SCHOOL OF PUBLIC HEALTH,

COLLEGE OF HEALTH SCIENCE,

UNIVERSITY OF GHANA, LEGON

SEVERE MATERNAL MORBIDITY AND ASSOCIATED FACTORS IN SUNTRESO AND KUMASI SOUTH GOVERNMENT HOSPITALS, ASHANTI REGION, GHANA

BY

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(10444949)

THIS THESIS IS SUBMITTED TO THE EPIDEMIOLOGY DEPARTMENT OF THE SCHOOL OF PUBLIC HEALTH, COLLEGE OF HEALTH SCIENCES, UNIVERSITY OF GHANA, LEGON IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE AWARD OF MASTER OF PHILOSOPHY IN APPLIED EPIDEMIOLOGY AND DISEASE CONTROL

JUNE, 2015

DECLARATION

I, Nana Yaw Peprah, declare that this thesis is the result of my own original research undertaken under supervision and that it has neither in whole nor in part been presented for another degree in this university or elsewhere.

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ACKNOWLEDGEMENTS

I am grateful to my supervisor Professor Edwin Afari for his valuable contributions in putting together this project. I also express my sincere thanks to the Acting Programme Manager of the National Malaria Control Programme, Dr. Kezia Malm and Deputy Director of Ghana Field Epidemiology and Laboratory Training Program (GFELTP), Dr. Donne Ameme for their immense support and all faculty members of the School of Public Health, Legon for their constructive and relevant suggestions.

I also thank the Ashanti Regional Health directorate especially Dr. Oduro and Dr. Akosua Gyasi –Darkwa for their motivation and guidance throughout the research process. My sincere thanks also go to the management and staff of Suntreso and Kumasi South Hospitals especially Nana Konadu and Gifty Dufie for helping me with the data collection. Many thanks to my wife Eunice for showing keen interest in my work and also to the patients who agreed to be part of this study.

I specially thank God for the wisdom, strength and protection throughout the project.

ABSTRACT

Background: Ghana's maternal mortality ratio is one of the highest in the world. To achieve significant reduction in maternal mortality there is a need to go beyond analyzing mortality and explore the risk factors of maternal morbidity. Studying severe maternal morbidity enables faster quantitative analysis and makes it possible to obtain in-depth information on the affected woman herself. The research was conducted therefore to determine factors contributing to severe maternal morbidity in Suntreso and Kumasi South Government hospitals in the Ashanti region of Ghana

Methods: A case control study was conducted at the Suntreso and Kumasi South Government Hospitals of Ghana between January 2015 and June 2015. Near miss indicators were assessed through the WHO near miss classification system after following up all obstetrics and gynecology in-patient admitted within the study period. Univariate analyses of categorical variables were expressed as frequencies and proportions. Bivariate analysis was used to show associations between independent variables and severe maternal morbidity. Factors independently associated with severe maternal morbidity were determined by logistic regression.

Results: Among 2,238 pregnant women, 15 maternal near miss (MNM), 7 maternal deaths (MD) and 71 potentially life-threatening conditions (PTLC) were identified. Seventy four obstetric cases were referred to KATH for further management. The maternal near miss ratio was 6.9 cases/1,000 LB and PLTC ratio 32.6 cases / 1,000 LB.

The maternal mortality ratio was 229.6 cases/ 100,000 LB with a mortality index of 31.8%.

The most diagnosed potentially life threatening condition was postpartum hemorrhage (57.7%). Risk factors of severe maternal morbidity identified were preterm delivery (<37 weeks) [aOR 7.8 95%CI (3.0 – 20.2)], caesarean section in current pregnancy [aOR 9.7 95% CI (3.1-30.2)], and anemia during the current pregnancy [aOR 8.1 95% CI (2.9 - 22.2)].

Conclusion: Maternal near miss and potential life-threatening ratios were low. Factors associated with potentially life-threatening conditions were preterm delivery, caesarean section in current delivery and anemia in current pregnancy. The use of herbal preparation though not found to be associated with SMM was used by almost half of the study participants.

Key words: Potentially life-threatening, maternal near miss, Ashanti Region, Ghana.

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ICU	Intensive Care Unit
IPTp	Intermittent Preventive Treatment for Pregnancy women
KATH	Komfo-Anokye Teaching Hospital
LB	Live Birth
LLINs	Long-lasting Insecticidal Nets
MD	Maternal Death
MMR	Maternal Mortality Ratio
MNM	Maternal Near-Miss
MDG5	United Nations Millennium Development Goal five
MMWG	Maternal Morbidity Working Group
MI	Mortality Index
PLTC	Potentially Life-Threatening Conditions
SMO	Severe Maternal Outcome
SMM	Severe Maternal Morbidity
SMOR	Severe Maternal Outcome Ratio
WHO	World Health Organization
WLTC	Women with Life-Threatening Conditions

CHAPTER ONE

1.0 INTRODUCTION

1.1 Background Information

Maternal morbidity is defined by the Maternal Morbidity Working Group (MMWG) of World Health Organization (WHO) as ill health in a woman who is pregnant (regardless of the site or duration of pregnancy) from any cause related to or aggravated by the pregnancy or its management, but not from accidental or incidental causes. Maternal morbidity can be conceptualized as a spectrum ranging, from mild to severe with the most severe form being life threatening condition (maternal near miss). Severe maternal morbidity(SMM) can be classified as life-threatening conditions (maternal near-miss) and potentially life-threatening conditions(PLTC) (Say, et al., 2009) . Maternal near-miss morbidity is defined as "a woman who nearly died but survived a complication that occurred during pregnancy, childbirth, or within 42 days of termination of pregnancy"(Mantel, et al, 2009). The working group also defined severe maternal complications also known as "potentially life-threatening conditions" as an extensive category of clinical conditions, including diseases that can threaten a woman's life during pregnancy and labour and after termination of pregnancy.

United Nations Millennium Development Goal five (MDG5) which is aimed at reducing maternal mortality by 75% by 2015 has been an area of extensive research in both developed and developing countries. Globally, approximately 800 women die every day from pregnancy related causes which could have been prevented (WHO, 2014).

Maternal mortality has been used as a standard measure of the success of obstetric interventions. However, there are few cases compared to severe maternal morbidity in

some countries which make it difficult to formulate guidelines on small numbers. Despite the fact that the maternal mortality ratio is considered one of the main indicators of a country's status in the area of maternal health, the burden of maternal mortality is only a small fraction of the burden of maternal morbidity – the health problems borne by women during pregnancy and the postpartum period (Lozano et al., 2011). World Health Organization (WHO) has recommended the need to step-up interventions to improve maternal health. In this endeavor, key stakeholders reviewed ways of improving obstetric care worldwide and have suggested the use of severe maternal morbidity as an additional measure. In view of this, new indicators such as severe maternal morbidity indicators have been developed to more effectively evaluate maternal health issues.

Globally, it has been estimated that up to 9 million women survive obstetric complications every year (WHO 2014; Lozano et al., 2011), and for every woman who dies of pregnancy-related causes, 20 to 30 others experience acute or chronic morbidity, often with permanent sequelae that undermine their normal functioning (Reichenheim, et al., 2009). These sequelae can affect women's physical, mental or sexual health, their ability to function in certain areas such as cognition, mobility, participation in society, their body image and their social and economic status (Reichenheim et al., 2009). The burden of maternal morbidity – like that of maternal mortality – is estimated to be highest in low- and middle-income countries including Ghana, especially among the poorest women (Storeng, et al., 2010).

In Ghana even though about 73% of births occur in health facilities and even higher in the Ashanti region(86%), (GSS, 2014) the estimated incidence of potentially life-threatening condition was 157 cases per 1000 live births and maternal near-miss was

28.6 cases per 1000 live births(Ö. Tunçalp, et al., 2014). Recent research in Ghana underlines the fact that morbidity is a continuum and indicates that if the underlying causes of poor maternal health outcomes are addressed, it is likely that changes will improve health outcomes across the continuum of morbidity(Ö. Tunçalp et al., 2014). The maternal morbidity evaluation is important in that it can provide insight into risk factors and potential strategies for the prevention of maternal morbidity as well as maternal mortality, as women who experience the severe maternal morbidity share many characteristics with women who have died (Pattinson & Hall, 2003) . The concept therefore has become increasingly important for public health specialist in the area of maternal health.

1.2 Problem statement

Globally, severe maternal morbidity affects about nine million pregnant women every year (WHO 2014 ; Lozano et al., 2011). The burden of maternal morbidity is estimated to be highest in low- and middle-income countries, especially among the poorest women (Storeng et al., 2010) . Cases of severe maternal morbidity(SMM) occur in larger numbers than maternal mortality (WHO 2014; Lozano et al., 2011; Say, et al, 2009a) . These severe maternal morbidity conditions which are preventable can undermine their normal functioning (Reichenheim, et al., 2009). These affect women's physical, mental, social and economic status (Reichenheim et al., 2009).

In a research conducted among 3,438 pregnant women in Accra, 516 had potentially life-threatening conditions and 131 had severe maternal outcomes. The incidence of maternal near-miss was 28.6 cases per 1000 live births(Ö. Tunçalp, et al., 2013).

Different factors have been observed to be associated with severe maternal morbidity. Higher age, previous abortion and caesarean delivery, non-adherence to antenatal care, current caesarean delivery, bad perinatal results and level of consciousness has been found to be significantly related to SMM elsewhere (Galvão et al., 2014). It is also known that if the underlying causes of poor maternal health outcomes are addressed, it is likely that changes will improve health outcomes across the continuum of morbidity(Ö. Tunçalp et al., 2014).

Even though WHO has recommended monitoring and analysis of maternal morbidity to improve maternal health (WHO, 2013) because SMM generate more information, than maternal mortality Studies on maternal morbidity are not extensive in Ghana especially in the Ashanti region where this study was done. Therefore to achieve significant reduction in maternal morbidity and its associated consequences there is the need to explore the risk factors of maternal morbidity to help improve maternal health.

1.2.1 Conceptual framework

Factors associated with severe maternal morbidity are grouped into socio-demographic and clinical factors. There are many factors associated with severe maternal morbidity of which some were measured in this study. The measured variables in this study have been design into the conceptual framework below (figure1). An understanding of these factors would be useful in the development of appropriate interventions that will lead to the reduction in severe maternal morbidity. These factors interact directly and indirectly to the development severe maternal morbidity.

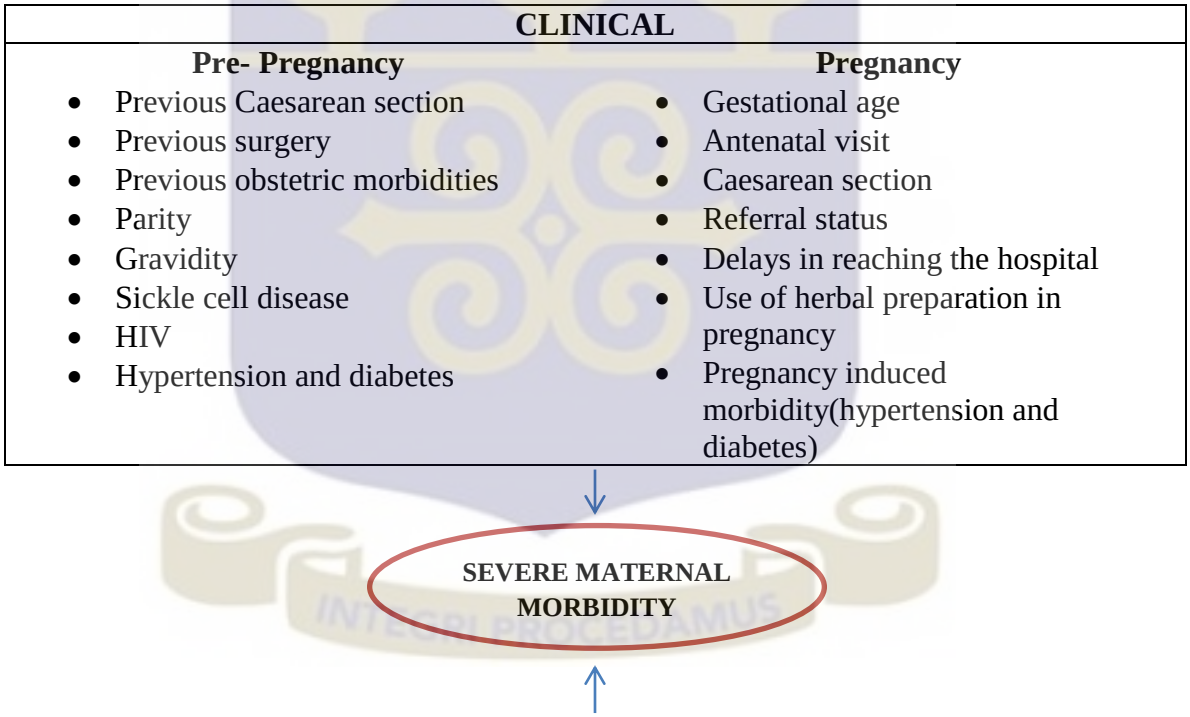

Figure 1 : Conceptual framework of severe maternal morbidity

1.3 Justification

Severe maternal morbidity is of major public health importance in Ghana and the world in general. Achieving reduction in the incidence of severe maternal morbidity is critical in reducing the maternal mortality rate.

Studying factors contributing to severe maternal morbidity will be useful to the respective hospitals, Ashanti Regional Health Directorate and the nation as a whole. This study is intended to be used by health-care workers, programme managers and policy-makers who are responsible for quality of maternal health care within a health-care facility or the health system. This study may stimulate the need for implementing maternal morbidity analysis in various hospitals across the nation. The indicators of SMM and factors associated with severe maternal morbidity will be determined and appropriate intervention will help achieve reduction in the number of maternal morbidity and therefore the maternal death. The long-term consequences associated with maternal morbidity will also be reduced. This study will also provide baseline data on the near miss indicators for the facilities that will be used for the study. Assessing the baseline data will help us appreciate whether interventions on maternal health are being productive or not.

1.4 General Objective:

To determine factors contributing to severe maternal morbidity in Suntreso and Kumasi South Government hospitals in the Ashanti Region of Ghana, 2015

1.4.1 Specific Objective:

1. To assess the indicators of maternal near miss in Suntreso and Kumasi South Government hospitals in the Ashanti Region of Ghana, 2015
2. To determine socio-demographic factors associated with severe maternal morbidity in Suntreso and Kumasi South Government hospitals in the Ashanti Region of Ghana, 2015
3. To determine the clinical factors associated with severe maternal morbidity in Suntreso and Kumasi South Government hospitals in the Ashanti Region of Ghana, 2015

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 Severe Maternal Morbidity

Maternal mortality review has been used for improving obstetric care over the years, in 2009 WHO working group on maternal mortality and morbidity proposed the use of maternal morbidity review as key component for improving the quality of maternal care (Say, et al., 2009). Severe maternal morbidity has a higher incidence than maternal mortality and the advantage of interviewing survivors, is critical for improving the quality of obstetric care (WHO, 2013; Lozano et al., 2011;Say, et al., 2009). Maternal morbidity spans from mild, moderate and severe. Severe maternal morbidity can be classified as life-threatening conditions (maternal near-miss) and potentially life-threatening conditions(PLTC) (Say, et al, 2009) . The WHO Working Group on maternal morbidity and mortality, defined maternal near-miss morbidity as "a woman who nearly died but survived a complication that occurred during pregnancy, childbirth, or within 42 days of termination of pregnancy"(Say et al, 2009 ; Mantel et al., 1998). The working group also defined severe maternal complications also known as "potentially life-threatening conditions" as an extensive category of clinical conditions, including diseases that can threaten a woman's life during pregnancy and labour and after termination of pregnancy. This definition has been used to develop an instrument for standardization and assisting facilities and health systems to evaluate and improve the quality of maternal care.

Potentially life threatening is for diseases in the category below

- Severe postpartum hemorrhage
- Severe pre-eclampsia
- Eclampsia
- Sepsis or severe systemic infection
- Ruptured uterus

According to WHO working group on maternal morbidity, three sets of criteria can be used in the definition of maternal near miss:

Management based: These criteria depend on the management of the cases of severe morbidity. The management-based criteria include admission to an intensive care unit (ICU), delivery by caesarean section, hysterectomy, blood transfusion and anesthetic accident. This criterion is simple to use and it is easy to collect information. The only disadvantage is that the criteria for admission to intensive care unit may vary from country to country, depending on hospital capacity and location of the ICU. The use of this criterion is limited in developing countries because ICU facilities are few and are located away from maternity units.

Clinical signs and symptoms: This set of criteria use clinical signs and symptoms generally built on obstetric complications, focusing on major causes of maternal mortality such as hemorrhage, sepsis and hypertension. These are easy to use and interpret. In developing countries where there are few facilities for ICU, shortage of blood and inadequate laboratory investigation capability, this criterion may be the most appropriate.

The criteria depend on the consensus of the hospital or unit on the broad definition of cases of SMM. The main problem with this definition is comparison of cases across the world. The use of these criteria needs global standardization by WHO for easy use and generalizability of results.

Organ- or system-based: The third set of criteria comprises an organ- or system based definition which depends on the identification of organ or system dysfunction or failure. This definition depends on, for example, the fact that bleeding must cause vascular hypovolemic and renal failure, or that sepsis leads to circulatory failure or respiratory failure, and eclampsia will lead to cerebro-vascular accident and brain dysfunction or renal failure, liver failure or coagulation failure. The dysfunction of an organ or system selects a specific end point which is very good for identification.

This includes:

- Cardiovascular dysfunction
- Respiratory dysfunction
- Renal dysfunction
- Coagulation/hematological dysfunction
- Hepatic dysfunction
- Neurological dysfunction
- Uterine dysfunction

The organ dysfunction-based approach although will ideally rely on a minimum standard of critical care, including laboratory investigations, clinical criteria alone could be used to identify severe organ dysfunction in resource limited settings (Say, et al.,2009b).

2.2 Maternal near miss indicators

Prior to WHO standardization the prevalence of maternal near miss varied depending on the criteria/terminology used. In a WHO systematic review, 30 studies were included in the systematic review with mainly cross-sectional designs and 24 were conducted in hospital settings, mostly teaching hospitals. The prevalence of severe maternal morbidity varied between 0.80% – 8.23% in studies that use disease-specific criteria while the range is 0.38% – 1.09% in the group that use organ-system based criteria. Rates were within the range of 0.01% and 2.99% in studies using management-based criteria (Say, et al., 2004). In another systematic review, from 82 studies with 46 countries, prevalence rates varied between 0.6 and 14.98% for disease-specific criteria, between 0.04 and 4.54% for management-based criteria and between 0.14 and 0.92% for organ-based dysfunction based on Mantel criteria (organ dysfunction based). The rates are higher in low-income and middle-income countries of Asia and Africa. Based on meta-analysis, the estimate of near miss was 0.42% (95% CI 0.40–0.44%) for the Mantel criteria .(O. Tunçalp, et al., 2012).

For a Sub-Saharan Africa systematic research, where 12 studies were used: six were cross-sectional, five were prospective and one was a retrospective.

These researches were done in hospitals and some were community based with different definitions and terminologies for maternal near miss including acute obstetric complications, severe life threatening obstetric complications and severe obstetric complications. The incidence ratio and case-fatality ratio for maternal near misses ranged from 1.1%- 10.1% Ruptured uterus, sepsis, obstructed labor and hemorrhage were the commonest morbidities that were analyzed (Kaye, et al, 2011). A Prospective and retrospective reviews of medical records were conducted in nine referral hospitals in three African countries (Benin, Côte d'Ivoire, and Morocco). The incidence of near-miss cases was varied: from 1% to almost a quarter of all deliveries were near misses. Near-miss cases were 15 times more common than deaths (ranging from a ratio of 9 : 1–108 : 1). The most frequent types of maternal near miss were hemorrhage and hypertensive diseases of pregnancy (Filippi et al., 2005).

In Brazil, a cross-sectional study with a nested case–control component was carried out in two reference maternity hospitals. In this research case identification was prospective and data collection was performed according to WHO criteria and definitions. This showed 1,102 SMM cases, 17 maternal deaths of the 16,243 deliveries reviewed. The MNM outcome ratio was 5.8 cases/1,000 live births ; the total prevalence of SMM + MNM was 72.6 cases/1,000 live birth, the maternal near miss: mortality ratio was 4.5cases/1 maternal death and mortality index of 18% (Galvão et al., 2014) .

In another study in Brazil which was conducted between February 2011 and October 2012, showed an incidence of maternal near miss of 10.21 per 1,000 live births and a near-miss-to-mortality ratio of 30.8 maternal near miss to every maternal death. Maternal near miss was identified most prevalently by clinical criteria, at an incidence rate of 5.2 per 1,000 live births (Dias et al., 2014). A cross-sectional study in Baghdad recorded maternal near-miss rate of 5.06 per 1,000 live births, while the overall maternal near miss: mortality ratio was 9:1. One third of the near-miss cases were referred from other facilities and the mortality index was the same for referred women and for in-hospital women (11%) (Jabir et al., 2013).

Nelissen et al. conducted a research in Tanzania for a two-year period (2009-2011) and recorded 216 maternal near misses, 32 maternal deaths and maternal near miss incidence ratio was 23.6 per 1,000 live births(2.4%) (Nelissen et al., 2013). A study in South Africa revealed a facility-based incidence of SAMM was 541 cases per 100,000 births (95% CI 368–767). The commonest organ systems involved were cerebral (42%), coagulation (19%), and vascular dysfunctions (16%). The commonest obstetric diagnoses were eclampsia (39%) and obstetric haemorrhage (32%). Approximately 65% of cases were avoidable (Gandhi, et al., 2004). Ali, et al in Sudan looked at near-miss case and events, maternal deaths and their causes retrospectively in Kassala Hospital, eastern Sudan over a 2-year period, from January 2008 to December 2010. There were 9578 deliveries, 205 near-miss cases and 40 maternal deaths. Maternal near-miss and maternal mortality ratio were 22.1/1000 live births and 432/100 000 live births, respectively.

Hemorrhage accounted for the most common event (40.8%), followed by infection (21.5%), hypertensive disorders (18.0%), anemia (11.8%) and dystocia (7.9%). The mortality index were 22.2%, 10.0%, 10.0%, 8.8% and 2.4% for infection, dystocia, anemia, hemorrhage and hypertensive disorders, respectively (Ali, et al., 2011) .

A higher prevalence of 16% of all deliveries at a referral hospital in Liberia was classified as near-miss events and 28 maternal mortalities over the period of study. Near-miss events were six times more common than deaths. The majority of women experiencing a near-miss event (85%) were in critical condition upon arrival at the hospital (Lori & Starke, 2012). A study in Accra among 3,438 pregnant women, had recorded 131 severe maternal outcomes (94 near miss cases and 37 maternal deaths). More than half (64.4%) of the women had been referred to the facility. The incidence of maternal near-miss was 28.6 cases per 1000 live births (2.9%). The proportion of maternal near miss to maternal deaths was about three times more frequent which is lower than what was found in Liberia (Lori & Starke, 2012; Ö. Tunçalp et al., 2013).

2.3 Risk factors of Severe Maternal Morbidity

2.3.1 Socio-demographic

Maternal age is associated with severe maternal morbidity in most researches. In an unmatched case-control analysis using data from the United Kingdom with 1,753 women who experienced severe maternal morbidity and 3,310 women/controls who delivered immediately before the cases in the same hospital, being younger and older were independent risk factors. Maternal age less than 20 years [aOR 1.63 95%(1.23- 1.87) for women aged 35 or over (aOR 1.58(1.37 1.82)] (Nair, et al., 2014) .

In a research conducted in the United States using the National Hospital Discharge Survey to identify deliveries with maternal diagnoses and procedures that indicated potentially life-threatening diagnosis, severe maternal morbidity was more common at the extremes of reproductive age (Callaghan, et al., 2008). In another study involving all 19 maternity units within the South East Thames region and six neighboring hospitals caring for pregnant women from the region found maternal age to be related with severe maternal morbidity. Specifically age over 34 years is associated with severe maternal morbidity ($p < 0.05$)(Waterstone, et al., 2001). Goffman, et al., reviewed hospital charts for cases of maternal mortality or near-miss and for controls overmatched 1:3. Eight cases of mortality and 69 near-miss cases were found. Significant risk factors with their odds ratios and 95% confidence intervals were: age 35 to 39 years (2.3, 1.2 to 4.4) and >39 years (5.1, 1.8 to 14.4) (Goffman, et al., 2007).

A cross-sectional multicenter study conducted in 27 referral obstetric units in Brazil reported that maternal near miss ratio and maternal mortality ratios increased with age, but these ratios were also higher among adolescents aged 10 to 14 years. On multivariate analysis, younger age was not identified as an independent risk factor for severe maternal outcome (SMO), while this was true for older age (PR 1.25; 1.07-1.45). A cross-sectional study with a nested case–control component was conducted from June-2011 to May-2012 in this study. Case identification was prospective and data collection was performed according to WHO criteria and definitions. SAMM/NM were associated with higher age ($p = 0.018$) (Galvão et al., 2014). In another study in Brazil, which was conducted between February 2011 and October 2012, the results presented are estimates for the study population (2,337,476 births), based on a sample of 23,894 women interviewed.

Maternal near miss was associated with maternal age 35 or more years (RR = 1.6; 95%CI: 1.1-2.5) (Dias et al., 2014). In case–control study where severe maternal morbidities data were collected through the Australasian Maternity Outcomes Surveillance System; Maternal age [adjusted odds ratio (aOR) 2.20 for women aged 35 or over compared with women aged 25–29, 95%CI 1.64–3.15] and previous pregnancy complications (aOR 1.30, 95%CI 1.21–1.87) were significantly associated with morbidity (Biro, et al., 2012).

A prospective case control study was conducted at the maternity units of the Obafemi Awolowo University Teaching Hospitals Complex, Ile-Ife Nigeria between July 2006 and July 2007. Maternal age was not associated with severe maternal morbidity: less than 20 years [OR= 0.82; 95% CI: ((0.16 – 4.35)] more than 34 years [OR= 1.12; 95% CI ((0.51 – 2.49)] (Adeoye,et al, 2013) . In a prospective observational study of all women delivering at the facility including those with pregnancy-related complications, in Accra, Ghana among 3438 women, 516 had potentially life-threatening conditions and 131 had severe maternal outcomes (94 near miss cases and 37 maternal deaths).

In this study none of the socio-demographic variables including maternal age were found to be associated with severe maternal morbidity(Ö. Tunçalp et al., 2013). Adolescent may be a vulnerable group because of the rate of unexpected pregnancies among this group of people, which increase the occurrence of unsafe abortions, the discontinuation of formal education and are associated with lower adherence to prenatal care (Ham P, Allen C:, 2012). In a similar fashion, although for distinct reasons, older pregnant women are also considered at high risk of obstetric complication due to a higher prevalence of associated morbid conditions and/or multiparity (Jacobsson, et al., 2004).

All the papers reviewed showed no association between marital status and severe maternal morbidity. These studies were varied including case control and cohort studies (Adeoye et al., 2013; Nelissen et al., 2013; Pacheco, et al., 2014; Ö. Tunçalp et al., 2013). Ethnic/tribe in case-control study in the United Kingdom Compared with white European women, the odds of severe maternal morbidity were 83% higher among black african women (adjusted odds ratio (aOR) = 1.83; 95% Confidence Interval (CI) = 1.39–2.40), 80% higher among black Caribbean (aOR = 1.80; 95% CI = 1.14–2.82), 74% higher in Bangladeshi (aOR = 1.74; 95% CI = 1.05–2.88), 56% higher in other non-whites (non-Asian) (aOR = 1.56; 95% CI = 1.05–2.33) and 43% higher among Pakistani women (aOR = 1.43; 95%CI = 1.07–1.92). This national study demonstrates an increased risk of severe maternal morbidity among women of ethnic minority backgrounds which could not be explained by known risk factors for severe maternal morbidity (Nair, et al., 2014) .

Apart from the above none of the studies identify any tribe or ethnic group with association with severe maternal morbidity. Educational level of the mother has not been identified as having an association with severe maternal morbidity (Adeoye et al., 2013; Goffman et al., 2007; Ö. Tunçalp et al., 2013).Smoking and alcohol though consumed by some pregnant women has not been seen to be associated with severe maternal morbidity in case control the odds of severe maternal morbidity did not differ by socioeconomic status, between (Galvão et al., 2014; Nair et al., 2014). Likewise in a cross-sectional study all the socio demographic variables were not found to be associated with severe maternal morbidity(Ö. Tunçalp et al., 2013)

2.3 Risk factors of Severe Maternal Morbidity

2.3.2 Clinical factors

Caesarean section either emergency or elective has been found to be associated with severe maternal morbidity. In a Canadian study using a retrospective population-based cohort study of all women (excluding Quebec and Manitoba) who delivered over 14-year period, planned cesarean group had increased postpartum risks of cardiac arrest (adjusted odds ratio [OR] 5.1, 95% confidence interval [CI] 4.1–6.3)(Liu et al., 2007). In another study which was retrospective case-control study, the cases consisted of women admitted to the intensive care unit during pregnancy and up to 42 days postpartum. Controls were women who delivered immediately before and after the indexed case. The risk factors for a patient to be managed in obstetric intensive care unit admission for severe maternal morbidity included emergency caesarean section (OR=14.9, 95% CI 5.38–41.45) and primary postpartum hemorrhage (OR=5.4, 95% CI 1.79–4.35) (Selo-Ojeme, et al., 2005). Galvao et al., conducted a study in Brazil, which found previous caesarian was significantly related with severe maternal morbidity (Galvão et al., 2014) a case-control study in Australia also revealed that the risk of severe maternal morbidity amongst women is increased in previous caesarean deliveries group(Lindquist, et al., 2014).

In another study where Medical Birth Registry and Hospital Discharge Registry were analysed, severe maternal morbidity was more frequent in cesarean than vaginal deliveries ($p<0.001$), and more frequent in non-elective than in elective operations ($p<0.001$) (Pallasmaa, et al., 2008).

In unmatched case-control analysis using data from the United Kingdom Obstetric Surveillance System (UKOSS) from February 2005-January 2013 where Cases of 1,753 women who experienced severe morbidity during the peripartum period and Controls of 3,310 women who delivered immediately before the cases in the same hospital were identified. Anaemia in current pregnancy was found a risk factor in this study [OR 1.89 95%CI (1.07 to 3.35)] (Nair, et al., 2014).In a facility-based, cross-sectional study conducted in 6 public hospitals in Baghdad between March 1, 2010 and the June 30, 2010. Anemia (55%) and previous cesarean section (45%) among others were the most common associated conditions with severe maternal morbidity (Jabir et al., 2013) . The case–control study was carried out between 01/03/2009 and 28/02/2010 in two public high-risk maternities facilities and in two intensive care units for referral of obstetric cases. All cases hospitalized due to complications during gestation period, childbirth or up to 42 days of puerperium and who fulfilled any of Mantel's and/or Waterstone's criteria were identified. Four to five pre-natal consultations (OR=1.78; 95% CI:1.05-3.01) and 1–3 pre-natal consultations (OR=1.89; 95% CI:1.03-3.49) were independently associated with severe maternal morbidity (de Moraes et al., 2013).

In a prospective case control study was conducted in Ile-Ife Nigeria between July 2006 and July 2007. The protective factors included antenatal care attendance at the facility [OR=0.19; 95% CI: (0.09– 0.37)] (Adeoye et al., 2013).

A retrospective, cohort study was conducted to evaluate the socio-demographic and obstetric characteristics of the women. having attended fewer than six prenatal visits (OR: 1.1; 95% CI: 1.01 – 1.69) was identified as one of the risk factors to severe maternal morbidity (Alvaro José C. Pacheco et al., 2014).

Severe maternal morbidity during pregnancy, delivery and pueperium nationwide cohort study was carried out in the Netherlands: In this study the number of pregnancies and deliveries were not related with severe maternal morbidity (Zwart et al., 2008) . Adeoye et al. used a case control study to determine factors associated with severe maternal morbidity. In this study the risk of SMM/NM was not found to be related with parity and gravidity (Pacheco et al., 2014).

CHAPTER THREE

3.0 METHODS

3.1 Study Design

A prospective case–control study was conducted to identify risk factors associated with PLTC (SMM). All pregnant women admitted for delivery and from women with pregnancy-related complications, who were experiencing severe morbidity between 26th January, 2015 and 7th June, 2015 in Suntreso and Kumasi South Government Hospitals in the Ashanti Region, were used in this study to assess the near miss indicators. When a case is identified (PLTC), two eligible controls were selected. Risk factors were identified using multivariate analysis.

3.2 Study Area

3.2.1 Demography

The research was conducted in the Suntreso Government Hospital and Kumasi South Government Hospital. Kumasi south hospital is located at Chirapatre, within the industrial hub of the Kumasi metropolis and serves the people of Asokwa, Atonsu, Gyenyase, Esreso, Ahensan and Kaase. The Suntreso Government Hospital is located at North Suntreso and serves North and South Suntreso, Patasi estate, Kwadaso, Adoato, Asuoyeboa, Breman and Suame. The metropolis has number of both public and private health facilities with the private facilities numbering over two hundred.

The metropolis has a population of 1,976936 of which 30.3% is in Asokwa where Kumasi South is located and 24.2% for Bantama where Suntreso is located. Expected birth for 2015 in Asokwa and Bantama is estimated at 23,960 and 19,137 respectively

(Ghana Statistical Service, 2010). It is known that most people use public health facilities than the private ones .The two hospitals have an average delivery of 250 per month for each facility.

Both institutions have teams of obstetrician's, pediatricians, and well trained anesthetists available all the time and are equipped with a blood bank, intensive care units and surgical theaters.

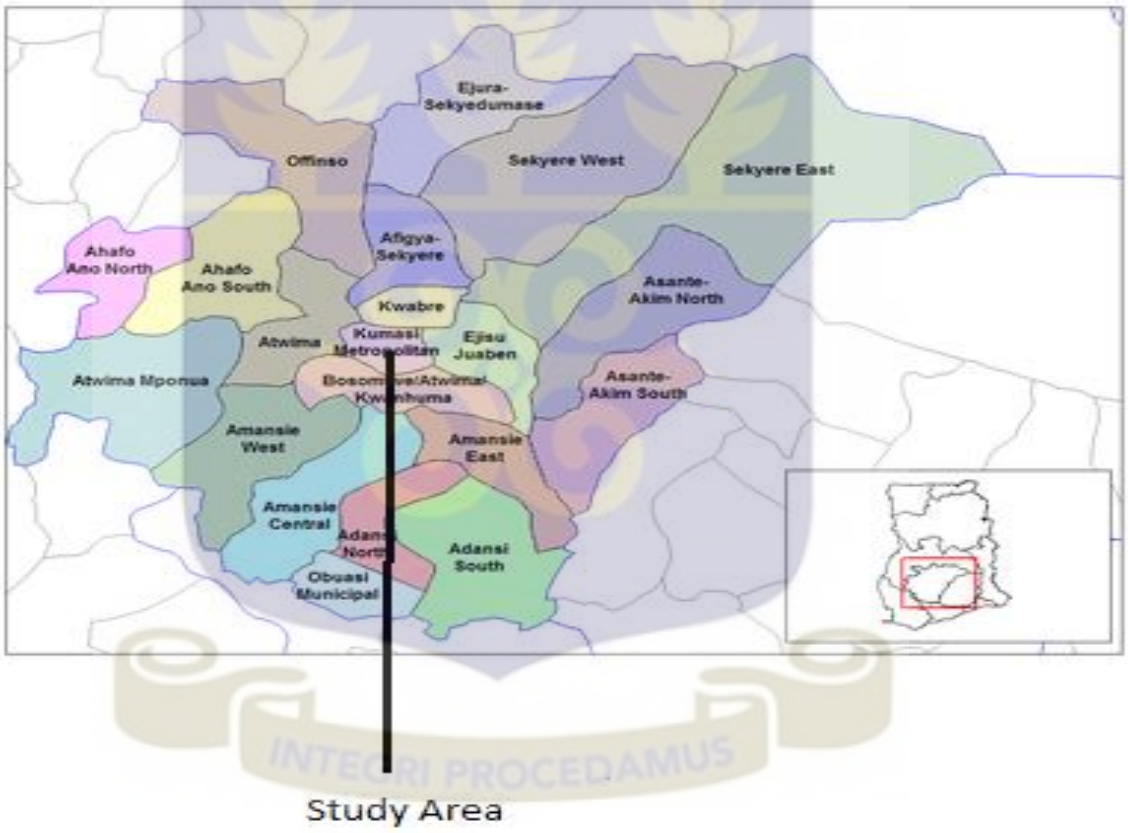

Figure 2: Map of Kumasi Metropolis where the study was carried out

3.3 Study Population

The study population included all women delivering at the facility, including those with pregnancy-related complications. For the purpose of the case control study, the term severe maternal morbidity (SMM) is used to describe patients who have suffered potentially life threating condition (PLTC). For the case control study; any pregnant woman admitted and discharge in Kumasi South and Suntreso Hospital from 26th January to 7th June and gives her consent was included in the study.

A case of PLTC (SMM) was defined as

Case:

- Women who have PLTC whiles pregnant, or in labour
- Arriving at the facility with potentially life threatening conditions
- Those who develop any of those conditions (i.e. PLTC) during their stay at the health-care facility during the study period
- Admitted and discharge in Kumasi South and Suntreso Hospitals from 26th January to 7th June 2015
- Gives her consent

Control:

- Pregnant women admitted and discharge in Kumasi South and Suntreso Hospitals from 26th January to 7th June 2015, without any complication
- Gives her consent

Exclusion criteria

The exclusion criteria for cases and controls were those who refuse to participate in the study.

3.4 Sample size determination

$$n = [Z\alpha/_2\sqrt{2pq} + Z_\beta\sqrt{(p_1q_1 + p_0q_0)}]^2/(p_1 - p_0)^2$$

OR

$$n = 2pq(Z\alpha/_2 + Z_\beta)^2/(p_1 - p_0)^2$$

n: sample size for one sample

$z_{\alpha/2}$: z value for a two-sided test corresponding to the chosen α

z_β: z value for a one-sided test for the chosen β

p_1: proportion of cases exposed

p_0: proportion of controls exposed

p* : mean estimated proportion $(p_1 + p_0)/2$

q = 1-p Where Z = 1.96 is the standard score for the confidence interval of 95%

d = allowable error of 5% Power= 80% Cases: Control = 1: 2

Using p_1: proportion of cases exposed as approximately 50%

p_0: proportion of controls exposed as approximately 30%

These proportions are from a research in Accra/Ghana, using the variable caesarean delivery (Ö. Tunçalp et al., 2013). Using StatCalc from Epi Info 7, the required minimum number of cases is 70 and controls of 140 making a total of 210

3.5 Sampling method

Kumasi South and Suntreso Government Hospitals were purposively selected because of the high number of deliveries per months in each facility, availability of Obstetrics and Gynecology specialists to manage the PLTC/MNM cases. Each hospital sees an average of 250 deliveries a month.

The study was done in a 2-step process: daily review of admission and discharge register of the obstetric and gynecological department was done to identify PLTC and MNM conditions, weekly summary of total admission, deliveries and maternal death were done at the end of the week. Supplementary information from the healthcare providers were enquired when needed. The first case was the first PLTC seen in the hospital when the study started and the rest of the cases were enrolled consecutively. Women with potentially life-threatening conditions were identified on the basis of whether they had any severe complication (severe postpartum hemorrhage [PPH], severe pre-eclampsia, eclampsia, sepsis or severe systemic infection, or ruptured uterus).We included all admitted patients that fulfilled the current criteria for PLTC and for MNM according to the WHO-Working Group on Maternal Mortality and Morbidity. Patients were included in the study only once, even if they were admitted on more than one occasion during the study period.

All the cases were selected when they were admitted with the condition or whiles on the admission in the hospital during the study period. Two controls were randomly selected for each case (cases were selected consecutively). When a case is identified, all patients who were eligible to be controls (patient admitted within 24hours before or after the case

was identified) were listed and numbered and two numbers were selected at random from a covered box at a ratio of two control participant to one PLTC.

Three groups were selected according to the definition criteria and defined as: PLTC group, MNM group and the control group but only the PLTC and the control groups were used for the risk factor analysis.

3.6 Data collection technique and tools

Two data collection tools were used to collect quantitative data. Data collection tools adapted from a modified WHO maternal near-miss surveillance and assessment questionnaire was used in this research(Say, et al., 2009).

Data was collected on socio-demographic and clinical characteristics. Both cases and control were interviewed using a questionnaire. In determining the maternal near miss indicators any person who meets the WHO criteria (Say, et al., 2009) for PLTC and MNM were included. A maternal near-miss case per WHO is defined as "a woman who nearly died but survived a complication that occurred during pregnancy, childbirth or within 42 days of termination of pregnancy. Potentially life-threatening conditions are clinical conditions, including diseases that can threaten a woman's life during pregnancy and labour and after termination of pregnancy.

These conditions were used as part of the inclusion criteria set for the PLTC: severe postpartum haemorrhage, severe pre-eclampsia, eclampsia, sepsis/severe systemic infection, and ruptured uterus (Say, et al., 2009).

The data was collected by the following methods:

1. Record review: Checklist was completed by the end of every week from the maternity records and patient folders. This was to record the number of live birth, potentially life threatening condition, maternal near miss and maternal death using the WHO classification.

2. Active Case Search: After obtaining written consent from patients, trained midwives and the Principal investigator undertook an active search of cases in both hospitals to identify eligible PLTC patients in the study period.

3. Interview: The structured questionnaire was administered on the cases and control to capture socio-demographic and clinical variables.

3.7 Variables

The main dependent variable was severe maternal morbidity. The independent variables of interest were varied and include; information on socio-demographic and clinical factors related to severe maternal morbidity.

Socio-demographic variables;

- Age
- Education level
- Marital status
- Occupation
- Use of alcohol
- Smoking

Clinical variables;

Pre- Pregnancy

- Previous Caesarean section
- Previous surgery
- Previous obstetric morbidities
- Parity
- Gravidity
- Sickle cell
- HIV
- Hypertension and diabetes

Pregnancy

- Gestational age
- Number of antenatal visit
- Caesarean section
- Referral status
- Delays in reaching the hospital
- Use of herbal preparation in pregnancy
- Pregnancy induced morbidity(hypertension and diabetes)

3.8 Ethical clearance

Ethical approval was sought from the Ghana Health Service Ethical Review Committee. Permission was obtained from the Ashanti Regional Health Directorate, medical superintendents of the two health facilities included in the study. Informed consent was obtained from the patients and confidentiality assured before the study. They were fully informed about the purpose, procedures, risks and benefits of participating in the study. For participants who cannot read, the consent form were read and explained to them in the presence of an impartial witness. Participants who agreed to be part of the study were required to sign or thumbprint the consent form.

All the information obtained from this study were kept confidential and used for the purpose indicated for the study. The information will be securely stored (both softcopy and hardcopy) without the names of the participants, in a file which is only be accessible to the research team. Extraction of data from maternity records was carried out by trained midwives including the principal investigator who is a medical officer.

Participants were made to know that there is no risk associated with participating in this study. The participants were however informed of possible minor discomforts in answering certain questions for which they may choose not to answer. Participants were informed that participation in the study was voluntary and they may withdraw from the study at any time without attracting any penalty. Participants were not coerced into taking part in the study and questionnaires were administered at participant's own convenient time in the hospital before discharge.

Questionnaire were in English but appropriately translated into a language clearly understood by the participant when the need arose. Participants were told of the direct and indirect benefits of the study which included helping with the reduction of maternal morbidity and mortality and its accompanying economic burden.

3.9 Training of interviewers

The field workers (midwives) were trained a week prior to the commencement of the data collection. The training focused on ensuring that the field workers understood the objectives of the study, familiar with tools and their interpretation, and were able to perform the tasks. Simulated practices were carried out to increase the agreement and consistency between field workers and the trainer.

3.10 Pre-testing and review of data collection tools

The data collection tools were pre-tested at Manhyia Government Hospital which has similar setting as the chosen hospitals. The tools were pre-tested in order to ensure they reflected the local conditions, and that the questions were clear and well understood by the respondents as well as making sure that the tools were well formatted. The necessary modifications were made after the pre-test.

3.11 Quality control

Trained midwives were used in the data collection to ensure quality data collection. During the data collection, the principal investigator supervised the field workers and data collected were randomly crosschecked from the participants for correctness. Double entry of data into Epi info software version 7 was done by two independent data entry clerks and discrepancies resolved by referring to the original data collection tools.

Data validation was ensured during the data entry process by using a validation program whilst creating the data entry fields.

3.12 Data processing and analysis

Double entry of the data into Epi info software version 7 was done by two independent data entry clerks. Data cleaning and verification were done to ensure good quality data. For each variable, the frequencies were run to identify the number of missing variables and incorrectly entered data. Missing data were excluded from the analyses when necessary. Where an input needs to be corrected, the variables were listed and the necessary corrections done. In calculating the near miss indicators, the number of live birth, PLTC, MNM, maternal mortality, were capture over the study period using a checklist. For the maternal near miss indicators were calculating using the formulae below (Say, et al., 2009)

Table 1: Calculating maternal near miss indicators

Indicators	**Formulae**
Live birth (LB):	n(LB)
Maternal near-miss (MNM)	n(MNM)
Maternal death (MD):	n(MD)
Severe maternal outcome(SMO):	MNM+MD
Severe maternal outcome ratio (SMOR):	(MNM + MD) per 1000 live births (LB).
MNM ratio (MNMR):	MNM per 1000LB
Maternal near-miss mortality ratio	MNM : MD
Mortality index (MI)	MD/(MNM + MD) expressed as percentage

Maternal near miss indicators were expressed in frequencies, proportions and rates. Categorical variables like marital status, educational level et cetera were expressed in the form of frequencies, proportions and means with standard deviations calculated for age. Bivariate analysis was done using odds ratio and their corresponding 95% CI to assess association between selected independent variables and severe maternal morbidity .The odds ratio with associated p-values was calculated for each predictor variable.

In the multivariate analysis, logistic regression modeling was used to assess the strength of association between factors predictive of severe maternal morbidity. We used variables that were statistically significant in the bivariate analysis and those that are known to be associated in literature as the members of the model. The confidence Interval (CI) of 95% was used and a p-value of <0.05 was considered statistically significant.

CHAPTER FOUR

4.0 RESULTS

4.1 Maternal near miss indicators

During the study period, 2,238 pregnant women were seen in the two facilities and seventy four obstetric cases were referred to komfo-Anokye Teaching Hospital (KATH) which is the only tertiary facility in the region that receives referrals from the lower facilities. There were 2,178 live births (LB), 52 stillbirth, 15 maternal near miss and 71 women with potentially life-threatening conditions (PLTC). There were 22 women with a severe maternal outcome (15 maternal near miss and 7 maternal mortalities), with a SMO ratio of 10.1 cases/1,000 LB. The maternal near miss incidence ratio was 6.9 cases/1,000 LB and the severe maternal complication incidence ratio 32.6 cases / 1,000 LB (Table 2). The maternal near miss: mortality ratio was 2.1, and the maternal mortality ratio for the studied population was 229.6 cases/ 100,000 LB.

Table 2: Maternal near miss indicators in Suntreso and Kumasi South Government Hospital between January and June 2015.

Indicator	**Measure**
Maternal near miss (MNM)	15
Maternal death (MD)	7
Live birth (LB)	2178
Severe maternal outcome (SMO)	22
Maternal near miss ratio (MNMR)	6.9 cases per 1000 live birth
Severe maternal Outcome ratio (SMOR)	10.1 cases per 1000 live birth
Maternal near miss mortality ratio	2.1
Mortality index	31.8%

The most diagnosed potentially life threatening condition was postpartum hemorrhage 41(57.7%) and the least being sepsis 2 (2.82%).The total was more than seventy one PLTC cases identified because some patient had more than one of the conditions(Figure 3).

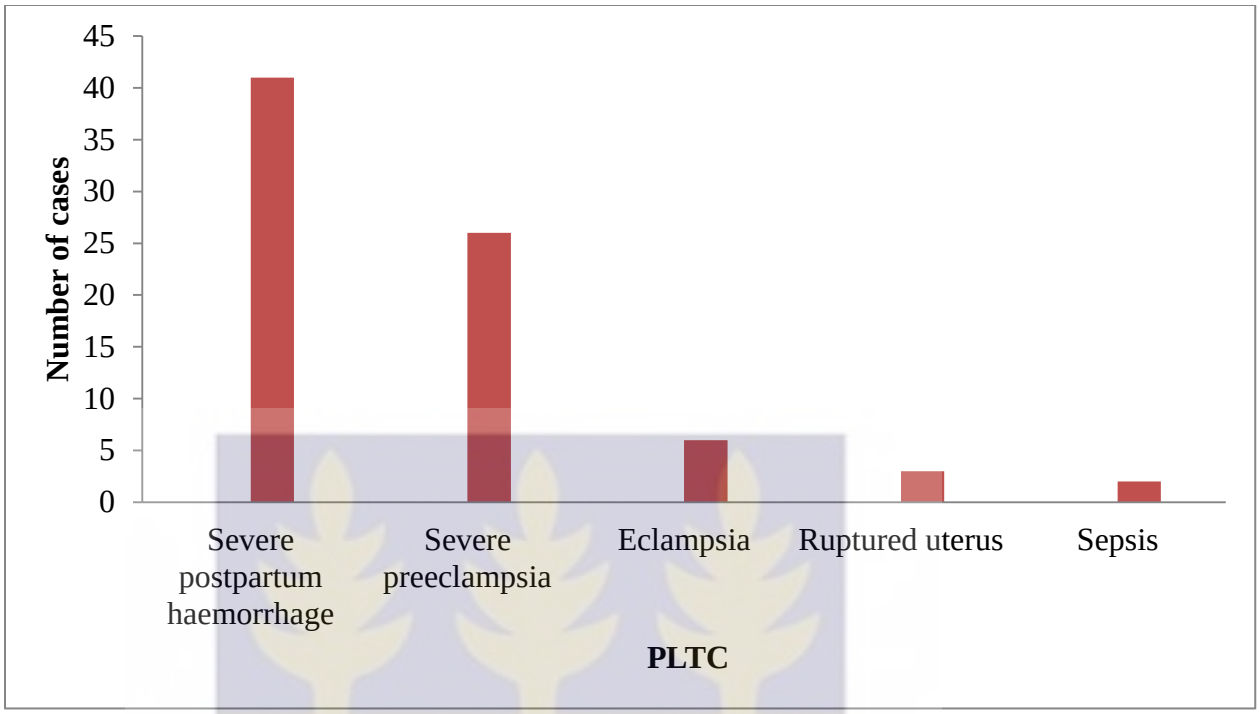

Figure 3: Causes of potentially life threatening conditions (PLTC) in Suntreso and Kumasi South Government Hospitals between January and June 2015.

4.2 Socio-demographic and clinical characteristics of severe maternal morbidity

Over the study period seventy one cases of PLTC and one hundred and forty-two controls were identified, enrolled and analyzed in this study. The age for the cases ranged from 15 to 42 years whiles that of the controls recorded a minimum age of 14 years and the maximum of 40years.The mean age of the cases and controls were 28.7 years(standard deviation: ± 7.9) and 26.8years(standard deviation: ± 5.4) respectively. The mean age of the cases is different from the controls (P-value 0.036). Majority 151(70.9%) of the study participants are within the ages of 20 and 34years with 34(47.9%) of the cases and 117(82.4%) of the controls being in that age group. Most 149(70.0%) of the study participants were either married or cohabitating with 47(66.2%) of the cases and 102(71.8%) controls in that category. Considering education, 21(29.6%) cases and 55(38.7%) controls had up to Junior High School education. Only 5(2.4%) of the cases and controls had ever smoked whiles 54(25.4%) had ever taken alcohol. None of those who had ever smoked and/or taken alcohol did so during their current pregnancy (Table 3).

Table 3: Association between Socio-demographic characteristics and PLTC (SMM) of cases and control in Suntreso and Kumasi South Government hospital between January and June 2015.

Characteristics	Case n (%)	Control n (%)	Odds ratio(95%CI)	P-value
Maternal age(years)				
<20	15(21.1)	15(10.6)	3.4(1.5-7.7)	0.01
20 – 34	34(47.9)	117(82.4)	1.0	
≥ 35	22(31.0)	10(7.0)	7.6(3.3-17.5)	
Educational status				
None	9(12.7)	15(10.6)	1.0	0.57
Primary	13(18.3)	18(12.7)	1.2(0.4-3.6)	
Junior high	21(29.6)	55(38.7)	0.6(0.2-1.7)	
Senior high	18(25.4)	30(21.1)	1.0(0.4-2.8)	
Tertiary	10(14.1)	24(16.9)	0.7(0.2-2.1)	
Marital status				
Single	22(31.0)	37(26.1)	1.3(0.7-2.4)	0.69
Divorced/Separated	2(2.8)	3(2.1)	1.5(0.2-9.0)	
Married/Cohabitation	47(66.2)	102(71.8)	1.0	
Tribe				
Ga-adangme	8(11.3)	9(6.3)	1.0	0.32
Ewe	7(9.9)	10(7.0)	0.8(0.2-3.1)	
Akan	49(69.0)	99(69.7)	0.6(0.2-1.5)	
Others	7(9.9)	24(16.9)	0.3(0.1-1.2)	
Occupation				
Farming	3(4.2)	5(3.5)	1.0	0.55
Artisan	3(4.2)	13(9.2)	0.4(0.1-2.6)	
Professionals	11(15.5)	24(16.9)	0.8(0.2-3.8)	
Unemployed	15(21.1)	18(12.7)	1.4(0.3-6.8)	
Others	10(14.1)	19(13.4)	0.9(0.2-4.5)	
Religion				
Christian	64(90.1)	120(84.5)	1.0	0.29
Muslim	7(9.9)	18(12.7)	0.7(0.3-1.8)	
Others	0(0.0)	4(2.8)		
Smoking				
Yes	2(2.8)	3(2.1)	1.3(0.2-8.2)	1.00
No	69(97.2)	139(97.9)		
Alcohol				
Yes	19(26.8)	35(24.6)	1.1(0.6-2.1)	0.74
No	52(73.2)	107(75.4)		

Aside maternal age (P-value=0.01) none of the measured socio-demographic (SD) variables was significantly associated with severe maternal morbidity (Table 3).Majority 167 (78.4%) of the participants were more than 36 weeks in gestation when they delivered. One hundred and thirty eight (64.8%) were in their second to fourth pregnancies followed by those with one pregnancy 39 (18.3%) and the rest were grandmultips (>4 pregnancies). Considering parity, 144 (67.6%) study participants had had one to four deliveries prior to this current delivery whiles 59(27.7%) had never delivered prior to this current delivery. Most of the participants 119(55.9%) spent less than 24hours in the hospital and 63(29.6%) stayed between 24hours to 72 hours whiles the rest stayed for more than 72hours .Twenty (8.6%) of the studied population had previous caesarean section. Out of the 213 participants 11(5.2%) had never received antenatal care from a health facility prior to delivery whiles 148(69.5%) had 4 or more visit prior to delivery. Close to half of the participant 94 (44.1%) used herbal medication during this current pregnancy. During delivery 77(36.2%) sustained some form of vulvo-vaginal laceration/tear and 25 (11.7%) delivered before arriving in the hospital whiles 78(36.6%) delivered within 3hours of arrival in the health facility. Only 18(8.5%) of the clients were referred from other facilities for further management in either Suntreso or Kumasi South Government hospital. Out of the referred clients, 10(55.6%) were referred from government hospital/clinic and the rest from private clinic and maternity homes (Table 3).

Only 22(15.5%) of the controls and 17(23.9%) of the cases had the current pregnancy as their first ever pregnancy. Twenty five (41.0%) of the nulliparous women were cases and the rest were controls. There was no significant association between parity, gravidity of the participants and severe maternal morbidity [parity (p=0.32), gravidity (p= 0.17)] (Table 4a).

Table 4a: Association between clinical characteristics and PLTC (SMM) in Suntreso and Kumasi South Government Hospital between January and June 2015.

Variable	Cases n(%)	Controls n(%)	Odds ratio(95%CI)	P-value
Parity				
0	25(35.2)	36(25.4)	1.0	0.32
1-4	43(60.6)	99(69.7)	0.6(0.3-1.2)	
>4	3(4.2)	7(4.9)	0.6(0.2-2.6)	
Gravidity				
1	17(23.9)	22(15.5)	1.0	0.17
2-4	40(56.4)	98(69.0)	0.5(0.3-1.1)	
>4	14(19.7)	22(15.5)	0.8(0.3-2.1)	
Previous Surgery				
Yes	7(9.9)	3(2.1)	5.1(1.3-20.2)	0.02
No	64(90.1)	139(97.9)		
Antenatal visit				
≤3	34(47.9)	31(21.8)	3.3(1.8-6.1)	<0.001
>3	37(52.1)	111(78.2)		
Herbal use				
Yes	28(39.4)	67(47.2)	0.7(0.4-1.3)	0.31
No	43(60.6)	75(52.8)		
Gestational age(weeks)				
≤36	33(46.5)	13(9.2)	8.6(4.1-18.0)	<0.001
≥ 37	38(53.5)	129(90.8)		
Mode of delivery				
Caesarean section	19(26.8)	7(4.9)	7.1(2.8-17.8)	<0.001
Vaginal delivery	52(73.2)	135(95.1)		
Delivery before arrival				
Yes	13(18.3)	11(7.7)	2.7(1.1-6.1)	0.04
No	58(81.7)	131(92.3)		

Table 4b: Association between clinical characteristics and PLTC (SMM) in Suntreso and Kumasi South Government Hospital between January and June 2015.

Variable	Cases n (%)	Controls n (%)	Odds ratio(95%CI)	P-value
Referral status				
Referred	9(12.7)	9(6.3)	2.2(0.8-5.7)	0.13
Not referred	62(87.3)	133(93.7)		
Anaemia				
Yes	28(39.4)	10(7.0)	8.6(3.9-19.1)	<0.001
No	43(60.6)	132(93.0)		
HIV				
Reactive	4(5.6)	6(4.2)	1.4(0.4-5.0)	0.73
Not reactive	67(94.4)	136(95.8)		
Prolonged labour				
Yes	1(1.4)	3(2.1)	0.7(0.1-6.5)	1.00
No	70(98.6)	139(97.9)		
Sickle cell anaemia				
Yes	0(0.0)	4(2.8)		0.30
No	71(100)	138(97.2)		

4.3 Risk factors for severe maternal morbidity

All the socio-demographic factors measured were not associated with severe maternal morbidity except maternal age (p=0.01). Seven out of ten participants who had had any type of surgery (excluding caesarean section) prior to this current pregnancy had severe maternal morbidity. Previous surgery was significantly related to having severe maternal morbidity [Odds ratio 5.1, 95%CI (1.3-20.2)]. The odds of having severe maternal morbidity was thrice more in those who had less than four antenatal visit [Odds ratio 3.3 95%CI (1.8 – 6.1)] whiles the odds of having severe maternal morbidity is 8.4 times more among those who delivered preterm (<37 weeks) compared with

term pregnancy[Odds ratio 8.4 95%CI (4.0 – 17.5)]. Majority of the study participant had vaginal delivery and the mode of delivery was significantly associated with severe maternal mortality(P-value <0.001) with the odds of having severe maternal morbidity being seven times more in caesarean section than having vaginal delivery[Odds ratio 7.1 95% CI(2.8 – 17.8)]. Those who delivered before arriving at the health facility had a significantly higher odds of having severe maternal morbidity than those who delivered in the health facility [Odds ratio 2.7 ; 95% CI (1.1-6.3)] (Table 4a).

Some associated conditions present in the participants included anemia, HIV, prolonged labor, and sickle cell anemia. Among all the associated conditions measured, only anemia was significantly related to severe maternal morbidity [Odds ratio 8.6 95% CI (3.9 - 19.1)] .The other clinical variables measured including referral status were not significantly associated with severe maternal morbidity (Table 4b)

4.3.1 Multivariate analysis to determine severe maternal morbidity risk factors

In the analysis, delivering at gestational age less than 37 week has greater odds of developing severe maternal morbidity than term delivery [aOdds ratio 7.8; 95%CI (3.0 – 20.2)].

In the multivariate logistic regression, having previous surgery (excluding caesarean section) is not associated with severe maternal morbidity but having caesarean section as a mode of delivery in current pregnancy was significantly associated [aOdds ratio 9.7;95%CI (3.1 - 30.2)]. Anemia in the current pregnancy increases the odds of severe maternal morbidity by approximately eight times [aOdds ratio 8.1; 95% CI (2.9 – 22.2)] All the other variables used in the model were not risk factors to developing severe maternal morbidity (Table 5).

Table 5: Multivariate logistic regression for risk factor identification of severe maternal morbidity in Suntreso and Kumasi South Government Hospital between January and June 2015.

Variable	Crude Odds ratio (95% C I)	Adjusted Odds ratio (95% C I)
Gestational age(weeks)		
(≤36)	8.4(4.0-17.5)	7.8(3.0 – 20.2)
(37-42)		
Antenatal visits		
≤3	3.3(1.8-6.1)	2.1(0.9 – 5.1)
>3		
Maternal age(years)		
<20	3.4(1.5-7.7)	2.6(0.8 – 8.1)
20-34	1.0	1.0
>34	7.6(3.3-17.5)	6.9(0.8-20.3)
Previous surgery		
Yes	5.1(1.3-20.2)	4.6(0.7 – 29.5)
No		
Caesarean section		
Yes	7.1(2.8-17.8)	9.7(3.1-30.2)
No		
Delivery before hospital arrival		
Yes	2.7(1.1-6.1)	2.8(0.8 – 9.4)
No		
Anemia		
Yes	8.6(3.9-19.1)	8.1(2.9 – 22.2)
No		

CHAPTER FIVE

5.0 DISCUSSION

This study presents the results of near miss indicators and risk factors associated with severe maternal morbidity. This concept of maternal near miss and severe maternal morbidity as an adjunct in reducing maternal mortality is increasing globally. However, incidence of maternal near miss varies widely because different criteria were used prior to the WHO standard criteria(Say, et al, 2004). Even when using the criteria proposed by the WHO, studies report huge differences in incidence of maternal near miss, ranging from 5.0 to 33.2 per 1,000 live births (Cecatti et al., 2011; Ellen Nelissen, 2013; Lobato, et al, 2013).

In this study we recorded a severe maternal outcome and maternal near miss incidence ratio of 10.1 cases / 1000 LB and 6.9 cases / 1000 LB respectively with potentially life threatening incidence ratio of 32.6 cases / 1000 LB. These findings are lower than what was found in most researches including the one conducted at Korle-bu Teaching Hospital in Ghana (Dias, M. A. B, et al, 2014; Pacheco et al., 2014;de Oliveira, et al, 2013; Ö. Tunçalp et al., 2013). It is difficult to compare findings from this study to what was found in the Korle-bu Teaching hospital research because of facility capacity differences and the fact that the teaching hospitals receive more referred PLTC/MNM cases than the regional and district hospitals where this research was conducted. The PLTC/MNM ratios were low because of the number of possible PLTC/MNM cases that were referred.

These referred cases if managed at the hospital where the research was conducted may have changed the figures, most likely increase the number and ratios of PLTC/MNM.

The maternal near miss: mortality ratio of 2.1, this is low compared to other researches (Nelissen et al., 2013; Ö. Tunçalp et al., 2013) . This coupled with high intra-hospital mortality index among near-miss cases found in this study suggests that the quality of care provided to women with severe morbidity needs to be further reviewed per WHO interpretation of indicators. This might be attributed to the low capacity to manage PLTC/MNM cases at the regional and district level including the low doctor patient ratio at the lower levels in the health sector.

Ghana's maternal mortality ratio (MMR) was estimated by the World Bank in 2013 at 380 per 100,000. In the annual report of Ashanti Region where this research was conducted MMR for 2013 was 315 deaths per 100,000 LB compared with 190 in 2010. In this study Maternal mortality ratio for the studied population was 229.6 cases/ 100,000 LB which is well above UN Millennium Development Goal (MDG) 5 target of 185 per 100,000 LB by 2015. This however, is an improvement on the 2013 Ashanti regional figure. This may be attributable to the improvement in maternal health care over the years (GSS, 2014) and some help extended to the facilities by visiting specialists from Komfo-Anokye Teaching Hospital over the years.

The most diagnosed potentially life threatening condition was severe postpartum hemorrhage and hypertension in pregnancy, this findings is also seen in other studies conducted in low-resource countries (Adisasmita, et al, 2008 ; Ö. Tunçalp, et al., 2013).

With regards to factors associated with severe maternal morbidity, preterm delivery, Caesarean section in current delivery and anemia in current pregnancy were found to be risk factors to severe maternal morbidity. None of the socio-demographic variables were seen as risk factor though there was association between maternal age and severe maternal morbidity at the bivariate level. Some researches show association between maternal age and SMM (Biro, et al, 2012; de Moraes et al., 2013) whiles a case control study in Nigeria showed no association between maternal age and SMM (Adeoye et al., 2013). With respect to educational and marital status, some studies suggest no association between SMM and marital /education status (Galvão et al., 2014), whiles others found some association (Adeoye et al., 2013; de Oliveira, et al, 2013) . In this study, no association was seen between marital status, educational level and severe maternal morbidity possibly because the population under study lives under similar socioeconomic conditions.

Anaemia in pregnancy is a risk factor to severe maternal morbidity. The proportion of study participants who had anaemia during this current pregnancy was approximately 18% which is quite good compared with some research and Ghana Demographic and Health Survey 2014 report (Engmann, et al., 2008; GSS 2014). We have to note that anemia in the present population excluded sickle cell anemia. A case control study in Sudan and a cross-sectional study in Tanzania demonstrated that anaemia is a risk factor to severe maternal morbidity(Marchant et al., 2002 ; Ali, et al., 2011;).

Nutritional intervention and decrease in malaria in pregnancy (Takem & D'Alessandro, 2013) through intermittent preventive treatment (IPTp) by women during pregnancy and Long-lasting insecticidal nets (LLINs) may have helped to improve the anaemia levels in pregnancy. Its association with SMM can also be linked to the fact that minimum amount of haemorrhage with an anaemic patient may lead to severe postpartum haemorrhage and therefore it possible association.

In this study, preterm delivery was significantly related to severe maternal morbidity. This was reported in some research whiles others did not report significant association (Wianwiset, 2012; Adeoye et al., 2013; Pacheco, A. J. C. et al., 2014) . Having adequate number of number of ante-natal visits (at least 4 visits) prior to delivery was not seen to be protective of SMM. In this study close to 31% had less than the required minimum number of antenatal visits. In the GDHS 2014 report approximately 87% had four or more ANC visits which are higher than what was seen in this study (69%). Other studies involving severe maternal morbidity cases also found a high proportion of insufficient number of antenatal visit (de Moraes et al., 2013; Pacheco, et al., 2014). Despite the fact that antenatal care in Ghana has largely improved in the past decade(GSS; 2014), about 5% of the study population never attended antenatal care and this is troubling since this increases their chances of having some form of maternal morbidity. Understanding the reasons for not attending antenatal (which is beyond the scope of this study) will be good for appropriate interventions.

In this study vaginal delivery is seen as protective of developing SMM compared to caesarean section though 12% of the study population was exposed to caesarean section in this current pregnancy.

This association was seen in other researches (Adeoye et al., 2013; Pacheco, A. J. C. et al., 2014). Cesarean section in the current pregnancy is of extreme importance in view of the high and continually rising rates of this interventions (Rozenburg P, 2004; Mittal, et al, 2014).

In this study, having a Cesarean section as mode of delivery in the current pregnancy was identified as a risk factor to severe maternal morbidity. This is because such treatment modalities may have been employed after the occurrence of a complication. Therefore this increased odds associated with caesarean section may be related to using this intervention (caesarean section) to prevent a women's conditions becoming life threatening. The reverse can also be true; where complications may develop after the caesarean section.

Not much is known about the association between the use of herbal medication prior to delivery and severe maternal morbidity. Though this study showed no significant association between herbal medication use and severe maternal morbidity as many as 95 (44.6%) pregnant women used some form of herbal preparation during pregnancy and prior to delivery. This increasing trends of herbal preparation use in pregnancy has been reported by other researchers(Louik et al., 2010 ; Kennedy, et al., 2013)There is therefore the need to research into the content and possible benefit and risk of these herbal medications to the mother and baby.

5.1 Limitation of the study

- The huge number of severe maternal morbidity referrals to KATH led to underestimation of the PLTC and MNM ratios whiles over estimating the mortality index.
- Possible recall bias from the participant may have influence the answers to the questions and therefore the findings(case control design).

CHAPTER SIX

6.1 Conclusion

There was a relatively low incidence of maternal near miss and potentially life threatening condition for the period under study. The mortality index was high and postpartum hemorrhage was the most cause of severe maternal morbidity.

The identified risk factors associated with these conditions were preterm delivery, caesarean section in current delivery and anemia in current pregnancy. The use of herbal preparation though not found to be associated with SMM was used by almost half of the study participant.

6.2 Recommendations

Based on the findings the following recommendations are being made for consideration

Ministry of health

Study should be used to inform interventions to achieve our national goals by identifying high risk patient:

- Anemia in pregnancy, possible caesarean section, and preterm delivery should be categories as high risk group and managed appropriately to avert the chances of severe maternal morbidity and mortality.

- Research into the type of herbal preparation being used by pregnant women and the effect on the outcome of pregnancy since close to half of the study population was using a kind of herbal preparation

- Should conduct severe maternal morbidity studies in other parts of the country to produce a more comprehensive national picture

Ashanti Regional health directorate

- The Ashanti Regional Health Directorate should increase capacity to manage severe maternal morbidity in the facilities so as to decrease the number of referrals from the district and regional hospitals to the teaching hospital.

Kumasi South and Suntreso Hospitals

- Anemia in pregnancy, possible caesarean section, and preterm delivery should be considered as high risk group and managed appropriately to avert the chances of severe maternal morbidity and mortality in the Suntreso and Kumasi South Hospitals
- Effective intervention to prevent and manage severe postpartum haemorrhage in the facilities should be done since majority of the potentially life threatening cases were severe postpartum haemorrhage.

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APPENDICES

APPENDIX I: PARTICIPANT INFORMATION SHEET

Title of Research: Severe maternal morbidity and associated factors in Suntreso and Kumasi South Government hospitals-Ashanti region, Ghana, 2014/2015.

Institutional Affiliation:

School of Public Health, University of Ghana, Legon.

Personal Introduction:

The Lead Investigator is Nana Yaw Peprah who is an Mphil Student pursuing Epidemiology and disease control at the School of Public Health, Legon. I am conducting a study on severe maternal morbidity and associated factors in Suntreso and Kumasi South Government hospitals in the Ashanti region. This study is for academic purposes and a requirement for the award of master of philosophy in epidemiology and disease control and supervised by Professor Col E. A Afari of School of Public Health, University of Ghana, Legon.

Procedure

Structured questionnaire will be administered to participants at their own convenient time in the hospital just before discharge. Extraction of data from maternity records will be carried out by trained midwives including the principal investigator who is a medical officer.

Confidentiality

All the information obtained from this study will be kept confidential and used for the purpose indicated for the study. The information will be securely stored (both softcopy and hardcopy) without the names of the participants, in a file which will only be accessible to the research team.

Risk and Benefit

Participant will be made to know that there is no risk associated with participating in this study. The participants will be however informed of possible minor discomforts in answering certain questions for which they may choose not to answer. Participants will be informed that participation in the study was voluntary and they may withdraw from the study at any time without attracting any penalty.

In case any aspect of this research is not clear to you, the participant can contact me, Nana Yaw Peprah (naya_pep@yahoo.com, Tel; 233 0202536123) or my supervisor Prof. Col. Afari (afariea@yahoo.co.uk Tel; 233 0208131828), Ms Hannah Frimpong, Adminstrator,Ghana Health Service, Ethics Review Committee (233 0507041223 or 233 0243235225)

CONSENT FORM

I…….have read/understood the content of this study. I have been adequately informed about the purpose, procedure, potential risk and benefits of the study. I have been given the opportunity to ask questions about the study and my questions were answered satisfactorily. I know that I can choose not to participate in this study or withdraw from this study at any time without the loss of any benefit which I would have otherwise been entitled to. I agree to participate in this study

Signature/thumbprint of participant/Guardian…….

Signature/thumbprint of Witness …….

Interviewer statement

I have clearly explained the study to the participant in the language that he or she understands best and he/she has agreed to participate in the study.

Name of interviewer..... Signature ……

Date consent signed……..

APPENDIX II: DATA COLLECTION TOOLS

Questionnaire

TITLE: **Severe maternal morbidity and associated factors in Kumasi South and Suntreso Government hospitals-Ashanti region/Ghana.**

Consent/confidentiality: This is a research aimed at improving the quality of obstetrics care at this facility through finding near miss indicators and factors contributing to severe maternal morbidity in Kumasi South and Suntreso Government hospitals-Ashanti region/Ghana. Confidentiality will be highly upheld by the researcher. We wish therefore to have your consent to answer the following questions.

Facility Code……..	Individual ID……
Date ……..	Time……..
Date of hospital arrival ……../……../…….	Date of hospital discharge/death…./…./…….
1a. Date of birth ……./……/…….	1b. Age in years……

2	Marital Status	☐ Single ☐ Divorced/Separated ☐ Married/Cohabitation
3	Occupation	☐ Trader ☐ Farming ☐ Artisan ☐ Professionals ☐ Unemployed ☐ Others specify ……..
4	Tribe	☐ Ga-adangme ☐ Ewe ☐ Akan ☐ Others specify……..

5	Religion	☐ Christian ☐ Muslim ☐ Other please specify …….
6	Education	☐ None ☐ Primary ☐ Junior High Secondary ☐ Senior High Secondary ☐ Tertiary
7	Have you ever smoked (any type)	☐ Yes ☐ No
8	If yes to 7 ,when was the last time you smoked	☐ before this pregnancy ☐ during this pregnancy
9	Have you ever taken alcohol?	☐ Yes ☐ No
10	If yes to 9 , when was the last time you took alcohol	☐ Before this pregnancy ☐ During this pregnancy
11	What quantity of alcohol do you take per day?	☐ 1 unit per day ☐ 2-3 units per day ☐ > 3 units per day
12	Gestational age (weeks)	……
13	Estimated delivery date (as provided in antenatal records)	……
14	Number of pregnancies (including current pregnancy)	……..
15	Number of pregnancies (including current pregnancy)	……
16	Number of previous births (excluding current delivery)	……..
17	Number of previous c---sections	……
18	Any other previous surgery (excluding c---section)	☐ Yes ☐ No
19	History of antenatal visit with current pregnancy	☐ Yes ☐ No
20	Number of antenatal visits with the current pregnancy	…….
21	Have you had herbal enema during this pregnancy	☐ Yes ☐ No
22	When was the last time you had the herbal enema	☐ More than 2weeks before labour ensued ☐ Less than 2weeks before labour ensued
23	Was there any complication related to pregnancy, childbirth, or postpartum	☐ Yes ☐ No

	period observed?	
24	Final mode of delivery/end of pregnancy	☐ Caesarean section ☐ Vaginal Delivery
25	If the answer is 3 (C---section) above, circle one of the following conditions	☐ Nulliparous, single cephalic, ≥37 weeks, in spontaneous labor ☐ Nulliparous, single cephalic, ≥37 weeks induced or prelabor CS ☐ Multiparous (no previousCS), single cephalic, ≥37 weeks, in spontaneous labor ☐ Multiparous (no previous CS), single cephalic, ≥37 weeks,induced or prelabor CS) ☐ All multiparous with previous CS, single cephalic, ≥37 weeks ☐ All nulliparous women with single breech pregnancy ☐ All multiparous woman with single breech (including previous CS) ☐ All women with multiple pregnancies (including previous CS) ☐ All women with single transverse/oblique lies (including previous CS) ☐ All women with a single cephalic pregnancy ≤36 wks (including previous CS)
26	About conditions at arrival in the facility and the referral process, specify.(0=No,1=Yes)	☐ A---Delivery or abortion occurred before arrival at the facility ☐ B--- Delivery within 3 hours of arrival in the health facility ☐ C--- Laparotomy within 3 hours of hospital arrival or in other hospital ☐ D---Women referred from other health facility ☐ E--- Type of the referring institution
27	Timelines	
28	Time of arrival at the hospital	
29	Time of arrival at the labor ward	
30	Time of C---section decision (if applicable)	

31	Time of C---section (if applicable)	
32	Potentially life threatening condition(PLTC)	☐ The condition was NOT present during the hospital stay ☐ The condition was present within 12hrs of hospital arrival ☐ The condition was present after 12hrs of hospital arrival
33	Cause of PLTC	☐ Severe postpartum hemorrhage ☐ Severe preeclampsia ☐ Eclampsia ☐ Sepsis or severe systemic infection ☐ Ruptured uterus
34	Contributory/associated Conditions	Please specify: (0=No, 1=Yes). ☐ Anemia ☐ HIV infection ☐ Previous c---section ☐ Prolonged/obstructed labor ☐ Sickle cell anemia

END OF WEEK SUMMARY

Number of deliveries	
Number of live birth	
Number of stillbirth	
Number of maternal death	
Number of maternal near miss	
Number of potentially life threatening	

Date of Data Collection: ……

Data Collector's Name: …….