COLLEGE OF HEALTH SCIENCES

UNIVERSITY OF GHANA

DETERMINANTS OF PERINATAL MORTALITY: A CASE CONTROL STUDY IN THE TEMA METROPOLIS IN THE GREATER ACCRA REGION OF GHANA

BY

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THIS THESIS IS SUBMITTED TO THE UNIVERSITY OF GHANA, LEGON, IN PARTIAL FULFILMENT OF THE REQUIREMENT FOR THE AWARD OF MASTER OF PHILOSOPHY IN APPLIED EPIDEMIOLOGY AND DISEASE CONTROL

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DECLARATION

I, BOAKYE-YIADOM ADOMAKO hereby declare that with the exception of the references made to other peoples' work which I have duly acknowledged, this dissertation which is my original work has neither in whole nor in part been presented to the University or elsewhere for another degree.

Signature ……..

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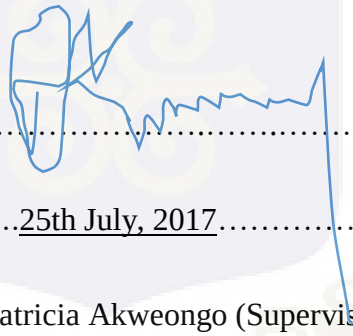

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Dr. Patricia Akweongo (Supervisor)

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Date ……25th July, 2017……...…

Dr. Reginald Quansah (Co-supervisor)

DEDICATION

This work is dedicated to God Almighty and to all the mothers who have ever suffered a perinatal death.

Dr Boakye-Yiadom Adomako

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LIST OF ABBREVIATIONS

AM-	Accra Metropolis
ANC-	Antenatal care
CS-	Caesarean Section
DHS-	Demographic and Health Survey
END-	Early Neonatal Death
ENDR-	Early Neonatal Death Rate
GAR-	Grater Accra Region
GHS-	Ghana health Service
ICD-	International Classification of Diseases
IPT-	intermittent preventive treatment
ITNs-	Insecticide Treatment Nets
LBW-	Low Birth Weight
MDGs-	Millennium Development Goals
NHIA-	National Health Insurance Authority
NICU-	Neonatal Intensive Care Unit
OECD-	Organization for Economic Cooperation and Development
PI-	Principal Investigator
PNM-	Perinatal Mortality
PNMR-	Perinatal Mortality Rate
PTB-	Preterm Birth
PTD-	Preterm Delivery
RHD-	Regional Health Directorate
SB-	Still Birth
SDGs-	Sustainable Development Goals

SP-	Sulfadoxine-Pyrimethamine
TGH-	Tema General Hospital
TMHD-	Tema Metro Health Directorate
TTI-	Tetanus Toxoid Injection
UNICEF-	United Nations Children's Emergency Fund
WHO-	World Health organisation

ABSTRACT

Introduction: More than five million newborns are stillborn or die within the first 7 days of life each year globally. In Ghana prematurity, low birth weight, multiple births, birth complications and first order pregnancies are known to be major determinants of perinatal deaths. However it is unclear what the major contributors to perinatal mortality in the Tema Metropolis are. This study was conducted to assess the determinants of perinatal mortality in the Tema Metropolis in the Greater Accra region of Ghana.

Methods: A 1:2 unmatched case-control study design was used. Cases were all stillbirths and neonatal deaths within seven days after delivery in Tema General Hospital from February 2017 to June 2017. Control group were those newborns delivered in Tema General Hospital during the same period, who survived the perinatal period. Structured questionnaires were used to collect data. Data analysis was done with STATA version 13.

Results: The factors significantly associated with reduced odds of perinatal mortality were early antenatal booking (odds ratio (**OR)** = 0.06), higher number of antenatal visits (OR = 0.28), uptake of at least the third dose of the routine Sulfadoxine-Pyrimethamine **(IPT3)** (OR = 0.21) and sleeping under Insecticide Treated Net **(ITN)** (OR = 0.10). Those associated with higher odds of perinatal mortality were; presence of an obstetric complication (OR = 13.66), presence of maternal infection (OR = 3.14), a baby being male (OR = 5.08), preterm delivery (OR = 2.58), low birthweight (OR = 4.29) and baby requiring aggressive resuscitation (OR = 20.71, 95% CI: 1.56-273.95, p = 0.021).

Conclusion: Early entry to antenatal care, higher number of antenatal visits, uptake of IPT3 and sleeping under ITN may protect against perinatal mortality in the Tema Metropolis. Obstetric complications, maternal infections, a baby being male, preterm delivery, low birthweight and baby requiring aggressive resuscitation may increase risk of perinatal

mortality. There is the need for education and campaigns in the Tema metropolisto help improve high levels of antenatal attendance, use of ITN and IPT3 uptake for pregnant women.

CHAPTER ONE

1.0 INTRODUCTION

Perinatal survival is directly linked to effective maternal and newborn care throughout pregnancy, labour, and the postpartum period (J. Vogel et al., 2014). Millennium Development Goals 4 (reduce child mortality) and 5 (improve maternal health) were closely tied to each other because the health of a mother is essential for the health of the newborn infant (Chinkhumba, De Allegri, Muula, & Robberstad, 2014). Perinatal mortality rate is a good indicator of the extent of pregnancy wastage (failure of a couple to produce a live birth or failure of a live newborn to survive the first week of life). It is also a good indicator of the quality as well as the quantity of health care available to a mother and a newborn (Tachiweyika et al., 2011). Research in some countries on child mortality has revealed that the proportion of under-five child deaths occurring in the first month of life has been increasing (Titaley, Dibley, Agho, Roberts, & Hall, 2008).

A perinatal death is a fetal death (stillbirth) or an early neonatal death (END). A stillbirth is the death of a fetus weighing 1000g or more, or of 28 weeks gestation or more if weight is unavailable (World Health Organization - WHO). An early neonatal death (END) is the death of a baby in the first 7 days of life (0 to 6 days).

I conducted this study is to assess the determinants of perinatal mortality in the Tema Metropolis in the greater Accra region of Ghana.

1.1 Background

According to the World Health organization, more than five million babies are either stillborn or die within the first 7 days of life each year globally. In the year 2009, about 2.6

million babies were stillborn and 2.8 million newborns died in the first week of life (WHO, 2016). Nearly forty percent of deaths among children under 5 years of age occur during neonatal period and about seventy five percent of these neonatal deaths occur in the early neonatal period. About one-third of these deaths occurs during the intra-partum period and these could mostly be prevented (Carlo et al., 2010).

The perinatal mortality rates in the developed regions of the world is about 10 per 1000 births compared to approximately 50 per 1000 births in less developed regions of the world. Estimates in the regions indicate that West African countries have some of the highest rates of perinatal mortality in the world (World Health Organization 2006).

Finding ways to end these preventable perinatal deaths is paramount on the international public health agenda and accurate data on perinatal mortality is in great demand all over the world. Among the United Nations Sustainable Development Goals (SDGs) is the goal to end preventable perinatal deaths, neonatal deaths and deaths of children under 5 years by 2030 (Wojcieszek et al., 2016). Hence there are major interventions taking place all over the world to address the issues about maternal and child health in order to achieve the goals set (WHO, 2006). However the progress in preventing these stillbirths and early neonatal deaths is quite slow (Allanson et al., 2016). Even though there is a reduction in the mortality rates of children under five years, perinatal mortality is still high in low and middle income countries like Ghana and reducing perinatal deaths rates has been a major challenge in most of these countries.

There is the need to have better estimates of perinatal mortality as well as reliable information on its determinants in low and middle income countries. Improving the data is the first step towards making these deaths count in public-health action (Stanton, Lawn, Rahman, Wilczynska-Ketende, & Hill, 2006). Proper documentation of the perinatal deaths and the identification of their determinants are very important steps to develop more focused

and appropriate health policies and interventions for reducing perinatal deaths. However, information on the causes and determinants of perinatal mortality in most low and middle income countries is scanty (Diallo et al., 2010). Many countries in the West African sub-region like Ghana, with high perinatal death rates often have weak data management and healthcare systems, resulting in inadequate reliable information on perinatal morbidity and mortality and scarcity of high-quality data (Diallo *et al.* 2010). This makes the problem barely visible to donors and policymakers.

1.2 Problem statement

The Perinatal mortality rate for Ghana is considered high at 21 per 1000 births (DHIMS 2, 2015). Majority of all the neonatal deaths in Ghana occur in the first week of life (0 to 6 days after birth) (Demographic Health Survey, 2008). The perinatal mortality rate for the Greater Accra region for the year 2015 was slightly higher than that of the country, 22 per 1000 births. The perinatal mortality rate for Tema General Hospital for the year 2015 was as high as 66 per 1000 births. This is about 3 times the rates for Ghana and the Greater Accra Region in 2015. Globally, the main contributors to perinatal deaths are preterm birth, birth asphyxia, multiple pregnancy, congenital malformations or anomalies and hereditary disorders (Liu et al., 2015); WHO, 2006); (Tromp et al., 2009).

In Africa preterm delivery (Prematurity), Low birth weight, maternal Infections, obstetric complications and Maternal hypertension are known to be the main contributors to perinatal deaths (Ngoc et al., 2006); (Edmond et al., 2008); (Ezechi et al., 2015); (Allanson, Muller, & Pattinson, 2015). In Ghana, even though harmful cultural practices contribute to perinatal mortality, prematurity, low birth weight, multiple births, birth complications including asphyxia and first order pregnancies are the known to be the major determinants of perinatal deaths (Baddoo, 2014); (Engmann et al., 2012). Perinatal mortality in the Tema Metropolis

in the Greater Accra Region of Ghana remains high (DHIMS 2). However majority of these deaths in this industrialized and cosmopolitan area remain unexplained. This study was done to assess the determinants of perinatal mortality in the Tema Metropolis in the Greater Accra region of Ghana.

1.3 Justification

Perinatal mortality in the Tema Metropolis remains high but majority of these deaths remain unexplained. The findings of this study may help mothers, health workers, person in authority and policy makers to know the maternal, fetal/neonatal and delivery related determinants of perinatal deaths in the Tema Metropolis in the Greater Accra Region which may ultimately help in developing policies to reduce perinatal deaths. Reducing perinatal mortality usually involves established interventions along with the means to make them effective in each setting.

Focused interventions to likely key findings in this study may help to significantly reduce perinatal mortality in the Tema Metropolis in the Greater Accra Region of ghana. Occasionally it may be difficult to distinguish stillborn infants from those live born infants who die soon after birth (especially those who are extremely preterm, asphyxiated, or neurologically depressed and die soon after birth. Assessing the determinants of both still births and early neonatal deaths together may help in the formulation of perinatal programs and interventions that may help to reduce mortality.

1.4 Conceptual Framework

Perinatal mortality is influenced directly or indirectly by a number of factors. This conceptual framework attempts to explain or highlight the influence of various factors on

perinatal mortality. These factors have been grouped into socio-demographic, maternal, fetal/neonatal and delivery factors.

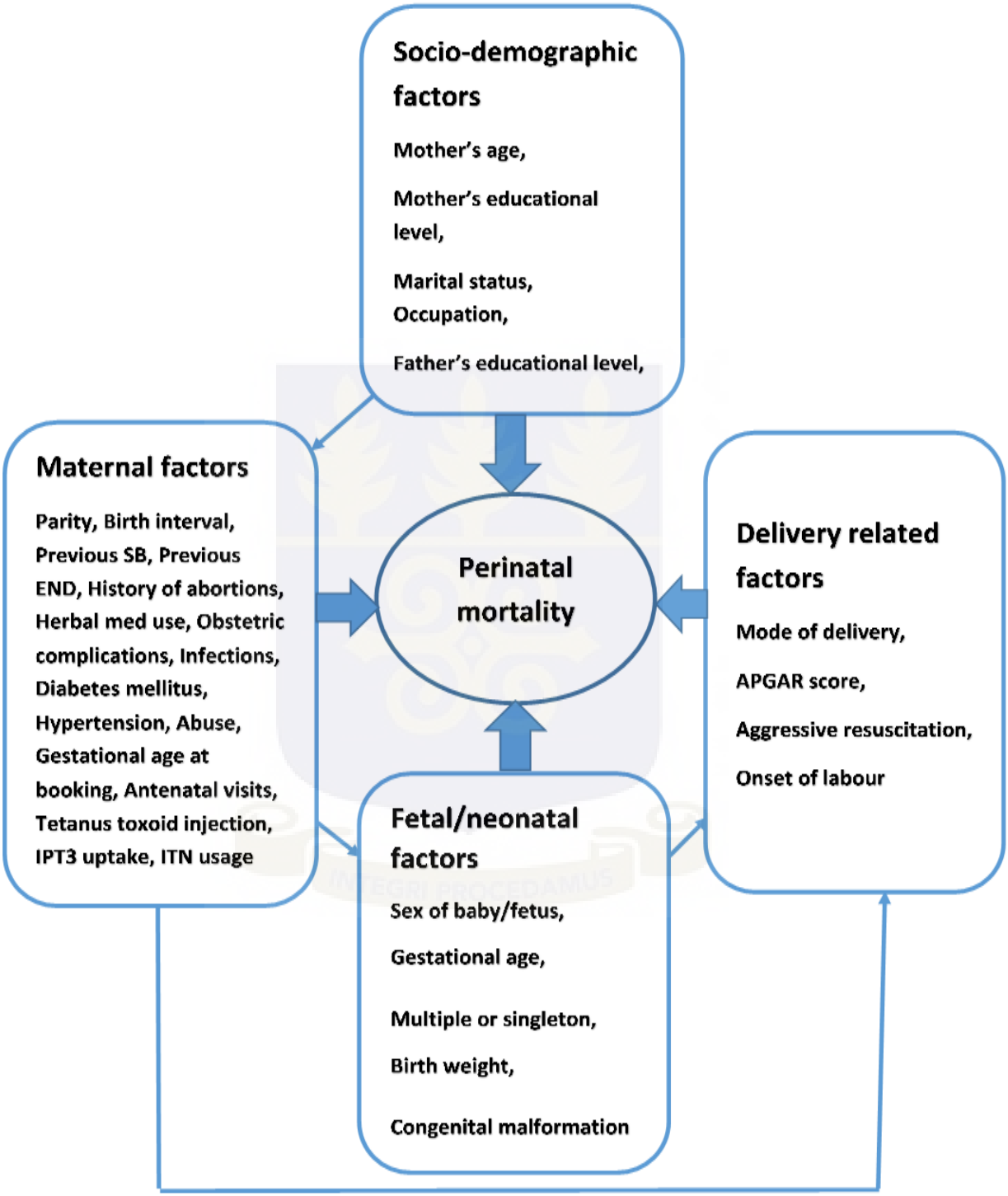

Figure 1: Conceptual framework for the determinants of perinatal mortality in the Tema Metropolis in the Greater Accra Region of Ghana.

The different categories of determinants of perinatal mortality presented in the diagram above are well-known concepts.

World-wide, socio-demographic characteristics are known to influence perinatal mortality in both developed and developing countries. Extremes of age are known to be associated with increased perinatal mortality. Very young girls in the teenage period do not have fully developed reproductive system, predisposing them to complications of labour such as obstructed labour. Likewise older women (40years or more) especially those who have been managing infertility may be exposed to fetuses with congenital malformations which are major causes of perinatal mortality. Marital status of a woman is also recognized as a factor influencing decisions to attend antenatal clinic. Unmarried women may have their autonomy to seek health care compared to married women. Women who are married also receive both financial and moral support from their partners and are likely to be accompanied by their partners to antenatal clinic. Educational background of both mothers and fathers are known to influence perinatal mortality. Those with higher education are likely to be exposed to new knowledge and hence they are likely to attend ANC compared to those with lower educational background. Mothers who are gainfully employed are more likely to be financially independent and hence more likely to seek antenatal services without waiting for financial assistance from their partners.

Also the framework shows the link between socio-demographic factors and maternal factors and their influence on perinatal mortality. Some maternal factors may be influenced by the socio-demographic factors and maternal factors are in turn likely to influence perinatal mortality. For example adequate number of antenatal visits (which may be influenced some socio-demographic factors as stated above) may help in educating pregnant women on good health practices and also enhance early identification and diagnosis of obstetric complications and coexisting medical conditions. Some of the maternal factors may directly

affect some fetal/neonatal factors and delivery related factors. For example obstetric complications may influence early delivery iatrogenically to save the life of the mother, hence may result in prematurity or low birth weight which are some of the main causes of perinatal mortality. Infections, other medical conditions and obstetric complications may again influence the onset of labour (labour may be induced). Infections may also affect the mode of delivery. Hypertension and its complications such as pregnancy-induced hypertension, pre-eclampsia, eclampsia, may be an indication for the obstetrician to empty the uterus as quickly as possible even when the gestation is not term. Nulliparous women (yet to have first delivery) may have a higher risk of complicated or obstructed labour and hence may have a higher risk of perinatal mortality and are also more likely to be delivered through CS. Previous abortions with cervical manipulation may predispose mother to incompetent cervix that has the potential to cause subsequent abortions and preterm delivery (causing prematurity) which may lead to perinatal mortality.

It is widely known that being male and having a low birth weight tend to increase the risk of perinatal mortality. Congenital malformations are also known to increase the risk of perinatal death. A low Apgar score especially in the 1st minute is usually associated with (but not the only criterion for diagnosing) birth asphyxia, a known major cause of perinatal mortality.

1.5 Study Objectives

1.5.1 General Objective:

To assess determinants of perinatal mortality in the Tema Metropolis in the Greater Accra region.

1.5.2 Specific objectives:

1. To determine the maternal factors associated with perinatal mortality in the Tema Metropolis.
2. To determine fetal/neonatal factors associated with perinatal mortality in the Tema Metropolis.
3. To determine delivery related factors associated with perinatal mortality in the Tema Metropolis.

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 Perinatal Mortality

Large numbers of babies are either born dead or die soon after birth. Majority of live newborns lose their lives during the first week.

Without a major reduction in newborn deaths in the first week of life, reduction in the overall neonatal mortality and mortality among children under five years of age is unlikely to be realized. This is because globally majority of the neonatal deaths occur within the early neonatal period (the first 7 days) (Carlo et al., 2010). Very important for the prevention of perinatal deaths is understanding of their causes and determinants within a given population (Wojcieszek et al., 2016). Understanding the causes and determinants of perinatal death is essential when developing an effective perinatal health policy (Engmann et al., 2011). Neonatal deaths and still births have many common determinants. The most common determinants of perinatal mortality in low and middle income countries are preterm delivery, infections, hypertensive disorders and birth asphyxia (Allanson et al., 2015). Perinatal deaths may also be as a result of poor maternal health, inadequate care during pregnancy, inappropriate management of complications during pregnancy and delivery, poor hygiene during delivery and the first critical hours after birth, and lack of newborn care(Safer, 2007). A study by Kulkarni et al in India to investigate the causes of perinatal mortality using by verbal autopsy showed that some important factors associated with perinatal mortality were unskilled deliveries, low level of antenatal care and lack of equipment for the management of premature and low birth weight babies at the primary healthcare level (Kulkarni, Chauhan, Shah, Menon, & Puri, 2007). Poor service delivery as well as perceived poor quality of care, especially among the poorest groups, are some important factors associated with perinatal mortality (Chinkhumba et al., 2014).

2.2 Socio-demographic Factors Influencing Perinatal Mortality

Social factors have very great influence on the outcome of a birth (Safer, 2007). In a study conducted in a rural area in Burkina Faso to determine the causes and determinants of still births and neonatal deaths using verbal autopsy, it was found that the major factors associated with neonatal deaths were the social, cultural, economic, and environmental factors (Nagalo, Ouedraogo, Tall, & Ye, 2015).

It is said that poverty may influence the occurrence of perinatal mortality (Essén, Hanson, ÖSTERGREN, Lindquist, & Gudmundsson, 2000). Unfavorable living conditions as well as the lack of funds for medical expenses may be a reason for increased perinatal death (Yirgu, Molla, Sibley, & Gebremariam, 2016).

Education of women is essential for improved health outcomes. A study in Ethiopia showed that survival of newborns is improved among women with at least secondary level of education (Mekonnen, Tensou, Telake, Degefie, & Bekele, 2013). A meta-analysis revealed an association between perinatal mortality and low level of maternal education (Berhan & Berhan, 2014). However, another study in Rwanda did not show any significant association between maternal education and perinatal mortality (Musafili, Essén, Baribwira, Selling, & Persson, 2015).

It has been documented that advanced maternal age constitutes a risk to both mother and newborn. Recent studies have demonstrated a significant increase in the incidence of cesarean section, pregnancy induced hypertension, gestational diabetes, and perinatal mortality mothers with advance age (Schoen & Rosen, 2009). Another study showed an increase in perinatal mortality and neonatal death in relation to advance maternal age (above 40 years) (Jacobsson, Ladfors, & Milsom, 2004). Adolescents have higher risks for low birth weight, preterm delivery, and small-for-gestational-age infants which are major causes

of perinatal mortality (Conde-Agudelo, Belizán, & Lammers, 2005). Advanced maternal age may be associated with adverse maternal and perinatal outcomes in pregnancies. However a study conducted to ascertain whether advanced maternal age was associated with increased perinatal morbidity and mortality revealed that advanced maternal did not have adverse effect on the perinatal outcomes of pregnancies (Mullins & Kumar, 2012). Another study by Yaniv et al (2011) showed that advanced maternal age is not an independent risk factor for perinatal mortality (Yaniv et al., 2011).

In our societies, a father is the main income earner and decision maker of a family. So, father's education plays an important role in earning income and is essential to the survival of newborns. A study in Rajshahi District, Bangladesh revealed that the higher a father's educational attainment, the lower perinatal, neonatal, post-neonatal and child mortality level (Mondal, Hossain, & Ali, 2009). A study by Habib et al (2008), revealed that paternal social characteristics appear to have stronger influence on perinatal mortality than maternal characteristics in developing countries (Habib et al., 2008).

2.3 Maternal Factors Influencing Perinatal Mortality

Previous studies have reported primigravidae and null parity as high risk for perinatal death in Africa (Habib et al., 2008) (Engmann et al., 2009) (Diallo et al., 2010). Among the reasons listed for this is the higher risk of obstructed and complicated labour. A study to determine the relationship between parity and perinatal mortality conducted in Sweden, showed a U-shaped relationship, with first as well as third, fourth and higher order pregnancies being at higher risk compared to second order pregnancies (Gardosi, Clausson, & Francis, 2009). However another study in West Gojam zone, Ethiopia, revealed that babies who were born to multiparous mothers showed a better chance of surviving the perinatal period compared

to the first babies (Yirgu et al., 2016). Another study suggested that null parity is associated with a higher risk of preterm delivery resulting in poor perinatal outcomes (Ota et al., 2014). There is an association between number of antenatal visits and perinatal mortality. There is an evidence that routine antenatal visits for healthy pregnant women helps in reducing perinatal mortality (Hofmeyr & Hodnett, 2013).

A study conducted in 2014 by Vogel et al on maternal complications and perinatal mortality showed that vast majority of perinatal deaths occur in women with obstetric complications and thus the early identification and management of these complications could significantly reduce perinatal mortality rates. Another study suggested that complications during the pregnancy, no medical care for these complications, poor knowledge about complications and symptoms had significant relationship with perinatal mortality (Rakotoseheno et al., 2008). However another study in a South African province showed that a significant proportion of women had no recognisable obstetric condition at the time of a late perinatal death, hence to be able to predict poor perinatal outcome emphasis should not be put on detecting maternal complications prior to a perinatal death (Allanson et al., 2015).

Shorter birth interval (delivery within two years from previous delivery) is known to increase the risk of perinatal death. Mekonnen et al (2013) found that children born within two years from previous delivery were 2.2 times more likely to die compared to children born at an interval of 2 or more years from the previous delivery (Mekonnen et al., 2013). This could result from maternal depletion syndrome (from the shorter birth interval) and competition between siblings for limited resources (Rutstein, 2005).

A history of still birth may influence the occurrence of another. However a study carried out by Surkan et al showed that rate of still birth among mothers who had experienced a previous still birth for their first pregnancy was lower compared to mothers whose first infant had

been born alive. According to them this may be so because there was probably enhanced supervision of the pregnancy and delivery of women with a history of stillbirth (Surkan, Stephansson, Dickman, & Cnattingius, 2004).

Previous abortion has been documented as a determinant of perinatal mortality. This is because previous abortion history has been associated with low birth weight and preterm birth, and this risk may increase with the increasing number of previous abortions (Brown, Adera, & Masho, 2008). Another study showed that the rates of preterm births, prematurity and perinatal mortality increase with the number of preceding abortions (Voigt et al., 2009). According to Desale et al (2016), nearly one million of all early neonatal deaths that occur each year globally are as a result of infections in pregnancy. Infections in pregnancy may result in different undesirable obstetric outcomes, including preterm delivery, premature rupture of membranes, still birth, spontaneous abortion, congenital infection, and congenital anomalies (Desale, Thinkhamrop, Lumbiganon, Qazi, & Anderson, 2016). In a study by Mazor-Dray et al, maternal urinary tract infections (UTI) was found to be associated with preterm birth but it was not associated with increased rates of perinatal death compared with women without urinary tract infections (Mazor-Dray, Levy, Schlaeffer, & Sheiner, 2009). In a study to determine the effect of maternal Human immunodeficiency Virus (HIV) infection on perinatal mortality in southwest Tshwane, there was a thirty percent increased risk of having a perinatal death among the mothers living with HIV compared to mothers without HIV. This was because mothers living with HIV had increased incidence of preterm birth and intra-partum asphyxia (Pattinson, Hulsbergen, & Van Hoorick, 2010). According to Bellizzi et al, about five percent of all early neonatal deaths were attributable to signs suggestive of puerperal infections in studies carried out in Honduras and Indonesia (Bellizzi, Bassat, Ali, Sobel, & Temmerman, 2017).

Pre-gestational diabetes has been found to be associated with a higher rate of perinatal mortality. (Melamed & Hod, 2009).(Engmann et al., 2009) According to Starikov et al, pre-gestational diabetes currently complicates 4% of pregnancies, while gestational diabetes complicates approximately 8% of pregnancies (Starikov, Dudley, & Reddy, 2015). Congenital abnormalities and preterm labor are the main factors contributing to the higher perinatal mortality among women with preexisting Diabetes mellitus (Vitoratos, Vrachnis, Valsamakis, Panoulis, & Creatsas, 2010). Some studies showed that women with diabetes mellitus had worse pregnancy outcomes compared to women without diabetes and pre-gestational diabetes was associated with more frequent complications than gestational diabetes (García-Patterson et al., 2011; Rashid, Khatoon, Hasnat, Amin, & Azad, 2017).

The prevalence of hypertensive disorders in pregnancy is increasing and their etiology and pathophysiology remain poorly understood (Olson-Chen & Seligman, 2016). Hypertensive disorders of pregnancy complicate 7% to 10% of pregnancies and are among the major causes of perinatal morbidity and mortality (Vadhera & Simon, 2014). A study to determine the prevalence and impact of hypertensive disease on perinatal outcomes suggested that both non-severe hypertension and severe hypertension increases risk of still birth, preterm delivery and babies with small size for their gestational age all of which are major causes of perinatal mortality (Johnson et al., 2016). According to Ebeigbe et al, early onset pregnancy induced hypertension (PIH) is associated with an increased risk of perinatal death compared to a late onset pregnancy induced hypertension (Ebeigbe & Aziken, 2010). Women who are pregnant and are victims of intimate partner violence (IPV) have high rates of stress and are more likely to deliver before term or deliver a low birth weight infant. They are also more likely to have an increased perinatal complications and are less likely to obtain prenatal care (Chambliss, 2008). A study done by Kendall-Tackett to determine the impact of physical and sexual violence or abuse on pregnancy and breastfeeding revealed that a

pregnant woman who has been abused in the past has an increased risk of depression and post-traumatic stress disorder which also increases the risk of pregnancy and perinatal complications (Kendall-Tackett, 2007). According to Sarkar (2008), physical or sexual intimate partner violence or both on women varies from 15% to 71% in many countries and violence on pregnant women increases risk for perinatal death. (Sarkar, 2008). A study conducted by Sarkar in 2013 revealed that domestic violence occurred in every society, irrespective of class, creed, religion and country. Pregnant women experienced physical and sexual abuse, irrespective of their age. Women who experienced violence were less likely to receive antenatal care and had a higher risk of perinatal than women having no violence during pregnancy (Sarkar, 2013)

Early initiation of antenatal care is widely believed to improve maternal and fetal outcomes (Ifenne & Utoo, 2012). According to Okunlola et al, in 2008, in Nigeria, pregnant women who did not book early for antenatal care were more likely to deliver through caesarean section, more likely to experience delivery complications and more likely to have low birth weight babies compared to pregnant women who booked early for antenatal care. However, they found that the gestational age at booking had no significant association with perinatal outcome as the outcome was same for both mothers who booked early and those who booked late (Okunlola, Owonikoko, Fawole, & Adekunle, 2008).

The results of a study suggested that in an area of high malaria transmission, intermittent preventive treatment (IPT) with sulfadoxine pyrimathamine (SP) may be a safe and effective way of reducing of malaria in pregnancy which may altimately help to reduce low birth weight and perinatal mortality (Tagbor, Bruce, Agbo, Greenwood, & Chandramohan, 2010).

A study to determine the association between herbal medicine use during pregnancy and perinatal mortality in Tumpat District, Kelantan, Malaysia showed that the use of herbal medicines during the first trimester of pregnancy were significantly associated with an increased risk of perinatal mortality. However the use of herbs during the third trimester of pregnancy were associated with a decreased risk of perinatal mortality. These findings suggested the use of herbal medicines in late pregnancy were protective against perinatal mortality, while their use in early pregnancy had an increased risk of perinatal mortality (Ab Rahman et al., 2007).

Maternal Tetanus Toxoid injection (TTI) during antenatal care is known to provide enormous benefits for both newborns and mothers. Maternal Tetanus Toxoid injection was shown to have a protective role in a study carried out in Ethiopia on the trends and determinant of neonatal mortality (Mekonnen et al., 2013).

It is known that the use of insecticide treated bed nets (ITN) helps in reducing malaria transmission and decreases mortality but evidence on the direct impact of bed nets on perinatal mortality has been mixed. A study carried out in Eastern Uganda estimated that one perinatal death was prevented for every 7 nulliparous women who slept under a bed-net (Nankabirwa et al., 2011).

2.4 Fetal/Neonatal Factors Influencing Perinatal Mortality

Newborn twins have higher risk perinatal mortality as they are much more likely to suffer from low birth weight, prematurity, fetal distress and birth asphyxia. Multiple pregnancies expose mother and infants to extremely high risks especially in developing countries (J. P. Vogel et al., 2013). A study conducted in a community in Guinea-Bissau revealed a very high perinatal twin mortality rate of 218/1000 which was three-fold higher than that of singletons (Bjerregaard-Andersen et al., 2012). In a study on the perinatal mortality in Lagos

University Teaching Hospital, the rate of perinatal mortality was higher among those with multiple pregnancies (Olamijulo & Olaleye, 2010). However another study has shown that the perinatal mortality of multiple pregnancies does not impact significantly the overall perinatal mortality (Hernández-Herrera & Ramírez-Sánchez, 2010).

It is generally known that boys have higher mortality rates in the early neonatal period than girls. However, in some societies the mortality rate among girls is higher than that among boys because of the strong preference for boys (Safer, 2007). A study in 2013 in Ethiopia confirmed that male newborns have a much higher risk dying compared to female newborns (Mekonnen et al., 2013). A study showed that being a male fetus is a significant risk factor for spontaneous preterm birth which is a major cause of perinatal mortality (Peelen et al., 2016).

Birth weight has a great influence on perinatal mortality. Low birth weight and intra-uterine growth retardation are likely to increase perinatal mortality. A birth weight less than 2000g is a strong risk factor for perinatal mortality (Bjerregaard-Andersen et al., 2012). Another study in rural Central Africa showed that newborns weighing 1500 g or more are likely to survive even in remote areas (Engmann et al., 2009).

Preterm birth results in prematurity. Premature babies have poorly developed systems (both anatomic and physiologic systems) and hence have a higher risk of perinatal death (Yirgu et al., 2016). Preterm babies often die of hypothermia (poorly developed thermoregulatory systems) and respiratory distress syndrome (underdeveloped lungs) (Tachiweyika et al., 2011). Preterm delivery is a known to increase the rates of perinatal mortality even in advanced settings where equipment and expertise are available for comprehensive neonatal care (Tegegne, Enquoselassie, & Yusuf, 2010).

Congenital malformations or birth defects as well as birth injuries account for an increasing proportion of newborn deaths in both developed and developing countries. Mortality attributable to congenital anomalies is higher in poorer countries (Rosano, Botto, Botting, & Mastroiacovo, 2000). A study in rural northern Ghana highlighted birth injuries as a major causes of perinatal death (Engmann et al., 2012).

2.5 Delivery Factors Influencing Perinatal Mortality

Perinatal mortality may occur during the intra-partum or delivery period. Perinatal death during this period is the result of fresh stillbirth (FSB). An estimated 2.6 million stillbirths occur worldwide every year, of which over 40% are intra-partum related. (J. Vogel et al., 2014). A study carried out in rural Central Africa show the ratio of fresh to macerated stillbirths of approximately 10-fold higher than expected, suggesting a more prominent role for improved intra-partum obstetric interventions (Engmann et al., 2009).

Induction of labor for non-recognized indications at term is associated with an increased risk of adverse outcomes and hence caution is needed with a liberal policy of induction of labor at term in an otherwise uncomplicated pregnancy (Grivell, Reilly, Oakey, Chan, & Dodd, 2012). According to Bailit et al and Burkman, babies born with elective induction are associated with better outcomes compared to spontaneous labor. However elective induction may be associated with an increased hysterectomy risk (Bailit et al., 2010; Burkman, 2010). The appropriate use of labor-inducing drugs is not unsafe and improves outcomes in complicated (Suzuki, Hiraizumi, & Satomi, 2011).

Caesarean section poses some risk to the unborn fetus, especially those surgeries performed as an emergency procedure and for the well-being of the mother. However, the usual causes of perinatal mortality associated with caesarean section are mostly preventable (Ezechi et al., 2015). A study by Alshaheen & Abdal Karim (2010) showed that the perinatal mortality

was significantly higher in vaginal deliveries compared with caesarean deliveries and caesarean section reduced the perinatal mortality in both nulliparous and parous women in term breech infants (Alshaheen & Abdal Karim, 2010).

Apgar score after birth can be used as a rapid method for assessing the survival of newborn (Vahabi, Haidari, Akbari, & Gorbani, 2010). Low Apgar score is an important predictor of the newborn morbidity and death rate (Akello, Nabiwemba, Zirabamuzaale, & Orach, 2008; Atanasova, Slavkova, Yonov, & Valkova, 2011).

About ten percent of newborns may need immediate resuscitation interventions to facilitate lung development and begin spontaneous respiration after birth. A complete resuscitation procedure may be required by less than one percent of newborns (Szarpak, 2013). According to Afjeh et al, there is a positive correlation between the need for resuscitation and several risk factors of perinatal mortality (Afjeh, Sabzehei, & Esmaili, 2013). A study showed that significant risk factors for perinatal deaths included baby not being resuscitated (Akello et al., 2008). Resuscitation is said to be the most common procedure performed in neonatology. However, most of the contemporary guidelines on newborn resuscitation are based on experience rather than scientific evidence (Chabernaud, 2009). New contributions based on scientific evidence support the use of room-air instead of 100% oxygen in the resuscitation of both term and preterm newborns (Vento & Saugstad, 2011).

2.6 Summary

The socio-demographic, maternal, fetal/neonatal and delivery related factors act by themselves independently or collectively, and interact differently to impact on perinatal mortality in most studies. Most of the literature deal with specific individual factors or specific group of factors associated with perinatal mortality. However a better

understanding of how all these factors interrelate would be useful in planning effective actions and policies that will help reduce perinatal mortality.

CHAPTER THREE

3.0 METHODS

3.1 Study Design

An unmatched case control study design was used to carry out this study in the Tema Metropolis from February 2017 to June 2017.

3.2 Study Area

Tema Metropolis is one of the 16 administrative districts in the Greater Accra Region, located in the Southeastern part of Ghana. It is bounded in the North-East by Ashaiman Municipality, in the North-West by Adentan Municipality, on the West by Ledzokuku-Krowor Municipality, in the South by the Gulf of Guinea and in the East by the Kpone-Katamanso District. Generally, the metropolis stretches between latitude 5037'N in the southern coastline and latitude 5041'N at its northernmost limits. The Greenwich Meridian (longitude zero) passes through the Metropolis, and situated only about 50 from the Equator; hence, Tema Metropolis is considered as being the city in the center of the world. On the Tema coastline can be found a large Harbour, which stretches nearly 2 km long; and a Military Naval Base. These, along with its numerous large as well as small industrial establishments, make Tema very important for the economy and security of Ghana.

Tema Metropolis is made up of communities officially numbered 1 to 26. The Tema Metropolitan Assembly has classified the metropolis into 1st, 2nd and 3rd class residential areas. The estimated 2012 population of Tema Metropolis is 371,220, making it the second largest populated district of the 16 districts in the Greater Accra Region, after Accra Metropolis.

The metropolis has a relatively well developed health infrastructure. The metropolis has the following public health facilities which provide preventive and curative services: Tema General Hospital (TGH) – which is the main referral centre in the metropolis, Tema Polyclinic (TPC), Manhean Health Centre (MHC), Tema Metropolitan Assembly Maternity and Children's Hospital (TMA-M&CH), Tema Port Health Services, U-Compound Community-based Health Planning and Service Compound (U-Cpd), Ziggishore CHPS (Est. 2012). Tema Metropolis also has numerous private health facilities which provide services to individual as well as company clients. The Metropolitan Health Management Team (MHMT) has organized the orthodox institutions into a body – the Tema Public and Private Health Providers Association, and works in collaboration with the group. Over 60 private facilities are registered members. Many allied health care providers such as pharmacy and chemical shops, private laboratories, etc. are set up in most communities in the metropolis. A range of alternate health providers such as homeopathic centres, herbalists, bone setters, spiritual camps and traditional birth attendants also operate in the metropolis.

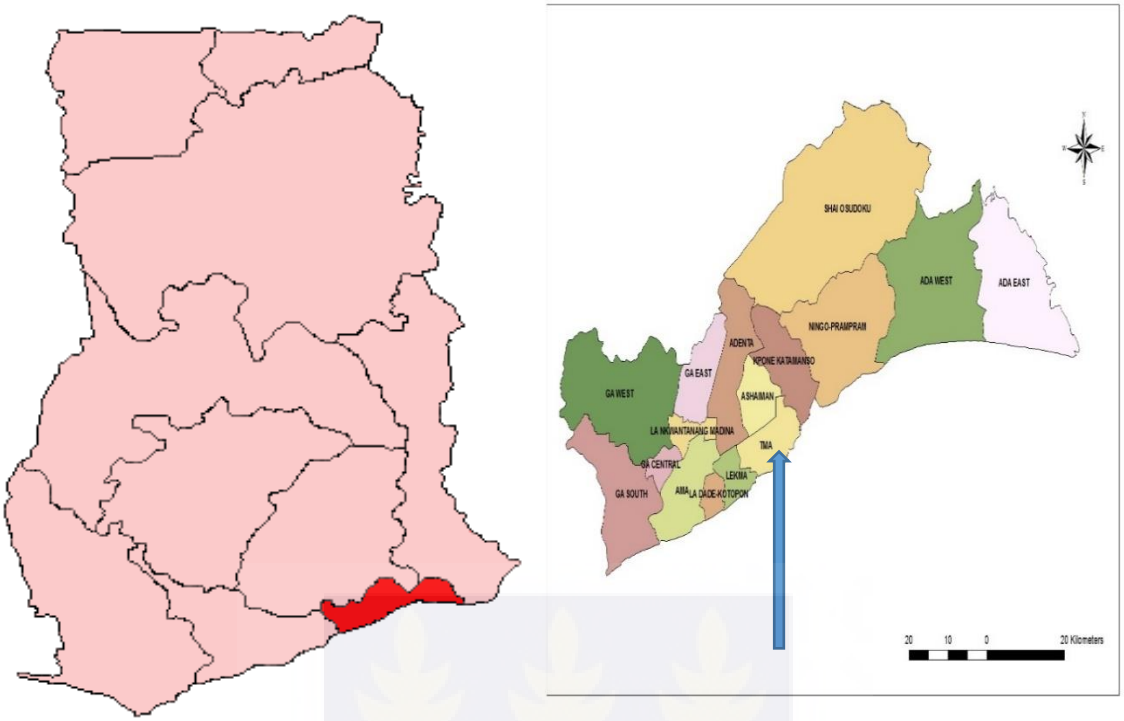

Figure 2: Map of Ghana (left) showing its ten regions and map Greater Accra Region (right) showing its Sixteen Districts (Tema Metropolis shown with an arrow).

3.3 Variables

Outcome variable – Perinatal mortality

Independent variables

The independent variables of interest collected from both the cases and controls were varied and they were grouped into Socio-demographic, Maternal, Fetal/Neonatal and Delivery related factors.

Table 1: The independent variables of perinatal mortality

Socio-demographic factors	Maternal Factors	Fetal/Neonatal Factors	Delivery related Factors
* Mother's age	* Parity	* Number of babies delivered	* Onset of labour
* Mother's educational status	* Birth interval	* Sex of the baby	* Mode of delivery
* Mother's Marital status	* History of still births	* Gestational age	* APGAR score
* Mother's Occupation	* History of END	* Birth weight	* Aggressive resuscitation of baby
* Father's educational status	* History of abortions	* Birth defect or birth injury	
* Father's Occupation	* Use of herbal medicine		
	* Obstetric complications		
	* Maternal Infections		
	* Diabetes mellitus		
	* Hypertension		
	* Assault		
	* Gestational age at booking		
	* Number of antenatal visits		
	* Maternal TT vaccination		
	* IPT3 uptake		
	* Bed net usage		

Operational definition of perinatal death (mortality): A stillbirth or an early neonatal death (END). A stillbirth is the death of a fetus of 28 weeks gestation or more prior to complete expulsion or extraction from the mother. An early neonatal death (END) is the death of a baby after delivery, in the first 7 days of life (0 to 6 days) (World Health Organization - WHO).

Table 2: The operational definitions, measurement scales and data sources for the socio-demographic variables in the study.

Variable	Definition (how is variable measured)	Scale	Data source
Mother's Age	Mother's age at child birth - the age (in years) of a mother as at last birthday: <20, 20 – 34, 35+	Nominal	ANC book interview
Mother's educational status	Mother's highest of education or school completed: No Schooling, Primary/JHS, Secondary/SHS, Tertiary	Ordinal	Interview
Marital status	Mother's legal marital status: Single, Married, Separated	Nominal	Interview
Occupation	Mother's principal work or business, especially as a means of earning a living: Farming, Trader/business woman, Artisan, Gov. work/private formal job, housewife, unemployed	Nominal	Interview
Father's educational status	Father's highest of education or school completed: No Schooling, Primary/JHS, Secondary/SHS, Tertiary	Ordinal	Interview
Father's occupation	Father's principal work or business, especially as a means of earning a living: Farming/fishing, Trader/business woman, Artisan, Gov. work/private formal job, unemployed	Nominal	Interview

Table 3: The operational definitions, measurement scales and data sources for the maternal independent variables in the study.

Variable	Description	Scale	Data source
Parity	The number of pregnancies carried to viable gestational age (>27 completed weeks and delivered dead or alive before index pregnancy: 0, 1 – 3, 4+	Nominal	ANC book/ Interview
Birth interval	The period of time, in years, between the delivery/birth from the index pregnancy and that from the preceding pregnancy: < 2, 2+, N/A	Binary	Interview
History of still birth	Any previous fetal death at 28 weeks gestation or more with no signs of life at birth: Yes, No, N/A	Binary	Interview
History of END	Any previous death of a live newborn at or before 7 days of life: Yes, No, N/A	Binary	Interview
History of abortions	Any previous spontaneous or induced termination of pregnancy before viable gestational age (before 28 weeks): Yes, No	Binary	ANC book/ Interview
Use of herbal medicine	The intake of local herbal preparations during the index pregnancy: Yes, No	Binary	Interview
Obstetric complications	The complications that directly arise from the pregnancy: Yes, No	Binary	ANC book/ Interview
Infection	Any infection present during the index pregnancy: Yes, No	Binary	ANC book/ Interview
Diabetes Mellitus	A mother suffering from Diabetes mellitus during pregnancy (pre-gestational and gestational): Yes, No	Binary	ANC book/ Interview

Table 4: The operational definitions, measurement scales and data sources for the maternal independent variables in the study.

Variable	Description	Scale	Data source
Hypertension	A mother suffering from Hypertension during pregnancy: Yes, No	Binary	ANC book/ Interview
Assault	Mother physically or sexually assaulted during pregnancy: Yes, No	Binary	Interview
Gestational age at booking	The age of a pregnancy, in weeks, at the first antenatal visit, where the origin is from woman's last normal menstrual period (LMP): <16, 17 – 27, 28+, N/A	Ordinal	ANC book
Number of antenatal visits	The number routine visits to the antenatal clinic: 0, 1 – 3, 4 – 7, 8+	Ordinal	ANC book
Maternal TT vaccination	The adequate number of tetanus toxoid vaccinations during the index pregnancy: 2 doses, 1 dose or no dose depending the number of doses previously given. A total of 5 doses protects throughout the childbearing years. Maximum of 2 doses recommended for each pregnancy: Yes, No	Binary	ANC book/ Interview
IPT3 uptake	Intake of at least the 3rd dose of Sulfadoxine-Pyrimethamine (for malaria prevention): Yes, No	Binary	ANC book/ Interview
Bed net usage	A mother usually sleeping under long lasting insecticide treated bed net during the period of the index pregnancy: Yes, No	Binary	ANC book/ Interview

Table 5: The operational definitions, measurement scales and data sources for the fetal/neonatal independent variables in the study.

Variable	Description	Scale	Data source
Sex of baby	Sex of the baby at birth: Male, Female	Nominal	Pink card/ Interview
Gestational age	The age of a pregnancy, in weeks, at birth, where the origin is from woman's last normal menstrual period (LMP): <37, 37 – 40, >40	Ordinal	ANC book
Number of babies delivered (singleton or Multiple)	Whether baby is a singleton or are twins, triplets or more: Multiple, Singleton	Binary	ANC book/ Interview
Birth weight	The weight of the baby at birth in kilograms as determined using a measuring scale: <2.5, 2.5–3.9, 4.0+, Not weighed	Ordinal	ANC book
Birth defect or birth injury	A physical defect present in a baby at birth or an injury sustained during delivery: Yes, No	Binary	Pink Card/ ANC book

Table 6: The operational definitions, measurement scales and data sources for the delivery related independent variables in the study.

Variable	Description	Scale	Data source
Mode of delivery	How baby was delivered or the type of delivery process: Vaginal delivery, Caesarean section	Nominal	ANC book
APGAR score	APGAR (Appearance, Pulse, Grimace, Activity, Respiration) score at 1minute: 1 – 3, 4 - 10	Ordinal	Pink Card/ ANC book
Aggressive resuscitation	Whether or not baby required aggressive suctioning and ventilation with or without chest compression.: Yes, No	Binary	Pink Card/ ANC book
Onset of labour	How labour started: Spontaneous, Induction, Caesarean section	Nominal	Interview/ ANC book

3.4 Sampling

The section contains discussions on the study population, sample size and how the cases and controls were selected for this study.

3.4.1 Case group and Control group

Cases and controls were selected from all babies delivered after 28 weeks of gestation in Tema General Hospital from February 2017 to June 2017. Cases were all stillbirths and neonatal deaths within seven days after delivery in Tema General Hospital from February 2017 to June 2017. Control group were those newborns delivered in Tema General Hospital during the same period, who survived the perinatal period.

3.4.2 Sample size

The sample size for the study was 309 comprising of 103 cases and 206 controls. Calculation of the sample size was done as follows: A ratio of 1 case to 2 Controls was adopted and 95% Confidence Interval at 5% level of Significance was applied. It is known from literature that early booking at the antenatal clinic is widely believed to improve maternal and perinatal outcomes (Ifenne & Utoo, 2012). A case control study conducted in the Marondera district in Zimbabwe, 2009, revealed that for 24.4% of the controls (no perinatal death), mothers booked after twenty seven weeks of gestation (Tachiweyika et al.,

2011). Putting the figure into the Epi info 7 Unmatched Case Control StatCalc package with 95% CI and power of 80%, it generated a sample size of 309 with 103 cases and 206 controls.

3.4.3 Sampling Method

The Tema General Hospital was purposely selected for this study as it is the metropolitan hospital and the main secondary referral health facility in the metropolis. It provides comprehensive Emergency Obstetric and Neonatal Care with Neonatal Intensive Care Unit (NICU) to manage extremely sick babies. The total deliveries for 2014 was 7,573 and for 2015 was 6,732.

Selection of cases

Cases were selected from the obstetric unit as well as the Neonatal Intensive Care unit (NICU). With a relatively rare outcome and a short duration for data collection, every perinatal mortality that occurred was selected as a case until the number required was reached.

Selection of control

A list, with the telephone numbers and addresses of mothers of all the live newborns who were discharged home, on the day of a perinatal death, was generated. Two controls were selected per perinatal mortality. The first was one delivered immediately before the selected case. The second was one delivered immediately after the selected case. Alternate day follow-up telephone calls were then made to the mothers until the 7^{th} post-natal day, to determine if the babies were alive.

3.5 Data collection

A structured questionnaire was used to collect data from the mothers of the selected babies (cases and controls). Some information given by the mothers were also verified from delivery registers, in-patient folders, maternal health records book, death notification forms and the neonatal cards (pink cards). In order to have complete data, we conducted face-to-face interviews with the mothers using the structured questionnaires. The mothers were counselled by a clinical psychologist, the principal investigator (a medical officer), midwives and staff nurses at the NICU. If they were found to be emotionally stable they were interviewed after they had given their consent. For the cases, the mothers were interviewed before they left the hospital or at the first post-natal review. Those who were found to be emotionally unstable were excluded from the study and given further counselling. For the controls, the interviews were conducted at least 7 days after delivery. It took about 20 minutes to complete an interview.

In the event that a mother (for the first control) refused or did not consent to be part of the study, we selected another control that is the one immediately before that first control whose mother refused to consent. If the mother for the second control initially selected refused to consent, we selected the one who was immediately after that, from the control list. The field workers (midwives and paediatric nursing staff) were recruited from their respective units in Tema General Hospital where the data were collected. These 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, were familiar with and knew how to use the study tools and were able to perform their various tasks.

The data collection tools were pre-tested in Tema Polyclinic which has similar characteristics as the General Hospital. The tools were pre-tested to enable us assess the field competence of the data collection tool and make the necessary modifications to ensure

they reflected the local conditions. It was also to ensure that the questions were clear and well understood by the respondents as well as making sure that the tools were well formatted.

3.6 Data Processing and Analysis

The data collected using the structured questionnaires were entered into an electronic database (Microsoft Excel, 2013). The data entered was then exported to STATA VERSION 13 for analysis. Descriptive data analysis was done and were expressed in the form of frequencies, proportions and percentages. The relationship between perinatal mortality and each selected independent variables were analysed using univariable logistic regression and reported as odds ratios (OR) with 95% confidence intervals (CI) and p-values <0.05 were judged significant.

Multiple logistic regression analysis were done and reported as odds ratios (OR) with 95% confidence intervals (CI) and p-values <0.05 were judged significant.

3.7 Ethical Consideration

Approval was obtained from the Ethical Review Committee of the Ghana Health Service. Permission was sought from the Greater Accra Regional Health Directorate, to use the Tema General Hospital as my study site for data collection and Tema Polyclinic for pretesting of the study tools. Permission was also sought from all the heads of the relevant institutions and departments.

Informed consent was sought from mothers of the selected babies and confidentiality assured before the study. They were given adequate information about the purpose, procedures, risks and benefits of participating in the study. For the mothers who could not

read the consent form was read and explained to them in the presence of an impartial witness (another clinical staff who knew about the study but not a field worker). Mothers who agreed to be part of the study were required to sign or thumbprint the consent form as an indication of their willingness to participate in the study.

All the information obtained from this study were kept confidential and used for the purpose indicated for the study. The information was securely stored without the names of the participants in a file, which was accessible only to the research team. Each name was assigned an ID code and kept confidential. The results of the study is reported in the aggregate and thus no information and no one will be able to trace back to the identity of a particular participant. Extraction of data from the mothers' records were done by trained health professionals including the principal investigator who have experience in the management of patients' records and information.

Mothers, especially those who had a perinatal death, were counselled and if they were found to be emotionally stable, they were interviewed after they had given their consent. They were informed about possible discomfort or sad memories in answering certain questions for which they had the choice not to answer. Those who were found to be emotionally unstable were excluded from the study and given further counselling.

Mothers were informed that participation in this study was voluntary and they could withdraw at any time from the study without attracting any penalty.

They were not coerced into taking part in this study and there was no direct compensation for participation. However each mother was given further counselling and education on pregnancy related issues and new born care by the health professionals (principal investigator and fieldworkers) after each interview. The telephone number of the principal investigator was made available to the mothers to call for further education.

CHAPTER FOUR

4.0 RESULTS

4.1 Perinatal Deaths

We recruited a total of 309 cases and controls at Tema General Hospital. This comprised of 103 cases (perinatal mortality) and 206 controls (no perinatal mortality).

Out of the 103 cases (perinatal deaths), 29 (28.2%) were classified as fresh stillbirths (stillbirths occurring in the intra-partum period), 24 (23.3%) were macerated stillbirths (stillbirths with skin not intact or macerated, implying a death >12 hours before delivery) and 50 (48.5%) were early neonatal deaths (death of live newborns in the first week of life).

4.2 Socio-Demographic Characteristics of Mothers of Cases and Controls

Majority of the mothers, 221 (71.5%) were between the ages of 20 and 34 years while mothers 30 years and above were 63 (20.4%). Mothers less than 20 years old (teenage mothers) were 25 (8.1%) (Table 6). Most of the mothers, 225 (73%) of the mothers had attained basic or secondary education. Two hundred and eighteen (70.6%) of the mothers were married (Table 6). A little over two-fifths of the mothers, 137 (44.3%) were traders or business women while 49 (15.9%) of the mothers worked in the formal sector (public/private). Thirty five (11.3%) of the mothers were unemployed (Table 7). Out of the 309 mothers, majority of them, 224 (72.5%) had partners (fathers of the babies) who had attained primary or secondary education and only 2 (0.7%) had partners (fathers) who had never been to school. Only 5 (1.6%) of the mothers had partners (fathers) who were unemployed (Table 7).

4.3 Socio-demographic Characteristics and Perinatal Mortality

This study looked at six socio-demographic characteristics that are widely known to influence perinatal mortality. Four of these socio-demographic were characteristics of the mothers of the babies whiles the remaining two were characteristics of their fathers.

The Tables 7 and 8 below show the associations between the socio-demographic characteristics and perinatal mortality. In the univariable logistic regression analysis, only father's occupation was found to be significantly associated with perinatal mortality ($p = 0.009$). Mother's age did not have significant association with perinatal mortality ($p = 0.435$). Whether a mother had not received formal education or had attained primary, secondary or tertiary education was not significantly associated with perinatal mortality ($p = 0.168$). The mother's marital status did not show any significant association with perinatal mortality ($p = 0.111$). The occupation of a mother had no significant association with the occurrence of a perinatal death ($p = 0.100$). The educational status of the father of a baby did not also have significant association with perinatal mortality ($p = 0.244$) (Table 7).

In the multivariable logistic regression analysis, father's occupation lost its significant association with perinatal mortality. Hence none of the socio-demographic characteristics was significantly associated with perinatal mortality in this study (Table 8).

Table 7: Association between Socio-demographic Characteristics and Perinatal Mortality

Variable	Perinatal mortality n (%) N=103	No perinatal mortality n (%) N=206	Total (%) N=309	P-value
Mother's age(years)				0.435
<20	9 (8.7)	16 (7.8)	25 (8.1)	
20-34	69 (67.0)	152 (73.8)	221 (71.5)	
35+	25 (24.3)	38 (18.4)	63 (20.4)	
Mother's education				0.168
No formal education	14 (13.6)	17 (8.3)	31 (10.0)	
Primary/JHS	39 (37.9)	66 (32.0)	105 (34.0)	
Secondary/SHS	32 (31.1)	88 (42.7)	120 (38.9)	
Tertiary	18 (17.5)	35 (17.0)	53 (17.1)	
Marital status (mother)				0.111
Single	34 (33.0)	49 (23.8)	83 (26.9)	
Married	65 (63.1)	153 (74.3)	218 (70.5)	
Separated	4 (3.9)	4 (2.0)	8 (2.6)	
Mother's occupation				0.100
Farming	2 (1.9)	5 (2.4)	7 (2.3)	
Trader/business woman	51 (49.5)	86 (41.8)	137 (44.3)	
Artisan	23 (22.3)	55 (26.7)	78 (25.2)	
Gov. work/private formal	21 (20.4)	28 (13.6)	49 (15.9)	
Housewife	1 (1.0)	2 (1.0)	3 (1.0)	
Unemployed	5 (4.9)	30 (14.6)	35 (11.3)	
Father's education				0.244
No formal education	2 (2.0)	0 (0.0)	2 (0.7)	
Primary/JHS	32 (31.1)	61 (29.6)	93 (30.1)	
Secondary/SHS	42 (40.1)	89 (43.2)	131 (42.4)	
Tertiary	27 (26.2)	56 (27.1)	83 (26.9)	
Father's occupation				**0.009**
Farming/fishing	8 (7.8)	1 (0.5)	9 (2.1)	
Trader/business man	29 (28.2)	63 (30.6)	92 (29.8)	
Artisan	34 (33.0)	78 (37.9)	112 (36.3)	
Gov. work/private formal	31 (30.1)	60 (29.1)	91 (29.5)	
Unemployed	1 (1.0)	4 (1.9)	5 (1.6)	

Table 8: Socio-Demographic Characteristics Associated with Perinatal Mortality: Unadjusted (crude) and Adjusted Odds Ratio.

	Unadjusted OR (Crude)		Adjusted OR	
Variable	**OR (95% CI)**	**P**	**OR (95% CI)**	**P**
Mother's age(years)		0.435		
<20	1.24 (0.52-2.94)			
20-34	Reference			
35+	1.45 (0.81-2.56)			
Mother's education		0.168		
No formal education	1.60 (0.64-4.01)			
Primary/JHS	1.15 (0.57-2.30)			
Secondary/SHS	0.71 (0.36-1.42)			
Tertiary	Reference			
Marital status (mother)		0.111		
Single	1.63 (0.96-2.77)			
Married	Reference			
Separated	2.35 (0.57-9.77)			
Mother's occupation		0.100		
Farming	2.40 (0.34-16.64)			
Trader/business woman	3.56 (1.27-9.98)			
Artisan	2.51 (0.85-7.42)			
Gov. work/private formal	4.50 (1.40-14.43)			
Housewife	3.00 ()0.21-42.10)			
Unemployed	Reference			
Father's education		0.244		
No formal education	●			
Primary/JHS	1.08 (0.58-2.04)			
Secondary/SHS	0.98 (0.54-1.76)			
Tertiary	Reference			
Father's occupation		**0.009**		0.581
Farming/fishing	32.00 (0.42-2.14)		20.6 (0.72-593.01)	0.077
Trader/business man	1.84 (0.19-17.47)		0.26 (0.12-4.18)	0.342
Artisan	1.74 (0.19-16.38)		0.27 (0.02-4.37)	0.358
Gov. work/private formal	2.07 (0.22-19.62		0.30 (0.02-5.31)	0.410
Unemployed	Reference		Reference	

● – undefined Reference value is 1.00

4.4 Maternal Factors and Perinatal Mortality

The first specific objective of this study was to determine the maternal factors associated with perinatal mortality. This study looked at sixteen maternal factors that might influence perinatal mortality.

Tables 9 and 10 below show the association between these maternal factors and perinatal mortality. In the In the univariable logistic regression analysis, the following maternal factors showed significant association with perinatal mortality: birth interval between the

index pregnancy and the preceding one (p = 0.002), history of still birth (p = 0.000), use of herbal medicine (p =0.003), obstetric complications (p = 0.000), infections (p = 0.000), Diabetes mellitus (p = 0.000), assault (physical or sexual) (p = 0.004), gestational age at booking (p = 0.018), number of antenatal visits (p = 0.000), 3rd dose Intermittent Preventive Treatment (IPT3 uptake) (p = 0.000) and Insecticide Treated Net (ITN) usage (p = 0.000) were associated with perinatal mortality (Table 9).

The maternal factors which were not significantly associated with perinatal mortality in the univariable logistic regression analysis were parity (p = 0.295), history of early neonatal death (p = 0.492), history of abortions (p = 0.934), hypertension (p = 0.101) and tetanus toxoid vaccination (p = 0.316) (Table 9).

In the multivariable logistic regression analysis, maternal determinants which were significantly associated with perinatal mortality were obstetric complications, infections, gestational age at booking, number of antenatal visits, 3rd dose Intermittent Preventive Treatment (IPT3 uptake) and Insecticide Treated Net (ITN) usage (Table 9a and Table 9b). A mother with an obstetric complication during the index pregnancy had increased odds of perinatal mortality (OR = 13.66, 95% CI: 5.59-33.42, p = 0.000) compared to a mother without an obstetric complication in the index pregnancy. A mother with an infection during the index pregnancy had increased odds of perinatal mortality (OR = 3.14, 95% CI: 1.34-7.38, p = 0.009) compared to a mother without an infection in the index pregnancy. Compared to antenatal booking at 28 weeks of gestation or more, booking earlier was significantly associated with decreased odds of perinatal mortality, that is, 17-27 weeks (OR = 0.37, 95% CI: 0.14–0.95, p = 0.038) and less than 16 weeks (OR = 0.06, 95% CI: 0.01–0.42, p = 0.005) (Table 10).

Higher number of antenatal visits was significantly associated with decreased odds of perinatal mortality; 4-7 visits (OR = 0.28, 95% CI: 0.08–0.94, p = 0.039) and 8 visits or more (OR = 0.05, 95% CI: 0.01–0.26, p = 0.000) compared to 1-3 visits (Table 9b). Mothers who took at least the 3rd dose of Sulfadoxine-Pyrimethamine (Intermittent Preventive Treatment - IPT3) had a lower odds of perinatal death (OR = 0.21, 95% CI: 0.08-0.53, p = 0.001) compared to mothers who did not take at least IPT3. Mothers who slept under Insecticide Treated Net (ITN) during the index pregnancy had lower odds of perinatal mortality compared to mothers who did not sleep under ITN during the index pregnancy (OR = 0.10, 95% CI: 0.04-0.24, p = 0.000) (Table 10).

Table 9: Association between Maternal Factors and Perinatal Mortality

Variable	Perinatal mortality n (%) N=103	No perinatal mortality n (%) N=206	Total (%) N=309	P-value
Parity				0.295
0	37 (35.9)	64 (31.1)	101 (32.7)	
1-3	53 (51.5)	124 (60.2)	177 (57.3)	
4+	13 (12.6)	18 (8.7)	31 (10.0)	
Birth interval (years)				**0.002**
<2	29 (28.2)	29 (14.1)	58 (18.8)	
2+	37 (35.9)	113 (54.9)	150 (48.5)	
N/A	37 (35.9)	64 (31.1)	101 (32.7)	
History of still birth				**0.001**
Yes	14 (13.6)	6 (2.9)	20 (6.5)	
No	52 (50.5)	136 (66.0)	188 (60.8)	
N/A	37 (35.9)	64 (31.1)	101 (32.7)	
History of END				0.493
Yes	4 (3.9)	5 (2.4)	9 (2.9)	
No	62 (60.2)	137 (66.5)	199 (64.4)	
N/A	37 (35.9)	64 (31.1)	101 (32.7)	
History of abortions				0.934
Yes	40 (38.8)	79 (38.4)	119 (38.5)	
No	63 (61.2)	127 (61.6)	190 (61.5)	
Use of herbal medicine				**0.004**
Yes	49 (47.6)	63 (30.6)	112 (36.3)	
No	54 (52.4)	143 (69.4)	197 (63.7)	
Obstetric complications				**0.000**
Yes	58 (56.3)	39 (18.9)	97 (31.4)	
No	45 (43.7)	167 (81.1)	212 (68.6)	
Infection/illness				**0.000**
Yes	38 (36.9)	33 (16.0)	71 (23.0)	
No	65 (63.1)	173 (84.0)	238 (77.0)	
Diabetes Mellitus				**0.000**
Yes	15 (14.6)	7 (3.4)	22 (7.1)	
No	88 (85.4)	199 (96.6)	287 (92.9)	
Hypertension				0.101
Yes	39 (37.9)	59 (28.6)	98 (31.7)	
No	64 (62.1)	147 (71.4)	211 (68.3)	
Assault				**0.004**
Yes	20 (19.4)	17 (8.3)	37 (12.0)	
No	83 (80.6)	189 (91.7)	272 (88.0)	
Gestational age at booking				**0.018**
<16 weeks	36 (35.0)	106 (51.5)	142 (46.0)	
17-27 weeks	58 (56.3)	90 (43.7)	148 (47.9)	
28+ weeks	9 (8.7)	10 (4.8)	19 (6.1)	
Number of antenatal visits				**0.000**
1-3	28 (27.2)	18 (8.7)	46 (14.9)	
4-7	61 (59.2)	110 (53.4)	171 (55.3)	
8+	14 (13.6)	78 (37.9)	92 (29.8)	
TT vaccination				0.317
Yes	97 (94.2)	199 (96.6)	296 (95.8)	
No	6 (5.8)	7 (3.4)	13 (4.2)	
IPT3 uptake				**0.000**
Yes	51 (49.5)	165 (80.1)	216 (69.9)	
No	52 (50.5)	41 (19.9)	93 (30.1)	
Bed net (ITN) usage				**0.000**
Yes	13 (12.6)	92 (44.7)	105 (34.0)	
No	90 (87.4)	114 (55.3)	204 (66.0)	

Table 10: Maternal Factors Associated with Perinatal Mortality: Unadjusted (crude) and Adjusted odds ratio

	Unadjusted OR (Crude)		Adjusted OR	
Variable	**OR (95% CI)**	**P**	**OR (95% CI)**	**P**
Parity		0.295		
0	1.35 (0.80-2.27)			
1-3	Reference			
4+	1.69 (0.77-3.71)			
Birth interval (years)		**0.002**		0.072
<2	3.05 (1.58-5.88)		2.55 (0.99-6.57)	0.053
2+	Reference		Reference	
N/A	1.77 (1.01-3.08)		●	
History of still birth		**0.001**		0.896
Yes	6.10 (2.13-17.43)		1.03 (0.22-4.84)	0.968
No	Reference		Reference	
N/A	1.51 (0.90-2.54)		●	
History of END		0.493		
Yes	1.77 (0.46-6.85)			
No	Reference			
N/A	1.28 (0.77-2.11)			
History of abortions		0.934		
Yes	1.02 (0.63-1.67)			
No	Reference			
Use of herbal medicine		**0.004**		0.177
Yes	2.06 (1.26-3.38)		1.84 (0.82-4.16)	0.138
No	Reference		Reference	
Obstetric complications		**0.000**		**0.000**
Yes	5.52 (3.13-9.72)		13.66 (5.59-33.42)	**0.000***
No	Reference		Reference	
Infection		**0.000**		**0.005**
Yes	3.06 (1.74-5.38)		3.14 (1.34-7.38)	**0.009***
No	Reference		Reference	
Diabetes Mellitus		**0.000**		0.053
Yes	4.85 (1.87-12.57)		5.57 (0.95-32.68)	0.057
No	Reference		Reference	
Hypertension		0.101		
Yes	1.51 (0.92-2.51)			
No	Reference			
Assault		**0.004**		0.051
Yes	2.68 (1.32-5.43)		2.95 (0.96-9.11)	0.060
No	Reference		Reference	
Gestational age at booking		**0.018**		**0.005**
<16 weeks	0.38 (0.14-1.02)		0.06 (0.01-0.42)	**0.005***
17-27 weeks	0.72 (0.27-1.88)		0.37 (0.14-0.95)	**0.039***
28+ weeks	Reference		Reference	
Number of antenatal visits		**0.000**		**0.000**
1-3	Reference		Reference	
4-7	0.36 (0.18-0.71)		0.28 (0.08-0.94)	**0.039***
8+	0.11 (0.05-0.29)		0.05 (0.01-0.26)	**0.000***
Maternal TT vaccination		0.317		
Yes	0.57 (0.19-1.74)			
No	Reference			
IPT3 uptake		**0.000**		**0.001**
Yes	0.24 (0.14-0.42)		0.21 (0.08-0.53)	**0.001***
No	Reference		Reference	
Bed net (ITN) usage		**0.000**		**0.000**
Yes	0.18 (0.09-0.35)		0.10 (0.04-0.24)	**0.000***
No	Reference		Reference	

* - statistically significant Reference value is 1.00

4.5 Fetal/Neonatal Factors and Perinatal Mortality

The second specific objective of this study was to determine the fetal/neonatal factors associated with perinatal mortality. This study looked at five fetal/neonatal factors that might influence perinatal mortality.

Tables 11 and 12 below show the association between the Fetal/Neonatal factors and perinatal mortality. In the univariable logistic regression analysis, the following Fetal/Neonatal factors showed significant association with perinatal mortality: sex of baby ($p = 0.000$), gestational age at delivery ($p = 0.000$), birth weight ($p = 0.000$) and birth defect/injury ($p = 0.001$). The number of babies delivered (singleton or multiple) was the only fetal/neonatal factor that was not significantly associated with perinatal mortality in the bivariate analysis (Table 11).

In the multivariable logistic regression analysis (Table 11), the fetal/neonatal factors associated with perinatal mortality were: sex of baby, gestational age at delivery and birth weight. The odds of perinatal mortality increased significantly with a baby being male (OR = 5.08, 95% CI: 2.79-9.27, $p = 0.000$) compared to a baby being female.

Compared to babies delivered at term (37-40 weeks), babies delivered preterm (less than 37 weeks) had increased odds of perinatal mortality (OR = 2.58, 95% CI: 1.35-6.01, $p = 0.006$). Compared to babies with an average weight (2.5-3.9kg), babies who weighed less than 2.5kg had increased odds of perinatal mortality (OR = 4.29, 95% CI: 1.92-9.59, $p = 0.000$).

Table 111: Association between Fetal/Neonatal Factors and Perinatal Mortality

Variable	Perinatal mortality n (%) N=103	No perinatal mortality n (%) N=206	Total (%) N=309	P-value
Number of babies delivered				0.365
Singleton	96 (93.2)	197 (95.6)	293 (94.8)	
Multiple	7 (6.8)	9 (4.4)	16 (5.2)	
Sex of baby				**0.000**
Male	71 (68.9)	75 (36.4)	146 (47.3)	
Female	32 (31.1)	131 (63.6)	163 (52.7)	
Gestational age (weeks)				**0.000**
<37	46 (44.7)	25 (12.1)	71 (23.0)	
37-39	42 (40.8)	131 (63.6)	173 (56.0)	
40+	15 (14.5)	50 (24.3)	65 (21.0)	
Birth weight (kg)				**0.000**
<2.5	41 (39.8)	24 (11.6)	65 (21.0)	
2.5-3.9	51 (49.5)	147 (71.4)	198 (64.1)	
4.0+	8 (7.8)	35 (17.0)	43 (13.9)	
Not weighed	3 (2.9)	0 (0.0)	3 (1.0)	
Birth defect or birth injury				**0.001**
Yes	11 (10.7)	4 (1.9)	15 (4.9)	
No	92 (39.3)	202 (98.1)	294 (95.1)	

Table 12: Fetal/Neonatal Factors Associated with Perinatal Mortality: Unadjusted (crude) and Adjusted Odds Ratio.

	Unadjusted OR (Crude)		Adjusted OR	
Variable	**OR (95% CI)**	**P**	**OR (95% CI)**	**P**
Number of babies delivered		0.365		
Singleton	Reference			
Multiple	1.60 (0.57-4.42)			
Sex of baby		**0.000**		**0.000**
Male	3.88 (2.28-6.59)		5.08 (2.79-9.27)	**0.000***
Female	Reference		Reference	
Gestational age (weeks)		**0.000**		**0.009**
<37	5.74 (3.00-10.99)		2.85 (1.35-6.01)	**0.006***
37-40	Reference		Reference	
40+	0.95 (0.48-1.84)		1.07 (0.52-2.22)	0.855
Birth weight (kg)		**0.000**		**0.006**
<2.5	4.92 (2.61-9.29)		4.29 (1.92-9.59)	**0.000***
2.5-3.9	Reference		Reference	
4.0+	0.65 (0.29-1.52)		1.19 (0.48-2.92)	0.708
Not weighed	●		●	
Birth defect or birth injury		**0.001**		0.050
Yes	6.04 (1.83-19.94)		3.66 (0.86-15.55)	0.079
No	Reference		Reference	

● – undefined * - statistically significant Reference value is 1.00

4.6 Delivery Related Factors and Perinatal Mortality

The third specific objective of this study was to determine the delivery related factors associated with perinatal mortality. This study looked at four delivery realted factors that might influence perinatal mortality.

Tables 13 and 14 below show the association between the delivery related factors and perinatal mortality. In the univariable logistic regression analysis (Table 13), all the selected delivery related factors showed significant association with perinatal mortality: onset of labour (p = 0.000), mode of delivery (p = 0.001), apgar score (p = 0.000) and aggressive resuscitation (p = 0.000).

However, in the multivariable logistic regression analysis, only aggressive resuscitation remained significantly associated with perinatal mortality**.** Babies who required aggressive resuscitation had an increased odds of perinatal mortality (OR = 20.71, 95% CI: 1.56-273.95, p = 0.021) compared to those who did not require aggressive resuscitation (Table 14)**.**

Table 13: Association between Delivery Related Factors and Perinatal Mortality

Variable	Perinatal mortality n (%) N=103	No perinatal mortality n (%) N=206	Total (%) N=309	P-value
Onset of labour				**0.000**
Spontaneous	56 (54.4)	154 (74.7)	210 (68.0)	
Induction	24 (23.3)	16 (7.8)	40 (12.9)	
Caesarean section	23 (22.3)	36 (17.5)	59 (19.1)	
Mode of delivery				**0.001**
Spontaneous vaginal	51 (49.5)	139 (67.5)	196 (63.4)	
Caesarean section	51 (49.5)	62 (30.1)	113 (36.6)	
APGAR score				**0.000**
1-3	97 (94.2)	11 (5.3)	108 (35.0)	
4-10	6 (5.8)	195 (94.7)	201 (65.0)	
Aggressive resuscitation				**0.000**
Yes	45 (43.7)	13 (6.3)	58 (18.8)	
No	5 (4.8)	193 (93.7)	198 (64.1)	
N/A	53 (51.5)	0 (0.0)	53 (17.1)	

Table 14: Delivery related Associated with Perinatal Mortality: Unadjusted and Adjusted Odds Ratio

	Unadjusted OR (Crude)		Adjusted OR	
Variable	**OR (95% CI)**	**P**	**OR (95% CI)**	**P**
Onset of labour		**0.000**		0.249
Spontaneous	Reference		Reference	
Induction	4.13 (1.99-8.56)	0.000	2.42 (0.45-12.92)	0.301
Caesarean section	1.76 (0.95-3.24)	0.067	1.56 (0.30-7.97)	0.596
Mode of delivery		**0.001**		
Spontaneous vaginal	Reference		Reference	0.289
Caesarean section	2.28 (1.39-3.75)		0.63 (0.16-2.43)	0.505
APGAR score		**0.000**		0.100
0-3	186 (23.54-944.80)		8.45 (0.67-107.17)	0.099
4-10	Reference		Reference	
Aggressive resuscitation		**0.000**		**0.049**
Yes	133 (22.60-789.67)		20.71 (1.56-123.95)	**0.021***
No	Reference		Reference	
N/A				

* - statistically significant Reference value is 1.0

CHAPTER FIVE

5.0 DISCUSSION

5.1 Perinatal Mortality

This study examined the factors associated with perinatal death and the multivariable analyses show that perinatal mortality significantly is associated with a number of factors including obstetric complications, maternal infections, gestational age at booking, number of antenatal visits, 3rd dose Intermittent Preventive Treatment (IPT3 uptake), Insecticide Treated Net (ITN) usage, sex of baby, gestational age at delivery, birth weight, and need for aggressive resuscitation of baby.

5.2 Socio-demographic Determinants of Perinatal Mortality

It is generally known that socio-demographic factors have influence on perinatal mortality (Nagalo et al., 2015; Safer, 2007). However in this study, none of the socio-demographic characteristics is significantly associated with perinatal mortality.

Extremes of maternal age is known to increase the risk of perinatal mortality (Conde-Agudelo et al., 2005; Jacobsson et al., 2004; Schoen & Rosen, 2009). However, in this study, maternal age was not to be significantly associated with perinatal mortality. This may be so because majority of the selected study participants (about 72%) are within the expected age bracket of 20 to 34 years and have similar proportions in both the cases and the controls. This is similar to findings by Yaniv et al (2011) where they noted that maternal age was not an independent risk factor for perinatal mortality (Yaniv et al., 2011). Though not significant, it is noted in this study that mothers who are less than 20 years have a reduced odds of perinatal mortality whiles mothers who are 35 years or older, have higher odds of perinatal mortality compared to mothers in the 20 to 34 years age group

Maternal educational level is generally accepted as an important predictor of perinatal mortality. A higher maternal level of education may increase mothers' knowledge about child health and healthcare services, and thereby improve mothers' healthcare-seeking behaviors during pregnancy. In this study however, none of the maternal educational levels has a significant association with perinatal mortality. Though not significant, the multivariable analysis shows that mothers who have attained at most secondary education have about 30% higher odds of perinatal mortality compared to mothers who have attained tertiary education whiles mothers with at most primary education or no education have over two-fold increase in the odds of perinatal mortality compared to those who have attained tertiary education. A study in Ethiopia showed that at least secondary level of education for women is essential to improve the survival of newborns (Mekonnen et al., 2013).

Marital status of the mother also shows no significant association with perinatal mortality in our study. However similar to a study done by MacDorman and Gregory, I noted that single and those mothers separated from their partners have increase odds of perinatal mortality than mothers who were married (MacDorman & Gregory, 2015). The marital status of a woman may be a factor influencing decisions to attend antenatal clinic. Women who are married also receive both financial and moral support from their partners and are likely to be accompanied by their partners to antenatal clinic.

Father's education plays an important role in earning income and is essential to the survival of newborns. Father's educational level does not show a significant association with perinatal mortality in our study, contrary to a study conducted in Rajshahi District, Bangladesh which revealed that the highest a father's educational attainment, the lower perinatal mortality level (Mondal et al., 2009).

5.3 Maternal Determinants of Perinatal Mortality

Maternal determinants significantly associated with perinatal mortality were obstetric complications, infections, gestational age at booking, number of antenatal visits, IPT3 uptake and ITN usage.

A mother with an obstetric complication during the index pregnancy has increased odds of perinatal mortality than a mother without an obstetric complication in the index pregnancy. This is probably so because these obstetric complications may influence early delivery by obstetricians to save the life of the mother, hence may result in prematurity or low birth weight which are some of the main causes of perinatal mortality. This finding is supported by the findings of the world health organization multi-country (29 countries) survey on maternal and newborn health conducted in 2014, to determine the prevalence and risks of perinatal deaths in women with medical and obstetric complications. They showed that vast majority of perinatal deaths occur in women with complications such as placental abruption, ruptured uterus, systemic infections/sepsis, pre-eclampsia, eclampsia, and severe anaemia (J. Vogel et al., 2014). Some of the obstetric complications identified in this study include antepartum haemorrhage secondary to placenta previa or abruption, severe pre-eclampsia/eclampsia, premature rupture of membranes, oligohydramnios and cord prolapse. Another study conducted in Madagascar suggested that complications during the pregnancy, no medical care for these complications, poor knowledge about the complications had significant relationship with perinatal mortality (Rakotoseheno et al., 2008).

Maternal infection is significantly associated with perinatal mortality. A mother with an infection during the index pregnancy has increased odds of perinatal mortality compared to a mother without an infection in the index pregnancy. Infections in pregnancy may result in different adverse obstetrical outcomes, including preterm delivery, premature rupture of membranes, intrauterine fetal death, congenital infection and anomalies, all of which are

major contributors to increased perinatal mortality rates. Infections identified in this study include Human Immunodeficiency virus (HIV) infection, syphilis, Urinary Tract Infection (UTI), skin infections and Malaria. This is similar to many other studies where it was observed that infections during pregnancy such as HIV, UTI, Tuberculosis, Malaria, Group B Streptococcus infection and syphilis, increased the risk of perinatal mortality (Bellizzi et al., 2017; Desale et al., 2016; Mazor-Dray et al., 2009).

Gestational age at booking is significantly associated with perinatal mortality. Compared to antenatal booking at 28 weeks of gestation or more, booking earlier is significantly associated with reduced odds of perinatal mortality. This is because early booking helps for early detection and management of adverse pregnancy related outcomes. A study in Nigeria has shown a similar relationship between the gestational age at booking and perinatal mortality (Ifenne & Utoo, 2012). They showed that early entry to antenatal care is important in reducing perinatal mortality.

Higher number of antenatal visits is associated with decreased odds of perinatal mortality compared to fewer visits (1-3 visits). This probably is so because adequate number of ANC visits helps in educating pregnant women on good health practices and also enhances early identification and diagnosis of obstetric complications and coexisting medical conditions. This finding is similar to the findings of a secondary analysis of the WHO antenatal care trial by Hofmeyr and Hodnett, which showed that routine antenatal visits for healthy pregnant women helps in reducing perinatal mortality (Hofmeyr & Hodnett, 2013).

This study also shows a protective role if mothers have at least the 3rd dose of Sulfadoxine-Pyrimethamine (SP) (Intermittent Preventive Treatment - IPT3)**.** Mothers who take at least the 3rd dose of Sulfadoxine-Pyrimethamine (Intermittent Preventive Treatment - IPT3) have a significant decrease in the odds of perinatal death compared to mothers who do not take

at least IPT3. It is generally known that pregnant women are more susceptible to malaria than the general population and the presence of plasmodium parasites in a pregnant woman's body regardless of symptoms, will have a negative impact on the health of both mother and fetus or baby. Hence treatment should not be restricted to only symptomatic pregnant women in order to reduce the morbidity and mortality associated with malaria. This is why routine administration of SP has proved protective. This finding is supported by a study done by Tagbor et al. They also suggested that in an area of moderately high malaria transmission, intermittent preventive treatment (IPT) with sulfadoxine pyrimathamine (SP) may be a safe and effective way of reducing of malaria in pregnancy which in turn may help to reduce low birth weight and perinatal mortality (Tagbor et al., 2010).

It is known that bed nets form a protective barrier around people sleeping under them and bed nets treated with an insecticide are much more protective than untreated nets. The insecticides that are used for treating bed nets kill mosquitoes, hence prevent mosquito bites and reduce malaria transmission. The evidence on the direct impact of bed nets on perinatal mortality has been mixed. I find that mothers who sleep under Insecticide Treated Net (ITN) during the index pregnancy have remarkable decrease in the odds of perinatal mortality compared to mothers who do not sleep under ITN during the index pregnancy. This current study result agrees with findings from a study carried out in Eastern Uganda which estimated that one perinatal death was prevented for every 7 nulliparous women who slept under a bed-net (Nankabirwa et al., 2011). Some of the mothers who participated in this study do not use ITN because they do not have it.

In this study, there is no significant association between parity and perinatal mortality. Though not statistically significant, it is noticed that both nulliparous mothers (no delivery prior to the index pregnancy) and multiparous mothers with four or more children prior to

the index pregnancy (grand multiparous women) have increased odds of perinatal mortality compared to mothers with 1-3 children prior to the index pregnancy. Many previous studies have shown that primigravidae and nulliparous women as groups at high risk for perinatal death in Africa (Diallo et al., 2010; Engmann et al., 2009; Habib et al., 2008; Ota et al., 2014). A study to determine the relationship between parity and perinatal mortality conducted in Sweden by Gardosi et al, however showed a U-shaped relationship, with first as well as third, fourth and higher order pregnancies being at higher risk compared to second order pregnancies (Gardosi et al., 2009).

Shorter birth interval (delivery within two years from previous delivery) is known to increase the risk of perinatal death. Mekonnen et al found that children born within two years from previous delivery were 2.2 times more likely to die compared to children born at an interval of 2 or more years from the previous delivery(Mekonnen et al., 2013). The shorter birth interval effect could be related to maternal depletion syndrome. I find no significant association between birth interval and perinatal mortality in this study even though mothers who delivered within a preceding interval less than 2 years have increased odds of perinatal mortality compared to mothers who delivered at an interval of 2 or more years.

Increased risk of perinatal mortality in diabetic pregnancies has been a well-known and recognized complication for decades. Studies consistently show a relationship between Diabetes mellitus and perinatal mortality (Melamed & Hod, 2009; Starikov et al., 2015; Vitoratos et al., 2010). However in this study, there is no significant association between Diabetes mellitus and perinatal mortality. This may be due to the fact the only a few of the study participants had diabetes mellitus in this study and may be influenced by the relatively small sample size.

A study by Johnson et al. suggested that both non-severe hypertension and severe hypertension increases risk of stillbirth, preterm birth and small for gestational age all of which are major causes of perinatal mortality (Johnson et al., 2016). I however, find no significant association between hypertension and perinatal mortality in this current study.

In this study there is no significant association between assault and perinatal mortality. Very few of the mothers reported of assault. Some women may be too embarrassed or ashamed to admit being sexually or physically assaulted by a partner. Though not statistically significant, those who were assaulted had about threefold increase the odds of perinatal mortality in multivariable analysis. This finding is in contrast to other studies which suggested that pregnant women who experienced physical and sexual abuse had a higher risk of perinatal than women having no violence during pregnancy (Kendall-Tackett, 2007; Sarkar, 2008, 2013).

This study does not show any significant relationship between maternal TT injection and perinatal mortality. Almost all the mothers (about 96%) had received the TT injection. Hence a much larger sample may be needed to detect any significant association with perinatal mortality. A study conducted in Ethiopia by Mekonnen et al has shown a protective role if mothers received Tetanus Toxoid (TT) injection before delivery (Mekonnen et al., 2013).

5.4 Fetal/Neonatal Determinants of Perinatal Mortality

I find that male children have a higher odds of dying than females during the perinatal period. Previous studies have also confirmed this (Mekonnen et al., 2013; Peelen et al., 2016). Contributing factors may include a higher likelihood (in males) of infections, jaundice, birth complications, congenital malformations and a greater risk of preterm birth.

It is known that even in-utero, females mature more rapidly than males, which provides an advantage for females, because the lungs and other organs are more developed.

Also studies consistently show a significant relationship between low birth weight and increased perinatal mortality risk. Birth weight has a great influence on perinatal mortality, with low birth weight likely to increase perinatal mortality (Bjerregaard-Andersen et al., 2012). I find that compared to babies with an average/normal weight (2.5-3.9kg), babies who weigh less than 2.5kg have increased odds of perinatal mortality (about fourfold increase in odds). Contributing factors to low birth weight may be preterm delivery, poor maternal nutrition and low prenatal vitamins, lack of rest by mothers, maternal stress and anxiety and use of alcohol, caffeine, tobacco and some other harmful drugs during pregnancy.

In general, it is known that preterm birth is associated with anatomic and physiologic under developments of all the systems of a baby which may increase the risk of perinatal death. In this study there is a significant association between gestational age at the time of delivery and perinatal mortality. Compared to babies delivered at term (37-40 weeks), babies delivered preterm (less than 37 weeks) have increased odds of perinatal mortality. This is similar to findings in many other studies which have indicated that preterm birth is a risk factor for perinatal mortality (Tachiweyika et al., 2011; Tegegne et al., 2010; Yirgu et al., 2016).

I also find no significant association between the number of babies delivered (singleton or multiple) and perinatal mortality. This may be so because multiple deliveries in this study are quite rare in both of the selected cases and the controls. This finding is contrary to what was established in some studies that multiple pregnancies increase the risk of perinatal

mortality (Bjerregaard-Andersen et al., 2012; Olamijulo & Olaleye, 2010; J. P. Vogel et al., 2013).

5.5 Delivery Related Determinants of Perinatal Mortality

Only one (aggressive resuscitation) out of the four delivery related factors is associated with perinatal mortality.

Immediately after birth, approximately 10% of newborns need interventions to facilitate lung recruitment and begin spontaneous respiration. A full and aggressive resuscitation procedure is required by < 1% of newborns (Szarpak, 2013). Similar to findings in a study done by Afjeh et al (2013), babies who require aggressive resuscitation have a remarkable increase in the odds of perinatal mortality compared to babies who do not require aggressive resuscitation. Typically babies with low first-minute apgar scores will require aggressive resuscitation but in this study, even though aggressive resuscitation is significantly associated with perinatal mortality, the first-minute apgar scores is not significantly associated with perinatal mortality.

I find no significant association between mode of delivery and perinatal mortality. This association was significant in bivariable analysis but this significance was lost in the multiple logistic regression probably due to the effect of the 'onset of labour'. This is contrary to a study by Alshaheen & Abdal Karim (2010) which showed that perinatal mortality was significantly higher in vaginal deliveries compared with caesarean deliveries and caesarean section reduced the perinatal mortality in both nulliparous and parous women in term breech infants. Another study by Ezechi et al also showed a relationship between mode of delivery and perinatal mortality, stating that caesarean section carried a substantial

hazard to the unborn fetus, especially if it was performed as an emergency procedure and for maternal well-being.

5.6 Strengths of the Study

A major strength of this study is that I examined both stillbirths and early neonatal deaths. Occasionally it may be difficult to distinguish stillborn infants from those live born infants who die soon after birth (those who are extremely preterm, asphyxiated, or neurologically depressed and die soon after birth). Examining both stillbirths and early neonatal deaths together may help in the evaluation of perinatal programs and interventions that are designed to reduce mortality.

5.7 Limitations of the Study

Differential recall bias from mothers especially from controls compared to cases. Cases are more likely to remember incidents preceding delivery compared to controls that had a normal uneventful delivery.

Causality could not be established from this study. However, I have found significant association between some of the independent variables (gestational age at booking, number of antenatal visits, IPT3 uptake, bed net (ITN) usage, obstetric complications, maternal infections, sex of baby, gestational age at delivery, birthweight and aggressive resuscitation) and perinatal mortality. This provides valuable insight into the determinants of perinatal deaths in the Tema Metropolitan Area and the Greater Accra Region as a whole.

There might be misclassification of some variables such as ‘gestational age at booking’ (calculated based on the last menstrual period - LMP) and ‘gestational age at delivery’ (calculated based on the last menstrual period (LMP) and delivery date). The recall of exact

date of LMP might not be precise. While it is relatively easy to detect or diagnose structural birth defects (related to a problem with body parts and structure), there are challenges in detecting functional, or developmental birth defects. Also, the challenge in distinguishing stillbirth from late abortions might also result in underestimating or overestimating cases and controls. However I do not think these misclassifications significantly biases the results.

CHAPTER SIX

6.0 CONCLUSIONS AND RECOMMENDATIONS

6.1 Conclusion

This study shows that early entry to antenatal care, higher number of antenatal visits, uptake of at least the third dose of the routine Sulfadoxine-Pyrimethamine (IPT3) and sleeping under Insecticide Treated Net (ITN) may protect against perinatal mortality. The Presence of an obstetric complication, presence of maternal infection, a baby being male, preterm delivery, low birthweight, and baby requiring aggressive resuscitation may increase perinatal mortality. Most of these determinants of perinatal mortality are modifiable. Therefore there is the need for comprehensive prevention strategies to reduce perinatal mortality.

6.2 Recommendations

National/Regional Health Directorate Ghana Health Service Directorate:

To develop policies on education campaigns in both the communities and health facilities to help improve high levels of antenatal attendance, use of Insecticide Treated Net (ITN) and IPT3 uptake for pregnant women.

There is also the need to expand the distribution of free or subsidized Insecticide Treated Nets to the entire population, especially pregnant women, which may optimize coverage as well as help increase its use.

Metro Health Directorate:

To ensure that pregnant women are educated at the various antenatal clinics in the Metropolis to recognize obstetric complications and infections, and report at the health

facilities for treatment. This will help to achieve a better health outcome for both mothers and infants.

Tema General Hospital:

To ensure health worker training on an evidence-based, practical approach to dealing with the wide spectrum of complications and infections that may occur throughout all the trimesters of pregnancy as well as the postpartum period.

Further research

Reducing perinatal mortality usually involves establishing interventions along with the means to make them effective in each setting. Hence there must be further research to find what interventions to these determinants are likely to be effective in reducing perinatal mortality significantly in the Tema Metropolis, Greater Accra Region and the country as a whole.

REFERENCES

Ab Rahman, A., Ahmad, Z., Naing, L., Sulaiman, S. A., Hamid, A. M., & Daud, W. N. W. (2007). The use of herbal medicines during pregnancy and perinatal mortality in Tumpat District, Kelantan, Malaysia.

Afjeh, S.-A., Sabzehei, M.-K., & Esmaili, F. (2013). Neonatal resuscitation in the delivery room from a tertiary level hospital: risk factors and outcome. *Iranian journal of pediatrics, 23*(6), 675.

Akello, B., Nabiwemba, E., Zirabamuzaale, C., & Orach, C. G. (2008). Risk factors for perinatal mortality in Arua regional referral hospital, West Nile, Uganda. *East African journal of public health, 5*(3), 180-185.

Allanson, E. R., Muller, M., & Pattinson, R. C. (2015). Causes of perinatal mortality and associated maternal complications in a South African province: challenges in predicting poor outcomes. *BMC pregnancy and childbirth, 15*(1), 1.

Alshaheen, H., & Abdal Karim, A. (2010). Perinatal outcomes of singleton term breech deliveries in Basra.

Atanasova, V., Slavkova, N., Yonov, M., & Valkova, A. (2011). Low Apgar score in term newborn infants and delivery pattern. *Akusherstvo i ginekologiia, 51*(3), 15-21.

Bailit, J. L., Gregory, K. D., Reddy, U. M., Gonzalez-Quintero, V. H., Hibbard, J. U., Ramirez, M. M., . . . Hatjis, C. G. (2010). Maternal and neonatal outcomes by labor onset type and gestational age. *American journal of obstetrics and gynecology, 202*(3), 245. e241-245. e212.

Bellizzi, S., Bassat, Q., Ali, M. M., Sobel, H. L., & Temmerman, M. (2017). Effect of puerperal infections on early neonatal mortality: a secondary analysis of Six demographic and health surveys. *PLoS One, 12*(1), e0170856.

Berhan, Y., & Berhan, A. (2014). A Meta-Analysis of Socio-Demographic Factors for Perinatal Mortality in Developing Countries: A Subgroup Analysis of the National Surveys and Small Scale Studies. *Ethiopian journal of health sciences, 24*, 41-54.

Bjerregaard-Andersen, M., Lund, N., Jepsen, F. S., Camala, L., Gomes, M. A., Christensen, K., . . . Beck-Nielsen, H. (2012). A prospective study of twinning and perinatal mortality in urban Guinea-Bissau. *BMC pregnancy and childbirth, 12*(1), 1.

Brown, J., Adera, T., & Masho, S. (2008). Previous abortion and the risk of low birth weight and preterm births. *Journal of epidemiology and community health, 62*(1), 16-22.

Burkman, R. (2010). Maternal and neonatal outcomes by labor onset type and gestational age.

Carlo, W. A., Goudar, S. S., Jehan, I., Chomba, E., Tshefu, A., Garces, A., . . . Derman, R. J. (2010). Newborn-care training and perinatal mortality in developing countries. *New England Journal of Medicine, 362*(7), 614-623.

Carlo , W. A., Goudar , S. S., Jehan , I., Chomba , E., Tshefu , A., Garces , A., . . . Group, t. F. B. S. (2010). Newborn-Care Training and Perinatal Mortality in Developing Countries. *New England Journal of Medicine, 362*(7), 614-623. doi: doi:10.1056/NEJMsa0806033

Chabernaud, J. (2009). Air or oxygen for neonatal resuscitation at birth? *Archives de pediatrie: organe officiel de la Societe francaise de pediatrie, 16*(8), 1194-1201.

Chambliss, L. R. (2008). Intimate partner violence and its implication for pregnancy. *Clinical obstetrics and gynecology, 51*(2), 385-397.

Chinkhumba, J., De Allegri, M., Muula, A. S., & Robberstad, B. (2014). Maternal and perinatal mortality by place of delivery in sub-Saharan Africa: a meta-analysis of population-based cohort studies. *BMC public health, 14*(1), 1.

Conde-Agudelo, A., Belizán, J. M., & Lammers, C. (2005). Maternal-perinatal morbidity and mortality associated with adolescent pregnancy in Latin America: Cross-sectional study. *American journal of obstetrics and gynecology, 192*(2), 342-349.

Desale, M., Thinkhamrop, J., Lumbiganon, P., Qazi, S., & Anderson, J. (2016). Ending preventable maternal and newborn deaths due to infection. *Best Practice & Research Clinical Obstetrics & Gynaecology, 36*, 116-130.

Diallo, A. H., Meda, N., Zabsonré, E., Sommerfelt, H., Cousens, S., & Tylleskär, T. (2010). Perinatal mortality in rural Burkina Faso: a prospective community-based cohort study. *BMC pregnancy and childbirth, 10*(1), 1.

Ebeigbe, P., & Aziken, M. E. (2010). Early onset pregnancy induced hypertension/eclampsia in Benin City, Nigeria. *Nigerian journal of clinical practice, 13*(4).

Edmond, K. M., Quigley, M. A., Zandoh, C., Danso, S., Hurt, C., Agyei, S. O., & Kirkwood, B. R. (2008). Aetiology of stillbirths and neonatal deaths in rural Ghana: implications for health programming in developing countries. *Paediatric and perinatal epidemiology, 22*(5), 430-437.

Engmann, C., Ditekemena, J., Jehan, I., Garces, A., Phiri, M., Thorsten, V., . . . Tshefu, A. (2011). Classifying perinatal mortality using verbal autopsy: is there a role for nonphysicians? *Population health metrics, 9*(1), 1.

Engmann, C., Matendo, R., Kinoshita, R., Ditekemena, J., Moore, J., Goldenberg, R. L., . . . Bose, C. (2009). Stillbirth and early neonatal mortality in rural Central Africa. *International Journal of Gynecology & Obstetrics, 105*(2), 112-117.

Engmann, C., Walega, P., Aborigo, R. A., Adongo, P., Moyer, C. A., Lavasani, L., . . . Hodgson, A. (2012). Stillbirths and early neonatal mortality in rural Northern Ghana. *Tropical Medicine & International Health, 17*(3), 272-282.

Essén, B., Hanson, B. S., ÖSTERGREN, P. O., Lindquist, P. G., & Gudmundsson, S. (2000). Increased perinatal mortality among sub-Saharan immigrants in a city-population in Sweden. *Acta obstetricia et gynecologica Scandinavica, 79*(9), 737-743.

Ezechi, O., Loto, O., Ndububa, V., Okogbo, F., Ezeobi, P., & Nwokoro, C. (2015). Caesarean section and perinatal mortality in South Western Nigeria. *Nepal Journal of Obstetrics and Gynaecology, 4*(1), 46-48.

García-Patterson, A., Aulinas, A., Sojo, L., Ginovart, G., Adelantado, J., de Leiva, A., & Corcoy, R. (2011). Poorer perinatal outcome in male newborns of women with pregestational diabetes mellitus. *Diabetic Medicine, 28*(4), 436-439.

Gardosi, J., Clausson, B., & Francis, A. (2009). The value of customised centiles in assessing perinatal mortality risk associated with parity and maternal size. *BJOG: An International Journal of Obstetrics & Gynaecology*, *116*(10), 1356-1363.

Grivell, R. M., Reilly, A. J., Oakey, H., Chan, A., & Dodd, J. M. (2012). Maternal and neonatal outcomes following induction of labor: a cohort study. *Acta obstetricia et gynecologica Scandinavica*, *91*(2), 198-203.

Habib, N. A., Lie, R., Oneko, O., Shao, J., Bergsjø, P., & Daltveit, A. (2008). Sociodemographic characteristics and perinatal mortality among singletons in North East Tanzania: a registry-based study. *Journal of epidemiology and community health*, *62*(11), 960-965.

Hernández-Herrera, R., & Ramírez-Sánchez, L. (2010). Impact of perinatal mortality in multiple pregnancies over total perinatal mortality in a hospital in Monterrey, Nuevo León. *Ginecologia y obstetricia de Mexico*, *78*(7), 352-356.

Hofmeyr, G. J., & Hodnett, E. D. (2013). Antenatal care packages with reduced visits and perinatal mortality: a secondary analysis of the WHO antenatal care trial-Comentary: routine antenatal visits for healthy pregnant women do make a difference. *Reproductive health*, *10*(1), 1.

Ifenne, D. I., & Utoo, B. T. (2012). Gestational age at booking for antenatal care in a tertiary health facility in north-central, Nigeria. *Nigerian Medical Journal*, *53*(4), 236.

Jacobsson, B., Ladfors, L., & Milsom, I. (2004). Advanced maternal age and adverse perinatal outcome. *Obstetrics & Gynecology*, *104*(4), 727-733.

Johnson, K. M., Zash, R., Haviland, M. J., Hacker, M. R., Luckett, R., Diseko, M., . . . Shapiro, R. (2016). Hypertensive disease in pregnancy in Botswana: Prevalence and impact on perinatal outcomes. *Pregnancy Hypertension: An International Journal of Women's Cardiovascular Health*, *6*(4), 418-422.

Kendall-Tackett, K. A. (2007). Violence against women and the perinatal period: the impact of lifetime violence and abuse on pregnancy, postpartum, and breastfeeding. *Trauma, Violence, & Abuse*, *8*(3), 344-353.

Kulkarni, R., Chauhan, S., Shah, B., Menon, G., & Puri, C. (2007). Investigating causes of perinatal mortality by verbal autopsy in Maharashtra, India. *Indian Journal of Community Medicine*, *32*(4), 259.

MacDorman, M., & Gregory, E. (2015). Fetal and perinatal mortality: United States, 2013. *National vital statistics reports: from the Centers for Disease Control and Prevention, National Center for Health Statistics, National Vital Statistics System*, *64*(8), 1-24.

Mazor-Dray, E., Levy, A., Schlaeffer, F., & Sheiner, E. (2009). Maternal urinary tract infection: is it independently associated with adverse pregnancy outcome? *The Journal of Maternal-Fetal & Neonatal Medicine*, *22*(2), 124-128.

Mekonnen, Y., Tensou, B., Telake, D. S., Degefie, T., & Bekele, A. (2013). Neonatal mortality in Ethiopia: trends and determinants. *BMC public health*, *13*(1), 1.

Melamed, N., & Hod, M. (2009). Perinatal mortality in pregestational diabetes. *International Journal of Gynecology & Obstetrics*, *104*(Supplement).

Mondal, N., Hossain, K., & Ali, K. (2009). Factors influencing infant and child mortality: A case study of Rajshahi District, Bangladesh. *Journal of Human Ecology, 26*(1), 31-39.

Mullins, E., & Kumar, S. (2012). Older mothers do not confer greater perinatal risk to dichorionic diamniotic twins. *Acta obstetricia et gynecologica Scandinavica, 91*(1), 152-154.

Musafili, A., Essén, B., Baribwira, C., Selling, K. E., & Persson, L. Å. (2015). Social equity in perinatal survival: a case–control study at hospitals in Kigali, Rwanda. *Acta Paediatrica, 104*(12), 1233-1240.

Nagalo, K., Ouedraogo, L., Tall, F. H., & Ye, D. (2015). Verbal Autopsy of Stillbirths and Neonatal Deaths in a Rural Area of Burkina Faso. *Open Journal of Pediatrics, 5*(02), 164.

Nankabirwa, V., Tumwine, J. K., Tylleskär, T., Nankunda, J., Sommerfelt, H., & Consortium, P. E. R. (2011). Perinatal mortality in eastern Uganda: a community based prospective cohort study. *PLoS One, 6*(5), e19674.

Ngoc, N. T. N., Merialdi, M., Abdel-Aleem, H., Carroli, G., Purwar, M., Zavaleta, N., . . . Mathai, M. (2006). Causes of stillbirths and early neonatal deaths: data from 7993 pregnancies in six developing countries. *Bulletin of the World Health Organization, 84*(9), 699-705.

Okunlola, M., Owonikoko, K., Fawole, A., & Adekunle, A. (2008). Gestational age at antenatal booking and delivery outcome. *African journal of medicine and medical sciences, 37*(2), 165-169.

Olamijulo, J., & Olaleye, O. (2010). Perinatal mortality in Lagos University Teaching Hospital: a five year review. *Nigerian quarterly journal of hospital medicine, 21*(4), 255-261.

Olson-Chen, C., & Seligman, N. S. (2016). Hypertensive emergencies in pregnancy. *Critical care clinics, 32*(1), 29-41.

Ota, E., Ganchimeg, T., Morisaki, N., Vogel, J. P., Pileggi, C., Ortiz-Panozo, E., . . . Network, N. H. R. (2014). Risk factors and adverse perinatal outcomes among term and preterm infants born small-for-gestational-age: secondary analyses of the WHO Multi-Country Survey on Maternal and Newborn Health. *PLoS One, 9*(8), e105155.

Pattinson, R., Hulsbergen, M., & Van Hoorick, L. (2010). The effect of maternal HIV infection on maternal conditions and perinatal deaths in southwest Tshwane. *Facts Views Vis Obgyn, 2*(4), 227-231.

Peelen, M. J., Kazemier, B. M., Ravelli, A. C., De Groot, C. J., Van Der Post, J. A., Mol, B. W., . . . Kok, M. (2016). Impact of fetal gender on the risk of preterm birth, a national cohort study. *Acta obstetricia et gynecologica Scandinavica, 95*(9), 1034-1041.

Rakotoseheno, H., Rakotonirina, E., Randriatsarafara, F., Rakotonantoanina, J., Randrianarimanana, V., Rakotomanga, J., & Ranjalahy, R. J. (2008). Prenatal consultations and perinatal mortality in Madagascar. *Journal de gynecologie, obstetrique et biologie de la reproduction, 37*(5), 505-509.

Rashid, F., Khatoon, H., Hasnat, M., Amin, R., & Azad, A. (2017). Perinatal Complications in Diabetes Mellitus with Pregnancy: Comparison between Gestational Diabetes Mellitus (GDM) and Diabetes Mellitus Prior to Pregnancy. *Mymensingh medical journal: MMJ, 26*(1), 124.

Rosano, A., Botto, L. D., Botting, B., & Mastroiacovo, P. (2000). Infant mortality and congenital anomalies from 1950 to 1994: an international perspective. *Journal of epidemiology and community health, 54*(9), 660-666.

Rutstein, S. O. (2005). Effects of preceding birth intervals on neonatal, infant and under-five years mortality and nutritional status in developing countries: evidence from the demographic and health surveys. *International Journal of Gynecology & Obstetrics, 89*, S7-S24.

Safer, M. P. (2007). Neonatal and perinatal mortality.

Sarkar, N. (2008). The impact of intimate partner violence on women's reproductive health and pregnancy outcome. *Journal of Obstetrics and Gynaecology, 28*(3), 266-271.

Sarkar, N. (2013). The cause and consequence of domestic violence on pregnant women in India. *Journal of Obstetrics and Gynaecology, 33*(3), 250-253.

Schoen, C., & Rosen, T. (2009). Maternal and perinatal risks for women over 44—a review. *Maturitas, 64*(2), 109-113.

Stanton, C., Lawn, J. E., Rahman, H., Wilczynska-Ketende, K., & Hill, K. (2006). Stillbirth rates: delivering estimates in 190 countries. *The Lancet, 367*(9521), 1487-1494.

Starikov, R., Dudley, D., & Reddy, U. M. (2015). Stillbirth in the pregnancy complicated by diabetes. *Current diabetes reports, 15*(3), 1-9.

Surkan, P. J., Stephansson, O., Dickman, P. W., & Cnattingius, S. (2004). Previous preterm and small-for-gestational-age births and the subsequent risk of stillbirth. *New England Journal of Medicine, 350*(8), 777-785.

Suzuki, S., Hiraizumi, Y., & Satomi, M. (2011). Does the use of labor-inducing drugs cause adverse perinatal outcomes? *Journal of Nippon Medical School, 78*(2), 126-127.

Szarpak, Ł. (2013). Knowledge of newborn resuscitation among emergency medical personnel. *group, 2*, 0.0001.

Tachiweyika, E., Gombe, N., Shambira, G., Chadambuka, A., Tshimamga, M., & Zizhou, S. (2011). Determinants of perinatal mortality in Marondera district, Mashonaland East Province of Zimbabwe, 2009: a case control study. *Pan African Medical Journal, 8*(1).

Tagbor, H., Bruce, J., Agbo, M., Greenwood, B., & Chandramohan, D. (2010). Intermittent screening and treatment versus intermittent preventive treatment of malaria in pregnancy: a randomised controlled non-inferiority trial. *PLoS One, 5*(12), e14425.

Tegegne, B., Enquoselassie, F., & Yusuf, L. (2010). Birth to pregnancy interval and its effect on perinatal outcomes in Addis Ababa, Ethiopia. *Ethiopian Journal of Reproductive Health, 4*(1), 37-51.

Titaley, C. R., Dibley, M. J., Agho, K., Roberts, C. L., & Hall, J. (2008). Determinants of neonatal mortality in Indonesia. *BMC public health, 8*(1), 1.

Tromp, M., Eskes, M., Reitsma, J. B., Erwich, J. J. H., Brouwers, H. A., Rijninks-van Driel, G. C., . . . Ravelli, A. C. (2009). Regional perinatal mortality differences in the Netherlands; care is the question. *BMC public health, 9*(1), 1.

Vadhera, R. B., & Simon, M. (2014). Hypertensive emergencies in pregnancy. *Clinical obstetrics and gynecology*, *57*(4), 797-805.

Vahabi, S., Haidari, M., Akbari, T. S., & Gorbani, V. A. (2010). New assessment of relationship between Apgar score and early neonatal mortality. *Minerva pediatrica*, *62*(3), 249-252.

Vento, M., & Saugstad, O. D. (2011). Oxygen supplementation in the delivery room: updated information. *The Journal of pediatrics*, *158*(2), e5-e7.

Vitoratos, N., Vrachnis, N., Valsamakis, G., Panoulis, K., & Creatsas, G. (2010). Perinatal mortality in diabetic pregnancy. *Annals of the New York Academy of Sciences*, *1205*(1), 94-98.

Vogel, J., Souza, J., Mori, R., Morisaki, N., Lumbiganon, P., Laopaiboon, M., . . . Roy, M. (2014). Maternal complications and perinatal mortality: findings of the World Health Organization Multicountry Survey on Maternal and Newborn Health. *BJOG: An International Journal of Obstetrics & Gynaecology*, *121*(s1), 76-88.

Vogel, J. P., Torloni, M. R., Seuc, A., Betrán, A. P., Widmer, M., Souza, J. P., & Merialdi, M. (2013). Maternal and perinatal outcomes of twin pregnancy in 23 low-and middle-income countries. *PLoS One*, *8*(8), e70549.

Voigt, M., Henrich, W., Zygmunt, M., Friese, K., Straube, S., & Briese, V. (2009). Is induced abortion a risk factor in subsequent pregnancy? *Journal of perinatal medicine*, *37*(2), 144-149.

Wojcieszek, A. M., Reinebrant, H. E., Leisher, S. H., Allanson, E., Coory, M., Erwich, J. J., . . . Flenady, V. (2016). Characteristics of a global classification system for perinatal deaths: a Delphi consensus study. *BMC Pregnancy Childbirth*, *16*, 223. doi: 10.1186/s12884-016-0993-x

Yaniv, S. S., Levy, A., Wiznitzer, A., Holcberg, G., Mazor, M., & Sheiner, E. (2011). A significant linear association exists between advanced maternal age and adverse perinatal outcome. *Archives of gynecology and obstetrics*, *283*(4), 755-759.

Yirgu, R., Molla, M., Sibley, L., & Gebremariam, A. (2016). Perinatal Mortality Magnitude, Determinants and Causes in West Gojam: Population-Based Nested Case-Control Study. *PLoS One*, *11*(7), e0159390.

APPENDICES

Appendix A: Consent Information for Participants

Study Title: Determinants of perinatal mortality in the Tema Metropolis in the Greater Accra Region, Ghana

Principal Investigator: Dr. Boakye-Yiadom Adomako

Qualification: MPhil Applied Epidemiology and Disease Control

Address: School of Public Heath, University of Ghana, Legon

Greetings, my name is ……..and I am conducting this interview on behalf of Dr. Boakye-Yiadom Adomako, a Master of Philosophy Applied Epidemiology and Disease Control resident, School of Public Health, University of Ghana.

A perinatal death is a fetal death (stillbirth) or an early neonatal death. A stillbirth is the deaths of fetuses (inside the womb of their mothers) weighing at least 1000g, or of 28 weeks pregnancy or more if weight is unavailable. An early neonatal death (END) is the death of a live newborn in the first 7 days of life (0 to 6 days). About 98% of these deaths occur in developing countries like Ghana. Perinatal mortality in Ghana remains high but majority of these deaths remain unexplained. Although some studies have been done in the developed world in relation to perinatal mortality, limited studies have been done in the Ghanaian context. This study may help us to know the determinants of perinatal deaths and also make recommendations to improve the data and use the data for action to address the problem.

You are being invited to participate in the study because you delivered your last pregnancy here and your baby meets our selection criteria. If you agree to participate in this study, I would ask you a few questions centered on your last pregnancy and childbirth. This will take about 20 minutes of your time.

I would like to look into your maternal health record book you used in this last pregnancy to record what was documented and also ask you some questions concerning your last pregnancy to enable me get the information needed.

If you agree to participate, you be among 360 mothers who will also be participating in the study in this hospital and also those in Tema General Hospital.

Participating in this study is entirely voluntary. You have the right to refuse to participate and this will not affect your rights in any way, especially to your healthcare. You are also at liberty to withdraw from this study at any stage of your participation. I would like to see you participate to the end.

There are no direct benefits or risks in participating. You will not be paid or compensated for your participation. However, the info that the study will come out with, will help us to understand the factors associated with perinatal mortality in Ridge Regional Hospital and the entire Greater Accra Region. The questions are not very sensitive. However, whenever you feel uncomfortable answering some of them, you may choose not to answer them.

All the info collected from you will be treated strictly confidential and will be used for the intended purpose only. You will not be identified by name in any dissemination reports or publications resulting from this study.

The Ghana Health Service Ethics Review Committee has reviewed and given approval for this study to be conducted.

Do you have any questions for clarifications?

If you have any further questions regarding this study, which I could not satisfy you with the appropriate answer, you may contact:

Dr. Boakye-Yiadom Adomako, (Principal Investigator) at School of Public Health, University of Ghana, Legon, Accra, Accra or on: Tel. 0244575431/0509078160 or e-mail: kofado@yahoo.co.uk:

Dr. Patricia Akweongo, (Supervisor), Department of Epidemiology, School of Public Health, University of Ghana, Legon; Tel. 0243138376.

Participant Consent

I have been adequately informed about the purpose, procedure, potential risks and benefits of this study. I have had the opportunity to ask questions and have been provided answers to my satisfaction. I know that I can refuse to participate in this study without any loss of benefit for which I would be entitled. I understand that even if I agree or as I have agreed, I can withdraw my consent at any time without losing any benefits or services to which I am entitled. I also understand that the information collected will be treated confidentially and will be used only for the purpose informed. Finally findings/results may assist us in policy development to reduce perinatal mortality.

I freely agree to participate in this study.

Right thumbprint

ID of participant……..

Signature ……...

Date…….

Telephone ……..

If participant cannot read the form themselves, a witness must sign here:

WITNESS

I was present while the benefits, risks and procedures were read to and /or interpreted to the understanding of the volunteer. All questions will be answered and the volunteer will agree to take part in the research. She will also voluntarily release her maternal health book to research assistants for records abstraction.

Date……

Signature……

I certify that the nature and purpose, the potential benefits, and possible risks associated with participating in this research have been explained to the above individual.

……..……

Signature of research assistant

……

Date

Appendix B: Questionnaire

STUDY TITLE: DETERMINANTS OF PERINATAL MORTALITY IN THE TEMA METROPOLIS IN THE GREATER ACCRA REGION OF GHANA

Participant ID ☐

Interviewer ID ☐

Date of Completion of form ☐

Please record the data as per question in the spaces provided or choose from the options provided.

1. Date of delivery ☐

2. What is the outcome of delivery a. Fresh still birth ☐ b. Macerated still ☐ c. Early neonatal death ☐ d. No Perinatal death ☐

A. SOCIO-DEMOGRAPHIC FACTORS

3. What was your age at delivery?
   a. < 20 ☐ b. 20 – 34 ☐ c. 35+ ☐

4. What is mother's highest educational level? a. No schooling ☐
   b. Primary/JHS ☐ c. Secondary ☐ d. Tertiary ☐

5. What is mother's marital status? a. Single ☐ b. Married ☐ c. Separated ☐

6. What is mother's occupation? a. Farming ☐ b. Trader/business woman ☐
   c. Artisan ☐ d. Gov. work/private formal job ☐ e. housewife ☐
   f. unemployed ☐

7. What is Father's highest educational level? a. No schooling ☐
   b. Primary/JHS ☐ c. Secondary ☐ d. Tertiary ☐

6. What is father's occupation? a. Farming/ fishing ☐ b. Trader/businessman ☐
   c. Artisan ☐ d. Gov. work/private formal job ☐
   e. unemployed ☐

B. MATERNAL FACTORS

7. How many children have you delivered (dead or alive) prior to this delivery?
   a. 0 ☐ b. 1 – 3 ☐ c. 4+ ☐

8. How long (in years.) is your previous delivery (if the index is not the first)?
   a. < 2 ☐ b. 2+ ☐ c. N/A ☐

9. Have you had a previous still birth? a. Yes ☐ b. No ☐
   c. N/A ☐

10. Have you had a previous early neonatal death? a. Yes ☐ b. No ☐
    c. N/A ☐

11. Have you ever had an abortion or miscarriage? a. Yes ☐ b. No ☐

12. Did you use herbal preparation during pregnancy? a. Yes ☐ b. No ☐

13. Did you have any complications (obstetric – give examples) during pregnancy?
    a. Yes ☐ b. No ☐

14. Did you have any infection/illness during pregnancy? a. Yes ☐ b. No ☐

15. Did you have Diabetes during pregnancy? a. Yes ☐ b. No ☐

16. Did you have Hypertension during pregnancy? a. Yes ☐ b. No ☐

17. Were you physically or sexually abused during pregnancy? a. Yes ☐ b. No ☐

18. How many weeks pregnant were you at the 1st ANC visit (please confirm)?
    a. < 16 ☐ b. 17 – 27 ☐ c. 28+ ☐

19. How many times did you attend ANC (please confirm)?
    a. 0 ☐ b. 1 – 3 ☐ c. 4 – 7 ☐ d. 8+ ☐

20. Did you take adequate TT injection during pregnancy (please confirm)?
    a. Yes ☐ b. No ☐ c. Completed ☐

21. Did you take the 3rd dose of SP (IPT3, explain) (please confirm)? a.
    Yes ☐ b. No ☐

22. Were you sleeping under ITN during pregnancy? a. Yes ☐ b. No ☐

C. FETAL/NEONATAL FACTORS

23. How many babies were delivered (index pregnancy)?
    a. Singleton ☐ b. Multiple ☐ (if multiple state the number) ☐

24. What is the sex of the baby? a. Male ☐ b. Female ☐
    NB write sexes if multiple ☐

25. What was the gestational age (weeks) at delivery (explain)? a. < 37 ☐
    b. 37 – 38 ☐ c. 39 – 40 ☐ d.40+ ☐

26. What was the birth weight (kilograms) of the baby? a. < 2.5 ☐
    b. 2.5 – 2.9 ☐ c. 3.0 – 3.9 ☐ d. 4.0+ ☐ e. Not weighed ☐

27. Any birth defect present? a. Yes ☐ b. No ☐

D. DELIVERY RELATED FACTORS

28. How did labour start? a. Spontaneous ☐ b. Induction ☐
    c. Caesarean section ☐

29. What was the mode of delivery? a. Spontaneous vaginal ☐
    b. Instrumental ☐ c. Caesarean section ☐

30. What was the 1st minute Apgar score?
    a. < 4 ☐ b. 4 – 6 ☐ c. 7 – 1 ☐

31. Was the baby aggressively resuscitated after delivery? a. Yes ☐ b. No ☐