THE GEOGRAPHY OF MATERNAL HEALTH INDICATORS IN GHANA

Ayodeji Emmanuel Iyanda, B.Sc.

Thesis Prepared for the Degree of

MASTER OF SCIENCE

UNIVERSITY OF NORTH TEXAS

May 2017

APPROVED:

Joseph Oppong, Major Professor
Chetan Tiwari, Minor Professor
Patti Hamilton, Committee Member
Paul Hudak, Chair of the Department of Geography and the Environment
David Holdeman, Dean of the College of Arts and Sciences
Victor Prybutok, Vice Provost of the Toulouse Graduate School

Iyanda, Ayodeji Emmanuel. *The Geography of Maternal Health Indicators in Ghana*. Master of Science (Applied Geography), May 2017, 80 pp., 4 tables, 14 figures, references, 88 titles.

Ghana is identified among the developing countries with high maternal mortality ratio in Africa. This study unpacked the Demographic and Health Survey data by examining the maternal health indicators at the district level using GIS methods. Understanding the geographic patterns of antenatal care, place of delivery, and skilled birth attendants at the small scale will help to formulate and plan for location-specific health interventions that can improve maternal health care behavior among Ghanaian women. Districts with high rates and low rates were identified. Place of residence, Gini-Coefficient, wealth status, internet access, and religious affiliation were used to explore the underlying factors associated with the observed patterns. Economic inequality was positively associated with increased use of maternal health care services. The ongoing free maternal health policy serves as a cushion effect for the economic inequality among the districts in the Northern areas. Home delivery is common among the rural districts and is more prominent mostly in the western part of Northern Region and southwest of Upper West. Educating women about the free maternal health policy remains the most viable strategy for positive maternal health outcomes and in reducing MMR in Ghana.

ACKNOWLEDGEMENT

I want to thank my major advisor, Dr. Oppong, for his time and patience throughout the thesis writing. I appreciate all the time he invested in giving constructive criticism. I also appreciate my thesis committee members, Dr. Tiwari and Dr. Hamilton, for their contributions and suggestions.

My special thanks goes to grad writing support, especially Allyson Jones and Erin Campbell, for their edits and suggestions. I appreciate your time and responses, thank you so much for making it a success. I will like to thank my other colleagues who contributed in diverse ways to the completion of this work through their encouragement and ideas. Bink, thank you for providing the district code ideas. At least, I was not alone in the intellectual journey, I appreciate the team spirit of the Health and GIS Research Group for various contributions.

TABLE OF CONTENTS

Page

LIST OF TABLES

Page

LIST OF FIGURES

Page

CHAPTER 1

INTRODUCTION

1.1 Background of the Study

High maternal mortality ratios (MMR) are a huge global health challenge, particularly in developing countries. Globally, there were 10.7 million deaths between 1990 and 2015 because of pregnancy, delivery complications, and other maternal causes (Alkema et al., 2015). Approximately 303,000 lives were lost to maternal mortality in 2015 (WHO and UNICEF, 2015). The World Health Organization (WHO) statistics indicate that Sub-Saharan African (SSA) countries account for about 66% of global maternal mortality and have the highest lifetime risk of maternal death (1 in 36, compared to 1 in 4900, globally). Although maternal mortality has been declining since the adoption of the Millennium Development Goals (MDG-5) in early 2000, which aimed to reduce maternal death by 75% and improve maternal health, the rate in developing countries remains about 14 times higher than in the developed countries (WHO and UNFPA, 2014). In fact, despite the implementation of several policies to address the problem, progress towards the reduction of maternal mortality is sluggish among many low-and-middle-income countries. This is particularly true in Ghana's case, where, despite the introduction of a free maternal healthcare policy and other health initiatives like the Community based Health Planning and Services (CHPS), the associated reduction of MMR that has been expected does not seem to be taking place. One puzzling question is why Ghana's maternal mortality ratio has not declined significantly, despite the introduction of multiple financial accessibility and user fee reforms. This study explores this question by examining the spatial disparities in several maternal health indicators, dubbed as process variables (WHO & UNICEF, 2015) that contribute to maternal health outcomes.

According to the WHO and UNICEF, antenatal care (ANC), health facility delivery, and assistance from a skilled birth attendant (SBA) are important maternal interventions that can reduce MMR (WHO & UNICEF, 2015). Antenatal care establishes a facility-based relationship between pregnant women and healthcare providers throughout the maternal circle—from the first month of conception through post-delivery. WHO recommend that pregnant women are to attend a minimum of four ANC visits, during which they are exposed to medical counseling, examination, and monitoring of extreme cases to ensure a positive birth outcome. According to WHO, all the pregnant women are expected to deliver their babies in a health facility and any delivery outside the health facility is discouraged. Delivery by a skilled birth attendant under safe conditions in a health facility prevents avoidable maternal and infant deaths (DeBrouwere, Tonglet & Lergerghe, 1998). A skilled birth attendant is defined as a person "trained to proficiency in the skills needed to manage normal (uncomplicated) pregnancies, childbirth and the immediate postnatal period, and in the identification, management and referral of complications in women and newborns" (Harvey et al., 2007). Hence, many studies have used these indicators to track the progress of MDG in reducing maternal mortality.

1.2 Spatial Distribution of MMR and Associated Challenges

Like other health phenomena, MMR varies between and within countries. Thus, aggregated country-level reports of MMR conceal the spatial variations within the country. At the district level, maternal deaths are not usually reported, due to their relative rarity. Even though death is a legal issue which must be reported, many developing countries do not report death appropriately due to the dearth of appropriate infrastructure and resources for data collection. This problem, is exacerbated by poor health policy implementation and leads to underestimation of the MMR in developing countries like Ghana.

Though Ghana has a relatively low MMR compared to other African countries, the current national MMR of 319 per 100,000 live births is high in comparison to other developing countries, such as India, where the MMR is 174 per 100,000. Ghana is thus classified as vulnerable and fragile, because of the high level of obstetric risk among women of reproductive age (WHO et al., 2015). In addition, the Ghana National Newborn Health Strategy and Action plan for 2014-2018 revealed that Ghana lags in two key maternal health indicators – the proportion of women who received four focused ANC visits and the proportion of deliveries occurring under the supervision of skilled birth attendants (GMOH, 2014).

Past methods of estimating maternal death have been criticized for their unreliability, misclassification, and underreporting because of these measurement challenges. In response, it is often the case that alternative health indicators are currently used to measure maternal mortality (Mensah & Oppong, 2007; WHO & UNICEF, 2015). Due to the unavailability of accurate data on the actual cause of death, maternal death figures are estimated using a variety of mathematical models that use some variables other than maternal death data. Thus, estimates of MMR tend to vary (Mensah & Oppong, 2007). The international statistical classification of diseases and related health problems (ICD-10), classifies maternal death as any death that results from direct or indirect causes during pregnancy, delivery, and the 42 days post-delivery (WHO, 2012). Due to poor health facility records (i.e. vital registrations such as birth and death records) and use of 'survivorship' or verbal autopsy techniques, deaths of pregnant women and new mothers due to diseases, violence, and accidents not related to the pregnancy are usually misclassified as maternal deaths, leading to misrepresentation in maternal mortality data (Setel et al., 2005). Accordingly, other methods have been suggested for collecting data on mortality, fertility, and demographic characteristics of a

population. One such method is sample vital registration (SVR), which, despite its lack of inclusiveness, serves as an alternative to population health or facility records (Setel et al., 2005).

1.3 Causes of Maternal Mortality and Maternal Health-Seeking Challenges

Antepartum and postpartum hemorrhage, hypertensive disorders, unsafe abortion, pre-eclampsia and eclampsia, obstructed labor, sepsis, and infections are known causes of maternal death among all countries (Say et al., 2014; WHO, 2016). Similarly, in Ghana, the leading causes of maternal mortality include postpartum hemorrhage, induced abortion, hypertensive disorders, infections, and ectopic gestation (Asamoah et al., 2010; Mensah et al., 2011; Der et al., 2013). Interestingly, almost all of these causes of maternal death are preventable if signs are recognized early during antenatal care and postnatal care.

Many factors limit access to, and utilization of, maternal health care services, in a variety of settings. Included among these limitation factors are education level (Asante-Sarpong et al., 2016), place of residence (Yaya, Bishwajit & Shah, 2016), religious affiliation (Gyimah et al., 2006; Dako-Gyeke et al., 2013), wealth disparity (Ahmed, Creaga, Gillespie & Tsui, 2010; Arthur, 2012), cultural influences (Bloom, Lipperveld & Wypij, 1999; Woldemicael, 2007; Ameyaw et al., 2016), and the proximity and availability of healthcare services (Buor, 2002; Kitui, Lewis & Davey, 2013; Ekwochi et al., 2015). This study uses a number of these variables to further elucidate the spatial variation of maternal health indicators at the district level.

In Ghana, fine scale spatial analysis of maternal health indicators is limited; only one study has evaluated skilled birth attendants in Ghana, at the regional level (Asamoah, Agardh & Cromley, 2014). Similarly, to the best knowledge of this researcher, only one district-level analysis has been carried out to examine the spatial impact of health care policies on skilled birth attendants (Johnson, 2016). Johnson (2016) examined four instances of maternal health care policies, namely

those from the cash-and-carry regime, free antenatal care, free delivery, and the most recent National Health Insurance Scheme (NHIS) implementation period. Neither Johnson (2016), nor Asamoah, Agardh & Cromley (2014), included antenatal care or delivery location in their studies. There is need to understand how the pattern of ANC visits and delivery assisted by SBAs vary among districts in Ghana. This study fills this gap in the research by using nationally representative cross-sectional data to examine the spatial variation of ANC visits, place of delivery, and assisted skilled birth at the district level.

For the purpose of this study, the 170 districts of Ghana were classified as North and South, based on the 2010 National Population Census classification and Ghana Statistical Services 2008 (GSS, 2008). The 38 districts that make up the Upper West, Upper East, and the Northern Regions, henceforth labelled as the North. The remaining seven regions, comprising 132 districts, are classified as the South.

Using Aday and Andersen's (1974) behavioral model of access to medical care and Human Disease Ecology model (Meade & Earickson, 2000), this study examines the spatial variation of maternal health indicators (antenatal care, place of delivery, and proportion of SBAs) among the 170 districts in Ghana. In addition, this study uses geographic information system (GIS) techniques and spatial analysis to identify district-level disparities in the maternal health indicators This information can be used to support location-specific health intervention and program prioritization.

1.4 Objectives and Research Questions

The goal of this study is to analyze the selected three maternal health indicators using the 2014 DHS dataset to understand the maternal health seeking behavior that could be used to intervene in Ghana's maternal mortality ratio from the district perspective.

A. Objective: To examine and compare spatial patterns of maternal health indicators in the 38 districts in the North and 132 districts in the South.

1. How does utilization of ANC vary between the districts in the South and the North?

2. How does the pattern of home and facility delivery vary between the South and North?

3. How does the pattern of assisted delivery by physician, nurse/midwife, and community health officer(CHO) vary between the districts in the South and the North?

B. Objective: To analyze factors driving the pattern of the three maternal health indicators stated above.

4. How do rural-urban residence, wealth status, level of development and globalization, and religious affiliations correlate with the three maternal health indicators in the North and the South of Ghana?

CHAPTER 2

CONCEPTUAL FRAMEWORK AND LITERATURE REVIEW

2.1 Conceptual Framework

This research draws its framework from two different models, namely, the behavioral model and Human Disease Ecology model to understand the varying patterns of ANC visits, place of delivery, and attendance by skilled personnel as indicators of maternal health-seeking behavior, in the context of the maternal mortality ratio (MMR) among the districts of Ghana. It also seeks to identify different associated factors influencing the spatial patterns of the three indicators. The behavioral model suggests that predisposing factor, enabling factor, and the need factor of an individual determine health care utilization at different geographic locations. While the Human Disease Ecology model assumes that personal characteristics, the environment, and external behaviors dictate health outcomes. Based on these two models, the following variables were identified as those which may influence maternal health seeking behavior: a woman's age, location of residence, educational status, wealth position, health insurance policy, decision-making autonomy, access to transportation and perception of distance to a health facility. Hence, a few of the variables are used to assess spatial variations among the districts in Ghana.

The remainder of this section introduces the conceptual frameworks in connection with relevant works on maternal health-seeking behavior, in the context of the MMR in Ghana.

2.1.1 Behavioral Model, Human Ecology Model and Health Vulnerability

Maternal health care utilization can partly be understood from the three components of the behavioral model: predisposing factors, enabling factors, and need factors (Aday and Andersen 1974). Predisposing factors are underlying factors that affect health-seeking behaviors. These factors include a mother's age, marital status, religion, education, ethnicity, and employment

status. Enabling factors include the resources (e.g. health insurance, income, etc.) available to an individual, household, or community (rural-urban, region, nation) where the mother resides. These enabling factors help to explain health care utilization, by shedding light on access to health care. Income, health insurance policy, and health education are believed to provide better access to healthcare without any delay. In contrast, those who lack these enabling factors have poorer access. Access to health care resources can be limited by a lack of physical access, financial cost, cultural barriers, and a lack of time (Bour, 2002). Lack of access of any kind can lead to three types of delay in seeking prompt care. The first type of delay occurs when the patient's decision to seek health care is delayed, the second is the patient's delay in arriving at a health facility for care, and the third delay occurs as result of a delay in the provision of adequate care by a health provider (Thaddeus & Maine, 1994). Thaddeus and Maine (1994) argue that both enabling and need factors expose patients to the first type of delay in seeking prompt care. In terms of the second type of delay, scarcity of, and geographic distance from, health facilities act as barriers to access, and are the main challenges in health care services utilization (Thaddeus & Maine, 1994; Ensor & Cooper, 2004; Ekwochi et al., 2015). The need factor is described as the health status or the illness level that motivates an individual to seek health care. During pregnancy, women are urged to make use of gynecological services for the general safety of the mother and the unborn child. In this study, the health status of a woman is pregnancy, which requires adequate medical attention throughout the gestation period. As has been identified in previous reproductive health studies (Gelberg, Andersen, & Leake, 2000; Asante-Sarpong et al., 2016), predisposing, enabling, and need factors affect and to some degree determine the health-seeking behaviors both during and after pregnancy, and can predict the obstetric risks of women.

This study combines Aday and Andersen's (1974) behavioral model with Meade and Earickson's (2000) Human Ecology of Disease triangle, to examine the spatial pattern of maternal health-seeking behavior. The relationship between these models is presented in Figure 1, below. Like Aday and Andersen's (1974) behavioral model, the Human Disease Ecology triangle has three components: population, behavior, and environment. These components represent the foundational elements of human ecology, and as such, allow us to understand the nature of health more clearly. As such, I will identify these foundational elements as they are represented in the present study. Examining the nature of the population, especially "as biological organisms—as the potential hosts of disease" (Meade and Earickson, 2000) is a crucial component of understanding human ecology in general, and particularly for understanding maternal mortality.

The population for this study consists of women between the ages of 15-49 assumed to be at a sensitive stage, especially in the first trimester of pregnancy. The first trimester, when a baby's body structure and organ systems develop, is the most crucial period for a baby's development, and most miscarriages and birth defects occur at this stage. Additionally, antepartum hemorrhage usually occurs in the first three months of pregnancy, due to complications such as uterine fibroid, which competes with the growth of fetus in the women's uterus (Murray, 1926; Evans & Brunsell, 2007). Uterine fibroid is primarily responsible for bleeding and loss of pregnancy among women of reproductive age, and if it is not well attended to, can harm the woman and endanger the pregnancy. In extreme cases, uterine fibroid can lead to maternal death and loss of pregnancy (Evans & Brunsell, 2007). In the Human Disease Ecology model, age and genetics are additional important elements; In terms of maternal mortality, it is evident that women experience a variety of health outcomes during and following pregnancy that are directly related to age and genetic composition.

The Human Disease Ecology triangle indicates that, in addition to population characteristics, behavior, and environment are also important aspects of understanding disease. Behavior is the observable aspect of culture which is interwoven with the level of education, exposure, technological advancement, and at the highest, shaped by the government policies. In the Human Disease Ecology triangle, Environment is concerned with the social, economic, political, cultural, and physical or built-up environment. For this study, it is clear that these environmental elements are key in determining women's health vulnerability. Level of health vulnerability also varies with an individual's place of residence, social relationships, age, gender, and economic resources to withstand insults; in most cases, the poor are more exposed to health risk outcomes (Rogers, 1997).

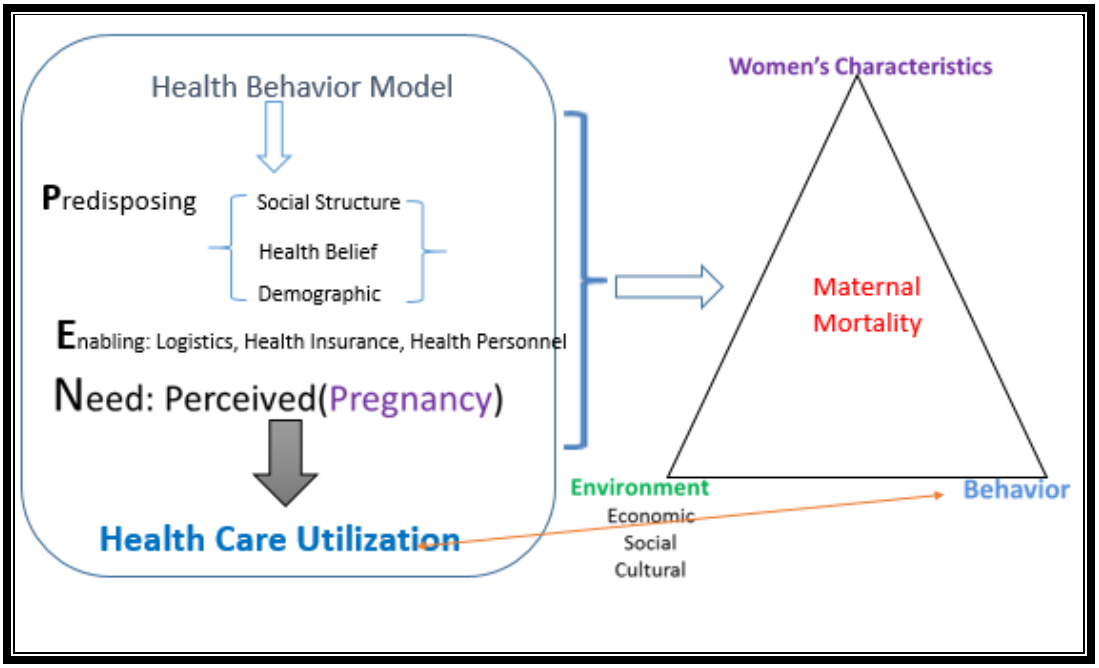

Figure 2.1. Adapted model from Behavioral Model (Aday & Andersen, 1974) and Human Disease Ecology (Meade & Earickson, 2000).

Finally, these combined factors influence the decisions and behavior to seek health care. Many studies have used the variables from the two merging models in Figure 2.1 and the HBM, separately of in combination to study health care utilization and health outcomes (Asante-Sarpong

et al., 2016). The next section review works that are important for understanding the goal of this study based on the three models presented.

2.2 Literature Review

2.2.1 Social and Economic Implications for Maternal Health-Seeking Behavior

The effect of socioeconomic factors on health and disease is being referred to in many studies worldwide (Anderson, 1973; Thaddeus & Maine, 1994; Andersen & Newman, 2005; Akowuah, 2016). Many of these studies have argued that women's education, household wealth, and access to transportation for emergency response are factors necessary for increased utilization (Aday & Andersen, 1974; Chakraborty et al., 2003; Mensah & Oppong, 2007; Glanz, Rimer & Viswanath, 2008; Amin et al., 2010; Arthur, 2012; Akowuah, 2016). Furthermore, household wealth indices and women's empowerment, which have been defined differently by several authors as social, cultural, political, and recently as sexual empowerment (Crissman, Adanu & Harlow, 2012; Corroon et al., 2014, Ameyaw et al., 2016), are important for successfully harnessing health care resources.

2.2.1.1 Economic Factors

In most developing countries, unlike in developed countries like the United States, wealth disparities rather than racial and ethnic disparities are more implicated in health-seeking behavior (Amin et al., 2010; Frieden, 2016; Yaya, Bishwajit & Shah, 2016). Wealth is usually measured by variables such as landed property, farm lands, and access to household vehicles. A multi-country study by Ahmed et al. (2010) using the 3Es (Economic, Education, and Empowerment) for 31 developing countries indicated that women in the lowest wealth quintile were 94% less likely to use skilled health services compared to women in the highest quintile. In Bangladesh, health-seeking behavior among women improved incrementally along the wealth quintile scale, moving

from poorest to richest (Amin et al., 2010). An Indian study showed that infant deaths, under-five mortality, and maternal mortality were higher among individuals with lower wealth status in comparison to those in higher wealth categories (Balarajan, Selvaraj, & Subramanian, 2011). In a study in Malawi, disparity in wealth influenced usage of ANC, skilled birth attendants, and postnatal care (Yaya, Bishwajit, & Shah 2016). Arthur (2012) used Ghana DHS data to explore the influence of wealth on ANC usage, despite the free maternal health policy introduced in 2005, and documented that wealth distribution still has a great effect on the rate of ANC usage with results varying significantly from the poorest to the richest, among all regions, age groups and numbers of previous births. Thus, many studies in the developing countries have concluded that wealth inequality increases disparities in health risks and utilization of healthcare services.

2.2.1.2 Educational Factor

Empirical findings suggest the educational status of women as an influential factor determining the utilization of maternal health care services and facilities. Educational status also correlates with other factors such as autonomy and economic variables (Chakraborty et al., 2003; Ahmed et al., 2010; Asamoah, Agardh, & Cromley, 2014). For instance, women with higher educational status and professional class are more likely to have access to and use health care services compared to their counterparts working on a farm or engaging in petty trade (Ahmed et al., 2010). Similarly, Chakraborty et al. (2003) indicate that women whose husbands engaged in business were more likely to seek modern health care services than the wives of their agrarian or unskilled worker counterparts. Corroon et al. (2014) explored the effect of different levels of gender empowerment on reproductive health outcomes in urban Nigeria, and results showed that authority to make personal decisions affects the rate of health care utilization among women (Corroon et al., 2014). In Ghana, many studies have underscored the importance of education in

improving maternal health care utilization at national, regional, and individual levels (Addai, 2000; Aseweh-Abor et al., 2011; Arthur, 2012; Ameyaw et al., 2017).

2.2.2 Influence of Family Ties, Community, and Belief on Maternal Health Seeking Behavior

2.2.2.1 Culture and Norms

There are ongoing debates about the use of biomedical services and traditional means of maternal health care during pregnancy (Verderese & Turnbull, 1975). Traditional birth attendance is still most appreciated in some of the communities in developing countries. In some areas, childbirth is a cultural process and norm among women, who prove their womanhood through self-delivery (Kyomuhendo, 2003). Some societies, of course, still depend largely on the old women in the family or village during childbirth with the help of local herbs and incisions. Aseweh-Abor et al. (2011) opined that home delivery is still a practice in Ghana because of dependency on the community elders and Traditional Birth Attendants (TBAs) for deliveries. Due to the incidence of maternal death and complications resulting from these traditional practices, efforts have been put in place to reach the unreachable village pregnant women and encourage them to uptake biomedical health services through community health officers (CHOs) or TBAs (Verderese & Turnbull, 1975; Nyortor et al., 2005). Meanwhile, Johnson and Wall (2014) claimed that the voluntary services of TBAs were a factor contributing to increased morbidity and mortality among rural women and therefore led to their total inclusion in maternal health care.

Social structure, in the form of social relations, plays an important role in influencing maternal health-seeking behavior. Ay et al. (2009) conducted a qualitative study in Turkey, a country with a predominantly Muslim population. The study assessed the impact of gender roles on health-seeking behavior among pregnant women, and their results showed that health decisions are made only when the condition of the women in pregnancy are considered as ‘serious’ by the

husband and the elders in the family. Their study revealed the effect of culture and community on how women behave towards seeking care during pregnancy. Distrust in male health providers is another factor that is responsible for lack of access to seek care from a formal health care, mostly among the Muslim wives. In a Ghanaian study, Ampim (2013) concludes that family ties and traditions influence how pregnant women seek health care. Thus, the culture and community affect how women seek care during pregnancy.

2.2.2.2 Community/Distance Factor

Many studies have examined the impact of community factors in accessing and utilization of health care services. Kitui, Lewis and Davey (2013) explored potential explanatory factors for health care utilization among 3,977 women using Kenya Demographic and Health Survey with GPS to estimate the distance to the nearest health facility. Though lack of physical access to a facility was the leading reason for home delivery among pregnant women, distance to a facility was not significant in determining the choice of place of delivery (Kitui, Lewis & Davey, 2013). In a similar study in Malawi, Yaya, Bishwajit and Shah (2016) found that place of residence was one of the determinants of ANC use, SBA, and postnatal care. Similarly, the work of Buor (2002) in Kumasi, Ghana, Sialubanje et al. (2014) in Zambia, and Ekwochi et al. (2015) in Enugu, Nigeria stressed the importance of distance to maternal health care utilization in the study areas. Clearly, distance and women's ability to pay for transport limits their health care options.

Community members are another important factor in a woman's choice of place of delivery. Using a combination of in-depth interview and focus group discussions to explore the impact of social factors on place of delivery among pregnant women in the Upper East region of Ghana, Moyer et al. (2014) documented the impact of community members on influencing a woman's place of delivery. In another study in Zambia, Sialubanje et al. (2014) identified factors

influencing women's personal intention in seeking health care in their next pregnancy episode. Their study found that community influence of important individual member of their family or community members influences their use of health care services. In a similar way, pregnant women's access to and utilization of health care during pregnancy is limited by family members who usually accompany them to seek services (Mumtaz & Salway, 2007). The role of the community factor cannot be underemphasized in the utilization of maternal health care services.

2.2.2.3 Religion and Beliefs

People's beliefs shape their decisions about actions in different areas of their lives including making health-seeking decisions. Gerrits (1997) conducted an anthropological study in Macua in the North of Mozambique among infertile women who prefer to seek care from the traditional healer rather than a medical officer because of their belief in the power of traditional healing. Gyimah, Takyi and Addai's (2006) study in Ghana assessing the role of religion in healthseeking behavior, especially toward fertility and conception, revealed how different religious affiliations behave towards maternal health care utilization. Moslems as well as traditionalists are less likely to use biomedical services than their Christian counterparts (Gyimah, Takyi and Addai, 2006; Onah, Ikeako, & Iloabachie, 2006; Ganle, 2015). From the religious aspect, Muslim wives are restricted from using formal health care because of their belief in Qur'anic prophesy about pregnancy, which states that they are not to be exposed to strangers, for example, a male health worker (Ganle, 2015). In an extension of the work of Gyimah et al. (2006), Dako-Gyeke et al. (2013) conducted a qualitative study with six focus group discussions and 13 in-depth interviews among community members, and religious and community leaders including orthodox and non-orthodox health care providers in two sub-districts of Accra, Ghana. This study was done to understand the influence of sociocultural interpretation on maternal health-seeking

behavior. The result of the study indicated that perceived threats, due to cultural beliefs and interpretations, propelled women to seek care from more than one healthcare provider –biomedical care and other informal sources (Dako-Gyeke et al., 2013). Thus, religion and beliefs remain an important sociocultural factor that influences maternal health outcomes in developing countries.

2.2.3 Decision-Making Autonomy and Perception of Maternal Health Risks

2.2.3.1 Decision-Making Autonomy

Studies have shown that women's autonomy is a big factor in maternal health-seeking behavior in developing countries (Blanc, 2001; Adjiwanou & LeGrand, 2014; Ameyaw et al., 2016). This has been measured by asking questions about the involvement of women in various household matters which has been used to measure decisions about contraceptive use and use of health care. The more power and 'say' a woman has over household matters, the more likely it is that she will make decisions in matters relating to her personal health, especially reproductive healthcare (Blanc 2001). Empirical researches have shown that increase in women's positive health-seeking behavior is linked with cooperation with their spouse (Ensor and Cooper, 2004; Adjiwanou & LeGrand, 2014). It is expected that women who have mutual understanding with their husbands are more likely to attend ANC and deliver in a health care facility under supervised care. Mumtaz and Salway (2007) suggested that women who have a strong interpersonal relationship and good communication with their spouse are more likely to have access to health care during pregnancy than those with a poor relationship with their husband's family members and other important relatives.

Various studies have attributed high education level among women to increase autonomy in decision-making during pregnancy. Woldemicael (2007) reinforced the significant implication of decision-making autonomy for health-seeking behavior among women in Eritrea and Ethiopia

by demonstrating the relationship among health-seeking behavior, socioeconomic factors, and place of residence (rural versus urban). This study concluded that maternal health-seeking behavior can be compromised by reduced decision-making autonomy (Woldemicael, 2007). In a similar manner, Bloom, Wypij and Gupta (2007) examined the impact of autonomy among 300 women in Varanasi, India. The authors found that women with greater control over finances, decision-making power, and freedom of movement are more likely to receive a higher level of ANC and use safe delivery care. A study conducted using the 2014 Ghana DHS also confirmed that autonomous decision making among women influenced women's choice to deliver in a health facility, especially among young females (Ameyaw et al. 2016). In contrast, Fotso et al. (2009) used this same variable to study the maternal health of the urban poor in Kenya and documented autonomy as a weak determinant of maternal health-seeking behavior. Fotso et al.'s findings are similar to the work of Mumtaz and Salway (2007) who, in their Punjab study, found that decision-making autonomy was a weak factor for ANC services. The conflicting results probably reflects the importance of cultural difference across space.

2.2.4 Organizational, Social Technology and Maternal Health-Seeking Behavior

Many studies have pointed to the influence of organization both political and apolitical, on health seeking behavior. Andersen and Newman (2005) contend that individual characteristics, the health facility and medical technology, and social norms are interrelated factors that determine health services utilization. There is no doubt that government policies and interaction with care providers play a significant role in health decision making. Experts have previously studied how effective organizational policies could impact health-seeking behavior and improve health outcomes among pregnant women based on the previous frameworks of health service utilization (Wendt et al., 2015). In developing countries because of the high-level burden of diseases, different

health intervention programs and policies have been designed and implemented. In recent times, many countries in Africa have adopted universal health insurance to reduce economic stress among the public (Atuoye et al., 2016). In Ghana, phases of health policies at the local and national level can be traced from 1957-2014. The National Health Insurance Schemes (NHIS) introduced in 2003 under the National Insurance Scheme Law, Act 650, and the Health Insurance Regulation of 2004, which was revised in 2012 under Act 852, have improved Ghanaians' health. Since the inception of the Scheme, insurance enrollment has been increasing, but a report revealed that there is a mismatch between enrollment and utilization due to low socioeconomic status (Sulzbach et al., 2005).

Likewise, in 2008, a free maternal health care initiative was introduced under the NHIS, which allows pregnant women to attend up to six ANC visits, a facility delivery, and two postnatal care visits within six weeks of delivery (Browne et al., 2016). Despite the national free maternal care initiative, there are huge disparities in health care use among women in Ghana. Evidence from a study of the influence of capitation policy on health care utilization in Ghana suggests that free maternal care will not be affected (Atuoye et al., 2016). This assurance is believed to have influenced both ANC attendance and health facility deliveries significantly, but at the end of 2015, WHO reported that Ghana was one of those countries in Sub-Saharan Africa that did not meet the MDG-5 in reducing its maternal mortality ratio. The question to why Ghana has not been able to see a reduction in MMR remains a puzzle and requires urgent action.

Asante-Sarpong et al. (2016) assessed the determinants of use of supervised delivery care under Ghana's fee exemption policy for maternal health care for two districts of the Central Region. Their study showed that despite the free care policy, some women in the districts rarely delivered in a health facility. They concluded that there was a mismatch between knowledge of

the free health policy and place of delivery in the two study areas. Increasing knowledge intervention programs among poor rural women, have been recommended to reduce poor maternal health knowledge at the community level in Ghana (Asante-Sarpong et al.,2016).

Apart from the government policies, the attitude of health providers also serves as a discouraging factor to health seeking. Maine and Thaddeus (1994) documented how patients' perception of health care facilities usually determine if a patient is to continue or discontinue health care patronage. This could affect a woman who is seeking health care from a provider for the first time. The reaction and general experience of a pregnant woman based on previous services received may discourage or encourage her to continue to seek care despite all odds, for example, a long distance to a health facility (Sialubanje et al., 2014). A provider's reputation is also important; a place with well-equipped health workers and functional equipment usually correlates with frequent use.

From the health point of view, most of the works carried out based on the popular Andersen and Newman's framework failed to realize the role of social technology in improving the utilization of health care services. In their model, the focus was on the medical technology, which is assumed to improve utilization and improve general health from the supply side (Andersen & Newman, 1973; Thaddeus & Maine, 1994). Although some studies have criticized Aday and Andersen's (1974) framework for its lack of cultural consideration, the factor of social technology, particularly the use of mobile phones and the internet, was not included in the model (see Andersen & Newman, 2005). The Andersen and Newman behavioral model should be revisited and consider a way of incorporating this social variable.

Furthermore, access to and use of social technology is based on wealth status in some settings, nevertheless, it is important for improving communication and knowledge for better

health care utilization. In developing countries, there is a growing recognition of information and communication technology and its importance in improving maternal and child health. Lagan, Sinclair, and George (2010) did an assessment of how the use of the internet influences pregnancy decision making in Ireland. The study found that in women who use the internet to seek pregnancy-related information, confidence increases as internet access increases. Several systematic reviews are available on the influence of social technology on maternal health (WHO, 2015; Oyeyemi & Wynn, 2015; Sondaal et al., 2016). Oyeyemi and Wynn (2015) examined the influence of a mobile phone project among pregnant women in five primary health centers in Ondo State in Nigeria. The comparative analysis showed that facility utilization was higher in Ifedore LGA, the project area, than in Idanre LGA, the control area. Meanwhile, antenatal registration and delivery care were higher in the control area than in the project area. Few empirical studies on mobile technology and maternal health seeking behavior have been conducted in Ghana (Abekah-Nkrumah, Guerriero, & Purohit, 2014). It is important to understand the influence of mobile health technology on maternal health seeking especially for the selected indicators in Ghana.

2.2.5 Spatial Analysis of Maternal Health Care Services

Different methods and concepts related to geography have been considered in studying aspects of maternal health care seeking at the global, regional and local levels (McLafferty, 2003). The need for geographical information techniques is increasing in many public health studies and the importance of such techniques has proven invaluable to the community of science, social science, and medicine (McLafferty, 2003). For instance, Burgert-Brucker et al. (2015), in their report for the United States Agency for International Development (USAID) through the Demographic and Health Survey (DHS) program, assessed “geographic variation in key indicators of maternal and child health across multiple countries in Sub-Saharan Africa.” Their study used

geographic information techniques and methods to analyze the spatial autocorrelation of maternal health care seeking behavior (ANC and SBA) using Global Moran's I and Local indicator of spatial association (LISA). Similarly, O'Meara et al. (2013) used spatial autocorrelation analysis to investigate uptake of ANC and the relationship to individual, household, and village-level factors in Kenya. The application of geo-spatial analysis is an important technique for identifying a local "hotspot" for planning health intervention (Burgert-Brucker et al., 2015). In Ghana, two known studies have examined the spatial analysis of maternal health indicators at a larger scale; one was done at the regional level on SBAs (Asamoah, Agardh & Cromley, 2014) while the other study was a district level analysis of health care policies at different periods (Cash-and-carry, free antenatal care, free delivery, and NHIS) and access to SBAs (Johnson, 2016). However, few studies have analyzed other spatial aspects of maternal health at the district level in Ghana.

In conclusion, women's education, wealth status, place of residence, and religion are important factors that influence the use of maternal health care services. Furthermore, increasing knowledge about health risks and benefits will facilitate increased use of these services while women's empowerment will increase access.

2.3 Gap in Knowledge and Study Contribution

There are existing empirical studies on the determinants of health care utilization and maternal outcomes in Ghana using different methods and techniques. Yet, a spatial analysis of maternal health indicators at the district level is limited, especially in the study area, Ghana, where most existing studies have focused on regional-level analysis. It is important to have a geographical perception of a problem from the community level. Using district level data can supplement community studies and provide insights on where the issue of maternal mortality is intense and therefore help to set specific targets for maternal health interventions to reduce MMR.

Secondly, few studies have considered social technology –access to mobile phone and internet services— as one of the determinants of health care utilization in Ghana. This study will include this variable to assess the selected maternal health indicators in Ghana. Lastly, the current research improves on the geographic scale used in previous studies for the three maternal health indicators selected because limited analyses are available at the geographic scale around which this study is designed.

CHAPTER 3

METHODOLOGY AND DATA SOURCES

3.1 Study Area

Physical settings: Ghana with a landmass of 238,533 km^2 (92, 099 mi^2), lies between 4^0 and 12^0 North. Its southernmost coast at Cape Three points is 4^0 30'. It extends inland for some 670 km to about 11^0 North. The distance (348 miles) across the widest part is between longitude 1^0 12' east and 3^0 15' west. It is found at the center of Gulf of Guinea coast, bordered by three countries: Burkina Faso to the north, Ivory Coast to the west, and Togo to the east. Figure 3.1 shows the 10 regions in Ghana which are subdivided into districts. The current Metropolitan, Municipal, and District Assemblies in Ghana is 210. There is a total of six metropolitan, 49 municipal and 161 districts with new ones created. Although, the number of districts in Ghana keeps changing, data for this study uses the 170 districts shapefile and the Demographic and Health Survey (DHS) was carried out based on this number (Figure 3.1).

Sociodemographic and economic: The 2010 National Population Census (NPC) estimated Ghana's total population to be 24,658,823. Between 1965 and 1989, a constant 45 percent of the nation's total female population was of childbearing age. Economically, Ghanaian men are twice as likely to be employed as females, and are mostly employed in the informal private sector (GSS, 2008). The results of the National Population Census (GSS, 2012) show that the female adult population is more likely to be self-employed or homemakers than their male counterpart.

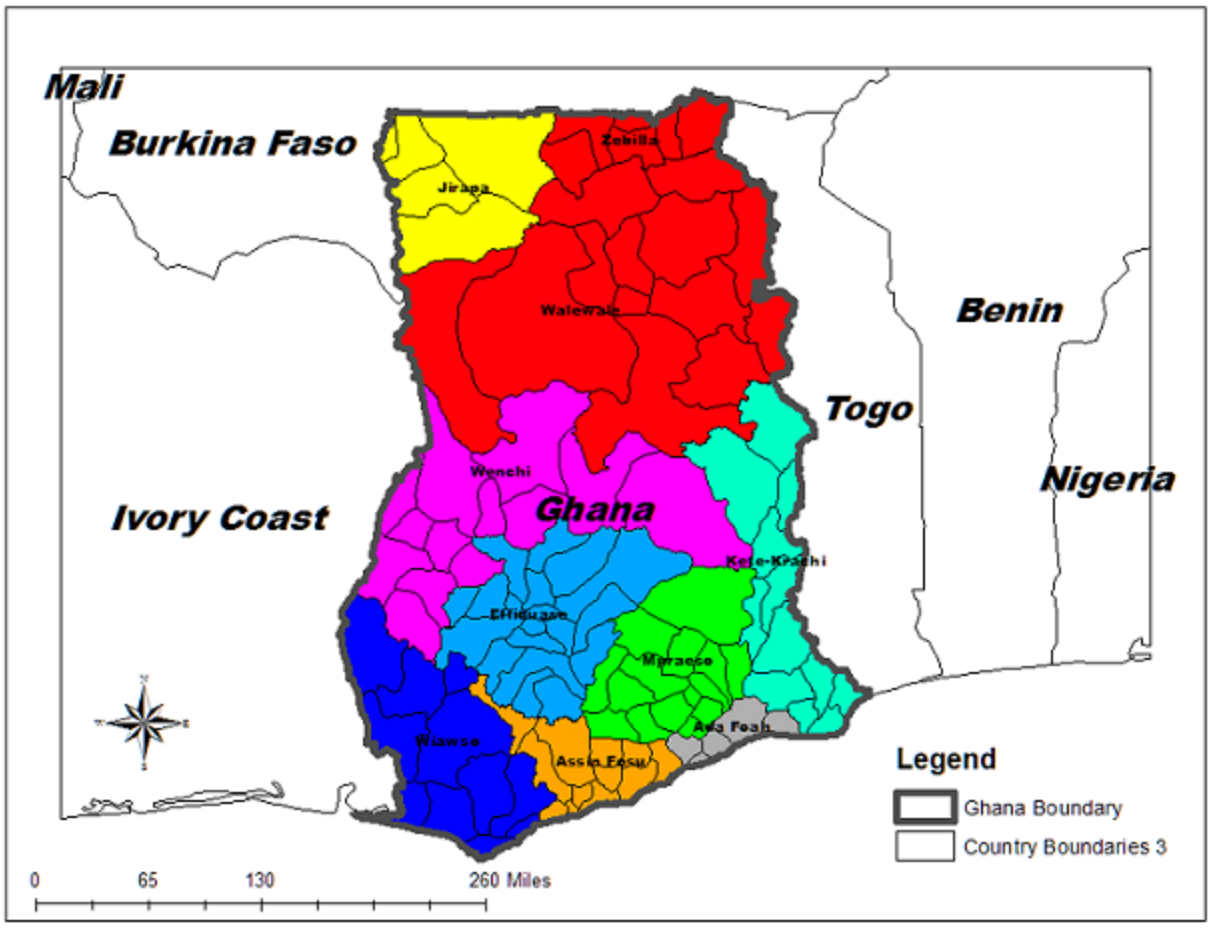

Figure 3.1 Map of Ghana showing the Districts

Since independence in 1967, Ghana has been experiencing rapid urbanization. There is a link between urbanization, technological advancement, and human development, which can also be correlated with the quality of the average citizen's health (GSS, 2008). Three regions—the Upper East, Volta, and Central Regions—had the highest MMR in 2010 (GSS, 2012). However, only facility maternal mortality data was accounted for in the NPC survey. At the end of 2015, WHO reported the MMR in Ghana to be 319 per 100,000 live births, far above the global ratio of 216 and the MDG's target of a 75-percent reduction (WHO and UNICEF, 2015).

3.2 Data and Method

3.2.1 Data Source

This study is based on secondary data sources. The main source of data for this study is from the Ghana Demographic and Health Survey (GDHS), sponsored by the United States Agency International Development (USAID). The data on economic inequality was from the Ghana Statistical Service (GSS, 2015).

3.2.1.1 Ghana Demographic and Health Survey

The survey design was in two stages. The GDHS includes a questionnaire on households, mother and child health data, collected at the district level (smallest administrative unit) from both urban and rural populations (approximately 52 percent rural). Approximately equal sample sizes were collected from the 10 regions. The 10 administrative units were subdivided into 427 clusters (216 urban clusters and 211 rural clusters) which included the enumeration areas (EAs), and households were randomly sampled from each cluster (GSS, GHS & ICF, 2014). By employing stratified random sampling technique, every element in the sample had an equal chance of being selected. The final sample included 9,396 cases, out of 12,831 households sampled, indicating a response rate of 73.23%. Many studies have used this data and have commended its representativeness. However, the qualitative compilation of some important variables such as distance travelled to obtain health care serves as one important limitation of the data for geographic study of maternal health-seeking behavior.

3.2.2 Research Variables:

3.2.2.1 Outcome and Explanatory Variables

Based on the goal of this study to assess maternal health seeking behavior, three outcome variables were selected, which are all derived from the GDHS. These variables include:

- Antenatal care (ANC) visits: No ANC visits, less than four (<4) ANC visits, and ≥ 4 ANC
- Place of delivery: Home or Health Facility
- Skilled Birth Attendance (SBA): Assisted by Doctors, Nurses/Midwives, Community Health Officers (CHOs)

The World Health Organization and other health bodies suggest at least four antenatal visits for pregnant women, and also consider only birth occurring in a health facility under the supervision of a SBA acceptable. An SBA is someone proficiently trained to manage normal pregnancy and delivery, and handle complications as they arise or refer patients to another provider (Harvey et al., 2007). Table 3.1 gives a summary of variables identified in the literature and the conceptual framework that are most likely to influence the number of ANC visits, place of delivery, and SBA presence at birth.

This study also explores several factors that may contribute to or interact with maternal health seeking behaviors. These are:

- Rural-urban residence
- Wealth status
- Economic inequality
- Development
- Religious affiliation

Rural-urban residence was defined as place of residence within a survey region. Ghana NPC classified any geographic area with population less than 5000 inhabitants as rural while population more than 5000 is classified as an urban area. Women found in these two categories were included accordingly based on the survey design. The method used in building the DHS Composite Wealth Index (CWI) has been described elsewhere (Rutstein & Stavesteig, 2014) and

it is used in this study to measure income. Furthermore, the wealth index was manipulated to represent three income categories: poor, middle, and rich. In order to measure economic disparities and how it may affect maternal health care use between regions defined as the North and the South in this study, Gini-Coefficient was used. The Gini-coefficient was calculated by the Ghana Statistical Services based on selected districts' economic characteristics. The percentage of individuals in the population who have access to the internet was used as a proxy for level of development and globalization. Internet access at the individual-level was aggregated for the district level analysis conducted in this study. Religious affiliation is captured using the percent of the population who self-identify as Christian or Muslim.

Table 3.1 Summary of the study'sconcepts, variables, models, and methods

Concept	Access/Utilization	Utilization	Access
Outcome variables:	Antenatal Care: No ANC, 1<4 ANC, ≥ 4 ANC visits	Place of Delivery: Home or Heath Facility	Skilled Health Services at delivery: Access to a Physician, Nurse/Midwife, & CHO
Explanatory Variables:	Rural-urban residence	Rural-urban residence	Rural-urban residence
	Wealth Index	Wealth Index	Wealth Index
	Gini-Coefficient	Gini-Coefficient	Gini-Coefficient
	Internet access	Internet access	Internet access
	Religious affiliation	Religious affiliation	Religious affiliation
Models:	Behavioral Model	Behavioral Model	Behavioral Model
	Human Disease Ecology	Human Disease Ecology	Human Disease Ecology
Method of Analysis:	Spatial Analysis, descriptive statistics Spearman's Correlation	Spatial Analysis, descriptive statistics, Spearman's Correlation	Spatial Analysis, descriptive statistics Spearman's Correlation.

3.3 Statistical Techniques

3.3.1 Spatial Pattern of Maternal Health Indicators: ANC Visits, Place of Delivery, and Assisted Birth Attendance

In order to examine the spatial patterns of the outcome variables at the district level in Ghana, percentage of respondents in the DHS sample was calculated for the outcome variables. Districts in Ghana (170) were originally coded numerically to 27, which most DHS data users find difficult to utilize. Due to the past difficulties among DHS data users to analyze the dataset at the district level, efforts were made to recode the numeric 27 districts by matching the codes with those found in the 2010 Ghana population census. This resulted in 170 district codes used in the present study. Further steps were taken to join and match variables in the DHS dataset with similar attributes in a Ghana shapefile containing the 170 districts in ArcMap. The dataset was measured in quintiles (five equal categories of 20%) and is expected to show finer spatial variation at the district level that aids geographic explanations. Furthermore, Spatial Autocorrelation (SA) was used to determine the presence of clusters of the three maternal health indicators among the districts. While SA is a global statistic tool which is useful for detecting spatial autocorrelation in data set, it does not reveal where the cluster(s) can be found in the study area. Thus, Local Indicator of Spatial Association (LISA) was a preferred explanatory tool used to detect local clustering, in proportion to the result of Global Moran's I (Anselin, 1995).

Global and Local Spatial Statistics

Global Moran's I is a statistical tool used to determine if the observed patterns are spatially clustered or not. If the statistic is significant, it suggests that there is evidence of global spatial clustering and that further fine-scale analysis is needed. I used two different local spatial statistical tests to examine local patterns in this study. The Local Moran's I test is used to determine areas with significant positive and negative autocorrelations. Getis-Ord Gi* hotspot analysis technique

is used to identify significant areas of high and low values while the optimized cluster analysis (LISA) is used to identify cluster-outliers (C-O). These tools were used systematically to identify districts with hot and cold spots for all the categories of the maternal health indicators selected in this study.

The choice of defining a spatial relationship is an important parameter specification in achieving the purpose of the tests described above. Spatial relationship describes and quantifies the relationships between the geographic features in a study area. There are several ways in which these can be defined in ArcGIS 10.4 software – through the use of contiguity matrices (queen or rook cases), inverse distance weighted relationships, zone of indifference, and K nearest method. This study uses a fixed distance band approach: this is a commonly used specification and is appropriate for polygon data.

3.3.2 Descriptive and Multivariate Analysis of the Three Maternal Health Indicators

Univariate and multivariate analysis was performed to analyze maternal health indicators for the 38 districts in the North and 132 districts in the South. The interquartile range (IQR) boxplot identifies outliers which enables us to understand district(s) that lagged or outperformed others in terms of the outcome variables. Mann-Whitney U, a non-parametric test was conducted for each of the outcome variables, to test the significance of the variance between North and South regions as defined in this study. Furthermore, to determine the extent to which the independent variables influence the pattern of maternal health indicators at the district level, Spearman's correlation (*rho*) was used to measure the association between each outcome variable and each independent variable.

CHAPTER 4

RESULTS AND ANALYSES

4.1 The Geography of Antenatal Care Visits, Place of Delivery, and Skilled Birth Attendance

The first part of this chapter presents the spatial pattern of the three maternal health indicators selected for the present study using choropleth maps for visualization. This study adopts descriptive statistics (boxplot) to identify the districts' positions in relation to the three maternal health indicators, to aid visualization, and to identify outliers among the districts. In addition, I used incremental spatial autocorrelation, a global Moran's I statistic, optimal local indicator of spatial association (LISA), and Getis-Ord Gi* to explore the spatial clusters. The 170 districts used in this study were grouped into North and South to make a comparison between the Northern and Southern parts of Ghana (Table 4.1).

Table 4.1 Reclassification of districts into groups

Regions	**No. of Districts**	**Group**
Greater Accra	10	
Western	17	
Eastern	21	
Ashanti	27	
Central	17	
Volta	18	
Brong Ahafo	22	
Subtotal	132	**South**
Northern	20	
Upper West	9	
Upper East	9	
Subtotal	38	**North**
	170[1]	

[1]The 2014 DHS Data was based on 170 districts

4.2 Spatial Pattern of Four ANC Visits, Less than Four ANC, and No ANC Visits in the South and North

The first research question was about the spatial distribution of the four minimum ANC

visits, < 4 ANC visits, and no ANC visit among the districts in the North and districts in the South. Figures 3-6 reveal geographic variation in the level of ANC use at the district level in Ghana. The output of the descriptive analysis in Figure 4.4 identifies the outliers among the districts that had below 50% for a minimum of four ANC visits. Some of the districts found in this category include Sekyere Central, Mampong Municipal, Chereponi, Sekyere East, Yilo Krobo, Gushiegu, Nkwanta South, and Nanumba South. Fourteen districts had no ANC visits. The districts that were in the low extremes include the Gushiegu, Nkwanta North, Nkwanta South, Akatsi, Basame Freha, Nanumba South, Yendi, and West Akim Districts.

4.2.1 Four ANC Visits

In analyzing the spatial pattern of the percentage of women who received at least four ANC visits among the districts, we observe high spatial disparities even within a region, for example in Ashanti region where this observation is clearly revealed. In the North, the variation in percentage of the minimum of four ANC visits shows a less disparity among the districts in the Northern Region. Districts in the highest quintile attained between 99% and 100% for the four minimum ANC visits compared to districts in the lowest quintile (between 0-74%). About 50% of the districts in the Northern and Eastern Regions exhibits the lowest uptake of a minimum of four ANC visits. Other districts that fall in the highest quintile are found across the study area (Figure 4.1A). No district in either the Upper East and Upper West regions was found in the lowest quintile. The median for the four ANC visits for the districts in the South is 89.5% while it was 88.5% for districts in the North.

Furthermore, result of the global Moran's Index shows a significant clustering pattern ($p < 0.05$) and LISA (Figure 4.1B) identified Saboba District in the Northern Region and Kwahu West District in the Eastern Region with high and low (HL) level of four ANC visits. Districts in

the Western Region were also identified with high rate surrounded by high rate of a minimum of ANC visits (HH). While in the Eastern Region, Kwahu East and Kwahu South districts were identified with low rate surrounded by low value of a minimum of ANC visits (LL). Although, the test of difference shows no significant difference in the pattern of the four minimum ANC visits between the South and the North (U = 2284.5; p > 0.05), the spatial evidence shows that the pattern of a minimum of 4ANC visits was significantly and positively clustered in the South than in the North (Figure 4.1B). In order to show the difference between the high and low significant clusters, Figure 4.1C further shows the areas with high rate of minimum of 4 ANC visits among the districts in the Western region, Central and Brong Ahafo.

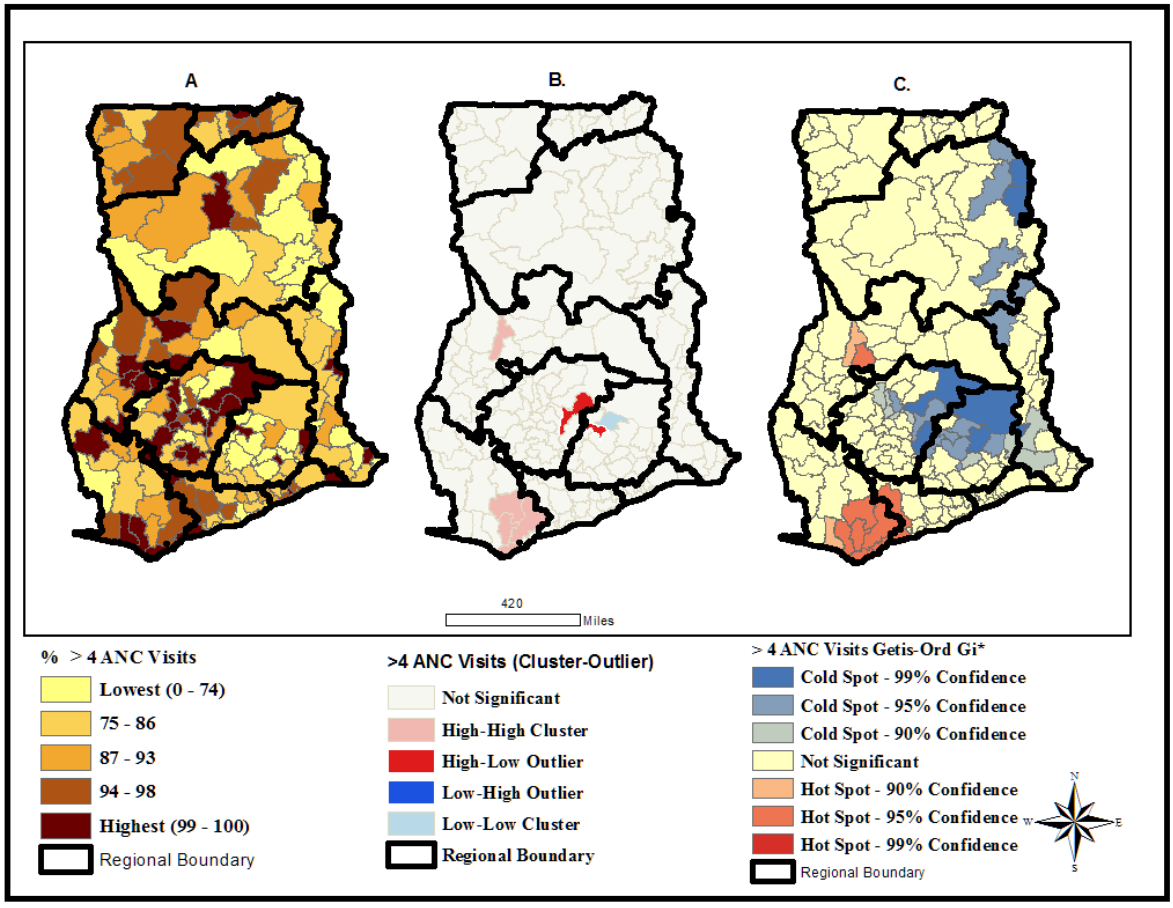

Figure 4.1. Map showing the spatial pattern of four ANC visits at the district level. (Note: A is the spatial distribution in quintile, B is the Cluster-Outlier analysis, C is the Getis-Ord Gi* analysis)

While the low rates were identified in the eastern part of Ashanti region, most of the districts in the Eastern region, upper and lower parts of Volta region and north-eastern parts of Northern Region. This spatial evidence is supported by other regional studies on the high rate of ANC visits in Ghana (Brugiviani and Peace, 2016).

4.2.2 Less than Four (<4) ANC Visits

Figure 4.2A presents the spatial distribution of less than the four (1-3) recommended ANC visits. Within-region spatial variation was high in most of the three regions in the Northern, Volta, and Eastern Regions compared to a low variation observed within the districts in Ashanti, Western, Upper West, and Upper East Regions. In addition, more than half of the districts in the Northern and Eastern Regions had less than the 4 ANC visits. The median for the less than four ANC visits for the districts in the South is 7% while it was 9.5% for districts in the North. This implies that districts in the North are more likely to receive below the required ANC visits than most of the districts in the South. This confirms the disparity between the districts in the Northern region and the Southern region in maternal health-seeking behavior.

Furthermore, result of Local Moran's I statistic in Figure 4.2B shows that Kwahu North, Yilo Krobo, Upper Manya, West Akim, Suhum/ Kraboa Coatar, North Dayi, Hohoe, Dangbe West Districts in the South have areas with high value of < 4 ANC visits surrounded by areas of high rate (HH). Meanwhile, in the North, Zabzugu Tatali, Nanumba North, and Nanumba South had significant HH values of less than 4 ANC visits. More so, outliers were also identified among the districts in the Western and Ashanti Regions where districts with high rates are surrounded by low rate of < 4 ANC visits (HL). Moreover, districts in the Volta Region have more of areas with low percentage of < 4 ANC visits surrounded by high rates (LH). Overall, the percentage of women that had <4 ANC visits did not vary significantly between districts in the South and those in the

north (U = 2178.5; p > 0.05). Figure 4.2C which shows the areas of high and low values identifies districts in the southeastern part on the Northern region, virtually all the districts in the Eastern Region, and districts in the southern and northern part of Volta region with significant hotspots. Districts in Ashanti and lower part of Western Region were indicated as cold spot for <4 ANC visits. Most districts in the Northern and Eastern Regions had less than the four ANC visits compared to districts in Ashanti and lower part of Western Regions. In summary, there is a substantial percentage of women that still do not utilize ANC services adequately.

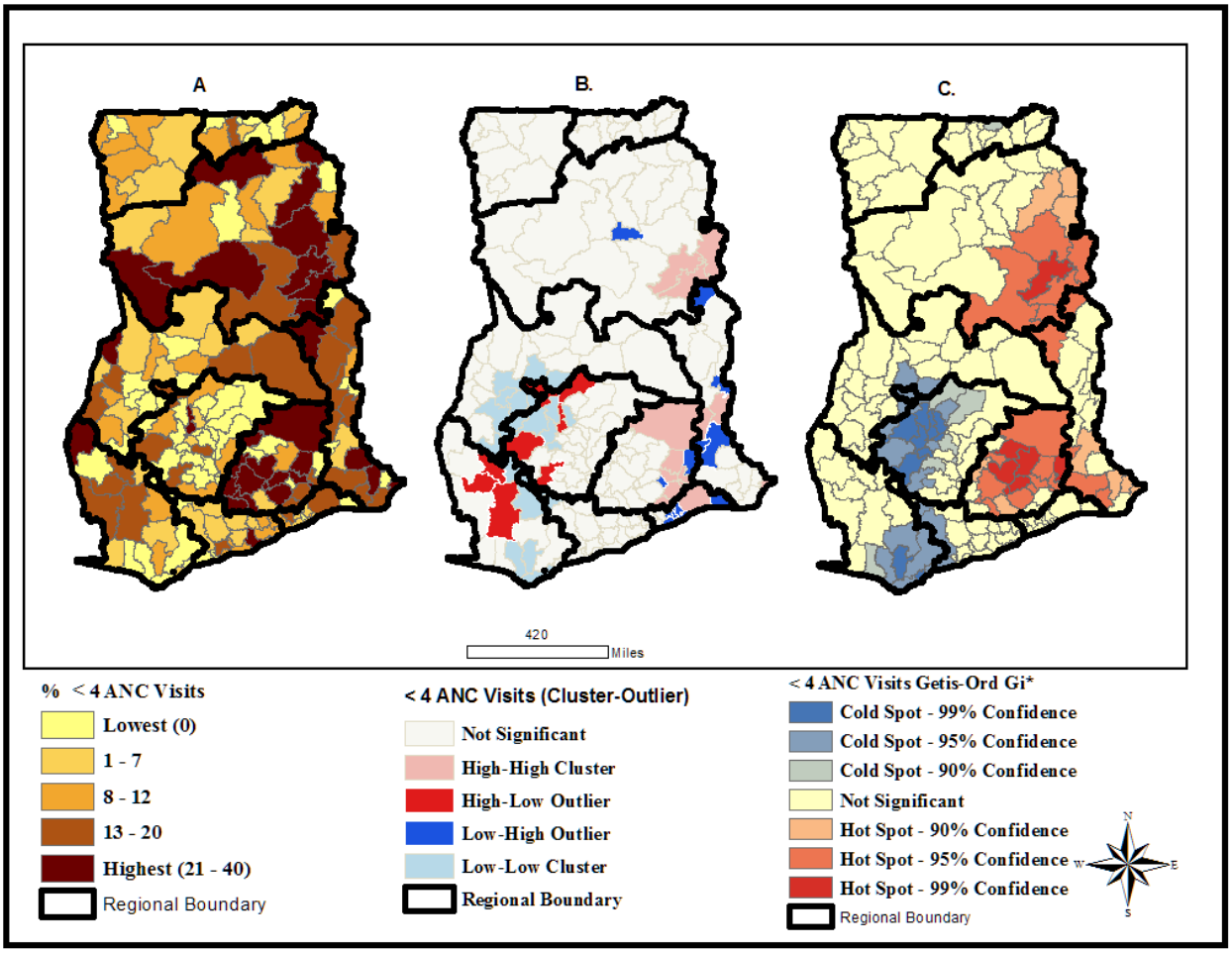

Figure 4.2 Map showing the spatial pattern of less than four (<4) ANC visits at the district level. (Note: A is the spatial distribution in quintile, B is the Cluster-Outlier analysis, C is the Getis-Ord Gi* analysis)

4.2.3 No ANC Visits

Figure 4.3A shows high levels of spatial variation of no ANC visits among the districts in the Northern, Eastern, and Volta Regions. A neighborhood effect was observed between the upper part of the Volta Region and southeastern part of the Northern Region for the district with no ANC visits at all. Districts in the Upper East and Central Regions show less disparities for women with no ANC visits. At least one district in the Ashanti Region and about two districts in the Eastern Region fall within the highest quintile of no ANC visits during pregnancy.

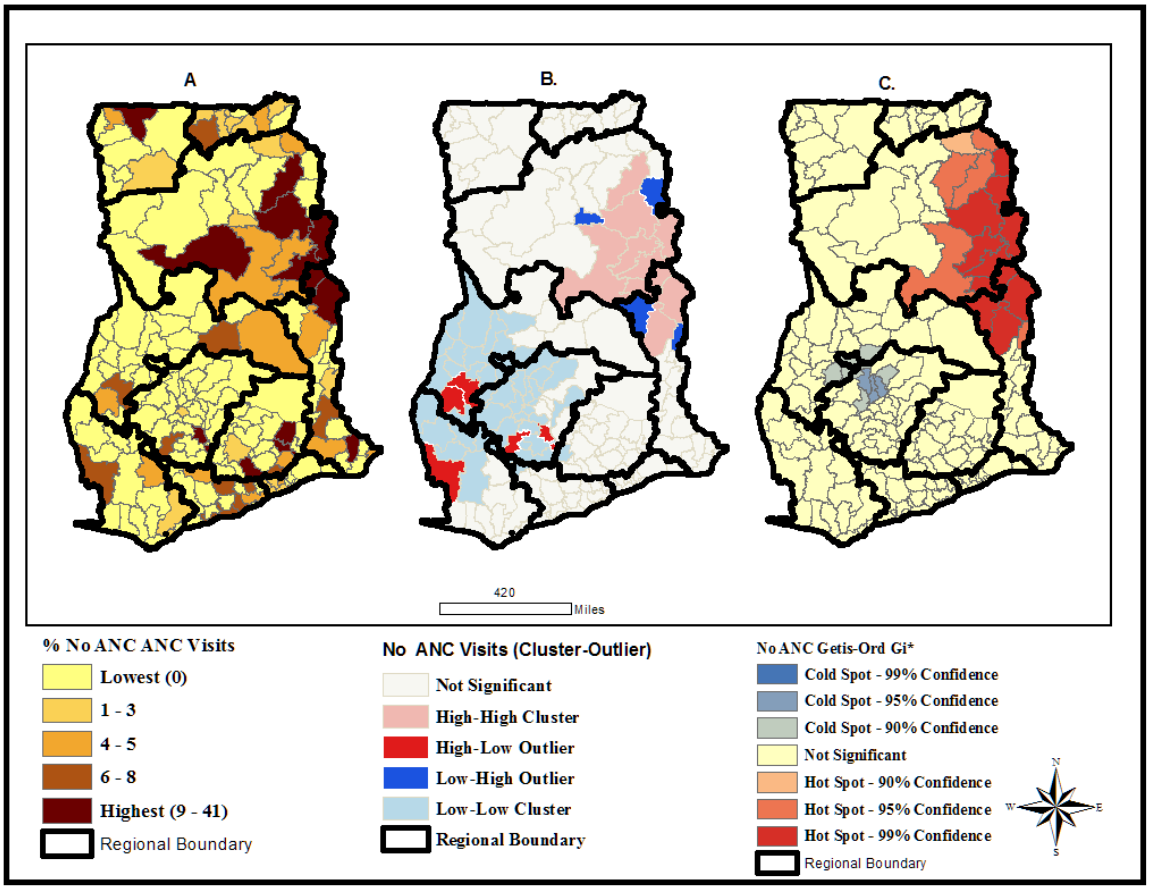

Figure 4.3 Map showing the spatial pattern of No ANC visits at the district level (Note: A is the spatial distribution in quintile, B is the Cluster-Outlier analysis, C is the Getis-Ord Gi* analysis)

Furthermore, LISA analysis in Figure 4.3B identified significant HH clusters in East Gonja,Yendi, Gushiegu, Nanumba North and Nanumba South, Zabzugu Tatali in the North and

Krachi East, Nkwanta South and Nkwanta North of Volta Region in the South. The LL clusters dominate the South especially in Ashanti, part of Brong Ahafo, and part of Western Regions. This indicates that many women in the North were more likely than the women in the South to not seek any care to ANC services. In addition, four districts in the Western Region including Wassa Amenfi West, Aowin/Suaman, five in Ashanti Region where districts like Afigya Kwabre and Ejura Sekye Dumasi were identified in the HL category (outlier). For the districts with LH outliers, Tamale Metro in the Northern Region, South Dayi and Jasikan in the Eastern Region and Dangbe East in Greater Accra were identified (Figure 4.3B). Furthermore, Getis-Ord Gi* shows hotspot for no ANC visits only for districts in the eastern part of Northern Region and upper part of Volta Region (Figure 4.3C).

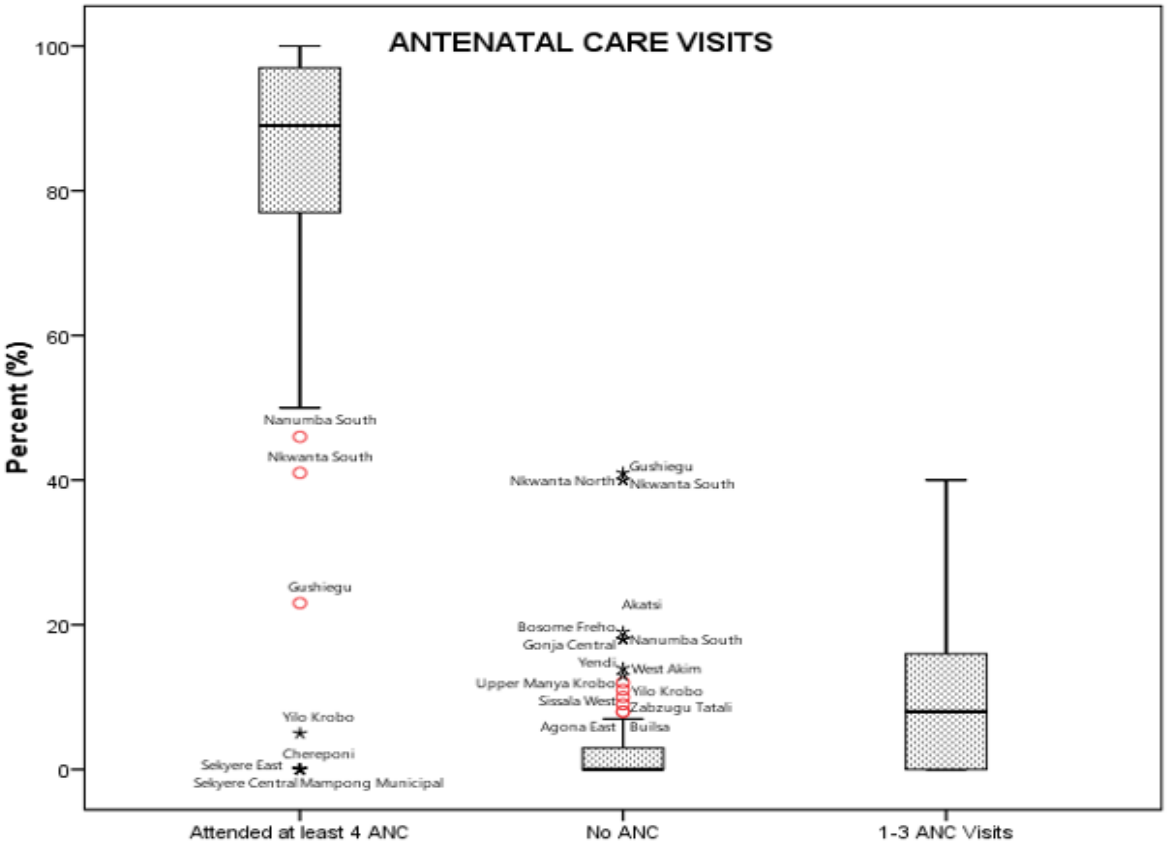

Figure 4.4 Antenatal care attendance among districts of Ghana. (Note: The red circle 'o' indicates out of range while the asterisk * denotes extreme cases)

This may indicate that most pregnant women in these districts are limited by some underlying factors in accessing ANC services. The test of difference for districts in the South and districts in North shows no significant difference in the rate of no ANC visits ($U = 10654$; $p > 0.05$). This result suggests that there is no difference among the districts in Ghana for women who do not obtain ANC visits in their first pregnancy or subsequent ones.

4.3 The Geography of Home and Facility Delivery in the Ghana

4.3.1 Home Delivery

Figures 7-9 show the geographical and descriptive patterns of place of delivery. For this analysis, values that fall within 32% -94% are classified as high, and less than that are considered low. Districts in the Upper West and the Northern Regions were mostly responsible for the high rate of home delivery experienced in the North. Meanwhile in the South, 80% of the districts in the Eastern Region had high incidence of home delivery; at least eight districts in the Western Region, four districts in the Ashanti Region, and almost all the districts in the Central Region were identified to have high rates of home delivery. The spatial variation of home delivery was observed to be higher among the districts in Ashanti Region compared to Northern Region where the variation is closely packed. Figure 4.5A shows that home delivery was extremely high in Tolon Kunmugu in the Northern Region, and Nzema East in the Western Region (Figure 4.7). These districts, along with Sekyere Central, Sekyere East, Mampong Municipal, and Chereponi had the lowest rates of facility delivery and should be prioritized for specific interventions to reduce the high rate of home delivery.

Across Ghana, at least one out of four (26.52%) women gave birth at home, but the North had higher home births than the South. The average home delivery among the districts in the South was 22.9% compared to 39.5% for districts in the North. The underlying factor responsible for this

includes lack of access to health facilities because of distance and cost (Buor, 2002). Despite the implementation of free maternal care policy throughout the country, in the North, high rates of home delivery still dominate. In fact, more than 95% of the districts in the Northern and Upper West Regions exhibits a high rate of home delivery.

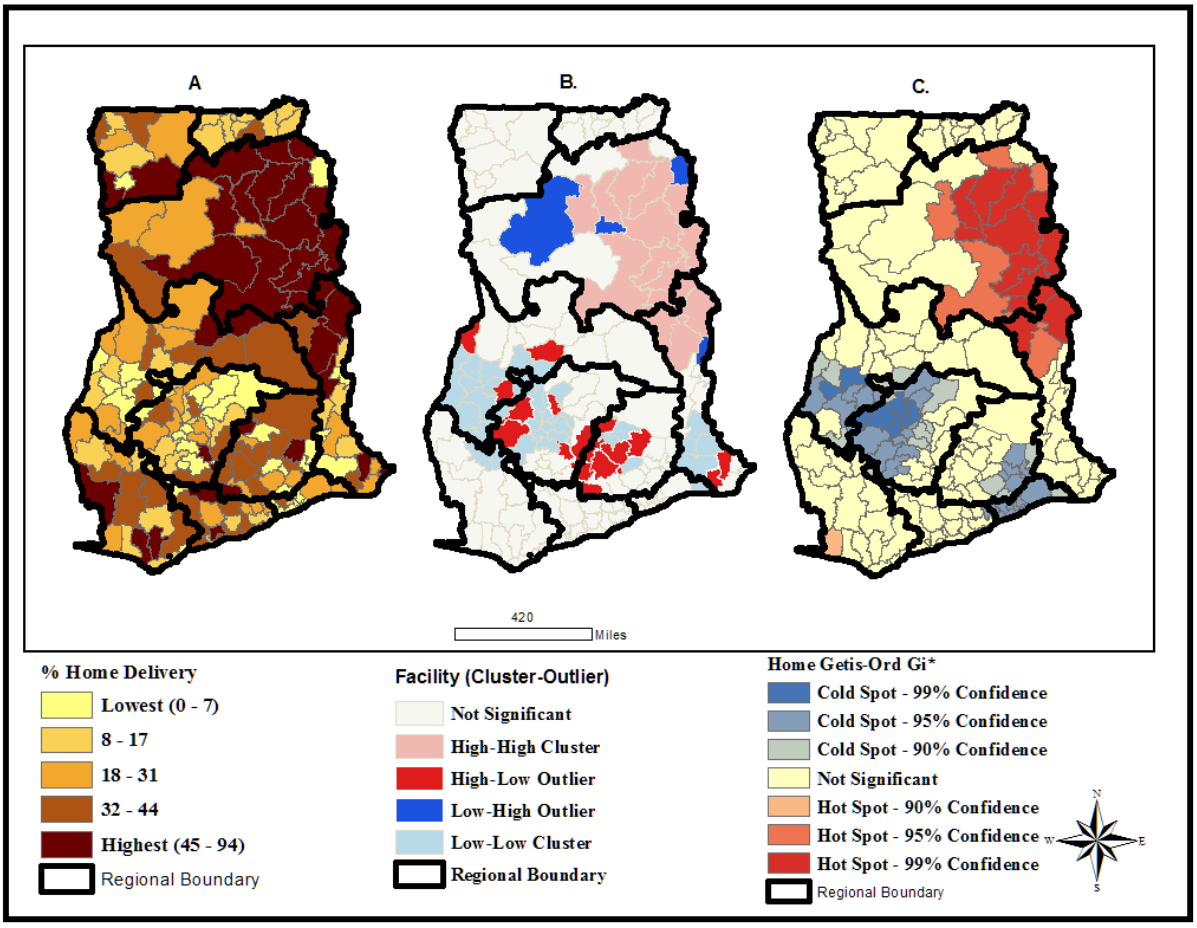

Figure 4.5 Map showing the spatial pattern of home delivery at the district level. (Note: A is the spatial distribution in quintile, B is the Cluster-Outlier analysis, C is the Getis-Ord Gi* analysis)

The LISA map in Figure 4.5B shows that the same districts with low rate of ANC visits also showed significant HH-cluster patterns for home delivery among the districts in the southeastern of Northern Region (East Gonja,Yendi,Gushiegu, Nanumba North and Nanumba South, Zabzugu Tatali, Maprisu East,Karaga, Savelugu Nanton, Tolon Kumbugu) in the North and

Krachi East, Krachi West, Nkwanta South and Nkwanta North in the upper part of Volta Region. In contrast to the HH-cluster patterns that dominate the districts in the North, all the LL-clusters were found in the South. No districts in the Western, Central and Upper West Regions were identified with any significant clusters or outliers. The concentrations of outliers, area with high rate surrounded by low rates (HL) of home delivery were predominant in the South. Meanwhile, low rate of home delivery surrounded by high rate of home delivery clusters are found more frequently in the North more than in the districts in the South. Getis-Ord Gi* shows the districts with very high and low significant cluster of home deliveries among the districts in the Northern Region and upper part of Volta Region (Figure 4.5C). The Mann-Whitney U test shows that there was a significant difference in the rate of home delivery between the districts in the North and South ($U = 10392.5$; $p < 0.05$). The spatial analysis shows that the districts in the North had significantly higher rates of clusters of home delivery than the districts in the South.

4.3.2 Facility Delivery

On the average, about three out of four (68.82%) women use some form of formal health facilities during delivery at the national level but the rate of facility delivery at the district level which was higher in the South (71.95%) than in the North (57.95%) (Figure 4.6). Facility delivery is prominent in the southeastern part of Brong Ahafo, and in the northeast and southwest of the Ashanti Region. Also, there is high spatial variation in facility delivery mostly among the districts in the Ashanti, Brong Ahafo, and Volta Regions in the South, and Upper West in the North than what was observed for districts in the Northern Region (Figure 4.6A). Furthermore, the districts in the southern part of Volta and Greater Accra have relatively high rates of health facility delivery. This is probably due to the proximity of health facility services in the urban districts of Greater Accra. Figure 4.6B shows that low facility delivery was more clustered among the districts in the

Northern Region and spilled to the upper districts in Volta Region. Districts in the Brong Ahafo and Greater Accra had HH-cluster patterns of facility delivery. LH-Outliers were identified in districts like Wenchi in Brong Ahafo, Ahafo Ano North in Ashanti and Ga West in Greater Accra. These districts had significant areas with low rate of health facility delivery surrounded by areas with high rate of facility delivery (LH). Furthermore, Tamale Metro in the Northern Region and Sekyere Afram Plains in the Eastern Region have areas with high facility delivery surrounded by areas with low facility delivery.

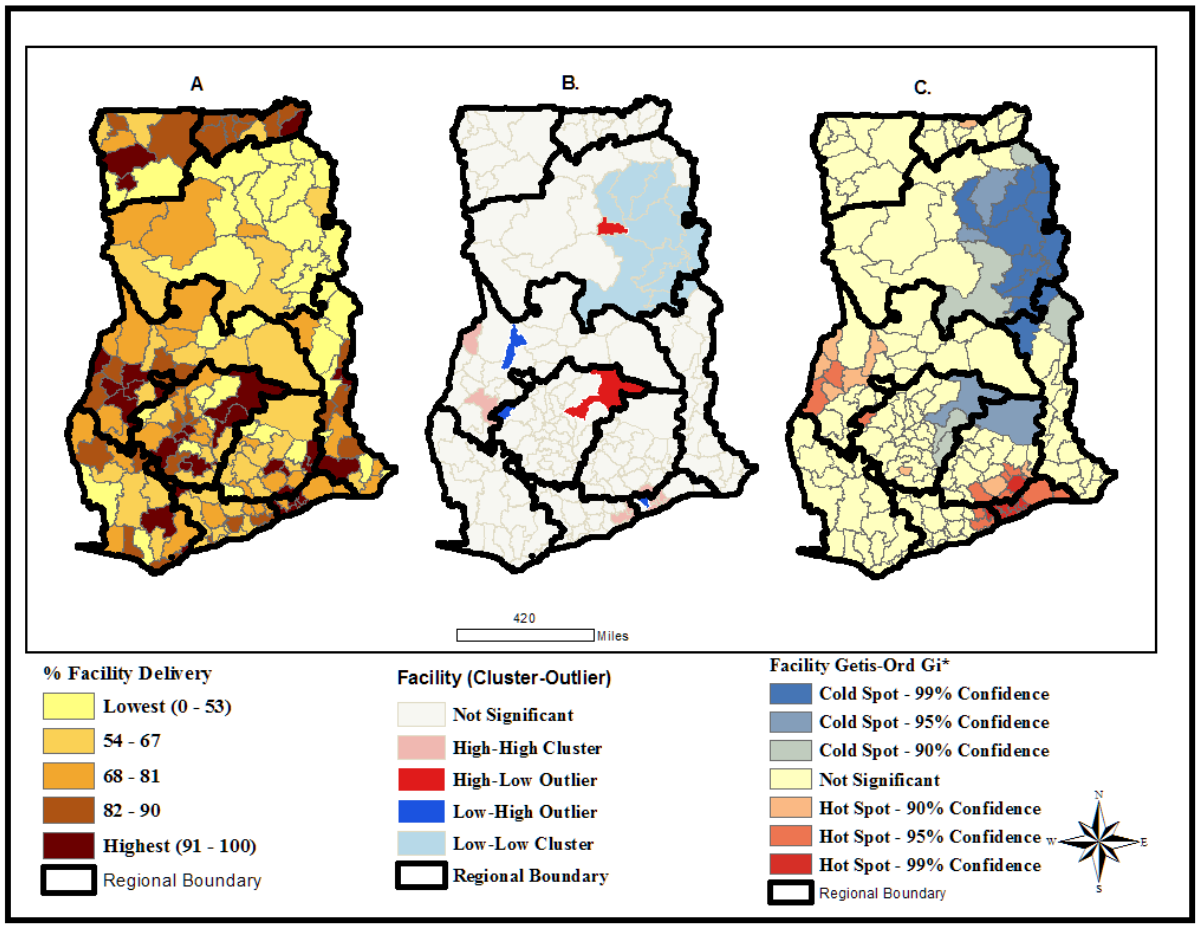

Figure 4.6 Map showing the spatial pattern of facility delivery at the district level. (Note: A is the spatial distribution in quintile, B is the Cluster-Outlier analysis, C is the Getis-Ord Gi* analysis)

Similar to the pattern observed for home delivery, it was expected that districts in the South

will have high concentration of high facility delivery compared to the districts in the North. Furthermore, the test of difference shows that there is a statistically significant difference in hospital delivery among the districts in the South and districts in the North ($U= 2498$; $p < 0.05$). The result of Getis-Ord Gi* for detecting significant cold and hot spots indicates that there is a significantly low rate of facility delivery among the districts in the South compared to districts in the North. This suggests that even in the South, where we expect to see high levels of facility delivery among the districts, there are fine-scaled spatial variations. For instance, Wenchi in Brong Ahafo has localities with low facility delivery surrounded by areas with high percentage of facility delivery. This evidence revealed the level of inequity in maternal health care utilization in the South.

Figure 4.7 Choice of Place of delivery in Ghana (The red circle 'o' indicates out of range while the asterisk * denotes extreme cases)

4.4 The Spatial Pattern of Assisted Delivery by Physician, Nurse/Midwife, and Community Health Officer

Geographic disparities in access to skilled birth attendants at birth in Ghana are described in Figures 10-12. No district in Ghana has more than 50% of physician-assisted delivery in a health care facility with the average access of 10.27%.

4.4.1 Physician-Assisted Delivery

Greater Accra shows less spatial variation among its districts because most of the districts show high rate of physician-assisted delivery. In fact, only Dangbe District has a low rate of physicians-assisted delivery in the Region. Meanwhile, among the districts in Eastern Region, the low spatial variation observed indicates that most of the districts have low access to physician-assisted delivery. In contrast, districts in Ashanti Region show high spatial variation in physician-assisted delivery where three districts were in the highest quintile and twice that number are in the lowest quintile. In the North, almost all the districts in all the three regions have no access to physician-assisted delivery. Northern Region has a uniform spatial pattern of low rates of physician-assisted delivery for all the districts. In the Western Region, about 90% of the districts were in the lower except for Juabeso District that falls in the highest quintile. Generally, scarcity of assisted delivery was more pronounced among the districts in the North, and this was most prominent among the districts in the Northern Region.

Furthermore, Figure 4.8B shows no significant patterns of physician-assisted delivery in Ghana except for the capital seat of the country, Greater Accra. The result of LISA shows the significant areas with low rate of physicians-assisted delivery surrounded by areas with high rate of physician-assisted care in two districts (Effutu and Agona East) in Central Region. Five districts in the southeastern part of Eastern Region were also found with low rate areas surrounded by high

rate areas. This means that within a geographic unit where some women had low significant access rate, some areas have high rate of physician-assisted delivery. This is an indication of inequality in health care resources due to different reasons such as socioeconomic status. The result of the Mann-Whitney U test shows that there is a significant disparity in access to physician-assisted delivery among the districts in the North and districts in the South ($U= 2256.5$; $p < .05$). Finally, Figure 4.8C suggests areas with significant deprivation and access between the districts in the North and in the South.

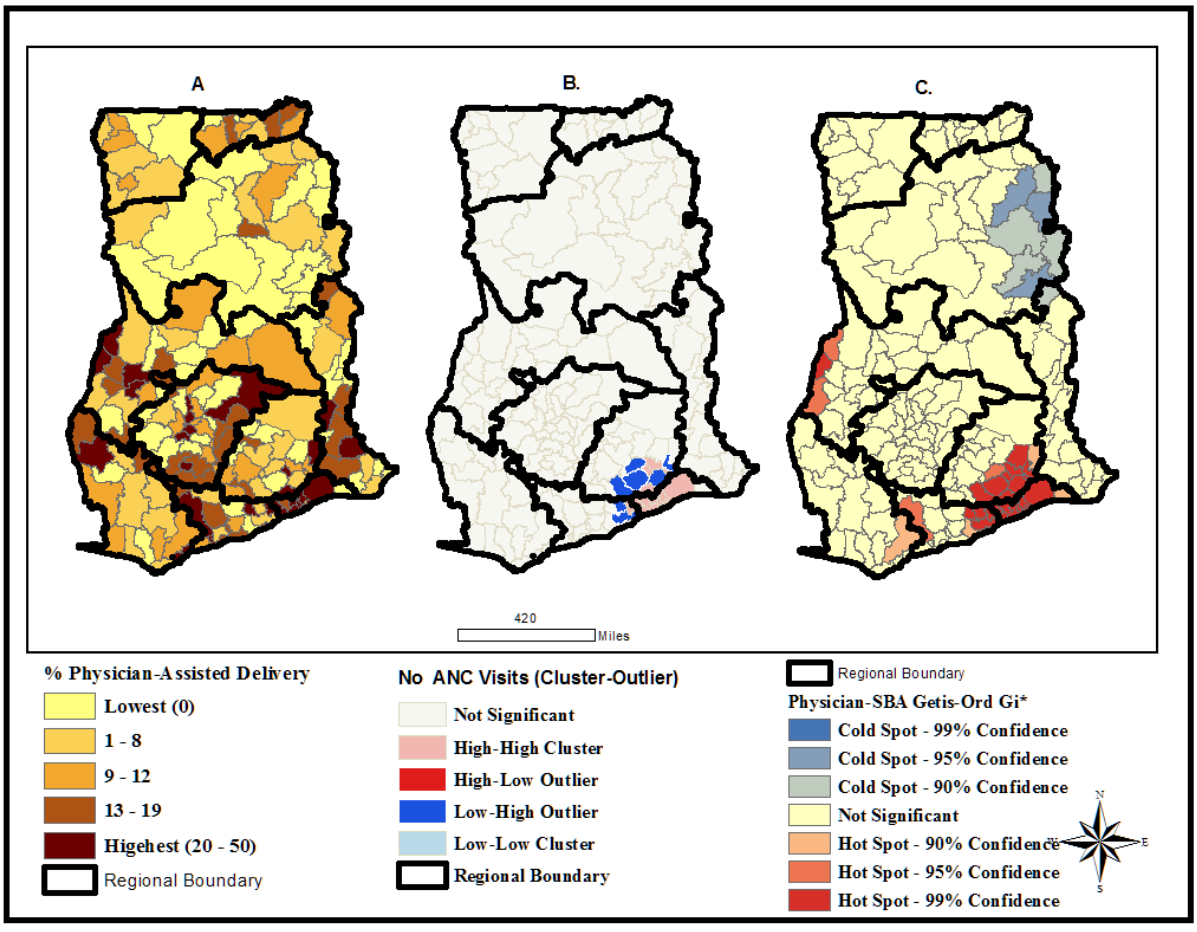

Figure 4.8 Map showing percentages of Physician-assisted Delivery. (Note: A is the spatial distribution in quintile, B is the Cluster-Outlier analysis, C is the Getis-Ord Gi* analysis)

4.4.2 Nurse/Midwife-Assisted Delivery

The average rate of nurse/midwife-assisted delivery in Ghana was 60.64%. However, some

districts were found to fall in the upper quintile (82-100%). Some of the districts found in this class were in the Upper East, Ashanti, Greater Accra, Western, and Brong Ahafo Regions. Ashanti Region shows the highest spatial variation followed by Volta and Western Regions. Meanwhile, among the districts in the Upper West and Northern Regions, there were almost uniform spatial pattern of low access to nurses/midwives-assisted delivery. Furthermore, in the Volta Region, three districts in the upper part and one in the southeast had low percentage of nurses/midwives-assisted delivery. Only four districts were in the lowest quintile in the Ashanti Region, two in the Western Region, four in the Eastern Region, and only one district in the Central Region. Access to midwife assistance during delivey was one strategy for reducing maternal moratlity in developing countries. Depite the effort in training SBA for safe delivery in Ghana, inequality in the availability and utilisation of trained nurses/midwives during delivery still persist in some districts.

Figure 4.9B identifies three districts in the South that had significant HH-cluster of nurse/midwife-assisted delivery in Brong Ahafo and Ashanti Regions. Wenchi District in Brong Ahafo and Ahafo Ano North District in Ashanti are the two areas with LH-outlier. These districts have areas with low rates surrounded by areas with high rates. Other districts with significant low and high outliers are found in the Northern and Volta Regions (Figure 4.9B). Figure 4.9C revealed cold and hot spot areas for nurse/midwife-assisted delivery. Some districts in the Upper East, south of Ashanti and Brong Ahafo have significant access to nurse/midwife-assisted delivery. However, the result of Mann-Whitney U test shows a significant difference in the pattern of nurse/midwife-assisted delivery ($U = 2480$; $p < 0.05$) between the North and the South. In summary, districts in the Northern as well as some districts in parts of Volta, Eastern and Ashanti Regions had significantly low access to nurse/midwife-assisted delivery.

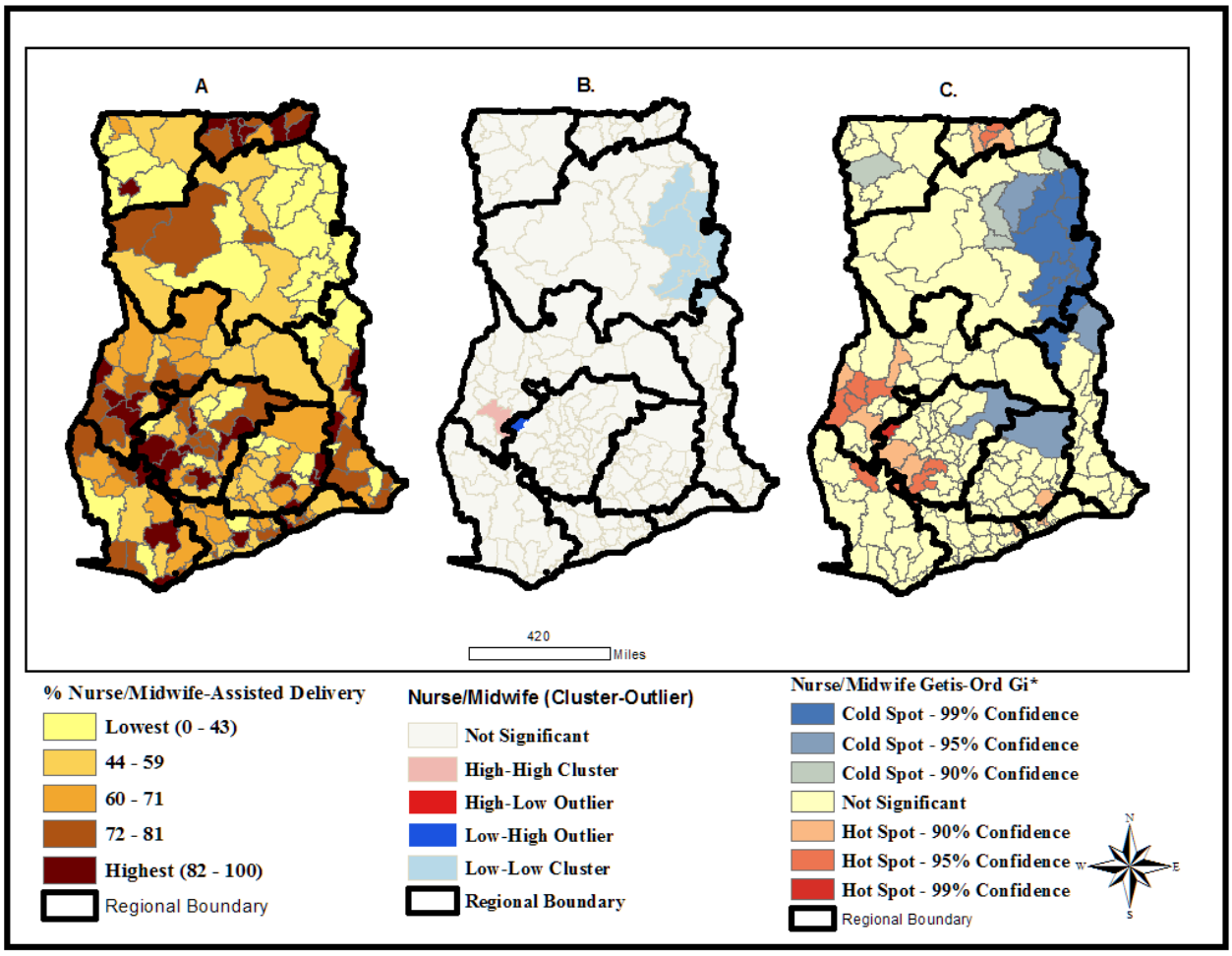

Figure 4.9 Map showing spatial pattern of Nurse/Midwife-assisted Delivery. (Note: A is the spatial distribution in quintile, B is the Cluster-Outlier analysis, C is the Getis-Ord Gi* analysis)

4.4.3 Community Health Officer-Assisted Delivery

Pockets of districts that exhibit high CHO-assisted delivery are found among the districts in the western part of Northern Region, southern part of Upper West Region and northern part of Brongh Ahafo. The highest percentage of delivery assisted by CHOs/nurses was between 20-45% mostly among the districts in the North, Upper West, Volta, and in Brong Ahafo regions (Figure 4.10A). Few districts in the in the South rely on CHO-assisted delivery. Volta Region shows a high spatial variation within the region for CHO-assisted delivery. In the Northern Region,

Sawla/Tuna/Kalba, West Gonja, Bole, Gonja Central and Saboba Districts were in the highest category (upper 20%) for the districts that depend mostly on CHO-assisted delivery. Furthermore, Krachi West, Asikuma/Odoben/Brakwa, and Saboba district which all lack assistance delivery by physician and nurse-midwife depend on CHO's assistance during delivery. Figures 10-12 suggest that Chereponi district lacks assisted delivery from the three types of skilled birth attendants.

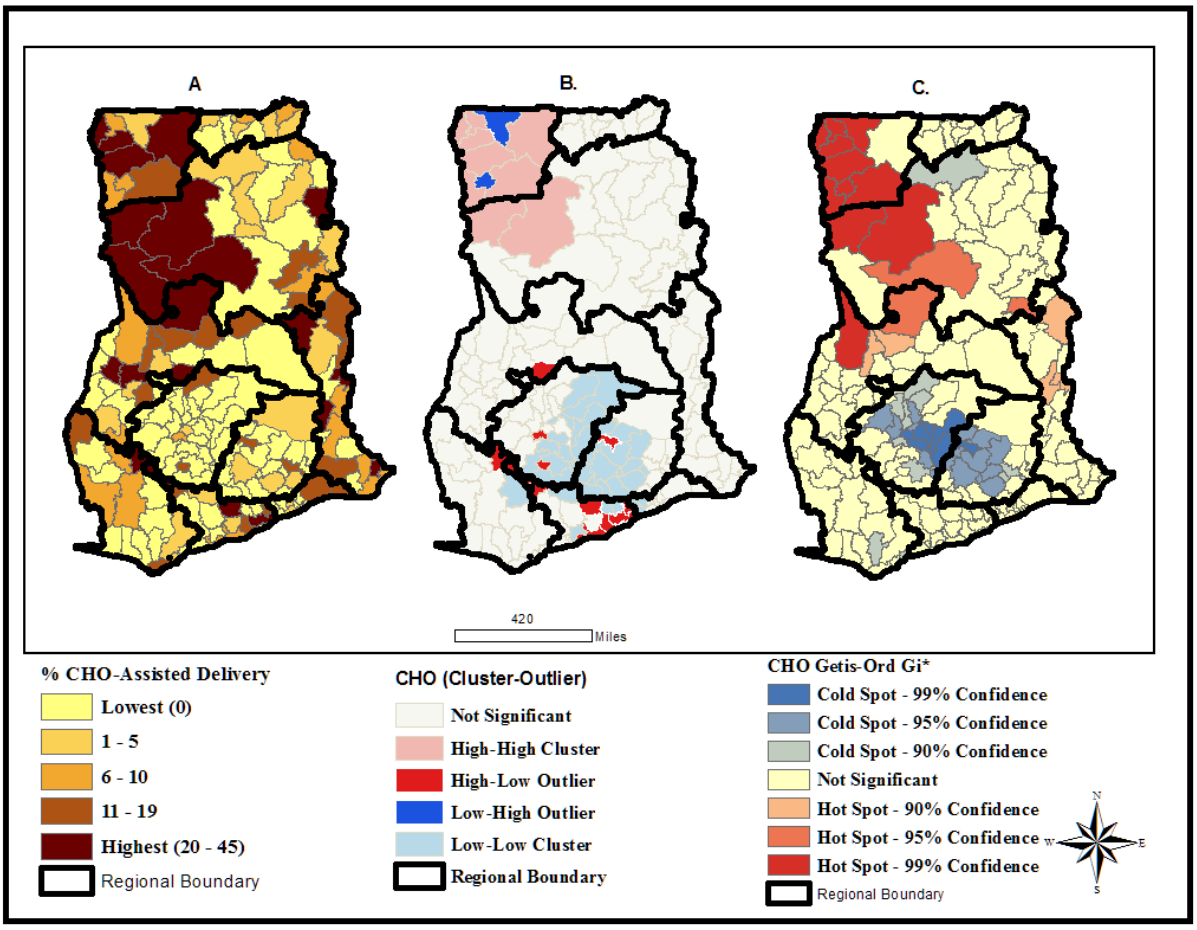

Figure 4.10 Spatial Patterns of Assisted Delivery by Community Health Officers. (Note: A is the spatial distribution in quintile, B is the Cluster-Outlier analysis, C is the Getis-Ord Gi* analysis)

In Figure 4.10B there is a significant cluster of districts with high dependence on CHO for assisted delivery in the Upper West, two districts in Volta Region, and west of the Northern Region. Significant high and low cluster patterns were identified in seven districts in Central Region (Upper Denkyia East, Mfantsiman, Upper Denkyira West, Gomoa East, Agona East, and

Asikuma/Odoben/Brakwa), Western (Sefwi Bibiani-Anhwiaso Bekwai), Eastern (Kwanhu), and Ashanti Regions (Obuasi Municipal) while two (Sissala and Wa Municipal) districts in Upper West have areas with low rate of CHO-assisted delivery surrounded by areas with high percentage of CHO- assisted delivery. Although Figures 12A and 12C show high rate of CHO dependence in the North, Figure 4.10B identifies significant clusters of high-low outliers in some districts in the South which is a sign of high dependency on CHO than expected in the North. More so, two districts were identified in the North with Low-High rate.

Figure 4.10C suggest that disadvantaged areas rely more on low cadre of health worker such as CHO. Finally, the test of differences shows that there is a significant difference in the rate of dependency on CHOs for districts in the South and districts in the North ($U = 10571$; $p < 0.05$).

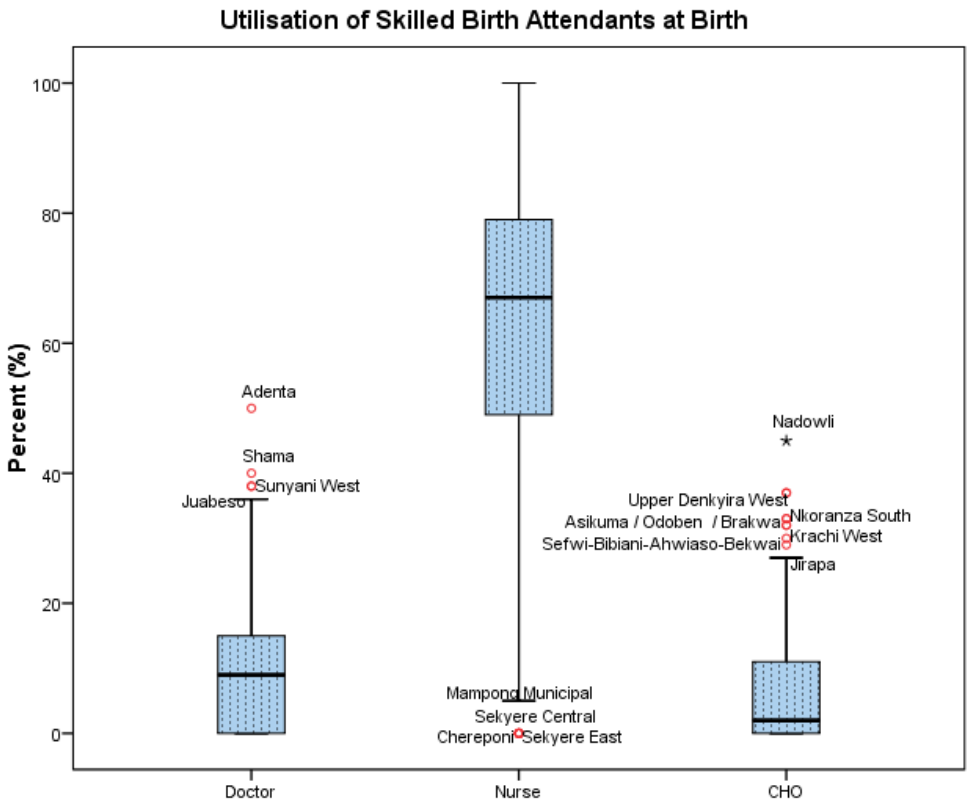

Figure 4.11 Pattern of assisted delivery in facility from Physicians, Nurse/Midwife, and CHO/Nurse (Note: The red circle ‘o’ indicates out of range while the asterisk * denotes extreme cases)

CHAPTER 5

DETERMINANTS OF MATERNAL HEALTH INDICATORS IN THE NORTH AND SOUTH OF GHANA

5.1 Introduction

To aid this research in understanding the nature of maternal health, analysis was conducted to test the effects of a number of independent variables on maternal health outcomes. These independent variables are rural-urban residence, educational attainment, wealth status/inequality, development/globalization, and religious affiliation in both the North and South of the study area. This chapter describes the results of correlational analysis using Spearman's correlation (rho) which measured the association between each of the outcome variables and each of the independent variables.

5.2 Place of Residence and Maternal Health Indicators

5.2.1 Antenatal Care and Place of Residence

Tests of association (rho) between each of the maternal health indicators and urban/rural residence for the districts in the South and North is presented in Table 5.1. In terms of ANC visits, results indicate significant relationships between ANC visits and urban/rural residence in Southern districts, however relationships between ANC visits and urban/rural residence in Northern districts were not statistically significant. For the districts categorized as South, urban residence had a weak positive relationship with a four or more ANC visits ($r = .185$; $p < 0.05$). Additionally, rural districts in the South share a weak positive relationship with < 4 ANC visits ($r = .174$; $p < 0.05$). These findings indicate that urban residence is associated with the highest level of use of maternal health services, in terms of ANC visits, whereas rural residence in these same districts is associated with moderate maternal health use based on this same measure

5.2.2 Urban-Rural Residence and Place of Delivery

In terms of place of delivery, statistically significant relationships were found between urban and rural residence and both places of delivery, whereas these same relationships in the North were not significant. In the north, it may be the case that distance to facility and availability of health facility may be better predictors of place of delivery than urban/rural residence. In urban districts categorized as South, analysis indicated a moderate positive association with facility delivery ($r = .446$, $p < 0.05$), and a weak inverse relationship with home delivery ($r = -.244$; $p < 0.01$). This direction of association was expected for the urban districts in the South, because of the higher number of facilities available in districts in the South, compared to those in the North. In rural areas in the South, rural residence had a weak inverse relationship with facility delivery ($r = -.211$; $p < 0.05$) but a moderate positive relationship with home delivery ($r = .463$; $p < 0.01$). The positive relationships between urban residence and facility delivery and between rural residence and home delivery indicate that (at least for districts in the South) place of residence is a useful indicator for explaining home delivery versus facility delivery.

5.2.3 Urban-rural Residence and Skilled Birth Attendants

In terms of the type of SBA assistance found in urban and rural districts in the North and South, significant relationships were observed in Southern districts, whereas only one significant association was observed in the Northern districts (Table 5.1). For urban residence in the South, results indicate a moderate positive relationship with physician-assisted delivery ($r = .422$; $p < 0.01$) and a weak positive association with nurse/midwife-assisted delivery (Table 5.2). By contrast rural residence in the south is associated with physician assisted delivery via a weak inverse relationship ($r = -.233$; $p < 0.01$). Meanwhile, urban districts in the North have a moderate positive association with delivery assisted by a nurse/midwife ($r = .402$; $p < 0.05$). It is not surprising to see

that women in the rural North have access to nurse/midwife-assisted delivery because of the CHPS programs. Considering the many challenges, they face, such as inaccessibility, due to poor transportation networks, as well as small population density that may make it difficult for government agency to assign physician or nurse/midwife in those remote areas.

Table 5.1 Association between the Explanatory and Outcome Variables in the North

	>4 ANC	**<4 ANC**	**No ANC**	**Physician**	**Nurse/ Midwife**	**CHO**	**Facility**	**Home**
Urban					.402*			-0.194
Rural								
Gini-Coefficient	.521**	-.424**		.590**	.687**		.748**	-.598**
Poor					-.352*			.437**
Middle				.428**	.434**		.376*	
Rich					.494**		.413*	-.325*
Christianity							.381*	
Islamic								
Internet Access					.380*			

**p < 0.01, *p < 0.05; N(North) = 38 Districts
Empty cells indicate non-significant values

5.3 Economic Profile and Maternal Health Indicators

The results of the Ghana Statistical Services (GSS) 2015 measure of economic inequality, calculated by the Gini-coefficient for all the districts in Ghana, is used as a district-level variable to examine the relationship between inequality and maternal health-seeking behavior patterns. Figure 5.1 shows that a pattern of high inequality dominates all the districts in the Upper East Region and two districts in the Upper West. Nine of the 20 districts in the Northern Region fell on the boundary between equality and inequality (Middle). Only two districts in Brong Ahafo fell in the lower end of the inequality scale, while the rest were found in the middle and highly unequal categories. Similarly, Volta, Western, Greater Accra, and Central Regions were in the middle and lower categories. Districts in the Ashanti Region have reduced inequality compared to the districts

in the Eastern Region. On average, the districts in the North have higher inequality compared to the districts in the South.

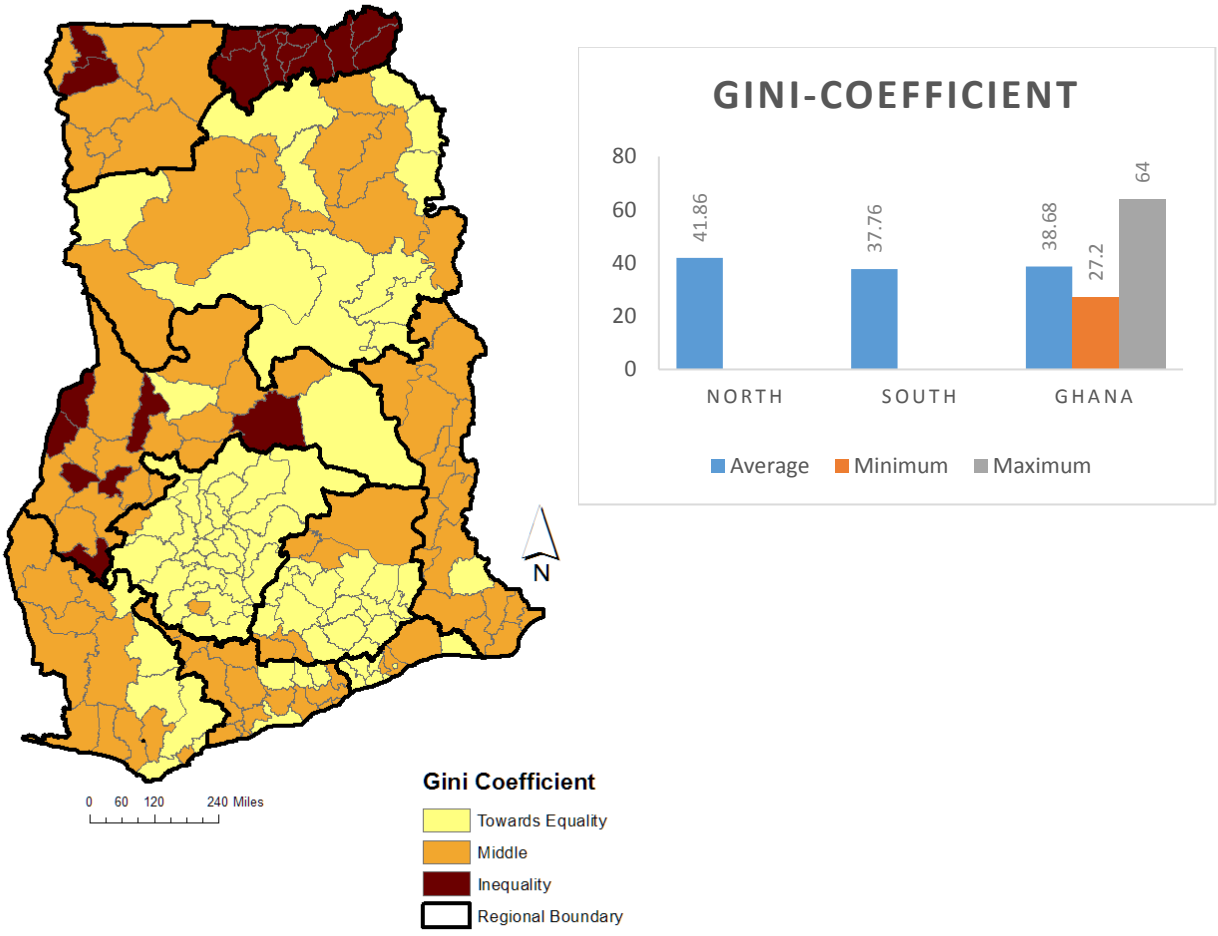

Figure 5.1 Geographic Pattern of Economic Inequality in Ghana.

5.3.1 Economic Inequality and Antenatal Care

The relationship between economic inequality and ANC visits is presented in Tables 3 and 4 for districts in the North and South. In the south, economic inequality has a non-significant relationship with the three categories of ANC visits. The scale of inequality ranges from 0-100, with values tending towards zero indicating increasing equality and towards 100 indicating increasing inequality. Most of the districts were clustered around the midpoint of the scale. For

districts in the South, Table 5.2 shows that Gini-Coefficient had a negative relationship with < 4 ANC visits and No ANC visits, while a minimum of four ANC visits had a positive non-significant pattern with Gini- coefficients. In other words, the Gini-coefficient is a poor predictor of four minimum ANC visits in the South. Economic inequality in the North tends to have a strong positive pattern with four ANC visits (Table 5.1). This implies that economic inequality influences four ANC visits fairly for districts in the North. The positive relationship between economic inequality and a minimum of four ANC visits shows the cushion effect of the free maternal health policy in the North compared to the districts in the South. Furthermore, a negative pattern was observed between < 4 ANC visits in the North and economic inequality. One regional study shows that the rich were more likely to attain the minimum four ANC visits in Ghana, though that analysis was based on the wealth quintile (Arthur, 2012). Since the Gini-coefficient measures wealth inequality in Ghana, it is expected that areas with high inequality will show low levels of ANC usage. Meanwhile, this study indicates that as inequality increases in the North, <4 ANC visits and no ANC visits tend to decrease.

5.3.2 Place of Delivery, Assisted Delivery at Birth, and Economic Inequality

Table 5.2 shows the significant relationship between district Gini-coefficient and CHO-assisted delivery. In the North, the Gini-coefficient had a strong positive relationship with facility delivery ($r = .748$, $p < 0.01$) and a moderate inverse relationship with home delivery ($r = -.598$, $p < 0.01$). This indicates that higher rates of inequality are associated with use of a health facility. That inequality is positively associated with this health indicator may be explained by the policies that have been introduced in the Northern part of the country, which act as a cushion for the usually negative effects of high rates of inequality. One can arguably presume that Ghana's free maternal

health policies have been less impactful in the South than they are in the North. Evidence of place of delivery seems to support that assumption but it can be further explored in the future.

In the South, there is a moderate positive relationship between inequality and the use of CHO-assisted delivery ($r = .308$, $p < 0.01$). This association may be explained by the lack of available physician-assisted services and nurse/midwife-assisted services in these districts. Presumably, inaccessibility will be common among the rural localities in the South where health facilities and highly skilled health workers are scarce.

Also, in the North, a strong positive relationship was observed between inequality and both physician-assisted delivery ($r = .590$, $p < 0.01$) and nurse/midwife- assisted delivery ($r = .687$, $p < 0.01$). Economic inequality among the districts in the North opens the door for different empowerment and health programs to bridge the disparities among the districts. Again, it can be said that the effect of Ghana's health policies is reducing the economic inequality effect in the North because of the intervention programs that have been implemented such as the CHPS. In the North, the relationship between Gini-coefficient and place of delivery and access to physician- and nurse/midwife-assisted delivery indicates that pregnant women were more likely to deliver in a health facility than in home and be assisted by physician or nurse/midwife depending on availability of trained health workers, regardless of the level of wealth inequality. The problem of utilization appeared to be more of non-availability of trained health workers than non-utilization of assisted care.

Table 5.2 Association between the Explanatory and Outcome Variables in the South

South	> 4 ANC	< 4 ANC	No ANC	Physician	Nurse/Mid.	CHO	Facility	Home
Urban	.185*			.422**	.260**		.446**	-.244**
Rural		.174*		-.233**			-.211*	.463**
Gini-Coefficient						.308**		
Poor	-.203*	.456**		-.341**	-.198*		-.366**	.641**
Middle								.195*
Rich	.422**	-.182*		.596**	.440**		.610**	-.370**
Christianity	.280**			.196*	.327**		.376**	
Islamic								
Internet Access	.420**	-.214*		.486**	.470**		.589**	-.394**

**p < 0.01, *p < 0.05; N(South) = 132 Districts
Empty cells indicate non-significant values

5.4 Wealth Status and Maternal Health

5.4.1 ANC Visits and Wealth Status

In contrast to the association between economic inequality and ANC visits, Table 5.2 shows that in the South, the rich were more likely to obtain a minimum of four ANC visits (r= .422, p < 0.01), and less likely to attend < 4 ANC (r= - .182, p < 0.05). This finding supports a regional study in Ghana that assessed the relationship between wealth and ANC visits. His aim was to determine whether the 2005 and 2008 fee exemption policies were influencing levels of ANC visits. In the South, the result shows that there is a positive relationship between a minimum of four ANC visits and the rich (the combination of richer and the richest in the Arthur's regional study). Arthur's regional study showed that four ANC visits increases as wealth increases. For districts in the North, wealth status is not significantly associated with

ANC visits. On the other hand, the women in the poor category in the South were less likely to obtain a minimum four ANC visits (r= - .203).

5.4.2 Wealth Status, Place of Delivery, and Assisted Delivery at Birth

Table 6 presents the association between wealth status, place of delivery, and type of delivery assistance in the South and North.

The rich in the South appears to use more of facility delivery (r= .610, $p < 0.01$) and low use of home delivery (r= - .370, $p < 0.01$). Similarly, the rich in the North were more likely to deliver in a health facility (r= .413, $p < 0.01$) with low tendency for home delivery (r= - .325, $p < 0.05$). Expectedly, the poor in both the South were less likely to deliver in a health facility (r= -.366, $p < 0.01$) and the poor also shows a higher tendency towards home delivery in both the North and the South (Table 5.2).

Furthermore, the findings on place of delivery is twofold in relationship to the current free health policy in Ghana as documented in other studies in Ghana. The findings from the both regions in this study between wealth and place of delivery is supported by other studies conducted at regional and individual levels in Ghana (Aseweh-Abor et al., 2011; Penfold et al., 2007; Moyer et al., 2017 & 2018) and in Tanzanian (Mrisho et al., 2007). In contrast to Dzakpasu et al. (2012) findings that suggest that the poor in Ghana have increased facility delivery because of free health policy, the poor at the district level use less of facility for delivery and more of home delivery.

Again, Table 5.2 shows that the rich in the South were more likely to be assisted by physician (r= .596, $p < 0.01$) or nurse/midwife (r= .440, $p < 0.01$) at delivery. But, the rich in the North were less likely to receive physician-assisted delivery but were more likely to have nurse/midwife-assisted delivery (r=.494, $p < 0.01$). This observation between the rich in the North and in the South in relation to physician assistance can be interpreted to be because of locational

factor and health resources availability. Similarly, the middle class in the North were likely to receive assistance from a physician at delivery ($r = .428$, $p < 0.01$) or from a nurse/midwife at the time of delivery when available ($r = .434$, $p < 0.01$). It is expected that the poor in the South and the North will have less (wealth) resources to obtain maternal health care services from the highly trained health workers (Table 5.1 & 5.2). This finding corroborates the regional study by Amoakoh-Coleman et al. (2015) using the 2008 DHS data and showed that the rich category is more likely to be assisted by a SBA compared to the poor.

5.4 Religious Affiliation and Maternal Health-Seeking Behavior

5.4.3 ANC Visits in the South and North of Ghana

The result of spearman's correlation analysis is presented in Tables 3 and 4 and shows that there is a weak association between Christians in the South and obtaining the minimum four ANC visits ($r = .280$, $p < 0.01$) and showed no significant relationship with < 4 ANC visits and no ANC visits. Meanwhile, in the North Christianity did not have any significant association with all the categories of ANC visits. Similarly, Islamic religion did not show any association with all the categories of ANC visits in both the South and the North (Table 5.1 & 5.2). Again, this finding is similar to the regional study by Gyimah, Takyi and Addai (2005) in Ghana in examining the effect of religious affiliation on maternal health.

5.4.4 Place of Delivery

Ghana Statistical Service (GSS) report shows that Christianity is the most dominant religion in both the urban and the rural districts in the South (GSS, 2008). It is highest in Accra (81.6%), 77.9% in rural forest, and 74.5% in in the coastal areas while it is least in the rural savannah of the North with 33.3% (GSS, 2008). This study explores the effect of religious affiliation on place of delivery. Results in the South show that Christian affiliation tend to be

weakly associated with health facility delivery (r= .376 p < 0.01) but showed no significant association with home delivery. Furthermore, Muslims in both regions have no significant relationship with place of delivery.

5.4.5 Skilled Birth Attendance and Religious Affiliation

In the South, Christians had moderate nurse/midwife-assisted delivery (r= .327, p< 0.01) with a partial association with physician-assisted delivery (r= .196, p< 0.05). Again, in the North, Christianity associated moderately with nurse/midwife-assisted delivery (r= .381, p< 0.05). No significant relationship was observed between Islamic religion and SBA at the district level. This finding corroborates Ganle's (2015) findings that show that Muslim women in the North use less of health facility services because of insensitivity of the care providers to the need and some other cultural reasons. Lastly, Islamic religion showed a poor association with all the maternal health indicators in the South. Nevertheless, more than the Christians in the South, Muslim women in the North and South should be targeted for appropriate interventions for improved maternal health care usage.

5.5 Development, Globalization, and Maternal Health-Seeking Behavior

Table 5.2 shows the impact of level of internet access as a measure of development and globalization on maternal health care utilization. Studies have shown the importance of information and communication technology in promoting good health in advanced countries and the transferred effect have been seen in the developing countries. In both the South and the North, the effect of the level of development among the districts is reflected in the level of accessibility to new age information technology and internet services usage. More interestingly, internet access shows no association with any of the maternal health indicators in the North.

5.5.1 ANC Visits, Place of Delivery, Skilled Birth Attendance, and Internet Access

In the South, access to internet on any device had a relatively moderate association with the minimum of four ANC visits ($r = .420$, $p < 0.01$), while access to internet indicates an inverse weak significant relationship with < 4 ANC visits ($r = -.214$, $p < 0.05$). However, it was not a puzzle to see that access to internet had a strong positive significant relationship with facility delivery and moderate association with physician and nurse/midwife-assisted delivery among the districts where development is more pronounced (Table 5.2). Meanwhile, as expected, there was weak inverse association with home delivery ($r = -.394$, $p < 0.01$). Other studies have applauded the impact of information and communication technology even in the Africa context (Obasola, Mabawonku & Lagunju, 2015).

Relationship between internet and mobile phones on maternal and child health in Africa is growing especially among the urbanized areas and low in the rural settings. Further explanation that can be provided is that the more developed a society is, the more likely the people will use high level of health facility services. This area of study is limited in Ghana and will need further study to the influence of ICT on maternal health especially in improving community health. Typically, one of the benefits of internet services is its influence on maternal health knowledge and information sharing among groups of people. No wonder that Abekah-Nkrumah, Guerriero, Purohit (2014) argue that ICT can enhance better relationship between the health providers and health users through email and short message services (SMS).

CHAPTER 6

SUMMARY OF FINDINGS AND CONCLUSION

6.1 Summary

This study examined the spatial patterns of maternal health indicators and associated factors responsible for district variation for maternal health intervention programs in reducing the prevalence of MMR in Ghana. The study, using spatial statistics was able to delineate areas of high rates and low rates of each maternal health indicators. Furthermore, the first three research questions were to examine the spatial pattern of ANC visits; place of delivery, and assisted SBAs which are discussed in relation to place of residence, economic inequality, wealth status, religion affiliation, and internet access.

6.1.1 Antenatal Care Visits in the North and the South

This study was able to identify areas of high and low clusters of the minimum of four ANC visits at the district level. GIS tools show that some districts in Ghana had high rates while some other districts had low rates. This shows the inequalities in ANC visits between districts. In respect to place of residence, findings from this study showed that urban-rural residence was associated with the district level pattern of ANC visits. The study found similar pattern with other regional level, city/town-level, and individual level studies that documented place of residence as an important factor influencing ANC uptake. For example, Babalola and Fatusi (2009) in their study found that urban residence, as a community variable was a predictor of maternal health care in Nigeria. Akowuah (2016) in Ghana also found that place of residence particularly, rural residence influence ANC visits in Kwabre East District in Ghana. In Malawi, Yaya, Bishwajit and Shah (2016) found that place of residence was one of the determinants of ANC usage and other maternal health indicators examined. However, more than place of residence there are other underlying

factors responsible for the geographic pattern of ANC usage in Ghana. More particularly, the CHPS program and free maternal health care policies that have been implemented in many districts in Ghana are acknowledged to have contributed to the improved ANC visits in general. While, some other access barriers are still limiting the use of ANC services in some of the districts with no ANC visits.

Furthermore, economic inequality did not have any significant effect on ANC visits in the South but rather had a positive effect on the uptake of a minimum of four ANC visits in the North. Furthermore, findings from this study shows that in the South, the rich more than the poor obtained the required minimum of four ANC visits. This observation, is tempting to question the impact of NHIS on pregnant women in obtaining the 4 minimum ANC visits among the poor at the district level. This is because, high rate of access to and utilization of ANC services is expected even in the face of wealth disparities among the districts with the existence of NHIS. Meanwhile, regional studies (Brugiavini & Peace, 2016) have indicated positive association between NHIS and ANC visits but there is persistent inequality in health care outcomes due to wealth status. Furthermore, the result in this study corroborates the findings by Gyimah, Takyi and Addai (2006) on the association of religion and ANC visits. Finally, internet access in this study which was used to measure level of development and effect of globalization on ANC visits showed a positive association towards accessing the minimum required ANC visits only among the districts in the South and not for the North. This finding is supported by an Ireland study which documents how internet usage influences maternal health decision-making. Limited studies in Ghana have used this variable to access maternal health care utilization.

6.1.2 Place of Delivery

The spatial analysis shows that there is geographic variation in home and facility delivery. Clusters of home delivery dominate the North while clusters of facility delivery predominates in the South. Many regional and individual studies have shown that home delivery is essentially high in the North than in the South. This study found similar results especially for the poor in the rural districts. Urban residents at the district level have better access to facility delivery because most of the facilities are in the urban South. Previous studies have shown that urban areas usually attract the largest share of resources including health resources distribution (Dussault & Franceschini, 2006; Fotso, Ezeh, and Oronje, 2009). Furthermore, the urban district women may have better access to the available facilities because of better transportation system compared to the rural districts where transportation is more of a challenge (Buor 2002), thus encouraging home delivery in most rural districts.

Other factors such as distance to a health facility and weather conditions could be associated with this maternal health behavior. A Malawian study found that weather conditions was one of the reasons why pregnant women practice off-facility delivery (Kumbani et al., 2013). This study had no access to weather variables to examine the relationship between weather conditions and the three maternal health indicators examined in this study. Future studies could investigate this gap at the district level. In Ghana, the behavior (off-site delivery) can be interpreted to be limited despite the evidence of home delivery among the districts compared to other African countries. This is as a result of the maternal health programs that have been instituted in Ghana especially the full integration of free maternal care under the NHIS in 2008. Nevertheless, in the South, the rich are more likely to deliver in a health facility than the poor in North. This is because there are more accessible and available facilities for the rich in the South than the rich in the North.

Furthermore, this study found that the poor in the South showed high correlation for home delivery and less likely to deliver in a health facility than the poor in the North. This finding is consistent with what Moyer and Mustafa (2013) documented for most of the studies conducted in developing countries and countries in sub-Sharan Africa including Ghana.

Findings on the relationship between religion and place of delivery support other studies in the developing countries like Nigeria by Onah, Ikeako, and Iloabachie (2006) and in Kenya by Fotso, Ezeh, and Essendi (2008). In addition, internet access as a measure of development shows association with facility delivery in the South compared to the districts in the North. This variable used here has been rarely used to examine the effect of ICT on maternal health indicators. However, internet access did not determine maternal health seeking-behavior in the North as it was observed in the South.

6.1.3 Assisted Skilled Birth in the North and South

This study shows the spatial patterns of SBAs among the districts and associated factors driving the observed patterns. Districts in Great Accra had the highest concentration of high rate of physician-assisted delivery compared to all other districts, but East Gonja District had significantly low physician-assisted care at birth. Generally, the Northern areas lack high level of health workers because of the low economic opportunities and less attractive benefits compared to the urban districts in the South. More specifically, the spatial analysis shows that physician assistance was more available in Sharma district in the Western and Sunyani Municipal in Brong Ahafo compared to other districts. In addition, this study found that Sekeyere Central and Mampong Municipal in Ashanti region lack adequate nurse/midwife-assisted delivery.

Also in the Volta region, pregnant women in Nkwanta South, Nkwanta North, and Krachi West districts had limited assisted delivery from nurses/midwives. Specifically, in the North, nine

(9) districts in the eastern part of Northern region lack nurses/midwives-assisted delivery. Through hotspot analysis the study found that most districts in the Northern and Upper Western Regions had limited assisted delivery by physician and nurse/midwife and thus depend on CHO-assisted delivery. Studies have considered poor road network system, long distance, lack of emergency transportation, lack of knowledge, and various delays at the higher order facilities to influence access to SBA (Thaddeus & Maine, 1994; Buor, 2002; Asante-Sarpong et al., 2016).

In general, the districts in the North are experiencing the major deprivation in maternal health resources compared to other districts in the South. Thus, this study recommends deployment of trained nurse/midwife in the Northern districts and intensify the current CHPS program where necessary. Thus, the issue of type 2 delay can be overcome and reduce maternal complications and probably the number of maternal deaths that result from this type of delay. To further this discussion on scarce human resources of health, Dussault and Franceschini (2006) showed in their study how other developing countries have upgraded their low health personnel cadre to assume the role of physicians where necessary. Special training of midwives and incorporating physician roles to some extent in the act of midwifery can help reduce the level of high maternal mortality in Ghana. Among factors that influence variation in assisted delivery by SBA is place of residence. Dussault and Franceschini pointed to many reasons why high cadre health workers (e.g. physicians) are reluctant to acknowledge rural areas deployments.

6.2 Conclusion and Implication of the Study

Spatial analysis of maternal health care indicators was presented at the district level which can be used to plan for interventions and reduce MMR in Ghana. This study has revealed the spatial disparities in maternal health indicators among the districts in Ghana. Previous studies have focused on the regional analysis and concealed geographic information for targeting areas that

exhibit unsatisfactory maternal health care behavior. Factors that influence the patterns of the three maternal health indicators in this study were wealth status, economic inequality, religion affiliation, and access to the internet. The evidence from this study shows the cushion effect of the current free maternal health policy under the auspices of NHIS for maternal health indicators especially where economic disparity is high. Generally, the poor at the district level, generally have limited utilization and access to facility delivery and SBA compared to the rich.

Furthermore, this study revealed areas that can be targeted for various specific intervention programs. The district level analysis can also serve as a framework for local health studies in districts with high home delivery, low facility delivery, low ANC uptake, and for allocation of health resources such as SBA—physicians, nurses, and midwives. The findings on the three maternal health indicators examined in this study can also be used by Ghana Ministry of Health and other health stakeholders to monitor maternal health resources at the district level. Specifically, there is need to increase awareness on more uptake of ANC visits among the poor women in at least five districts in the Northern region, three districts in the Volta region, and eight districts in the Eastern region. Physician-assisted delivery should be encouraged in East Gonja District by deploying physicians or upgrading the training of midwives. Meanwhile, more nurses/midwives are needed in Mampong Municipal and Sekeyere district for safe delivery. Lastly, the hotspot regions detected for home delivery could be a source of maternal mortality. Such districts require focus attention in order to reduce Ghana's MMR towards achieving the SDG 3.1 target of reducing maternal death to 70 per 100,000 by 2030. This is not an impossible task for the Ghanaian government if the areas identified can be targeted for appropriate interventions.

6.3 Study Limitations

This study acknowledges some research limitations because of the secondary data analyzed which is limited by the number of available variables and as such, those that will best explain the intention of the study were not captured or presented in the data. The knowledge about the health policies was not specifically captured in the DHS data which is an important variable to measure the free maternal health policy. Many studies have used the variable which asked the question whether a woman is a registered member of NHIS in relation to utilisation of the free maternal health policy. This variable does not measure the knowledge of free maternal health policy adequately. Having a variable that measures the knowledge of the policy will help to identify women without knowledge and therefore can help resolve the challenge by providing adequate information on the fee exemption policy.

This study maybe influenced by ecological fallacy. The problem occurs mostly when spatial phenomena are being studied at different spatial scale. Results and observations may not be interpreted the same way. Also, the explanatory variables were used to examine the association between maternal health indicators, it is difficult to claim causality from these associations. Furthermore, since the numbers of districts in Ghana is changing, this analysis performed using the 170 districts data which may limit the generalization for the current 216 districts in Ghana. Further analysis can be done on the 216 districts to examine the three selected maternal health indicators in reducing MMR.

APPENDIX A

KOLMOGROV-SMIRNOVA AND SHAPIRO-WILK NORMALITY TESTS

	Kolmogorov-Smirnov			Shapiro- Wilk		
Percent (%)	Statistic	df	Sig.	Statistic	df	Sig.
Physician	0.161	170	0.000	0.876	170	0.000
Nurse/Midwife	0.125	170	0.000	0.917	170	0.000
CHO	0.242	170	0.000	0.742	170	0.000
No ANC	0.337	170	0.000	0.466	170	0.000
<4 ANC	0.167	170	0.000	0.867	170	0.000
>4 ANC	0.219	170	0.000	0.696	170	0.000
Christianity	0.204	170	0.000	0.769	170	0.000
Islamic	0.252	170	0.000	0.684	170	0.000
<Primary Education	0.175	170	0.000	0.87	170	0.000
>Secondary Education	0.185	170	0.000	0.839	170	0.000
Home Delivery	0.11	170	0.000	0.927	170	0.000
Facility Delivery	0.115	170	0.000	0.894	170	0.000
Urban	0.209	170	0.000	0.871	170	0.000
Rural	0.179	170	0.000	0.878	170	0.000
Internet Access	0.225	170	0.000	0.761	170	0.000
a Lilliefors Significance Correction						

APPENDIX B

DISTRICT NAME AND CODE

REGION	DISTRICT	DIST_CODE
WESTERN	JOMORO	101
	ELLEMBELLE	102
	NZEMA EAST	103
	AHANTA WEST	104
	SEKONDI TAKORADI	105
	SHAMA	106
	MPOHOR WASSA EAST	107
	TARKWA NSUAEM	108
	PRESTEA / HUNI VALLEY	109
	WASSA AMENFI EAST	110
	WASSA AMENFI WEST	111
	AOWIN / SUAMAN	112
	SEFWI AKONTOMBRA	113
	SEFWI-WIAWSO	114
	SEFWI BIBIANI-ANHWIASO BEKWAI	115
	JUABESO	116
	BIA	117
CENTRAL	KOMENDA EDNA EGUAFO / ABIREM	201
	CAPE COAST METRO	202
	ABURA / ASEBU / KWAMANKESE	203
	MFANTSIMAN	204
	AJUMAKO-ENYAN-ESIAM	205
	GOMOA WEST	206
	EFFUTU	207
	GOMOA EAST	208
	EWUTU SENYA	209
	AGONA EAST	210
	AGONA WEST	211
	ASIKUMA / ODOBEN / BRAKWA	212
	ASSIN SOUTH	213
	ASSIN NORTH	214
	TWIFO HEMAN / HEMAN / LOWER DENKYIRA	215
	UPPER DENKYIRA EAST	216
	UPPER DENKYIRA WEST	217
GREATER ACCRA	GA SOUTH	301
	GA WEST	302
	GA EAST	303
	A M A	304
	ADENTA	305

	LEDZOKUKU / KROWOR	306
	ASHAIMAN	307
	TEMA	308
	DANGBE WEST	309
	DANGBE EAST	310
VOLTA	SOUTH TONGU	401
	KETA MUNICIPAL	402
	KETU SOUTH	403
	KETU NORTH	404
	AKATSI	405
	NORTH TONGU	406
	ADAKLU ANYIGBE	407
	HO	408
	SOUTH DAYI	409
	NORTH DAYI	410
	HOHOE	411
	BIAKOYE	412
	JASIKAN	413
	KADJEBI	414
	KRACHI EAST	415
	KRACHI WEST	416
	NKWANTA SOUTH	417
	NKWANTA NORTH	418
EASTERN	BIRIM SOUTH	501
	BIRIM MUNICIPAL	502
	WEST AKIM	503
	SUHUM / KRABOA COATAR	504
	AKWAPEM SOUTH	505
	AKWAPEM NORTH	506
	NEW JUABEN MUNICIPAL	507
	YILO KROBO	508
	LOWER MANYA	509
	ASUOGYAMAN	510
	UPPER MANYA	511
	FANTEAKWA	512
	EAST AKIM	513
	KWAEBIBIREM	514
	AKYEM MANSA	515
	BIRIM NORTH	516
	ATIWA	517
	KWAHU WEST	518

	KWAHU SOUTH	519
	KWAHU EAST	520
	KWAHU NORTH	521
ASHANTI	ATWIMA MPONUA	601
	AMANSIE WEST	602
	AMANSIE CENTRAL	603
	ADANSI SOUTH	604
	OBUASI MUNICIPAL	605
	ADANSI NORTH	606
	BEKWAI MUNICIPAL	607
	BOSOME FREHO	608
	ASANTE AKIM SOUTH	609
	ASANTE AKIM NORTH	610
	EJISU JUABEN	611
	BOSOMTWE /ATWIMA / KWANWOMA	612
	ATWIMA KWANWOMA	613
	K M A	614
	ATWIMA NWABIAGYA	615
	AHAFO ANO SOUTH	616
	AHAFO ANO N0RTH	617
	OFFINSO MUNICIPAL	618
	AFIGYA KWABRE	619
	KWABRE	620
	AFIGYA SEKYERE	621
	MAMPONG MUNICIPAL	622
	SEKYERE EAST	623
	SEKYERE AFRAM PLAINS	624
	SEKYERE CENTRAL	625
	EJURA SEKYE DUMASE	626
	OFFINSO NORTH	627
BRONG AHAFO	ASUNAFO SOUTH	701
	ASUNAFO NORTH	702
	ASUTIFI	703
	DORMAA MUNICIPAL	704
	DORMAA EAST	705
	TANO SOUTH	706
	TANO NORTH	707
	SUNYANI MUNICIPAL	708
	SUNYANI WEST	709
	BEREKUM	710

	JAMAN SOUTH	711
	JAMAN NORTH	712
	TAIN	713
	WENCHI	714
	TECHIMAN	715
	NKORANZA SOUTH	716
	NKORANZA NORTH	717
	ATEBUBU AMANTIN	718
	SENE	719
	PRU	720
	KINTAMPO SOUTH	721
	KINTAMPO NORTH	722
NORTHERN	BOLE	801
	SAWLA/TUNA/KALBA	802
	WEST GONJA	803
	GONJA CENTRAL	804
	EAST GONJA	805
	KPANDAI	806
	NANUMBA SOUTH	807
	NANUMBA NORTH	808
	ZABZUGU TATALI	809
	YENDI	810
	TAMALE METRO	811
	TOLON KUMBUGU	812
	SAVELUGU NANTON	813
	KARAGA	814
	GUSHIEGU	815
	SABOBA	816
	CHEREPONI	817
	BUNKPURUGU YONYO	818
	MAMPRUSI EAST	819
	MAMPRUSI WEST	820
UPPER EAST	BUILSA	901
	KASENA NANKANA WEST	902
	KASENA NANKANA EAST	903
	BOLGATANGA MUNICIPAL	904
	TALENSI NABDAM	905
	BONGO	906
	BAWKU WEST	907
	GARU TEMPANE	908
	BAWKU MUNICIPAL	909

UPPER WEST	WA WEST	1001
	WA MUNICIPAL	1002
	WA EAST	1003
	SISSALA EAST	1004
	NADOWLI	1005
	JIRAPA	1006
	SISSALA WEST	1007
	LAMBUSSIE KARNI	1008
	LAWRA	1009

REFERENCES

Abekah-Nkrumah, G., Guerriero, M. and Purohit, P., 2014. ICTs and maternal healthcare utilization. Evidence from Ghana. International Journal of Social Economics, 41(7), pp.518-541. http://dx.doi.org/10.1108/IJSE-11-2012-0218

Aday, L.A. and R. Andersen. 1974. A framework for the study of access to medical care. Health services research, vol. 9, no. 3, pp. 208-220.

Addai, I., 2000. Determinants of use of maternal–child health services in rural Ghana. Journal of biosocial science, 32(01), pp.1-15.

Adjiwanou, V., & LeGrand, T. (2014). Gender inequality and the use of maternal healthcare services in rural sub-Saharan Africa. Health & place, 29, 67-78.

Ahmed, S., A.A. Creanga, D.G Gillespie, A.O. and Tsui. 2010. Economic status, education, and empowerment: implications for maternal health service utilization in developing countries. PloS one, 5(6): e11190.

Akowuah, J. A. (2016). Socio-Economic determinants of antenatal care utilisation of pregnant mothers in selected health facilities in the Kwabre East district of Ghana (Doctoral dissertation, Kwame Nkrumah University of Science and Technology).

Ameyaw, E. K., Tanle, A., Kissah-Korsah, K., & Amo-Adjei, J. (2016). Women's Health Decision-Making Autonomy and Skilled Birth Attendance in Ghana. International Journal of Reproductive Medicine, 2016.

Amin, R., Shah, N.M. and Becker, S., 2010. Socioeconomic factors differentiating maternal and child health-seeking behavior in rural Bangladesh: a cross-sectional analysis. International journal for equity in health, 9(1), p.1.

Amoakoh-Coleman, M., E.K. Ansah, I.A. Agyepong, D.E. Grobbee, G. A. Kayode, and K. Klipstein-Grobusch. 2015. Predictors of skilled attendance at delivery among antenatal clinic attendants in Ghana: a cross-sectional study of population data. BMJ open, 5(5): e007810-2015-007810.

Ampim, G. A. (2013). *Men's Involvement in Maternal healthcare in Accra, Ghana. From Household to Delivery Room* (Master's thesis, The University of Bergen).

Anderson, J.G., 1973. Health services utilization: framework and review. Health services research, 8(3), p.184.

Andersen, R., & Newman, J. F. (2005). Societal and individual determinants of medical care utilization in the United States. *Milbank Quarterly*, *83*(4), Online-only.

Anselin, L. (1995). Local indicators of spatial association—LISA. Geographical analysis, 27(2), 93-115.

Arthur, E., 2012. Wealth and antenatal care use: implications for maternal health care utilisation in Ghana. Health economics review, 2(1), p.1. doi: 10.1186/2191-1991-2-14

Asante-Sarpong, H., Owusu, A.Y., Saravanan, S., Appiah, E. and Abu, M., 2016. Determinants of use of supervised delivery care under Ghana's fee exemption policy for maternal health care: the case of the Central Region. BMC Pregnancy and Childbirth, 16(1), p.172.

Asamoah, B. O., Agardh, A., & Cromley, E. K. (2014). Spatial analysis of skilled birth attendant utilization in Ghana. Global journal of health science, 6(4), 117.

Aseweh-Abor, P., Abekah-Nkrumah, G., Sakyi, K., Adjasi, C.K. and Abor, J., 2011. The socio-economic determinants of maternal health care utilization in Ghana. International Journal of Social Economics, 38(7), pp.628-648.

Atuoye, K. N., Vercillo, S., Antabe, R., Galaa, S. Z., & Luginaah, I. (2016). Financial sustainability versus access and quality in a challenged health system: an examination of the capitation policy debate in Ghana. *Health policy and planning*, czw058.

Ay, P., Hayran, O., Topuzoglu, A., Hidiroglu, S., Coskun, A., Save, D., ... & Eker, L. (2009). The influence of gender roles on health seeking behaviour during pregnancy in Turkey. *The European Journal of Contraception & Reproductive Health Care*, *14*(4), 290-300.

Balarajan, Y., Selvaraj, S. and Subramanian, S.V., 2011. Health care and equity in India. The Lancet, 377(9764), pp.505-515.

Blanc, A. K. (2001). The effect of power in sexual relationships on sexual and reproductive health: an examination of the evidence. Studies in family planning, 32(3), 189-213.

Bloom, S.S., D. Wypij, and M.D. Gupta. 2001. Dimensions of women's autonomy and the influence on maternal health care utilization in a north Indian city. Demography 38(1): 67-78.

Browne, J.L., G.A. Kayode, D. Arhinful, S.A. Fidder, D.E. Grobbee, and K. Klipstein-Grobusch. 2016. Health insurance determines antenatal, delivery and postnatal care utilisation: evidence from the Ghana Demographic and Health Surveillance data. BMJ open, 6(3): e008175- 2015-008175.

Brugiavini, A. and N. Pace. 2016. Extending health insurance in Ghana: effects of the National Health Insurance Scheme on maternity care. Health economics review, 6(1):1.

Buor, D., 2002. Distance as a predominant factor in the utilization of health services in the Kumasi metropolis, Ghana. GeoJournal, 56(2), pp.145-157.

Burgert-Brucker, C.R., J. Yourkavitch, S. Assaf, and S. Delgado. 2015. Geographic Variation in Key Indicators of Maternal and Child Health across 27 Countries in Sub-Saharan Africa. DHS Spatial Analysis Reports No. 12. Rockville, Maryland, USA: ICF International.

Chakraborty, N., M.A. Islam, R.I. Chowdhury, W. Bari, H.H Akhter. 2003. Determinants of the use of maternal health services in rural Bangladesh. Health promotion international 18 (4): 327-337.

Corroon, M., Speizer, I.S., Fotso, J.C., Akiode, A., Saad, A., Calhoun, L. and Irani, L., 2014. The role of gender empowerment on reproductive health outcomes in urban Nigeria. Maternal and child health journal, 18(1), pp.307-315.

Crissman, H. P., Adanu, R. M., & Harlow, S. D. (2012). Women's sexual empowerment and contraceptive use in Ghana. Studies in Family Planning, 43(3), 201-212.

Dako-Gyeke, P., Aikins, M., Aryeetey, R., Mccough, L., & Adongo, P. B. (2013). The influence of socio-cultural interpretations of pregnancy threats on health-seeking behavior among pregnant women in urban Accra, Ghana. BMC pregnancy and childbirth, 13(1), 211.

DeBrouwere, V., Tonglet, R., & Van Lerberghe, W. (1998). Strategies for reducing maternal mortality in developing countries: what can we learn from the history of the industrialized West?. Tropical medicine & international health, 3(10), 771-782.

Der, E. M., Moyer, C., Gyasi, R. K., Akosa, A. B., Tettey, Y., Akakpo, P. K., ... & Anim, J. T. (2013). Pregnancy related causes of deaths in Ghana: a 5-year retrospective study. Ghana medical journal, 47(4).

Dussault, G., & Franceschini, M. C. (2006). Not enough there, too many here: understanding geographical imbalances in the distribution of the health workforce. *Human resources for health*, *4*(1), 12.

Dzakpasu, S., Soremekun, S., Manu, A., ten Asbroek, G., Tawiah, C., Hurt, L., ... & Kirkwood, B. R. (2012). Impact of free delivery care on health facility delivery and insurance coverage in Ghana's Brong Ahafo Region. PloS one, 7(11), e49430.

Ekwochi, U., Ndu, I.K., Osuorah, C.D., Onah, K.S., Obuoha, E., Odetunde, O.I., Nwokoye, I., Obumneme-Anyim, N.I., Okeke, I.B. and Amadi, O.F., 2015. Delays in healthcare delivery to sick neonates in Enugu South-East Nigeria: an analysis of causes and effects. Journal of Public Health, p.fdv092.

Ensor, T. and S. Cooper. 2004. Overcoming barriers to health service access: influencing the demand side. Health policy and planning, 19(2), pp.69-79.

Evans, P. and Brunsell, S., 2007. Uterine fibroid tumors: diagnosis and treatment. Am Fam Physician, 75(10), pp.1503-8.

Frieden, J. (2016, October 24): Maternal Mortality Remains a Serious Problem: Racial disparities part of the issue, experts say. Retrieved from http://www.medpagetoday.com/OBGYN/Pregnancy/60978

Fotso, J., A.C. Ezeh, and H. Essendi. 2009. Maternal health in resource-poor urban settings: how does women's autonomy influence the utilization of obstetric care services? Reprod Health, 6(9):1-8.

Ganle, J. K. (2015). Why Muslim women in Northern Ghana do not use skilled maternal healthcare services at health facilities: a qualitative study. BMC international health and human iis, 15(1), 10.

Gelberg, L., R.M. Andersen, and B.D. Leake. 2000. The Behavioral Model for Vulnerable Populations: application to medical care use and outcomes for homeless people. Health services research, 34(6), p.127

Gerrits, T. (1997). Social and cultural aspects of infertility in Mozambique. Patient education and counseling, 31(1), 39-48.

Ghana Statistical Service (GSS), Ghana Health Service (GHS), and ICF International. 2015. Ghana Demographic and Health Survey 2014. Rockville, Maryland, USA: GSS, GHS, and ICF International

Ghana Statistical Service (2015). Ghana poverty mapping report. May 2015

Ghana Statistical Service (2012). Population & Housing Census. *Summary report of results. May 2012*

Ghana Statistical Service (2008). Ghana Living Standards Survey Report of The Fifth Round (GLSS 5). September 2008

Glanz, K., Rimer, B. K., & Viswanath, K. (Eds.). (2008). Health behavior and health education: theory, research, and practice. John Wiley & Sons.

Gyimah, S. O., Takyi, B. K., & Addai, I. (2006). Challenges to the reproductive-health needs of African women: on religion and maternal health utilization in Ghana. Social science & medicine, 62(12), 2930-2944.

Harvey, S.A., Y.C.W. Blandón, A. McCaw-Binns, I. Sandino, L. Urbina, C. Rodríguez, I. Gómez, P. Ayabaca, P. and S. Djibrina. 2007. Are skilled birth attendants really skilled? A measurement method, some disturbing results and a potential way forward. Bulletin of the World Health Organization 85(10): 783-790.

Johnson, F. A. (2016). A geospatial analysis of the impacts of maternity care fee payment policies on the uptake of skilled birth care in Ghana. BMC pregnancy and childbirth, 16(1), 41.

Johnson, L., & Wall, B. M. (2014). Women, Religion, and Maternal Health Care in Ghana, 1945-2000. Family & community health, 37(3), 223-230.

Kitui, J., Lewis, S. and Davey, G., (2013). Factors influencing place of delivery for women in Kenya: an analysis of the Kenya demographic and health survey, 2008/2009. BMC Pregnancy and Childbirth, 13(1), p.1.

Kumbani L, Bjune G, Chirwa E, Odland JØ. Why some women fail to give birth at health facilities: a qualitative study of women's perceptions of perinatal care from rural Southern Malawi. Reproductive health. 2013 Feb 8;10(1):1. doi:10.1186/1742-4755-10-9

Kyomuhendo, G. B. (2003). Low use of rural maternity services in Uganda: impact of women's status, traditional beliefs and limited resources. *Reproductive health matters*, *11*(21), 16-26.

Lagan, B. M., Sinclair, M., & George Kernohan, W. (2010). Internet use in pregnancy informs women's decision making: a web-based survey. Birth, 37(2), 106-115.

McLafferty, S.L., 2003. GIS and health care. Annual review of public health, 24(1), pp.25-42.

Meade, M., & Earickson, R. J. (2000). Medical Geography Guilford. *New York*.

Mensah J. and J. Oppong. 2007. Maternity protection and health insurance in Africa. Comparative overview of Ghana, Kenya, Rwanda, and Tanzania. Working paper: ILO

Moyer, C. A., Adongo, P. B., Aborigo, R. A., Hodgson, A., Engmann, C. M., & DeVries, R. (2014). "It's up to the woman's people": how social factors influence facility-based delivery in Rural Northern Ghana. Maternal and child health journal, 18(1), 109-119.

Moyer, C. A., & Mustafa, A. (2013). Drivers and deterrents of facility delivery in sub-Saharan Africa: a systematic review. *Reproductive health*, *10*(1), 40.

Mrisho, M., Schellenberg, J. A., Mushi, A. K., Obrist, B., Mshinda, H., Tanner, M., & Schellenberg, D. (2007). Factors affecting home delivery in rural Tanzania. Tropical Medicine & International Health, 12(7), 862-872.

Mumtaz, Z., & Salway, S. M. (2007). Gender, pregnancy and the uptake of antenatal care services in Pakistan. Sociology of health & illness, 29(1), 1-26.

Murray, P.M., 1926. Uterine Fibroids Complicating Pregnancy. Journal of the National Medical Association, 18(3), p.123.

Nyonator, F. K., Awoonor-Williams, J. K., Phillips, J. F., Jones, T. C., & Miller, R. A. (2005). The Ghana community-based health planning and services initiative for scaling up service delivery innovation. *Health policy and planning*, *20*(1), 25-34.

Obasola, O. I., Mabawonku, I., & Lagunju, I. (2015). A review of e-Health interventions for maternal and child health in sub-Sahara Africa. Maternal and child health journal, 19(8), 1813-1824.

O'Meara, W. P., Platt, A., Naanyu, V., Cole, D., & Ndege, S. (2013). Spatial autocorrelation in uptake of antenatal care and relationship to individual, household and village-level factors: results from a community-based survey of pregnant women in six districts in western Kenya. *International journal of health geographics*, *12*(1), 55.

Onah, H. E., Ikeako, L. C., & Iloabachie, G. C. (2006). Factors associated with the use of maternity services in Enugu, southeastern Nigeria. Social science & medicine, 63(7), 1870-1878.

Oyeyemi, S. O., & Wynn, R. (2014). Giving cell phones to pregnant women and improving services may increase primary health facility utilization: a case–control study of a Nigerian project. Reproductive health, 11(1), 1. doi: 10.3402/gha.v8.28887

Overbosch, G. B., Nsowah-Nuamah, N. N., van den Boom, G. J., & Damnyag, L. (2004). Determinants of antenatal care use in Ghana. Journal of African Economies, 13(2), 277-301.

Penfold, S., Harrison, E., Bell, J., & Fitzmaurice, A. N. N. (2007). Evaluation of the delivery fee exemption policy in Ghana: population estimates of changes in delivery service utilization in two regions. Ghana Med J, 41(3), 100-109.

Rogers, A. C. (1997). Vulnerability, health and health care. Journal of advanced nursing, 26(1), 65-72.

Rosenstock, I.M., 2005. Why people use health services. Milbank Quarterly, 83(4), pp.Online-only. DOI: 10.1111/j.1468-0009.2005.00425.x

Russell, S. (2008). Community-based Health and Planning Services: Decentralizing Ghana's Health System. Georgetown Undergraduate Journal of Health Sciences, 5(1), 1-9.

Rutstein, S. and S. Staveteig. 2014. Making the demographic and health surveys wealth index comparable. DHS Methodological Reports No. 9. Rockville (MD): ICF International

Setel, P. W., Sankoh, O., Rao, C., Velkoff, V. A., Mathers, C., Gonghuan, Y., ... & Lopez, A. D. (2005). Sample registration of vital events with verbal autopsy: a renewed commitment to measuring and monitoring vital statistics. Bulletin of the World Health Organization, 83(8), 611-617.

Sialubanje, C., Massar, K., Hamer, D. H., & Ruiter, R. A. (2014). Understanding the psychosocial and environmental factors and barriers affecting utilization of maternal healthcare services in Kalomo, Zambia: a qualitative study. *Health education research*, *29*(3), 521-532.

Sondaal, S.F.V., Browne, J.L., Amoakoh-Coleman, M., Borgstein, A., Miltenburg, A.S., Verwijs, M. and Klipstein-Grobusch, K., 2016. Assessing the Effect of mHealth Interventions in Improving Maternal and Neonatal Care in Low-and Middle-Income Countries: A Systematic Review. PloS one, 11(5), p.e0154664. http://dx.doi.org/10.1371/journal.pone.0154664

Sulzbach, S., Garshong, B., & Owusu-Banahene, G. (2005). *Evaluating the effects of the national health insurance act in Ghana: Baseline report*. Partners for Health Reformplus.

Thaddeus, S., & Maine, D. (1994). Too far to walk: maternal mortality in context. Social science & medicine, 38(8), 1091-1110.

Verderese, M. D. L., & Turnbull, L. M. (1975). The Traditional Birth Attendant in Maternal and Child Health and Family Planning: A Guide to Her Training and Utilization.

Wendt, A., Stephenson, R., Young, M., Webb-Girard, A., Hogue, C., Ramakrishnan, U., & Martorell, R. (2015). Individual and facility-level determinants of iron and folic acid receipt and adequate consumption among pregnant women in rural Bihar, India. *PloS one*, *10*(3), e0120404.

Woldemicael, G. 2007. Do women with higher autonomy seek more maternal and child health-care. Evidence from Ethiopia and Eritrea. Stockholm Research Reports in Demography. Stockholm: Stockholm University,

World Health Organization, 2015. World health statistics 2015. World Health Organization. (pdf doc. http://apps.who.int/iris/bitstream/10665/170250/1/9789240694439_eng.pdf?ua=1

World Health Organization. (2012). *The WHO Application of ICD-10 to deaths during pregnancy, childbirth and puerperium: ICD-MM*. World Health Organization.

World Health Organization and UNICEF, 2014. Trends in maternal mortality: 1990 to 2013: estimates by WHO, UNICEF, UNFPA, The World Bank and the United Nations Population Division: executive summary.

World Health Organization, & UNICEF. (2015). Trends in maternal mortality: 1990-2015: estimates from WHO, UNICEF, UNFPA, World Bank Group and the United Nations Population Division.

WHO, UNICEF, UNFPA, World Bank Group and the United Nations Population Division 2015. Trends in maternal mortality: 1990 to 2015: estimates by WHO, UNICEF, UNFPA, The World Bank and the United Nations Population Division: executive summary"

Yaya, S., Bishwajit, G. and Shah, V., 2016. Wealth, education and urban–rural inequality and maternal healthcare service usage in Malawi. BMJ Global Health, 1(2),