2.2 Causes of Maternal Mortality

It is reported that close to (99%) maternal deaths occur in third world countries with more than half of these deaths reported in sub-Saharan Africa and 1/3 in South Asia.

In spite of the amplified world focus on maternal mortality as a public health issue, little detailed knowledge is available on the levels of maternal mortality and morbidity and the causes of their incidence. The threat of maternal death comes as the risk of getting pregnant (Fillipiet *al*, 2016). It is reported that the risk of maternal mortality is the highest for adolescent girls under the age of 15 years (Conde- Agudeloet *al*, 2004; Patton *et al*, 2009).

Hypertension, abortion, sepsis, and obstetric hemorrhage are some commonly causes of maternal death. Studies indicate that deaths due to abortive outcomes and obstructed labor are tricky to capture because of unfortunate coverage consequential from inadequate skills and the sensitive temperament of abortion. In a study done by Say *et al* (2014) on the world causes of maternal death due to direct obstetric causes whereas that accounts for 27.5% (95% UI 19.7–37.5) of all deaths from known causes. Hemorrhage was reported the highest direct cause of maternal death globally and it represents 27.1% of maternal deaths. More than 2/3 of reported hemorrhage deaths were classified as postpartum hemorrhages. On the other hand, hypertension was reported as the second common direct cause globally at 14.0% while maternal mortality as a result of sepsis was at 10.7%, abortion recorded 7.9%, while embolism and other direct causes accounted for the remaining 12.8% deaths. Complications of delivery were seen to be more responsible for 2.8% (1.6–4.9) and obstructed labor for 2.8% (1.4–5.5) of all maternal deaths worldwide, both reported within the other direct category, which accounted for 9.6% of all maternal deaths worldwide.

2.3 Prevention of Maternal Deaths

According to W.H.O, reported maternal deaths can be easily avoided if women get access right to antenatal care in pregnancy, skilled care during childbirth and support in the weeks after childbirth. It is therefore necessary for all births to be attended by skillful health professionals and well-timed management could make a variation between life and death (Piane, 2009).

Bleeding after birth for a woman can result into death within very few hours if not attended by a professional. It is however advised that she be given oxytocin injection immediately after childbirth in order to reduce bleeding risks. There is need to eliminate infection after childbirth by the way of practicing good hygiene and if early signs of infection are recognized they should be treated as quickly as possible. Pre-eclampsia must also be detected

and managed before the onset of convulsions (eclampsia) by administering drugs such as magnesium sulfate for pre-eclampsia in order to lower a woman's danger of developing eclampsia (Uzanet *al*, 2011).

In order to contain maternal deaths, it is also important to prevent unwanted and too-early pregnancies in young girls. The adolescents must get access to family planning, safe abortion and quality post-abortion care.

2.4 Risk Factors for Maternal Mortality

The biggest number of maternal deaths in some parts of the world reflects inequities in access to health services; it also shows the gap between rich and poor. Close to all maternal deaths (99%) occur in third world countries with more than half of these deaths reported in sub-Saharan Africa and South Asia (WHO, 2014). Reports indicate that women at the farthest end of the reproductive age range have a higher risk of death because this is when most births occurs (Patton *et al*, 2009).

Higher risk of complication and death are linked to first pregnancy and more than 3 to 5 pregnancies (Gibbs *et al*, 2012). From research findings, it shows that pregnant single women lack support in many cases from their families and many of them try to induce an abortion while educated ones know where to get effective abortion services (Evjen-Olsen *et al*, 2008). In most cases, obese or anemic women are more likely to die in childbirth compared to normal ones (Leddy *et al*, 2008) due to increased risk owing to comorbid conditions. Women with severe anemia are unlikely to tolerate hemorrhage to the same degree as those with higher hemoglobin levels.

Enormously high levels of maternal mortality have been recorded in places with damaged infrastructure and communication systems. A good example is in Afghanistan and Somalia

(O'Hare *et al*, 2007). In some of these countries, governments spend more on defense compared to health and education.

The quality, distribution of staff members are pertinent risk factors for mortality since it is hard to predict the number of women with complications who are more likely to die (Mawartiet *al*, 2017). In many cases trained birth attendances are a significant risk factor in maternal mortality models. It is believed that those who live far away from facilities are likely to delay seeking medical attention; they are therefore likely to experience multiple referrals.

It has been established that an increasing number of women deliver with experienced medical care providers thus the quality of care becoming increasingly necessary. Accountability of the health sector is gradually becoming a new focus of intervention in improving the quality of care provided. On the other hand, accessibility of blood has become a key determinant of the quality of care received by sick women (McCaw-Binns & Munjanja, 2013).

2.5 Strategies to Reduce Maternal Mortality

The decrease of maternal deaths has become a priority for the international community with increased attention on the Millennium Development Goals (Khan *et al*, 2006). By 2013, there was a recorded 45% decline from 380 deaths/100 000 live births in 1990 to 210 deaths/100 000 live births this showed an important milestone, however this triumph was still diminishing far short of the global goal (WHO, 2015). In realizing the MDG target, it was necessary for every country to keep an average annual rate of reduction (ARR) in MMR of 5.5%. Instead, the standard ARR among countries between 1990 and 2013 was standing at 2.6%. However, countries indicated that with assurance and effort, they could accelerate the pace of progress that led to the ARR increasing to 4.1%. Moreover, a total number of 19 countries continued to record an average ARR of over 5.5% for every year from 1990 to 2013

while according to W.H.O records, the highest standard ARR ranged from 8.1% to 13.2% (WHO, 2014).

Since its formation, MDG 5b calls for a universal contact to reproductive health for all women by 2015, in the year 2014, although gains were recorded in each group, lack of uneven growth was measured by each of these indicators (UN 2014). A lot of work is required in ensuring that all women are getting essential preventive and most important reproductive health care services. It's agreeable that by the year 2030 countries must try to reduce MMR by at least 2/3 of their 2010 baseline level.

2.6 Maternal mortality indicators

The maternal mortality ratio (MMRatio) is the most commonly used indicator to determine the number of maternal deaths per live birth to be multiplied by a conventional factor of 100 000:

$$\text{MMRatio} = \frac{\text{Number of maternal deaths}}{\text{Number of live births}} \times 100\,000$$

Maternal mortality rate (MMRate) is an indicator of the risk of maternal death among women of child bearing age. It can also be cause-specific death rate and is normally multiplied by a factor of 1000:

$$\text{MMRate} = \frac{\text{Number of maternal deaths}}{\text{Number of women aged 15 - 49 years}} \times 1000$$

The MMRate on the other hand gives signal of the threat of maternal death in women by concealing the impact of conflicting levels of fertility in cross-country comparisons.

MMRate and the MMRatio relates in the following ways:

$$\text{MMRatio} = \frac{\text{MMRate}}{\text{General fertility rate}}$$

In this case, the universal fertility rate (GFR) is the ratio of live births to women aged 15–49 years.

PMDF expresses the salience of maternal deaths comparative to other causes of death among women of reproductive age by providing the proportion of maternal deaths among all deaths of females of reproductive age (PMDF):

$$\text{PMDF} = \frac{\text{Number of maternal deaths}}{\text{Number of deaths among women aged 15–49 years}}$$

The last indicator is mainly used for advocacy reasons. It is considered as the generation risk of maternal death (LTR). It reflects the probability of a woman dying from maternal causes over the course of her 35-year reproductive lifespan. It takes into account the probability of a death as a result of maternal causes each time a woman conceives. There are two common ways of deriving an estimate of the LTR, they include the following:

$$\text{LTR} = 35 \times \text{MMRate}$$

or

$$\text{LTR} = 1 - \left(1 - \frac{\text{MMR}}{100\,000} \right)^{\text{TFR}}$$

In this case;

TFR represents the total fertility rate – the probable lifetime births per woman given current age-specific fertility rates. On the other hand, Wilmoth (2009) gives an alternative approach below:

$$\text{LTR} = \frac{(T_{15} - T_{50})}{l_{15}} \times \text{MMRate}$$

T15 and T50 represents life table person. These are the number of years lived above the ages of 15 and 50 years and *l*15 is survivors to age 15 years.

2.7 Maternal mortality in Ivory Coast

The country has made little progress in combating maternal mortality, from 745 in 1990 to 645 deaths per 100,000 live births in 2015, an increase of 13.4% in 25 years with an annual rate of 0.6% against 44% worldwide. The 2015 Maternal Mortality Report (MMR) estimated Côte d'Ivoire's maternal mortality rate to stand at 645 deaths per 100,000 live births, this is in comparison to 546 for Sub-Saharan Africa. In 2012, this rate was estimated at 614 deaths per 100,000 live births in 2012.

Various studies have shown that certain diseases during pregnancy are risk factors for the survival of the mother and the newborn. This is anemia in pregnant women whose rate is estimated at 54%, HIV in pregnant women who experienced a sharp decline from 4.3% in 2005 to 2.7% in 2012 and the Malaria in pregnant women whose prevalence was estimated at 7% in 2012. The data show a rate of CPN4 which is 38.4% in 2015 against 34.76% in 2014

Actions to improve maternal health have been carried out by the country. These include; An order requiring the notification of cases of maternal deaths and the institutionalization of journals and the creation of the National Committee for the Surveillance of Maternal Deaths and Retaliation (SDMR) was signed in August 2015, strengthening the functioning of maternal health services through rehabilitation, maternity and operating room equipment and the integration of reproductive health services, and strengthening the skills of providers of emergency obstetric and neonatal care (SONU) and the holistic management of gender-based violence, including female genital mutilation, obstetric fistula, and the extension of family planning service.

CHAPTER THREE

METHODOLOGY

3.1 Study design

The study was a case controlled carried out to establish factors contributing to maternal mortality in a referral hospital from January 2015 to July 2016. The main outcome of interest was to determine the risk factors of death for mothers delivering in this referral hospital. The case group included 15-49 year old mothers who died in this referral hospital because of her pregnancy or delivery. The control group included 15-49 year old mother who has deliver in this referral hospital and did not died in her perinatal period of obstetrical complication.

3.2 Study area

The study was conducted in a referral hospital in Abidjan in October 2017: “centrehospitalier de yopougon “. Abidjan is the economical capital of Ivory Coast.

3.3 Study population

The study population comprised of 2 sub-populations of 15-49 year old mothers who had delivered in this referral hospital between 1st January 2015 and 31st July 2017:

- The case group included 15-49 year old mother who died in this referral hospital because of her pregnancy or delivery.
- The control group included 15-49 year old mother who has deliver in this referral hospital and did not died in her perinatal period of obstetrical complication.

3.3.1 Inclusion criteria

Case group

- Should be a 15-49 year old mother who died in this referral hospital because of her pregnancy or delivery.

Control group

- Should be a 15-49 year old mother who has delivered in this referral hospital and did not die in her perinatal period of obstetrical complication.

3.4 Determination of Sample size

The Sample size for the study was reached at using the formula (Kelsey et al. 1986) for case control studies.

$$n \geq \frac{\bar{P}(1 - \bar{P}) \left(1 + \frac{1}{c}\right) (Z_{\alpha} + Z_{\beta})^2}{(P_1 - P_0)^2}$$

N is estimated minimum sample size for cases

$$\bar{P} = \{(P_1 + P_0) / (1 + C)\}$$

C is the ratio of controls to cases = 1:1

Z_{α} is the critical value at α -level of significance (Type I error (α) = 0.05; $Z_{\alpha/2}$ = 1.96)

Z_{β} is the critical value for the desired power (Type II error (β) = 0.2; Z_{β} = 0.84)

P_1 is the proportion of exposure among cases ($P_1 = (P_0 * OR) / [1 + P_0(OR-1)]$)

OR is the expected odds ratio (how many times exposure is expected to increase the risk of having maternal death during child birth) = 1.4

P_0 = Proportion of exposed (primigravida) among controls = 0.34

Using the above formula, the total sample size required was 216 patients (108 cases and 108 controls)

3.5 Sampling method

Stratified sampling was used to select participants. Mothers were stratified by exposure status (the primigravida and multigravida). Simple random sampling was used to select the cases with proportional size allocation until the required sample size of cases was achieved.

The controls were selected randomly from the list of mothers who successfully delivered within the same period.

3.6 Data collection and analysis

Secondary data was retrieved from the referral hospitals database using records from January 2015 to July 2017 and stored in Excel 2013. Data was cleaned, coded and analyzed using STATA version 13 SE.

Data cleaning was done by checking for presence of extreme value and missing value.

For extreme value, data from file was confirmed with data on paper. For missing values, proportion of missing values was calculated and missing values were classified in terms of missing at random or not.

Descriptive analysis was done to assess the variables. For quantitative data, histograms were used to show the distribution of data; central tendency (mean, Median, mode) and dispersion (standard deviation, inter-quartile range) were reported in tables. For categorical data, bar/pie charts were used to show the distribution; frequencies and proportions were reported in tables.

Multiple binary logistic regression was used to estimate the effect of mothers' characteristics on the risk of a mother to die during child birth. Odds ratios and corresponding confidence intervals were reported.

3.7 Ethical Considerations

The research proposal was submitted to Ivory Coast ministry of health and ethical committee for clearance and approval. Further approval was sought from the Hospitals' management to be granted access to the patient information. All patient information was treated with utmost confidentiality.

CHAPTER FOUR

RESULTS

4.1 Characteristics of the mothers

A total of 216 mothers were recruited for this study. Half of the mothers died (cases) while delivering while the rest had a successful delivery and survived the process (controls). The graph below shows the distribution of age by mothers' survival status

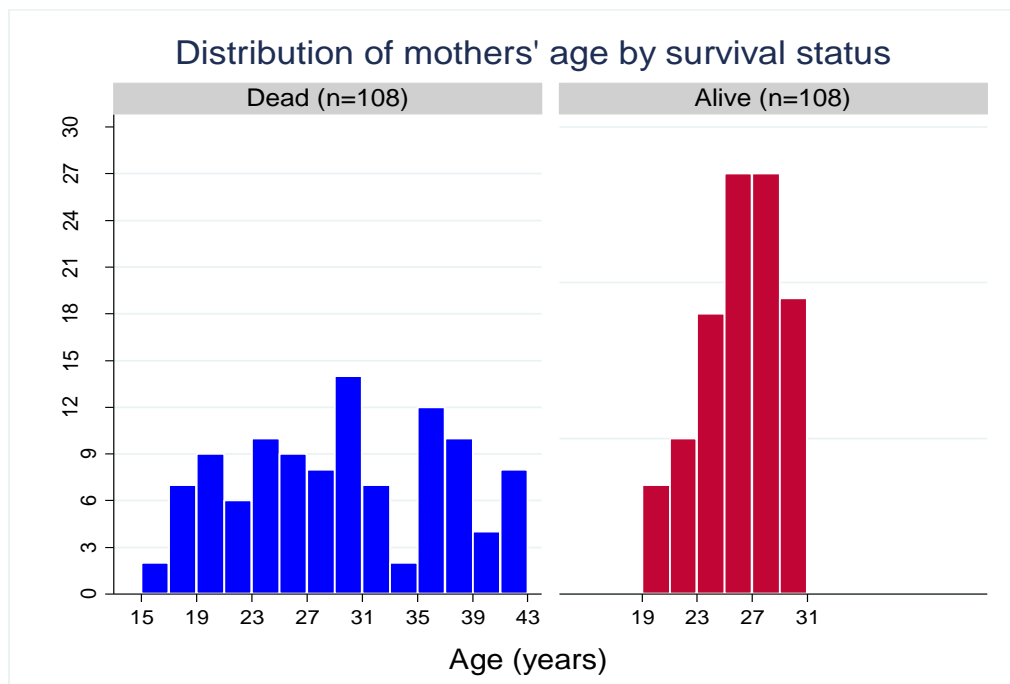


Figure 1: Distribution of mothers' age by survival status

The deceased ages' ranged from 16 years to 42 years; the distribution showed two sub populations, those aged between 16 and 33 years and those aged between 34 and 43 years. Among the mothers who were alive their age ranged from 19 to 30 years with a single mode at 27 years.

In terms of gravid, the distribution among the cases and the controls was the same. At least half of the mothers whether deceased or alive had carried at least one pregnancy.

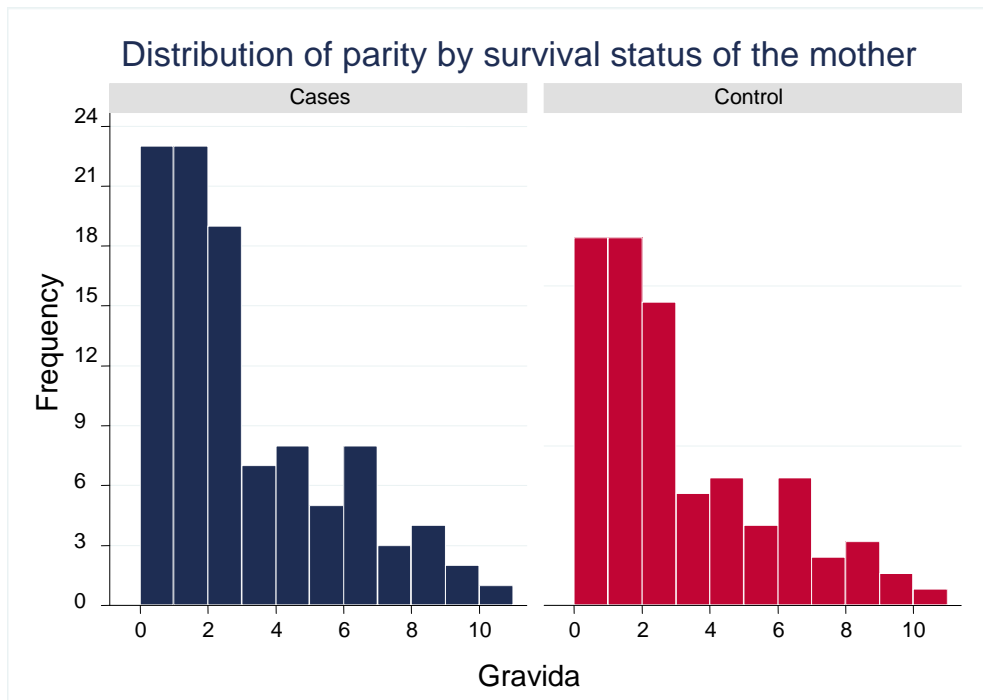


Figure 2: Distribution of Gravida by survival status of the mother

Antenatal Clinic attendance of the mothers differed between the deceased and the surviving mothers. Among the deceased, three quarters of the mothers had attended less than 4 ANC visits whereas among the surviving mothers all of them attended 4 ANC visits or more.

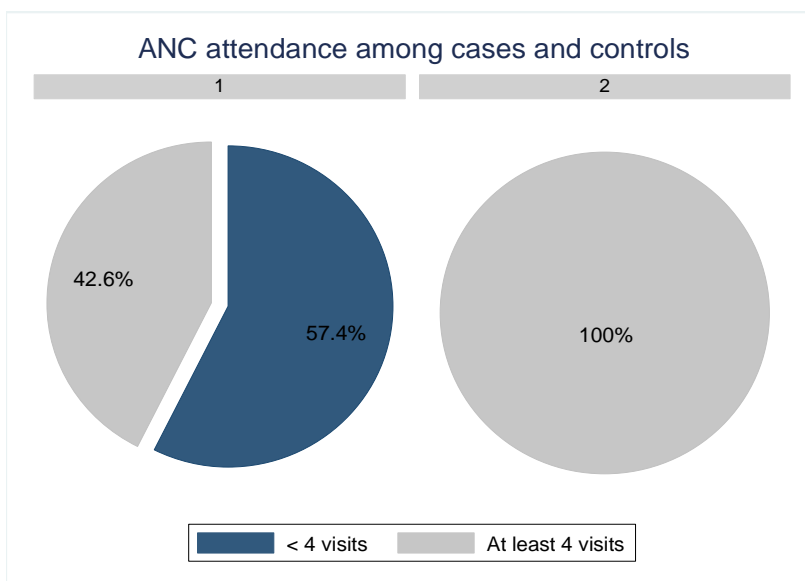


Figure 3: Distribution of ANC attendance by survival status of the mother

Table 1: Summary of the mothers' education and delivery history

Variable	Category	Cases n (%)	Control n (%)
Education level of mother	Primary level & below	18 (16.7)	29 (26.9)
	Secondary level & above	90 (83.3)	79 (73.1)
Time of delivery	Daytime	29 (26.9)	75 (69.4)
	Night	79 (73.1)	33 (30.6)
Delivery complication	Eclampsia	34 (31.5)	50 (46.3)
	Haemorrhage	67 (62.0)	14 (13.0)
	Infection	7 (6.5)	5 (4.6)
	None	-	39 (36.1)

Majority of the mothers had attained at least secondary level education and above; 83.3% among the deceased and 73.1% among the surviving mothers. Majority (73.1%) of the deceased mothers had undergone delivery process at night whereas more than half (69.4%) of the surviving mothers delivered during daytime. Among the deceased mothers, haemorrhage (62.0%) was the most frequent delivery complication followed by Eclampsia (31.5%) whereas among the mothers who survived the delivery process Eclampsia (46.3%) was the leading followed by haemorrhage (13.0%).

4.2 Determinants of maternal deaths during delivery

A multiple binary logistic regression model was fit to evaluate the effect of the mothers' characteristics (age and education level), gravida, ANC attendance, delivery time and complications on the probability of a mother to die while giving birth. All except, gravida and age of the mother were significantly associated with the probability of a mother to die during child birth. Table 2 shows the multiple binary logistic regression model output.

The model was significant; Log likelihood=-47.32; P-value <0.001

Table 2: Determinants of maternal death during child delivery

Variable	Category	OR	95% CI [OR]	P-value
Education level of mother	Primary level & below (ref)			
	Secondary level & above	0.05	[0.02; 0.21]	<0.001*
Time of delivery	Night (ref)			
	Daytime	0.12	[0.04; 0.35]	<0.001*
Delivery complications	Eclampsia (ref)			
	Haemorrhage	3.25	[1.10; 6.14]	0.033*
No of ANC attended	>4 (ref)			
	≤4	0.05	[0.01; 0.17]	<0.001*
Gravida	Primigravida (ref)			
	Multigravida	0.54	[0.15; 1.91]	0.340
Age of the mother	≤24 years (ref)			
	>24 years	1.13	[0.40; 2.31]	0.818

A mother with secondary level education was 95% (OR=0.05, p<0.001) less likely to die during child birth compared to a mother with low/no education, after adjusting for the effect of the other covariates in the model. With regards to time of delivery, a mother who delivered during the day was 88% (OR=0.12) less likely to die than who delivered during the day after adjusting for the effect of other covariates.

Mothers presenting with haemorrhage were found to be 3.2 times more likely to die during child birth compared to those experiencing Eclampsia adjusting for the effect of the other covariates in the model. Mothers who attended less than 4 ANC sessions were 95% less likely to die compared to the mother who attended more than 4 ANC sessions after controlling for the effect of the other covariates in the model.

Though not statistically significant, a mother who has been pregnant before (multigravida) was 46% (OR=0.54, P=0.340) less likely to die during child birth compared to one who is carrying her first pregnancy. Based on the regression, a mother older than 24 years was 13%

more likely to die during child birth compared to a mother aged 24 years or younger after adjusting for the effect of the other covariates in the model. Age of the mother was however not a statistically significant predictor for maternal mortality.

CHAPTER FIVE

DISCUSSION

Maternal mortality includes death of an expectant woman during pregnancy, child delivery, or within 42 days of pregnancy termination. These deaths occur due various pregnancy or child birth related complications with some women being more at risk to die than others. The goal of this study was to determine risk factors for maternal mortality during child birth among mothers delivered at Yopougon teaching hospital. Using the multiple binary logistic regression the mother's education level, time of delivery, type of delivery complication presented and number of ANC visits attended had a significant effect on the risk of a mother to die during child birth.

Poor education status of a mother has previously been reported to be a risk factor to maternal mortality in a study conducted in Pakistan (JPMS blogs, 2013) and Kenya (Yego et al, 2014). Just like the findings from the two studies, mothers who had died during child birth in this study had higher odds of having low or no education compared to the mothers who survived the delivery process. Mothers' education level was used as a proxy to the mother's level of awareness of reproductive health and their rights to quality maternal care as well as access to health services. This finding further affirms the importance of adequate understanding of good health and informs on how to make timely and appropriate decisions in matters pregnancy for the safety of mother and child.

Antenatal care is important for monitoring the progress of the pregnancy, the health of the mother and child in order to detect and address any pregnancy related problems that may arise at early stages (Oladapo et al, 2007). Mothers who attended more than 4 ANC had significantly reduced odd of dying during child birth compared to mothers who attended less than 4 ANC. This finding is in agreement with the studies by Yego et al, (2014), Kisuule et

al, (2013) and Ngoc et al, (2006) that reported a significant association between number of ANC visits and maternal mortality, with mothers who fail to attend ANC having higher odd to die compared to those who attended. Despite the initiation of the free maternal and child care in Ivory Coast since 2010, there is still need to improve current infrastructure, which has been one of the impediments for women's access to quality services that are needed in pregnancy and parturition in turn reducing maternal mortality. This could perhaps be a major contributing factor to the persistently high maternal mortality rate in Ivory Coast. Scale up on uptake of ANC by expectant women in Ivory Coast should be a priority, considering the high cases of pregnancy complications that were reported which if detected early can be resolved to save the mother's life.

The study found that mothers who deliver during the daytime shift had reduced odds of dying during child birth compared to mothers who delivered at night shifts. Since the 2002 civil war in Ivory Coast births attended by skilled personnel dropped gradually due to chronic shortages in staff to provide the much needed health care (WHO, 2011). While the country is working on policies to address this gap, there's a high likelihood that during the night shifts there is a lack of medical specialists to attend to delivery complications such as obstructed labour, haemorrhage that are known causes of maternal mortality if not addressed early. With shortage of staff, workers also end up working for long hours which leads to fatigue. Fatigue has been suggested to play a role increasing risk of adverse delivery outcomes later in shift (Aiken et al, 2016). This could perhaps explain the high frequency of maternal mortality experienced during the night shift in this study.

Several authors have identified haemorrhage as one of the leading causes of maternal mortality among other complications such as Eclampsia, sepsis, obstructed labour, hypertensive problems as well as ruptured uterus. In this study haemorrhage was the leading complication among the deceased mothers and Eclampsia among the mothers who survived.

Deceased mothers had significantly higher odds of having experienced haemorrhage compared to mothers who survived the delivery. This finding is agreement with the finding of a study conducted in Kenya by Yego et al, (2014), in which haemorrhage was found significantly increase the risk of maternal mortality. The timeliness of diagnosis of conditions that lead to haemorrhage and appropriate medical intervention are key in reducing maternal mortality due to haemorrhage.

CONCLUSION

This study identified education level of the mother, time (shift) of delivery, type of delivery complications and number of antenatal care visits attended during pregnancy as risk factors for maternal mortality during child birth in Yopougon teaching hospital. Improving literacy levels of women can help reduce maternal mortality due to pregnancy related complications since if women understand their reproductive health they are better placed to know when and where to seek medical attention in case of any complications arising during pregnancy. This can be achieved through offering reproductive health sessions to women as part of the free maternal and newborn care initiative to improve the women's knowledge and empower them to take an active role in their own health especially during pregnancy. Antenatal clinic attendance should be reinforced as a strategy to detect conditions indicating occurrence of complications like Eclampsia and haemorrhage that are known to put the mother at risk of death during child birth. While the issue of shortage of medical staff may take a while to be resolved, available staff should come up with a work schedule that allows them to take time off and rest in between shifts to reduce the work related fatigue and ensure mothers delivering during night shift receive quality care as those delivering during the daytime shifts.

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APPENDIX I: ETHICAL APPROVAL

MINISTÈRE DE LA SANTÉ
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REPUBLIQUE DE CÔTE D'IVOIRE
Union - Discipline - Travail

Abidjan, le 27 Novembre 2017

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COURRIER

Je soussigné Professeur ADJOUSSOU Stéphane, autorise Mr MIAN N'DA N'GUESSAN ANASTASE à utiliser les données du service de Gynécologie-Obstétrique du CHU de Yopougon dans le cadre de son étude sur la mortalité maternelle.

En foi de quoi, nous lui délivrons ce certificat pour servir et valoir ce que de droit.

Pr ADJOUSSOU S

Pr ADJOUSSOU Stéphane
Maître de Conférence agrégé
Gynécologie - Obstétrique
CHU DE YOPOUGON

