Social determinants and the role of maternal health care services for equity in maternal health in Ghana from 1988 – 2008

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Abstract

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Key words: maternal health, maternal mortality, social determinants, socio-economic factors, inequality, equity, fertility, modern contraception, antenatal care, skilled birth attendants, policy, health care services, Ghana

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To my lovely family

If I speak in the tongues of men and of angels, but have not love, I am a noisy gong or a clanging cymbal. And if I have prophetic powers, and understand all mysteries and all knowledge, and if I have all faith, so as to remove mountains, but have not love, I am nothing. If I give away all I have, and if I deliver up my body to be burned, but have not love, I gain nothing.

1 Corinthians 13:1-3 ESV

Abstract

Maternal health services are the least equitable health care services in most low- and middle-income countries. Improving maternal health in Ghana continues to be a major public health challenge. Socio-economic inequalities within the country are greatly reducing the use of maternal health care services despite government policy reforms to improve access to maternal health care services and interventions. The overall aim of this thesis was to assess equity in maternal health by socio-economic factors in Ghana from 1988 to 2008 and relate that to the role of policy and maternal health services. Studies I and II were based on data derived from the Ghana Maternal Health Survey (GMHS) 2007 and Studies III and IV used the Ghana Demographic and Health Surveys (GDHS) 1988, 1993, 1998, 2003, and 2008. We used logistic regression as our major analytical tool and Total Attributable Fraction (TAF) as our main index of inequality. Results from Study I showed that there exist socio-demographic disparities in dying from particular causes of maternal mortality in Ghana. Older and married women were the most vulnerable group to die from haemorrhage, the foremost cause of maternal mortality, whereas the highest risk population for deaths due to induced abortion was single young women below age 25. Further analysis of deaths due to induced abortion in Study II revealed a significant association with alcohol consumption. Studies III and IV demonstrated that there exist education- and income-related inequalities in modern contraceptive use, fertility, use of skilled birth attendants and antenatal care utilization. Meanwhile, the observed inequality trends differed by equity stratifier and the specific maternal health indicator used. There is a general development toward equity in the use of modern contraception that is not mirrored in the equity trends seen in the fertility rate. In terms of modern contraception and fertility, education-related inequalities are very pronounced, whereas income inequalities are the most prominent with antenatal care and skilled birth attendant utilization. However, income-related inequality in the use of maternal health care services is rapidly growing worse over time. We recommend that policy actions aimed at reducing inequality in maternal health in Ghana should target education- and income-related inequalities simultaneously. This could be done through 1) addressing financial loopholes in the free maternal health care policy in Ghana to eliminate direct and indirect financial barriers that hinder the use of maternal health care services; 2) sex education and family planning should be made an integral part of basic education so that even women at the

lowest level would learn about adverse maternal health consequences; 3) government and other stakeholders should support informal education through mass media such radio and television so that women who lack formal education or those no longer in school can benefit from on-going interventions; and 4) adopting a youth-friendly approach in providing family planning and contraception services.

Key words: maternal health, maternal mortality, social determinants, socio-economic factors, inequality, equity, fertility, modern contraception, antenatal care, skilled birth attendants, policy, health care services, Ghana

Abbreviations

AF	Attributable Fraction
ANC	Antenatal care
aOR	Adjusted odds ratio
CHPS	Community-based Health Planning and Services
CI	Confidence interval
DHS	Demographic and Health Survey
FIGO	International Federation of Gynaecology and Obstetrics
GDHS	Ghana Demographic and Health Survey
GHS	Ghana Health Service
GMHS	Ghana Maternal Health Survey
GSS	Ghana Statistical Service
HSES	High socio-economic status
ICM	International Confederation of Midwives
LMIC	Low- and middle-income countries
LSES	Low socio-economic status
MDG	Millennium Development Goal
MMR	Maternal Mortality Ratio
OR	Odds ratio
RII	Relative Index of Inequality
SBA	Skilled birth attendant (ce)
SES	Socio-economic status
SII	Slope Index of Inequality
sTAF	Stratum Specific Total Attributable Fraction

TAF	Total Attributable Fraction
TFR	Total Fertility Rate
UNFPA	United Nations Population Fund
UNICEF	United Nations Children's Fund
VAQ	Verbal autopsy questionnaire
WHO	World Health Organization

List of Publications

I. Asamoah BO, Moussa KM, Stafström M, Musinguzi G: Distribution of causes of maternal mortality among different socio-demographic groups in Ghana; a descriptive study. *BMC Public Health* 2011, 11(1): 159-168.

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IV. Asamoah BO, Agardh A, Pettersson KO, Östergren P-O: Magnitude and trends of inequalities in antenatal care and delivery under skilled care among different socio-demographic groups in Ghana from 1988 – 2008. *Submitted for publication.*

Contents

Introduction

Improving maternal and reproductive health remains a global challenge [1]. Women worldwide are threatened with various reproductive health issues as they go through their reproductive years. This is especially problematic in sub-Saharan Africa [1, 2]. On the surface, the most obvious and visible outcome is maternal mortality, but the problem goes far deeper. Beneath these mortalities [3] lie numerous morbidities [4-7] that women who survive these experiences must live with for the rest of their lives [8], and most of which pass unnoticed [9]. Globally, maternal mortality is the leading cause of death among females ages 15 to 49 years. Between 3 to 5 maternal deaths occur every 5 minutes, mostly in resource-poor settings. Estimates by the WHO, UNICEF, UNFPA, and the World Bank suggest that about 260 women die per 100,000 live births worldwide. This estimate varies from continent to continent, country to country, and within countries. In sub-Saharan Africa, Chad and Somalia had as many as 1100 and 1000 maternal deaths per 100,000 live births, respectively, in 2010, whereas Estonia and Greece recorded 2 and 3 maternal deaths per 100,000 live births, respectively, in the same year [2].

Millennium Development Goal 5

Maternal health is an essential aspect of global health but until recently had not received much attention from researchers, politicians, and the global community [10, 11]. In 2000, 189 heads of states signed the millennium declaration and agreed to commit themselves to 8 Millennium Development Goals (MDGs). MDG 5 focuses on improving maternal health and has two targets: 5a, to reduce the maternal mortality ratio by three-quarters between 1990 and 2015, and 5b, to achieve universal access to reproductive health. Following the millennium declaration, there have been some improvements in the uptake of maternal health interventions such as antenatal care (ANC), skilled birth attendance (SBA), and facility-based delivery [12, 13] but hardly any in resource poor countries that bear the highest burden of maternal mortality [14] and morbidity [15]. Recent estimates indicate that these targets are highly unlikely to be achieved globally, although

huge disparities exist in regional, country level, and within-country estimates [1, 16-18].

According to the MDG Report 2013, maternal mortality has been nearly halved between 1990 and 2010. An estimated 287,000 maternal deaths occurred worldwide in 2010, a decline of 47% from 1990. Sub-Saharan Africa, whose maternal mortality ratios (the number of maternal deaths per 100,000 live births) were 850 in 1990 and 500 in 2010, accounted for the highest global burden of maternal deaths in 2010 [19].

Despite these alarming statistics, sub-Saharan Africa still has the lowest coverage of maternal and reproductive health interventions in the world. In 2010, 45% of deliveries were attended by skilled health personnel in sub-Saharan Africa, compared to 42% in 1990. While the proportion of women with at least one ANC visit during pregnancy increased from 69% in 1990 to 77% in 2010 in sub-Saharan Africa, that of women who attended four or more ANC visits (the minimum number recommended by WHO) declined from 50% in 1990 to 46% in 2010 [20].

Contraceptive use and fertility

Modern contraception has played a major role in reducing the world´s total fertility rate, especially in resource poor settings [21-23]. Facilitating access to modern contraceptives for women has the potential benefit of improving maternal and child health and reducing mortality [24-27] through lowering the number of unintended pregnancies [28]. In most resource poor countries, particularly sub-Saharan Africa, modern contraceptive use is especially low and fertility is high, resulting in rapid population growth and high maternal and child mortality and morbidity [24, 26, 29, 30]. However, contraceptive use trends vary between and within countries [31-34], making it crucial to examine the effect of local family planning policies and interventions on the most vulnerable women [35].

Antenatal care

ANC is one of the factors that tend to promote delivery with a skilled health professional [36, 37] due to motivation given during antenatal sessions and increased familiarity with the health care staff [38]. In most low-income countries, women may attend at least one ANC visit during pregnancy [2] but fail to adhere [39] to the WHO recommendation of at least four visits for a given pregnancy [40, 41].

Skilled birth attendance

Several studies have presented evidence of an association between SBA utilization during childbirth and reduction in maternal mortality [42-45]. The use of SBA during childbirth is almost universal in high-income countries, but lags behind in most low-income settings in sub-Saharan Africa [46], despite it being an indisputable benefit in resource poor countries [47-49]. The unavailability of maternal health care services generally accounts for the low use of skilled care during childbirth [50]. However, even in settings where those services are available, women in certain groups (such as those with low socio-economic levels, minimal education, or who reside in rural areas) fail to access them. Reasons for this include the high direct and indirect costs of healthcare, lack of transportation, long distances to health facilities, inadequate information about services provided, and negative past experiences with providers [49-53]. Socio-cultural vulnerabilities also play a role in inhibiting women's use of skilled care at birth. For example, some women place a high value on home birth and fear they will lose social status, privacy, and control over the birth process with assisted delivery [52]. In some instances, the decision to deliver at a facility is not up to the woman but is made by husbands, mother-in-laws, community heads, soothsayers, or traditional healers [54]. Many women seek to give birth under conditions where they feel safe, protected, and secure [5, 55-57].

Postnatal care

The postnatal period represents a critical phase in the life of the mother and child. Most maternal deaths occur during this time, which the health care system often neglects, especially in resource-limited settings [58]. The WHO has recently reviewed evidence of helpful practices during the postnatal period and made recommendations for these practices to be included as part of the routine postnatal care services provided in low- and middle-income countries (LMIC). These recommendations include 24-hour postnatal care after birth before being discharged for those who delivered at a health facility. For home births, the first postnatal contact should be made as soon as possible within 24 hours after birth. It is also recommended that three additional postnatal contacts should be made for all mothers and newborns: on day 3 (48 to 72 hours), between 7 to 14 days after birth, and 6 weeks after birth [58]. These recommendations could reinforce old neglected postnatal care practices but need the cooperation of all stakeholders involved – policy makers, health professionals, community, and women – for successful implementation.

Background

Organization of health services in Ghana

The Ghana Health Service (GHS) is a governmental body mandated by an act of parliament (Act 525) to oversee the provision of, and access to, health services delivery in Ghana. Functionally, GHS is organized in five levels corresponding to the level of health care services provided in the country: national, regional, district, sub-district, and community [59]. All public health care services in Ghana are regulated by the GHS except the three teaching hospitals (Korle-Bu Teaching Hospital, Komfo Anokye Teaching Hospital, and Tamale Teaching Hospital). They also have been mandated by an act of parliament but are autonomous and provide advanced health services to support those of the GHS, in addition to training medical professionals and conducting medical research.

Overview of maternal and reproductive health in Ghana

Contraception and fertility in Ghana

In 1969, Ghana adapted an explicit, comprehensive population policy, making it one of the first countries in sub-Saharan Africa to do so [60]. The result was the launching of the Ghana National Family Planning Programme in May 1970. Its major focus was to lower the rate of population growth and facilitate economic growth. The programme's poor results are attributed to its provider-focused delivery strategy, coupled with a lack of institutional coordination [61]. When the policy was revised in 1994, its goals were a) to reduce the total fertility rate (TFR) incrementally from 5.5 to 5.0 by the year 2000, 4.0 by 2010, and 3.0 by 2020 through increased contraceptive use; b) to increase the modern contraceptive prevalence rate to 28% in 2010 and 50% in 2020; and c) to achieve a minimum birth spacing of 2 years for all births by 2020 [62].

Although contraceptive utilization in Ghana is generally low, the use of modern methods of contraception increased more than three-fold (from 5% to 17%) between 1988 and 2008, and in the same period Ghana's TFR dropped from 6.4 to 4.0, among the lowest countries in sub-Saharan Africa [63]. These positive trends raise the following questions of equity: Is access to modern contraceptive methods distributed equitably among all socio-economic sub-populations in Ghana? Are some sub-populations deprived of access to effective modern contraception? Is the inequality gap in the use of modern contraceptives and fertility services improving or worsening over time? The present thesis seeks to address this crucial knowledge gap that has not been explored in previous studies.

Antenatal care and skilled birth attendance in Ghana

Utilization of ANC and SBA is very low in Ghana. The proportion of births attended by SBAs was 57% in 2008 [64], far below the UN minimum target of 80% in 2005, 85% in 2010, and 90% in 2015. Moreover, differences exist in uptake and quality of these services within the country [65, 66].

Maternal mortality in Ghana

Ghana's maternal mortality rate remains high [1, 67], despite positive sustained economic growth over the past two decades [68]. According to the World Health Statistics [69], Ghana reported 630 maternal deaths per 100,000 live births in 1990 (range 340–1200), and 350 in 2008 (range 210–600). Hogan and colleagues estimated 549 (range 444–1157) and 409 (range 248–633) maternal deaths per 100,000 live births in Ghana for the same years [18]. In 2011, Lozano and colleagues estimated 328 maternal deaths per 100,000 live births (range 247–409) with an annualized rate of decline of 0.9% between 1990 and 2011. They concluded that at the current pace Ghana is extremely unlikely to achieve a 75% reduction in maternal mortality by the year 2015, or even before 2040 [1]. Several interventions have been designed by governmental and non-governmental agencies, international, and national groups to curb this alarming situation. The national health insurance scheme, which includes a free maternal health care package, is one such effort [70]. Nonetheless, highly vulnerable and hard to reach female sub-populations exist in the country [70, 71]. These must be identified before targeted interventions can occur.

Causes of maternal mortality in Ghana

The direct obstetric causes of maternal mortality in Ghana as identified by previous studies are haemorrhage (postpartum and antepartum), induced abortion, miscarriage, sepsis, obstructed labour, ectopic pregnancy, (pre-) eclampsia, and embolism. The indirect obstetric causes are mostly infectious and non-infectious diseases such as malaria, HIV/AIDS, hepatitis, respiratory infections, anaemia, sickle cell disease, meningitis, cerebrovascular diseases, and others [72-74]. Evidence suggests that women with different socio-demographic characteristics may be exposed to varying levels of risk for each of the causes listed. For example, in the Kwahu South District of the Eastern Region of Ghana, mothers with no education had about seven times greater risk of exhibiting all six indicators of pre-eclampsia (headache, visual disturbance, decreased urination, breathing difficulties, leg swelling, and seizures) than those with seven or more years of education. No significant correlation was found between education and postpartum haemorrhage [75]. The more we know about the characteristics of women at risk for specific causes of maternal mortality, the greater the chances of designing effective interventions to accelerate improvement in maternal health in Ghana.

The Concept of Inequality and Inequity in Maternal Health

The growing inequality in access to health care and in health outcomes is an issue of concern as countries strive to improve maternal health. Inequality in health is classified as inequity when it originates from socio-economic differences in the population and could be corrected by changes in policies, programmes, or practices. Thus, health inequality is the metric by which health inequity can be assessed [76, 77]. Inequity in health exists when people are unfairly deprived of resources they need to maintain their health or protect them from unwanted or undesirable conditions [78].

Inequity in health between and within countries has existed over the years [79] but in recent time there have been commitments from the global community to reduce this gap [77, 80]. The WHO Commission on Social Determinants of Health launched in 2005, whose major focus is on health equity, is a notable example [80, 81]. The commission has redefined the unfair differences within and between groups as social injustice, which carries with it moral implications. Through the lens of equity we can observe whether certain strata of the population (such as poor, young, single, rural residents and women with a low educational background) are being deprived of essential maternal health and family planning services needed to avoid unwanted pregnancies. In addition, by examining trends in maternal health services, including SBA, ANC, contraceptive use, and fertility control, we can determine if current policies, programs, and interventions are working to close or widen the inequity gaps existing among groups. However, the equity concept needs to be applied more cautiously when examining reproduction and the role of contraception than in other health interventions [78].

SBA utilization is one of the indicators that have been selected by the WHO Equity Analysis Group because of its relevance to health services and health system strength [16]. A recent study conducted in 54 low-income countries in which 12 maternal, newborn, and child health interventions were analysed, found SBA coverage to be the least equitable one, followed by completing four or more ANC visits [39]. The same study found that countries with similar levels of overall SBA coverage often had very different results in regard to the distribution of these interventions by wealth quintiles [39]. Many studies examining health inequity

within a population have only considered the wealth dimension [82, 83]. However, stratification by wealth alone is not the most appropriate way to measure inequities in health. Studies that investigate inequity in health should examine the multiple dimensions of inequality that exist within countries, such as age, residence (rural or urban), gender, marital status, and educational level [82] and take into account human rights challenges and policy needs and opportunities within a country. The health gaps between these groups may be as significant as the gap between the rich and poor [82].

Inequalities in health vary with time, place, and by specific health indicators [39, 84]. Creanga and colleagues compared two Demographic and Health Surveys (DHS) in 13 sub-Saharan African countries [85]. They reported a decrease in wealth-related inequalities in contraceptive use in some countries and an increase in others [85]. Gillespie and colleagues studied data from 41 developing countries and found that the poorest quintile had a total fertility rate of 6, twice as high as that found in the wealthiest quintile. They suggested that reducing inequality in access to modern contraception will also reduce the inequality in fertility [78]. Whereas aggregate measures of health inequality could be used in certain instances, such as for global monitoring, they are less useful at the country level in guiding decisions on policy and interventions than are single indicators [39].

In Ghana, with its poor maternal health indicators, more attention has been focused on attaining set international targets in maternal health care services, but little attention has been given to the inequality gap that exists in women who access these services. The magnitude and trends in inequality in modern contraceptive use, fertility services, SBA, and ANC utilization in Ghana have not previously been studied. Considering the socio-demographic disparities that exist in the country, especially in education, income, and rural/urban residence status, it is essential to investigate the trend in those disparities and how they have translated into inequalities regarding access to all of the healthcare services listed above.

Impact of health inequalities on health systems

Equity in health and health systems efficiency are closely linked [86, 87]. To strengthen health systems, equity needs to be integrated as a component of both outcome and impact [88]. As the health inequality gap within a country widens, people of high socio-economic status continue to improve their health, whereas the health of people with low socio-economic status worsens [76, 89]. In certain instances this may lead to an overall improvement in health as measured by aggregate country level health indicators [90, 91]. However, such an improvement

is not sustainable and at some point may level off. If the health systems and political structures continue to foster increasing health inequality, the overall efficiency of the health system will begin to decline. Thus, as certain population subgroups suffer from a disproportionately high burden of morbidity and mortality, the health of the entire population, and in some instances the health gains of the most advantaged groups, will be affected [77]. Therefore, monitoring and addressing inequities in health over time by appropriate policies, programmes, and practices is critical [77, 92]. The opposite could lead to deterioration or breakdown of the entire health system and reverse development.

Measures of inequality

To measure health or health-related inequality in a population, one may choose a relative or an absolute measure, or both. Two frequently cited articles by economists [93] and social epidemiologists [94] discuss both measures of inequality in seeking a method to best capture socio-economic differences in health [95]. Mackenbach and Kunst [94], although they agree with Wagstaff and colleagues [93] choices (Concentration Index, Relative Index of Inequality, and Slope Index of Inequality) also recommend other simple measures, such as the prevalence differences, and more sophisticated measures, such as regression based population attributable risk to complement each other. The theoretical foundations of both Mackenbach and Kunst's relative index of inequality, while accepted in several publications, have been strongly criticized by the epidemiological community. Recent studies have also stressed that relative assessments of inequality should be balanced by measures of absolute health inequalities, such as prevalence differences and slope index of inequality [95].

Theoretical Framework

The theoretical framework of this thesis has been derived from the statement of the WHO Commission on Social Determinants of Health that action on the social determinants of health will promote equity and reduce health inequalities [80]. Social determinants of health are linked to health inequalities because the root cause of health inequality is social inequality. Social determinants of health broadly encompass all aspects of the conditions under which people are born, raised, mature, work and age. These include but are not limited to the health system, and are influenced by the distribution of power and resources at the global, national, and local level [77, 80]. Therefore, the equity stratifiers (dimensions of

inequalities) used to monitor health inequality should reflect all relevant social conditions, including level of income, education, and residence, depending on the characteristics of the population and the health measure in question [77].

Conceptual model: Social determinants of maternal health outcomes in Ghana

The conceptual model below (Fig. 1) illustrates the distal factors that influence maternal and reproductive health in Ghana. The components that constitute these factors have been specified in Figure 2. Three intersecting circles represent three factors, health services, policy, and society, that interact with each other and, where they intersect create a fourth factor: inequalities in maternal and reproductive health. The inequalities are propagated by the way the contributing factors act over time. Two concentric circles represent individual level factors: D1, low socio-economic status (LSES) individuals, and D2, high socio-economic status (HSES) individuals. In a setting with great inequality in maternal health outcomes between HSES and LSES individuals, the impact of personal factors on maternal health outcomes differs between the two groups. The small central circle, D1, includes women with little or no education, low income, and rural residence. For these women many of the other factors that determine maternal health outcomes are beyond their control. By contrast, the individual level factors for HSES women are represented by the large circle, D2, which circumscribes the other circles. This implies that in settings with high inequality in maternal health outcomes between socio-economic subgroups, those women with HSES could overcome barriers to improved maternal health outcomes and enjoy less restrictions from health services, healthcare policies and societal factors. While Ghana's healthcare system affects all women, poor maternal health outcomes caused by these three factors are far more debilitating for LSES women.

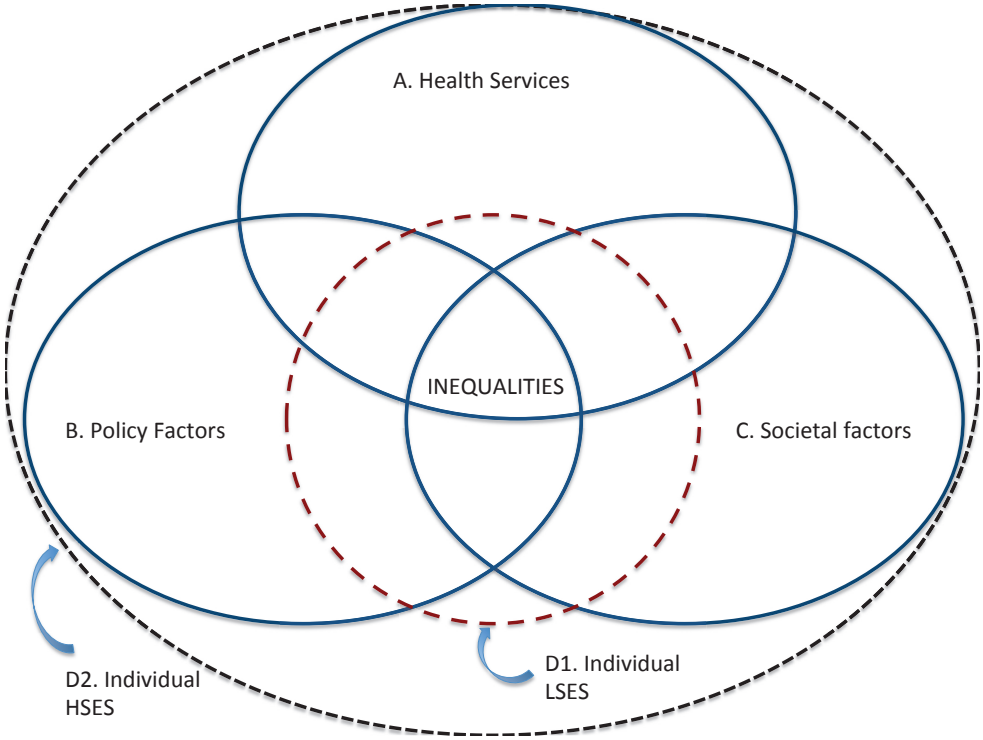

Figure 1. Social determinants of maternal health outcomes in Ghana

A detailed explanation of the proximal and distal causes of maternal mortality in Ghana is given in Figure. 2.

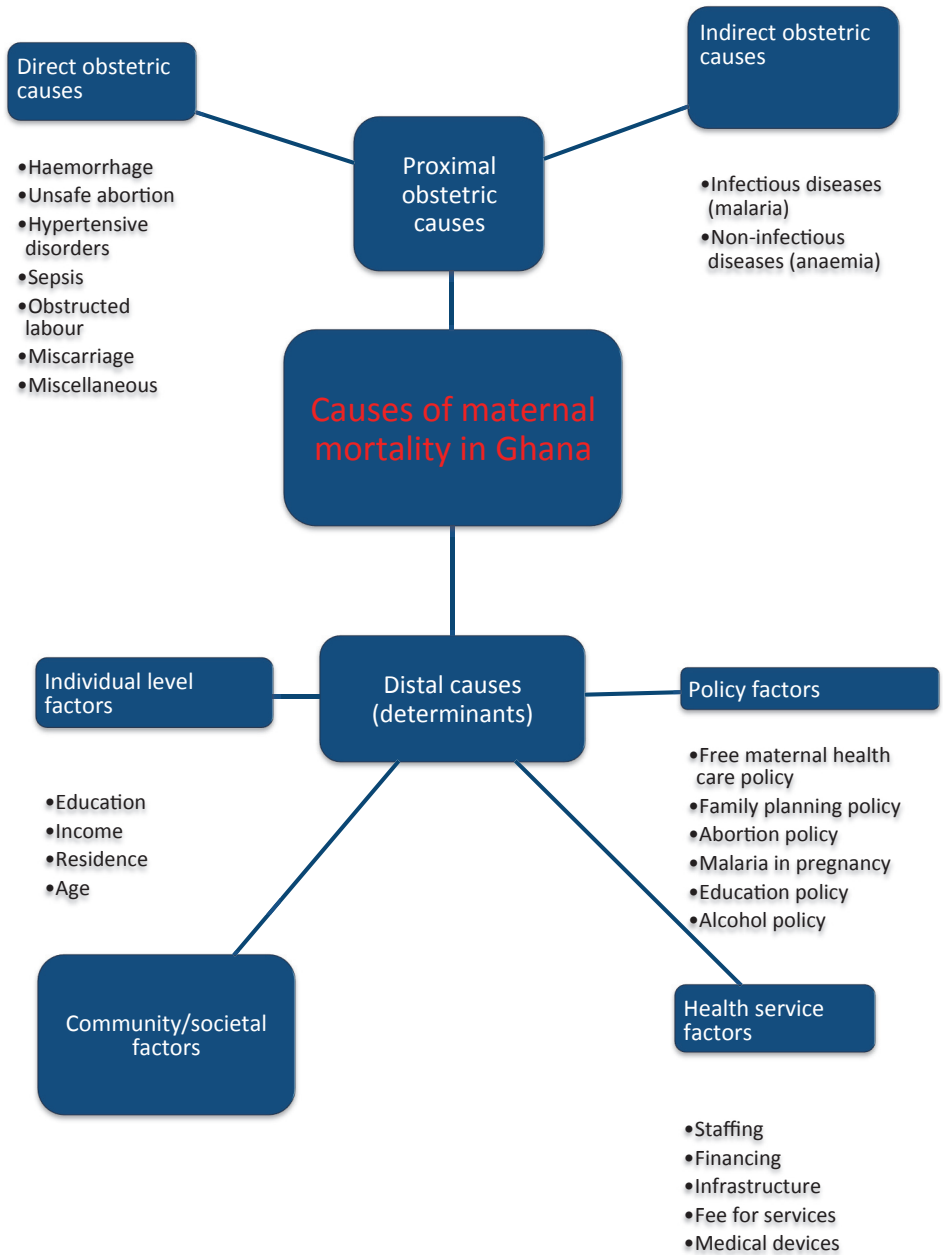

Figure 2. Causes of maternal mortality in Ghana

Aim

General aim

The overall aim of this thesis is to assess equity in maternal health by examining socio-economic factors in Ghana from 1988 – 2008 and considering their impact on maternal health services.

Specific aims

1. To assess and analyse the causes of maternal mortality in Ghana according to socio-demographic factors (Paper I)

2. To investigate a) the possible correlation between alcohol consumption and maternal deaths related to induced abortions and b) behavioural characteristics of victims of maternal deaths due to induced abortions, so that pathways for targeted interventions may be identified (Paper II).

3. To examine the gaps, trends, and patterns in modern contraceptive use and fertility within different socio-demographic subgroups in Ghana from 1988 to 2008 to address the following questions (Paper III):

- Do all sub-populations in Ghana have equal access to modern contraceptives?
- Are some sub-populations deprived of access to effective modern contraception?
- Is the inequality gap in the modern contraceptive use and fertility increasing or decreasing in the Ghanaian population?

4. To investigate the magnitude and trends in income, residence, and parity-related inequalities that limit access to adequate antenatal care and skilled birth attendance (Paper IV).

Material and Methods

Data source

The four studies in this thesis are based on data from the 2007 Ghana Maternal Health Survey (GMHS) and the Ghana Demographic and Health Surveys (GDHS) of 1988, 1993, 1998, 2003, and 2008. These surveys were conducted by the Ghana Statistical Service (GSS) and the Ghana Health Service (GHS). Table 1 gives an overview of the thesis studies, sample population, aim, design, and analytical methods. Approval for all data collected from the GMHS and GDHS were obtained from the Ghana Health Service Ethics Review Committee. All studies were carried out in compliance with the Helsinki Declaration.

Table 1. Overview of thesis: population, study design, and statistical analysis

Study	Population	Inclusion criteria	Aims	Study design	Statistical analysis
I	Women ages 12 – 49 who died of pregnancy-related causes according to GMHS 2007 (n = 605)	Maternal deaths defined as related to pregnancy, childbirth, and puerperium according to ICD-10 codes	Assess and analyse causes of maternal mortality in Ghana correlated to socio-demographic factors	Case control	Descriptive statistics, bivariate and multivariate logistic regression
II	Women ages 12 – 49 who died of pregnancy-related causes according to GMHS 2007 (n = 605)	Maternal deaths defined as related to pregnancy, childbirth, and puerperium according to ICD-10 codes	Investigate possible correlation between alcohol consumption and induced abortion-related maternal deaths	Case control	Descriptive statistics, bivariate and multivariate logistic regression
III	All eligible women ages 15 – 49 who were interviewed with Women´s Questionnaire	All eligible women ages 15 – 49 interviewed with Women´s Questionnaire. Sample comprised: 4488 women in year 1988 4562 women in year 1993 4843 women in year 1998 5691 women in year 2003 4916 women in year 2008	Examine gaps, trends, and patterns in modern contraceptive use and fertility within different socio-demographic subgroups in Ghana, 1988 – 2008	Time series of cross-sectional studies	Descriptive statistics, bivariate and multivariate logistic regression. Indices of inequality: TAF, RII, SII
IV	All eligible women ages 15 – 49 who were interviewed with Women´s Questionnaire	Women with at least one previous birth experience in 3 – 5 years prior to surveys. Sample comprised: 2716 women in year 1988 1980 women in year 1993 2376 women in year 1998 2777 women in year 2003 2147 women in year 2008	Investigate magnitude and trends in income, residence, and parity-related inequalities that limit access to adequate antenatal care and skilled birth attendance	Time series of cross-sectional studies	Descriptive statistics, bivariate and multivariate logistic regression. Index of Inequality: TAF

GMHS: Ghana Maternal Health Survey; TAF: Total Attributable Fraction

RII: Relative Index of Inequality; SII: Slope Index of Inequality

Data Collection

Studies I and II

The data for Studies I and II were derived from the 2007 GMHS. The sample covered 1600 clusters selected from the 10 administrative regions of Ghana across urban and rural areas. The primary sampling unit consisted of wards and sub-wards drawn from the 2001 population census. The sample size was estimated from the 2003 DHS. The data was collected in two phases. In Phase I, 240,000 households were selected out of which 226,209 completed the questionnaire, which solicited the number of people and deaths in a household by age and sex during the five years preceding the survey. For female deaths, additional questions were posed, including whether the woman was pregnant at the time of death and whether she died during childbirth or within two months of delivery. The purpose of the questionnaire was to identify households for the administration of the Verbal Autopsy Questionnaire (VAQ) in Phase II. Households that had reported one or more deaths of women between the reproductive ages of 12 to 49 years in the five years prior to the survey were revisited in Phase II and asked to complete a VAQ.

The VAQ

A verbal autopsy was used to identify true maternal deaths, defined as "the death of a woman during pregnancy or within 42 days of the end of pregnancy from causes related to or aggravated by the pregnancy or its management, but not from accidental or incidental causes" [96]. It is a technique of interviewing lay respondents, usually close relatives, about the signs and symptoms experienced by the deceased before death occurred [97]. In places with weak vital registration systems or low availability of medical care its employment has proven effective [97].

The VAQ provided details on 4203 maternal and non-maternal female deaths. The final causes of death were categorized according to the International Statistical Classification of Diseases and Related Health Problems (ICD-10) [96]. Of the above total, 605 were maternal deaths in the 12 to 49-year-old age group, the sample that was used in Studies I and II. The data collection process for those studies is outlined in Figure 3.

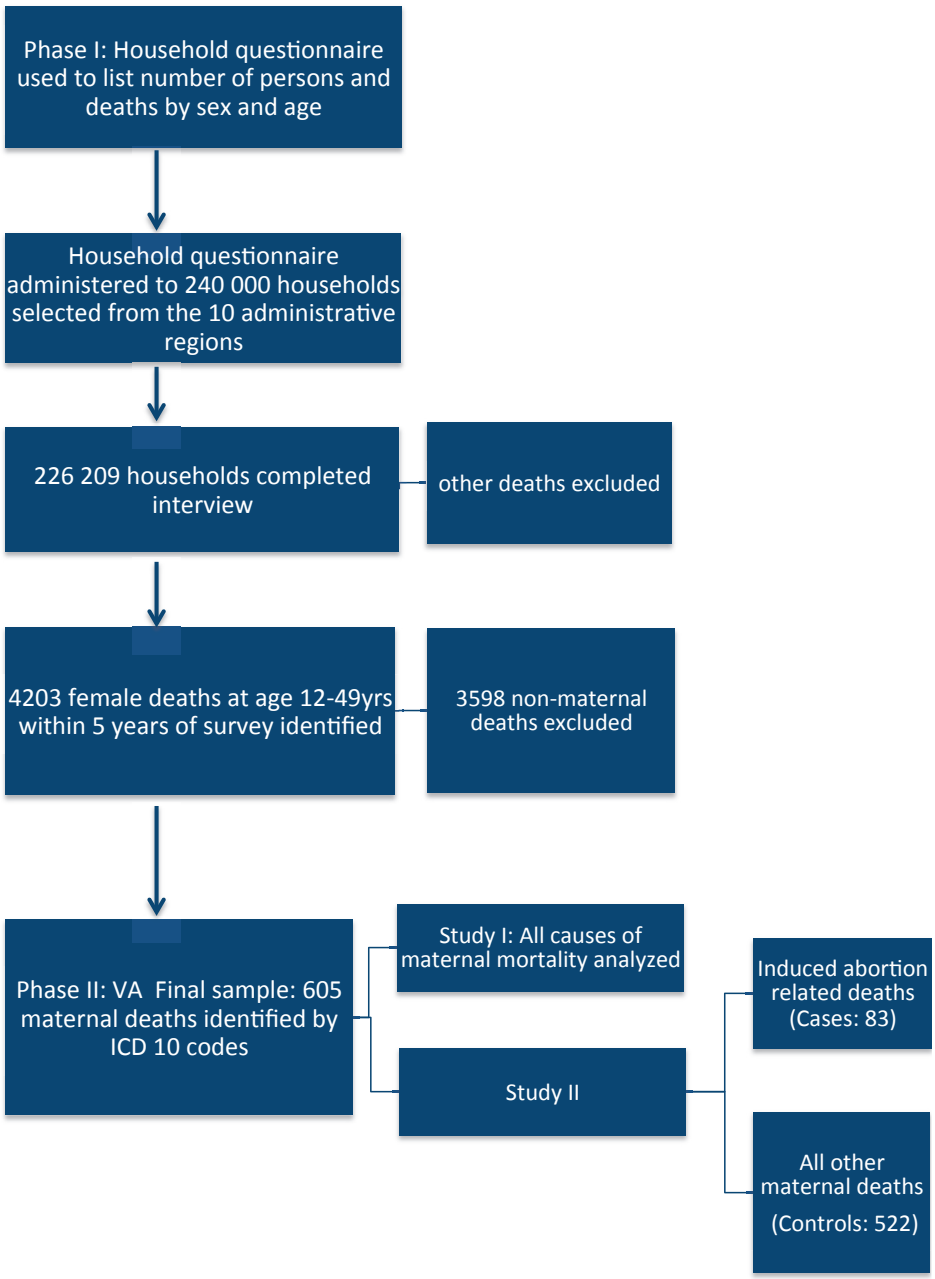

Figure 3. Flow chart of the data collection process for Studies I and II

Studies III and IV

A database was constructed using data from the GDHS of 1988 [98], 1993 [99], 1998 [100], 2003 [101], and 2008 [64], which employed standard DHS questionnaires and techniques for data collection [64, 98-101]. All participants were interviewed with the Women's Questionnaire. Eligible women were defined as women ages 15 to 49 who were present in a selected household the night before the interview, whether or not they were usual residents in the household. The Women's Questionnaire was used to collect information on the following topics: respondent's background characteristics; reproductive history; contraceptive knowledge and use; antenatal, delivery, and postnatal care; infant feeding practices; child immunization and health; marriage; fertility preferences and attitudes about family planning; husband's background characteristics; women's work; knowledge of STDs including HIV/AIDS; and anthropometric measurements of children and mothers. Study III analysed women's use of modern contraceptive methods and their fertility rate. Study IV analysed antenatal and delivery experiences of women with at least one previous birth experience in the last 3 to 5 years prior to the surveys. Respondents to the Women's Questionnaire totaled 4488 in 1988 (response rate 98%), 4562 in 1993 (response rate 96%), 4843 in 1998 (response rate 97%), 5691 in 2003 (response rate 96%), and 4916 in 2008 (response rate 97%).

Definition of variables

Independent variables

The following subparagraphs describe the independent variables used in this thesis.

Maternal age

This variable was categorized into eight age groups (12–14, 15–19, 20–24, 25–29, 30–34, 35–39, 40–44, and 45–49) for Studies I and II, and further dichotomized into 18 and below, or over 18 (for Study II). For Studies III and IV maternal age was categorized into three age groups (below 25, 25–34, and 35 or above).

Educational level

This variable was classified into four categories (Studies I to IV):

a) *Never attended school* (women who confirmed having no formal education). Studies I and II also included those whose educational attainment was unknown in this category.

b) *Basic education* (women with some level of formal education not exceeding 9 years, including those with primary, middle school, or lower secondary school education). Those who completed 9 years of basic education and had some extra years of education, but did not complete the upper secondary school level were also included in this category.

c) *Senior high school* (women with 12 years of formal education or whose education ended at the upper secondary school level). Those who completed 12 years of basic and secondary education and had some extra years of education, but did not complete tertiary level education, were also included in this category.

d) *Tertiary or higher education* (women who completed at least 15 years of formal education, including those with college, polytechnic, or university level studies).

Study IV combined senior high school and tertiary or higher education into one category: "senior high school or higher (secondary +)" for further analysis as the previous study showed them to be comparable (Study III).

Residence

This variable was coded as urban or rural (Studies I to IV). The categorization was not the respondent's own, but created based on whether the cluster or sample point number was defined as urban or rural. In Ghana urban or rural categorization is based mainly on population size.

Current marital status

Current marital status was classified in two categories (Studies I to IV):

a) *Single* (women who had never married, were separated, divorced, or widowed at the time of the interview)

b) *Married* (women who were married or living with a partner at the time of the interview)

Income level

Income level was based on yearly earnings as self-reports by respondents. For those with no regular income, the amount was based on daily, weekly, or monthly wages. This variable was originally categorized into five quintiles (poorest, poorer, middle, richer, richest) according to the GDHS. Income quintiles were later ranked into three groups: low income (poorest and poorer), average (middle), and high

income (richer and richest), using the fractional rank function in SPSS software (Studies III and IV).

Alcohol consumption

The main predictor variable in Study II was alcohol consumption. Such information was obtained in personal interviews with family members. Alcohol consumption patterns had four sub-variables: 1) *consumer of alcohol* (at any time in the past or present); 2) *consumer of alcohol within 12 months of death* 3) *frequency of alcohol consumption* (daily or weekly; occasionally; or abstained); and 4) *history of alcohol consumption* (less than one year, or one or more years).

Parity

This variable was coded from a question that assessed the number of children a woman had given birth to. Responses were grouped as nulliparous (zero births prior to the current pregnancy), para 1 to 3 (1 to 3 births), and para 4 + (4 or more births) (Study IV).

Dependent variables

Study I

Cause of maternal mortality

This involved causes related to pregnancy, childbirth, and the puerperium according to the ICD-10 codes [96] with data obtained through the verbal autopsy procedure described above. The final causes of death according to ICD-10 codes were grouped into 9 categories. The 5 main variables used in the logistic regression analysis were: 1) haemorrhage, either antepartum or postpartum; 2) induced abortion, including medical, attempted, failed, unspecified, and all other forms according to ICD-10 [96]; 3) other infectious diseases, mainly comprising malaria and other protozoa diseases, viral hepatitis, and tuberculosis; 4) other non-infectious diseases, including pregnancy-related deaths from anaemia and diseases of the respiratory, circulatory, and digestive systems; 5) miscellaneous, including maternal deaths from unspecified obstetric causes, uterine rupture, complications of obstetric surgery, embolism, complications of anaesthesia, obstetric shock, and other complications of labour and delivery. Additional variables described but not used in the logistic regression analysis were hypertensive disorders of pregnancy (including [pre-] eclampsia), sepsis, obstructed labour, and miscarriage (all forms of spontaneous abortion).

Study II

Induced abortion

The outcome variable for Study II was maternal deaths due to induced abortion including medical, attempted, failed, unspecified, or other forms of abortion according to ICD-10 codes. All spontaneous abortions (miscarriages) were excluded from the analysis.

Study III

Non-use of modern contraceptive methods

This variable was generated from responses to the question "Have you ever used any method of family planning?" The question had four response alternatives.

a) Used modern method (pill, IUD, injections, diaphragm, condom, female sterilization, male sterilization, implants, female condom, and foam or jelly). If a respondent used both a modern method and a traditional method, the modern method took priority and was categorized as had sometimes used a modern method.

b) Used traditional method only (periodic abstinence [rhythm], withdrawal, lactational amenorrhea, and abstinence).

c) Used only folkloric method (other).

d) Never used (respondents who claimed to have never used any method).

The responses were dichotomized into "sometimes used modern method of contraception" and "never used any modern method of contraception".

Fertility rate

This variable was generated from responses to a question that assessed the total number of children a woman had ever given birth to. The responses were re-categorized as: a) low fertility rate (having less than 4 live births), and b) high fertility rate (having 4 or more live births). Four children per woman was chosen as the cut-off because the total fertility rate in Ghana is currently estimated to be around 3.5.

Study IV

Two outcome variables were used to assess trends in pregnancy or birth experiences, namely, *number of antenatal care visits* and *skilled attendance at birth*. The maternity history contained up to six entries relating to births in the last three to five years, depending on the year of survey. For women with multiple birth experiences, the last birth experience was analysed in this study.

Antenatal care visits

ANC visits were assessed at two levels: a) no ANC visit or at least one visit, and b) less than four ANC visits or at least four visits.

Skilled attendance at birth

The definition of an SBA has evolved over the years. In 2004, the WHO, the International Confederation of Midwives (ICM) and the International Federation of Gynaecology and Obstetrics (FIGO) refined the definition of an SBA as "an accredited health professional – such as a midwife, doctor or nurse – who has been 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" [102]. The above definition developed due to the fact that diverse groups of health care professionals with various country-specific titles could provide the skills and competencies expected of an SBA [103-105]. This definition has been adopted in the present thesis. In Study IV, an SBA variable was generated by asking for "the type of person who assisted in the delivery of the child". Responses were dichotomized as a) women who had skilled attendance at birth from a doctor, nurse, or midwife, and b) those who had no skilled attendance at birth. Auxiliary health staff or home health aides cited in the 2008 survey were not considered SBAs.

Statistical methods and analysis

All analyses in this thesis were performed using the IBM software SPSS Statistics 20 and Microsoft Excel. The DHS sampling design uses clustered sampling, which includes both over-sampling and under-sampling. In Study IV, all analyses were conducted with weighted sample data to correct for over-sampling, under-sampling, and different response rates to the survey in different regions. Results produced by the unweighted sample were the same.

Study I

In Study I, descriptive analysis was carried out to show the distribution of causes of maternal mortality according to age, educational level, residence, and marital status. Cross-tabulations were performed on each of the nine dichotomized causes of maternal mortality and the socio-demographic variables above to determine how these causes differ from group to group. Logistic regression analysis was then carried out on the top five causes, using each dichotomized cause of mortality as the dependent variable. Age group, educational level, residence, and marital status

were used as the predictor variables/covariates. A crude OR was computed with 95% confidence interval (CI) using one covariate at a time. An adjusted Odds Ratio (aOR) was also computed using one covariate at a time and adjusting for the other variables in one model.

Study II

In Study II, the prevalence of all the variables in this study was measured within the sample population. Logistic regression analysis was then carried out to examine the association between the various alcohol consumption patterns (predictor variables/covariates) and induced abortion (dependent variable). This may be described as a type of case control study design where the cases are maternal deaths from induced abortion and the other maternal deaths served as controls to which cases were compared. The alcohol consumption variables used in the logistic regression analysis were: *sometimes consumed alcohol* and *frequency of alcohol consumption.* The two outcome variables (*sometimes consumed alcohol* and *consumer of alcohol within 12 months of death*) were practically identical. All exposed and unexposed cases were the same and very few controls overlapped, so differences were marginal. We, therefore, chose to analyze only *sometimes consumed alcohol*. Five logistic regression models were built. In Model 1, the alcohol consumption variables and induced abortion were analysed to obtain the crude OR for the different consumption patterns and induced abortion. In Models 2 to 5, stepwise adjustments were made for maternal age, marital status, rural/urban residence, and educational level as potential confounders. These confounders were not included in the same regression analysis as this would have most likely led to an over-adjustment and falsely underestimated the impact of alcohol.

Studies III and IV

Inequality indices

In Studies III and IV, regression-based TAF were primarily applied [106] as it was considered a more robust index for measuring inequalities in health. The RII and SII were also calculated, as were prevalence differences, to complement the TAF.

Total Attributable Fraction

TAF represents the proportion of the outcome that would not exist if all women had had the same prevalence as those with the highest socio-economic status, the assumption being that there is a causal pathway between socio-economic status and the outcome variable. The attributable fraction (AF) was calculated using the formula:

$$AF = (aOR - 1)/aOR$$

where aOR is the adjusted odds ratio by logistic regression analysis. TAF was calculated as follows:

$$TAF = \Sigma(sTAF) = \Sigma AFi*Pi$$

where AFi = attributable fraction for the outcome variable for a specific stratum

Pi = the proportion of all cases that fall in this stratum

AFi*Pi = the product of AFi and Pi, which represents the stratum-specific total attributable fraction (sTAF)

$\sum$ (sTAF) = the summation of all the strata-specific calculations, referred to as the overall TAF.

For those with the highest level of education, the AF and sTAF are by definition zero.

Relative Index of Inequality

In Study III, we applied a more refined method of calculating the RII proposed by Koolman and colleagues, which method is based on relative risk rather than OR [95, 107]. For dichotomous variables such as rural/urban residence, this produces relative risk (interpreted like the RII) directly comparable to the OR produced by logistic regression. For ranked variables such as education and income level, the above procedure produces a RII based on relative risk. It can be interpreted as the relative risk of each individual reporting an event or a particular health outcome had she moved from the very highest to the very lowest rank.

Slope Index of Inequality

The SII can be interpreted as the absolute difference in the probability of reporting a particular health outcome between the group or person with the lowest rank and the highest rank.

Results

Study 1

Figure 4 shows the distribution of the causes of maternal mortality in the sample population. The risk of dying from a specific cause of maternal mortality varies according to the socio-demographic characteristics of the woman (Table 2). Older (aOR $_{35\text{-}39\ years}$ 2.6, 95% CI 1.4 – 4.9) and married (aOR 2.7, 95% CI 1.2 – 5.7) women had higher odds of dying from haemorrhage, the leading cause, compared to younger unmarried women. Conversely, the high-risk group for induced abortion – the next highest single obstetric cause of maternal mortality, was single women below the age of 25 (aOR $_{married}$ 0.2, 95% CI 0.1 – 0.3: ref. single women, aOR $_{35\text{-}39\ years}$ 0.3, 95% CI 0.1 – 0.7: ref. 20—24 year old women). We found a decreasing trend in the risk of dying from infectious diseases related to pregnancy with increasing age (Table 2). The major infectious disease that caused pregnancy-related deaths was malaria, which accounted for 53.6% of all cases of infectious diseases related to maternal mortality. Contrary to the observed trend in infectious diseases, the risk of maternal deaths from miscellaneous causes increased with increasing maternal age. Women ages 40 to 44 years were approximately four times more likely to die from miscellaneous causes than younger women ages 20 to 24 years (aOR 3.7, 95% CI 1.5 – 9.2). Miscellaneous causes were mainly complications related to pregnancy, childbirth, and the puerperium, including those associated with obstetric surgery and anaesthesia (46.3%). Other miscellaneous sources were unspecified obstetric causes (26.8%), uterine rupture (17.1%), and embolism (9.8%). Anaemia (41.3%) was the major non-infectious disease related to maternal mortality.

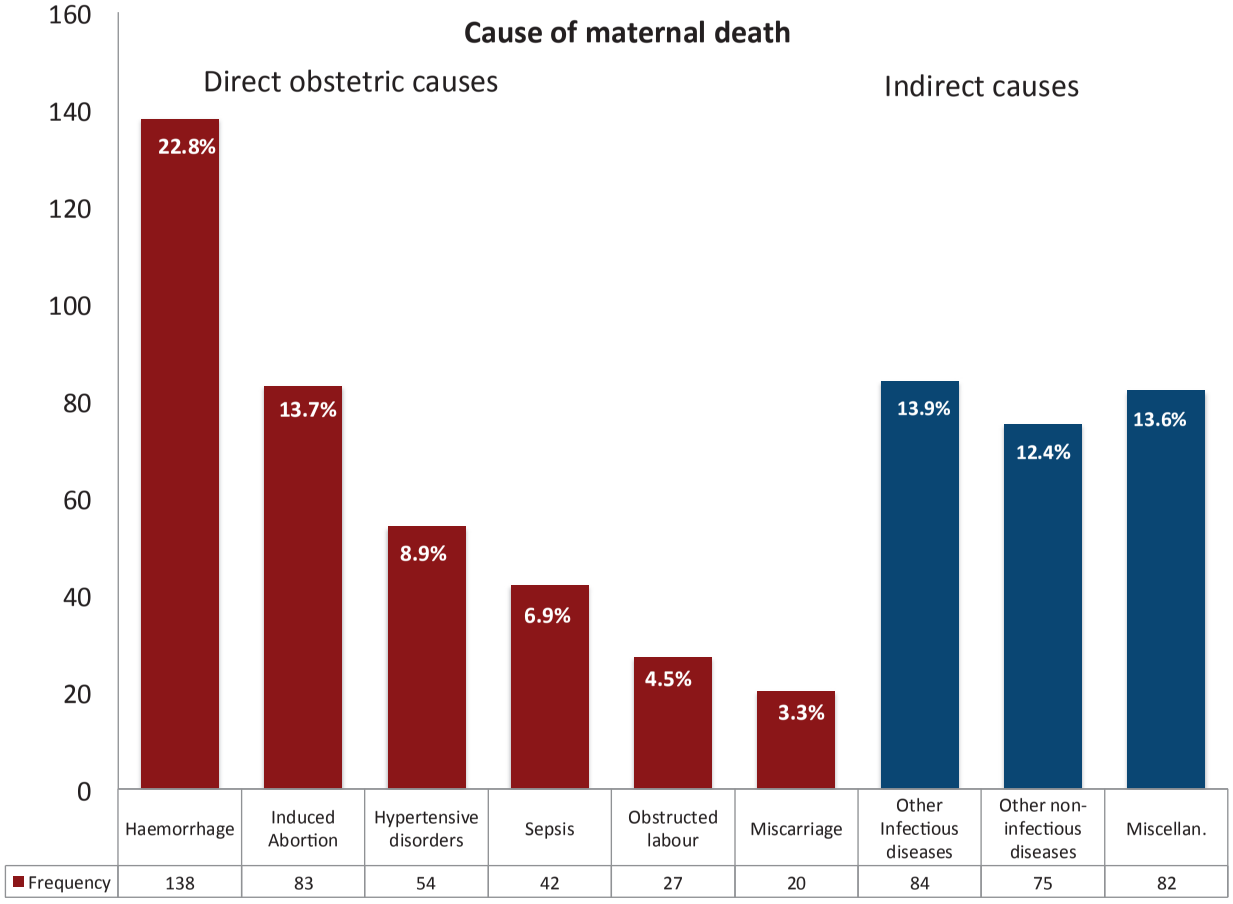

Figure 4. Causes of maternal mortality among 605 women who died from pregnancy-related causes in Ghana, 2000 to 2005 (Study 1)

Table 2. Causes of maternal mortality by educational level, residence, and marital status in 602 women of reproductive age (15 to 49), adjusted odds ratios (aOR) and 95% confidence intervals

Variables	Haemorrhage	Other infectious diseases	Induced abortion	Miscellaneous	Other non-infectious diseases
	aOR (95% CI)	aOR (95% CI)	aOR (95% CI)	aOR (95% CI)	aOR (95% CI)
Age group					
12 – 14			µ		
15 – 19	0.9 (0.3 – 2.3)	0.9 (0.4 – 2.2)	0.8 (0.4 – 1.9)	1.4 (0.5 – 3.9)	0.9 (0.4 – 2.3)
20 – 24	1 (ref.)	1 (ref.)	1 (ref.)	1 (ref.)	1 (ref.)
25 – 29	1.3 (0.7 – 2.4)	0.6 (0.3 – 1.2)	0.4 (0.2 – 0.9)	1.3 (0.6- – 3.1)	1.4 (0.7 – 2.7)
30 – 34	1.7 (0.9 – 3.2)	0.5 (0.2 – 1.1)	0.7 (0.3 – 1.4)	1.8 (0.8 – 4.2)	0.5 (0.2 – 1.2)
35 – 39	2.6 (1.4 – 4.9)	0.4 (0.2 – 0.9)	0.3 (0.1 – 0.7)	2.1 (0.9 – 4.8)	0.7 (0.3 – 1.5)
40 – 44	1.2 (0.5 – 2.8)	0.3 (0.1 – 1.0)	0.8 (0.3 – 2.1)	3.7 (1.5 – 9.2)	0.6 (0.2 – 1.7)
45 – 49	0.7 (0.1 – 3.5)		2.6 (0.8 – 8.8)	0.8 (0.1 – 6.3)	1.0 (0.2 – 4.7)
Educational level					
Never attended	1.2 (0.3 – 4.6)	2.3 (0.3 – 18.9)	0.8 (0.1 – 7.0)	1.1 (0.2 – 5.7)	0.9 (0.2 – 4.6)
Basic education	1.1 (0.3 – 4.3)	1.4 (0.2 – 11.1)	0.9 (0.1 – 7.8)	1.2 (0.2 – 5.8)	0.5 (0.1 – 2.6)
Senior high sch.	1.0 (0.2 – 4.3)	1.5 (0.2 – 13.4)	1.7 (0.2 – 15.7)	1.2 (0.2 – 6.9)	0.6 (0.1 – 3.3)
Tertiary/ higher	1 (ref.)	1 (ref.)	1 (ref.)	1 (ref.)	1 (ref.)
Residence					
Urban	1 (ref.)	1 (ref.)	1 (ref.)	1 (ref.)	1 (ref.)
Rural	1.3 (0.8-2.1)	0.9 (0.5 – 1.5)	1.3 (0.7 – 2.2)	0.9 (0.6 – 1.6)	1.1 (0.6 – 1.8)
Marital status					
Single	1 (ref.)	1 (ref.)	1 (ref.)	1 (ref.)	1 (ref.)
Married	2.7 (1.2 – 5.7)	2.0 (0.9 – 4.5)	0.2 (0.1 – 0.4)	0.8 (0.4 – 1.6)	0.9 (0.5 – 1.9)

*Adjusted for one another in the same model

µ: Individuals ages 12—14 were not analysed because there were not enough data (only 2 cases) to be included in the logistic regression analysis

Study II

In table 3 we tested the association between alcohol consumption and maternal deaths from induced abortion. The results show positive association between alcohol consumption and dying from induced abortion. We further analyzed the characteristics of women who consumed alcohol in our sample and found young age and low educational level as possible factors that lie behind the alcohol consumption patterns. Those who consumed alcohol had more than twice the risk of dying from induced abortion than women who did not drink after adjusting for the effect of maternal age, marital status, rural/urban residence status and educational level (Table 3).

Table 3. Association between alcohol consumption and induced abortion in 605 women who died from pregnancy-related causes in Ghana, 2000 to 2005 (adjusted odds ratios, 95% confidence intervals, with stepwise adjustment for potential confounders)

Variable	Model 1: OR (95 % CI)	Model 2: OR (95 % CI)	Model 3: OR (95 % CI)	Model 4: OR (95 % CI)
Consumed alcohol				
Yes	2.2 (1.19 – 3.93)	2.4 (1.29 – 4.44)	2.4 (1.29 – 4.44)	2.6 (1.38 – 4.87)
No	ref.	ref.	ref.	ref.
Level of alcohol consumption				
Frequently	2.1 (0.74 – 5.73)	2.4 (0.85 – 6.98)	2.4 (0.86 – 7.08)	2.6 (0.89 – 7.40)
Occasionally	2.3 (1.15 – 4.47)	2.4 (1.19 – 4.93)	2.4 (1.19 – 4.90)	2.7 (1.29 – 5.46)
Abstained	ref.	ref.	ref.	ref.

Model 1: adjusted for age Model 2: adjusted for age and marital status

Model 3: adjusted for age, marital status, and rural/urban residence

Model 4: adjusted for age, marital status, rural/urban residence, and educational level

Study III

The prevalence of modern contraceptive use has generally increased (Table 4) and the fertility rate has decreased (Table 5) over a 20 year period (1988 to 2008), although unequally among women in different socio-economic groups. Education- and income-related inequality in modern contraceptive use is declining over time (Table 6), whereas education- and income-related inequality in the fertility rate is

increasing over time (Table 7). Residence-related inequalities in both outcomes show a downward trend. The results of Study III suggest that closing the inequality gap resulting from socio-economic status (SES) will reduce the prevalence of modern contraceptive non-use from 59.3% to 17.2% (Fig. 5).

Table 4. Prevalence, adjusted odds ratios, and 95% confidence intervals of non-use of modern contraceptive method according to socio-demographic characteristics among Ghanaian women ages 15 to 49 in 5 years intervals, 1988 to 2008

Variables	Non-use of modern contraceptive method									
	1988		1993		1998		2003		2008	
	n (%)	aOR (95%CI)	n (%)	aOR (95%CI)	n (%)	aOR (95%CI)	n (%)	aOR (95%CI)	n (%)	aOR (95%CI)
Residence*										
Urban	1102 (72.4)	ref	1047 (60.9)	ref	994 (62.7)	ref	1369 (57.7)	ref	1180 (54.6)	ref
Rural	2468 (83.2)	1.4 (1.2 – 1.8)	2171 (76.4)	1.5 (1.3 – 1.7)	2425 (74.4)	1.2 (1.0 – 1.4)	2249 (67.8)	1.1 (0.9 – 1.3)	1735 (63.0)	1.1 (0.9 – 1.3)
Total	3570		3218		3419		3618		2915	
Educational level*										
Never attended	1598 (89.6)	6.6 (3.1 – 14.2)	1387 (86.9)	14.9 (8.5 – 25.6)	1424 (82.0)	5.2 (3.2 – 8.5)	1452 (75.7)	4.1 (2.8 – 6.0)	856 (68.9)	3.9 (2.7 – 5.5)
Basic education	1783 (75.3)	2.1 (1.0 – 4.4)	1608 (64.4)	3.4 (2.0 – 5.7)	1744 (66.2)	2.2 (1.3 – 3.4)	1834 (58.1)	1.5 (1.0 – 2.1)	1663 (57.5)	1.8 (1.3 – 2.5)
Secondary	174 (58.8)	1.1 (0.5 – 2.5)	202 (51.0)	2.0 (1.1 – 3.5)	209 (57.3)	1.7 (1.0 – 2.9)	265 (55.9)	1.2 (0.8 – 1.8)	325 (54.5)	1.3 (0.9 – 1.9)
Higher	15 (37.5)	ref	21 (29.2)	ref	42 (40.0)	ref	67 (46.5)	ref	69 (38.1)	Ref
Total	3570		3218		3419		3618		2913	
Income level*										
Low income	736 (81.0)	1.6 (1.3 – 2.0)	No data		958 (72.4)	1.5 (1.2 – 1.8)	1664 (71.2)	1.5 (1.2 – 1.8)	1337 (66.5)	1.3 (1.1 – 1.6)
Average income	355 (74.9)	1.3 (1.0 – 1.7)			392 (62.2)	1.1 (0.9 – 1.3)	629 (63.5)	1.2 (1.0 – 1.5)	509 (56.7)	1.0 (0.8 – 1.1)
High income	557 (64.2)	ref			699 (56.4)	ref	1325 (56.1)	ref	1069 (53.2)	ref
Total	1648				2049		3618		2915	

* Adjusted for age, marital status, and mutually for one another; aOR = adjusted odds ratio

Table 5. Prevalence, adjusted odds ratios, and 95% confidence intervals of high fertility rate (4 or more live births) according to socio-demographic characteristics among Ghanaian women ages 15 to 49 in 5 years intervals, 1988 to 2008

Variables	High Fertility									
	1988		1993		1998		2003		2008	
	n (%)	aOR (95%CI)	n (%)	aOR (95%CI)	n (%)	aOR (95%CI)	n (%)	aOR (95%CI)	n (%)	aOR (95%CI)
Residence*										
Urban	509 (33.4)	ref	432 (25.1)	ref	370 (23.3)	ref	527(22.2)	ref	434 (20.1)	ref
Rural	1241 (41.9)	1.4 (1.1 – 1.7)	1221 (43.0)	1.9 (1.5 – 2.2)	1272 (39.0)	2.0 (1.7 – 2.5)	1352(40.8)	1.1 (0.9 – 1.4)	1024 (37.2)	1.4 (1.1 – 1.8)
Total	1750		1653		1642		1879		1458	
Educational level*										
Never attended	989 (55.5)	4.5 (1.8 – 11.1)	846 (53.0)	6.2 (3.2 – 12.1)	871 (50.1)	8.8 (4.8 – 16.2)	986 (51.4)	3.8 (2.2 – 6.6)	689 (55.4)	7.9 (4.3 – 14.3)
Basic education	719 (30.4)	3.1 (1.3 – 7.5)	739 (29.6)	4.3 (2.2 – 8.4)	711 (27.0)	4.9 (2.7 – 8.8)	828 (26.2)	2.7 (1.6 – 4.7)	714 (24.7)	3.8 (2.1 – 6.8)
Secondary	29 (9.8)	0.6 (0.2 – 1.6)	53 (13.4)	1.4 (0.7 – 2.8)	42 (11.5)	2.0 (1.0 – 4.0)	42 (9.1)	1.0 (0.5 – 1.9)	37 (6.2)	1.3 (0.7 – 2.6)
Higher	13 (32.5)	Ref	15 (20.8)	ref	18 (17.1)	ref	22 (15.3)	ref	16 (8.8)	ref
Total	1750		1653		1642		1879		1456	
Income level*										
Low income	470 (51.7)	1.0 (0.8 – 1.3)	No data		595 (45.0)	1.1 (0.9 – 1.4)	1033 (44.2)	3.0 (2.3 – 4.0)	821 (40.8)	2.1 (1.6 – 2.7)
Average income	202 (42.6)	0.8 (0.6 – 1.1)			265 (42.1)	1.3 (1.0 – 1.7)	365 (36.9)	2.4 (1.8 – 3.1)	273 (30.4)	1.8 (1.4 – 2.4)
High income	385 (44.4)	ref			458 (36.9)	ref	481 (20.4)	ref	364 (18.1)	ref
Total	1057				1318		1879		1458	

* Adjusted for age, marital status, and mutually for one another; aOR = adjusted odds ratio

Table 6. Logistic regression-based Attributable Fraction, Stratum-specific Total Attributable Fraction, overall Total Attributable Fraction, and Relative and Slope Indices of Inequality regarding non-use of modern contraceptive method in each stratum in 5 years intervals, 1988 to 2008

Variables	Non-use of modern contraceptive method				
	1988	1993	1998	2003	2008
Residence*					
Urban	ref	ref	ref	ref	ref
Rural: AF (sTAF)	0.29 (0.20)	0.33 (0.22)	0.17 (0.12)	0.09 (0.06)	0.09 (0.05)
TAF	0.20	0.22	0.12	0.06	0.05
RII	1.43	1.47	1.12	1.06	1.05
SII	9.78	8.05	0.89	0.62	0.33
p-value	0.001	<0.001	0.081	0.299	0.355
Educational level*					
Never attended: AF (sTAF)	0.85 (0.38)	0.93 (0.40)	0.81 (0.34)	0.76 (0.30)	0.74 (0.22)
Basic education: AF (sTAF)	0.52 (0.26)	0.71 (0.36)	0.55 (0.28)	0.33 (0.17)	0.44 (0.25)
Secondary: AF (sTAF)	0.09 (0.004)	0.5 (0.03)	0.41 (0.03)	0.17 (0.01)	0.23 (0.03)
Higher	ref	ref	ref	ref	ref
TAF	0.64	0.79	0.65	0.48	0.50
RII	11.32	18.86	6.00	6.63	4.55
SII	27.9	21.83	7.09	8.96	5.41
p-value	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
Income level*					
Low income: AF (sTAF)	0.38 (0.17)	No data	0.33 (0.15)	0.33 (0.15)	0.23 (0.11)
Average income: AF (sTAF)	0.23 (0.05)		0.09 (0.02)	0.17 (0.03)	0
High income	ref		ref	ref	ref
TAF	0.22		0.17	0.18	0.11
RII	2.11	No data	1.89	1.93	1.59
SII	16.12		4.00	5.08	2.58
p-value	< 0.001		< 0.001	< 0.001	0.005

* Adjusted for age, marital status, and mutually for one another

AF Attributable Fraction

sTAF Stratum-specific Total Attributable Fraction

TAF Total Attributable Fraction

RII Relative Index of Inequality

SII Slope Index of Inequality

Table 7. Logistic regression-based Attributable Fraction, Stratum-specific Total Attributable Fraction, and overall Total Attributable Fraction of high fertility rate in each stratum in 5 years intervals, 1988 to 2008

Variables	High fertility rate (4 or more live births)				
	1988	1993	1998	2003	2008
Residence*					
Urban	ref	ref	ref	ref	ref
Rural: AF (sTAF)	0.29 (0.21)	0.47 (0.35)	0.50 (0.39)	0.09 (0.06)	0.29 (0.20)
Total Attributable fraction(TAF)	0.2	0.35	0.39	0.06	0.20
RII	1.15	1.33	1.33	1.07	1.14
SII	0.54	0.70	0.69	0.49	0.84
p-value	0.006	< 0.001	< 0.001	0.137	< 0.001
Educational level*					
Never attended: AF (sTAF)	0.78 (0.44)	0.84 (0.43)	0.89 (0.47)	0.74 (0.39)	0.87 (0.41)
Basic education: AF (sTAF)	0.68 (0.28)	0.77 (0.34)	0.80 (0.35)	0.63 (0.28)	0.74 (0.36)
Secondary: AF (sTAF)	–	0 (–)	0.50 (0.01)	0 (–)	0.23 (0.01)
Higher	ref	ref	ref	ref	ref
TAF	0.72	0.77	0.83	0.67	0.78
Relative Index of Inequality (RII)	4.70	3.89	5.60	3.17	7.17
Slope Index of Inequality (SII)	3.24	2.08	2.30	4.82	5.89
p-value	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
Income level*					
Low income: AF (sTAF)	0 (–)	No data	0.09 (0.04)	0.67 (0.37)	0.52 (0.29)
Average income: AF (sTAF)	–		0.23 (0.05)	0.58 (0.11)	0.44 (0.08)
High income	ref		ref	ref	ref
Total Attributable fraction(TAF)	0		0.09	0.48	0.37
Relative Index of Inequality (RII)	1.09		1.29	5.95	3.52
Slope Index of Inequality (SII)	0.33		0.63	5.86	4.90
p-value	0.701		0.176	< 0.001	< 0.001

* Adjusted for age, marital status, and mutually for one another

AF Attributable Fraction
sTAF Stratum-specific Total Attributable Fraction
TAF Total Attributable Fraction
RII Relative Index of Inequality
SII Slope Index of Inequality

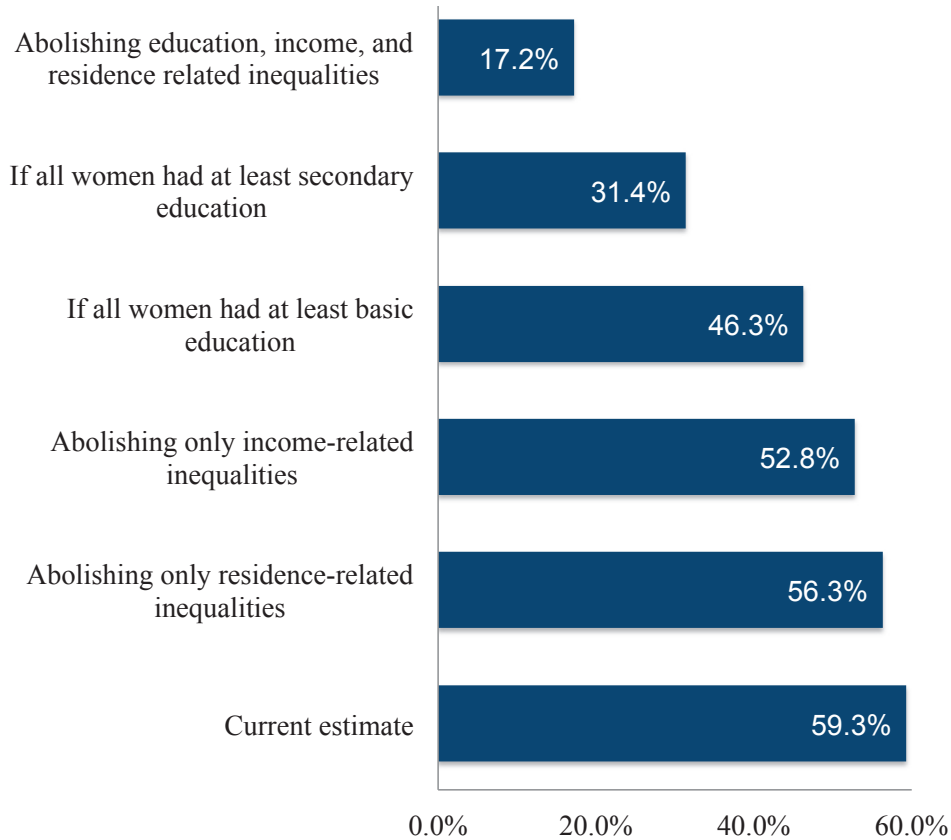

Figure 5. Implications of abolishing inequalities related to socio-economic status on prevalence of non-use of modern contraceptives

Study IV

The most significant findings in Study IV are that the rural/urban gap, educational inequalities in ANC, and differences in utilizing SBAs seem to be closing over time while income inequalities are on a sharp rise (Tables 8 and 9). While SBA utilization increased extensively in high- and middle-income women between 1988 and 2008, it declined in low-income women (Fig. 6). There was a similar increase in SBA utilization across all educational strata (Fig. 6). Parity-related disparities in the utilization of ANC and SBAs have also been increasing over time.

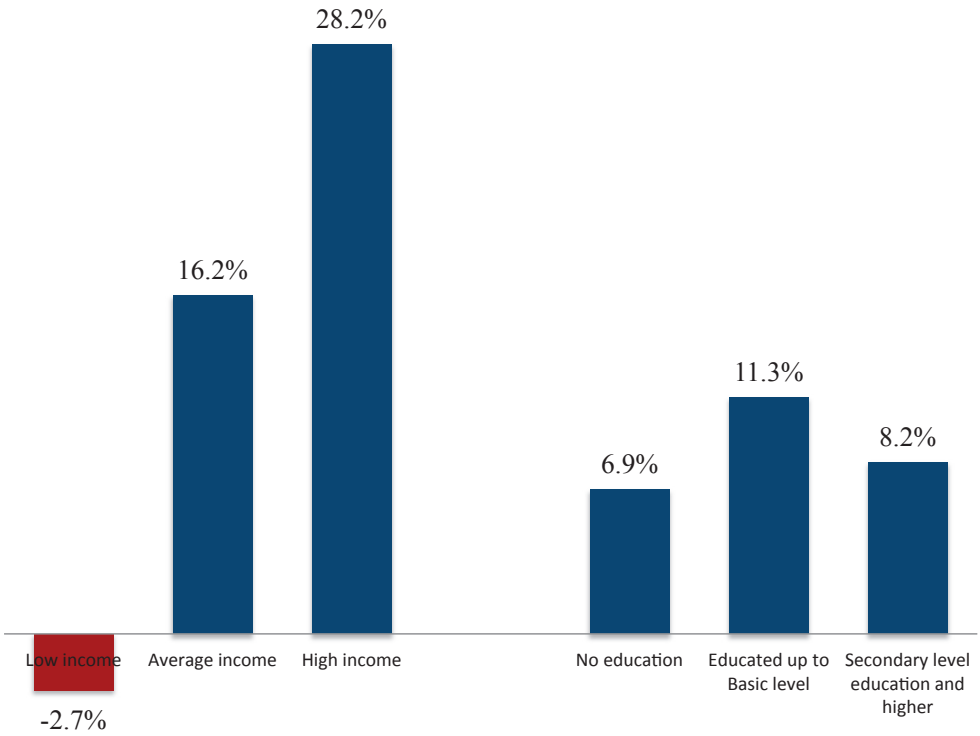

Figure 6. Absolute change (prevalence difference, %) in the utilization of skilled birth attendants by socio-economic subgroups, 1988 to 2008

Table 8. Association between education, income, residence, parity, less than four antenatal visits, and lack of skilled birth attendance among Ghanaian women ages 15 to 49 in 5 years intervals, 1988 to 2008 (adjusted odds ratios and 95% confidence intervals)

Variables	Less than four antenatal visits			
	Adjusted* OR 95% CI			
	1993	1998	2003	2008
Residence				
Urban	ref	ref	ref	ref
Rural	3.5 (2.7 – 4.6)	2.3 (1.8 – 3.1)	2.4 (1.7 – 3.2)	1.5 (1.1 – 2.1)
Highest educational level				
No education	9.7 (4.4 – 21.7)	9.9 (4.1 – 23.9)	4.4 (2.1 – 9.5)	2.1 (1.1 – 4.1)
Basic education	4.4 (2.0 – 9.6)	5.4 (2.3 – 12.8)	2.6 (1.2 – 5.6)	1.6 (0.8 – 3.0)
Secondary plus	ref	ref	ref	ref
Income level	No data			
Low income		1.4 (1.1 – 1.9)	2.3 (1.6 – 3.2)	3.2 (2.2 – 4.8)
Average income		1.2 (0.9 – 1.6)	2.3 (1.7 – 3.2)	2.7 (1.8 – 4.1)
High income		ref	ref	ref
Parity				
Nulliparous	ref	ref	ref	ref
Para 1 – 3	1.1 (0.8 – 1.6)	1.5 (1.1 – 2.1)	1.3 (1.0 – 1.7)	1.9 (1.3 – 2.7)
Para ≥ 4	1.3 (0.9 – 1.9)	2.1 (1.3 – 3.2)	2.3 (1.5 – 3.3)	3.6 (2.3 – 5.9)
	Skilled attendance at birth			
Residence				
Urban	ref	ref	ref	ref
Rural	4.9 (3.8 – 6.3)	8.2 (6.4 – 10.6)	4.5 (3.5 – 5.8)	3.0 (2.4 – 3.9)
Highest educational level				
No education				
Basic education	5.3 (3.0 – 9.2)	6.9 (3.8 – 12.5)	6.5 (3.7 – 11.6)	6.1 (3.3 – 11.2)
Secondary plus	2.3 (1.3 – 3.9)	2.2 (1.3 – 4.0)	2.6 (1.5 – 4.5)	3.1 (1.7 – 5.7)
	ref	ref	ref	ref
Income level		No data		
Low income	1.7 (1.3 – 2.2)		1.6 (1.2 – 2.0)	4.3 (3.2 – 6.7)
Average income	1.2 (0.9 – 1.7)		1.1 (0.8 – 1.5)	2.7 (2.0 – 3.5)
High income	Ref		Ref	Ref
Parity				
Nulliparous	Ref	Ref	Ref	Ref
Para 1 – 3	1.6 (1.1 – 2.4)	1.8 (1.3 – 2.5)	1.9 (1.3 – 2.6)	1.8 (1.3 – 2.4)
Para ≥ 4	1.7 (1.0 – 2.8)	2.0 (1.3 – 3.1)	3.6 (2.2 – 5.3)	2.6 (1.8 – 3.8)

*Mutually adjusted for one another, age, and marital status

Table 9. Logistic regression-based Attributable Fraction, Stratum-specific Total Attributable Fraction, and overall Total Attributable Fraction for women not attending any antenatal visit, insufficient antenatal visit (< 4 visits) and lacking of skilled birth attendance in each stratum in 5 years intervals, 1988 to 2008

No antenatal care visit					
	1988 AF (sTAF)	1993 AF (sTAF)	1998 AF (sTAF)	2003 AF (sTAF)	2008 AF (sTAF)
Residence*					
Urban		ref	ref	ref	ref
Rural		0.73 (0.68)	0.52 (0.47)	0.62 (0.59)	0.44 (0.39)
TAF		0.68	0.47	0.59	0.39
Highest educational level*					
No education		0.94 (0.68)	0.92 (0.70)	–	0.29 (0.15)
Basic education		0.76 (0.20)	0.77 (0.18)		0.17 (0.08)
Secondary plus		ref	ref		ref
TAF		0.88	0.88		0.23
Income level*					
Low income		No data	0.09 (0.05)	0.67 (0.56)	0.71 (0.56)
Average income			–	0.47 (0.06)	0.55 (0.07)
High income			ref	ref	ref
TAF			0.05	0.62	0.63
Parity					
Nulliparous*		ref	ref	ref	ref
Para 1 – 3		0.38 (0.19)	0.23 (0.10)	0.17 (0.07)	0.76 (0.36)
Para ≥ 4		0.38 (0.14)	0.38 (0.16)	0.56 (0.27)	0.88 (0.39)
TAF		0.33	0.26	0.34	0.75
Less than four antenatal visits					
	1988 AF (sTAF)	1993 AF (sTAF)	1998 AF (sTAF)	2003 AF (sTAF)	2008 AF (sTAF)
Residence*					
Urban		ref	ref	ref	ref
Rural		0.71 (0.62)	0.57 (0.50)	0.58 (0.52)	0.33 (0.28)
TAF		0.62	0.50	0.52	0.28
Highest educational level*					
No education		0.90 (0.50)	0.89 (0.52)	0.77 (0.47)	0.52 (0.26)
Basic education		0.77 (0.34)	0.82 (0.33)	0.62 (0.23)	0.38 (0.18)
Secondary plus		ref	ref	ref	ref
TAF		0.84	0.85	0.70	0.44
Income level*					
Low income		No data	0.29 (0.16)	0.57 (0.40)	0.69 (0.51)
Average income			0.16 (0.04)	0.57 (0.11)	0.63 (0.11)

High income			ref	ref	ref
TAF			0.20	0.51	0.62
Parity					
Nulliparous*		ref	ref	ref	ref
Para 1 – 3		0.09 (0.04)	0.33 (0.15)	0.23 (0.10)	0.47 (0.22)
Para ≥ 4		0.23 (0.08)	0.52 (0.20)	0.57 (0.23)	0.72 (0.26)
TAF		0.12	0.35	0.33	0.48
Lacked skilled attendance at birth					
	1988	1993	1998	2003	2008
	AF (sTAF)	AF (sTAF)	AF (sTAF)	AF (sTAF)	AF (sTAF)
Residence*					
Urban	ref	ref	ref	ref	ref
Rural	0.80 (0.69)	0.88 (0.80)	0.78 (0.71)	0.66 (0.59)	0.58 (0.50)
TAF	0.69	0.80	0.71	0.59	0.50
Highest educational level*					
No education	0.80 (0.44)	0.86 (0.47)	0.85 (0.51)	0.85 (0.50)	0.73 (0.38)
Basic education	0.57 (0.24)	0.55 (0.24)	0.62 (0.24)	0.68 (0.26)	0.47 (0.22)
Secondary plus	ref	ref	ref	ref	ref
TAF	0.68	0.71	0.75	0.76	0.60
Income level*		No data			
Low income	0.41 (0.20)		0.41 (0.20)	0.77 (0.57)	0.77 (0.59)
Average income	0.23 (0.04)		0.09 (0.02)	0.63 (0.11)	0.52 (0.07)
High income	ref		ref	ref	ref
TAF	0.24		0.22	0.68	0.66
Parity					
Nulliparous*	ref	ref	ref	ref	ref
Para 1 – 3	0.38 (0.17)	0.44 (0.22)	0.47 (0.21)	0.44 (0.20)	0.44 (0.16)
Para ≥ 4	0.41 (0.16)	0.50 (0.17)	0.72 (0.28)	0.62 (0.24)	0.62 (0.20)
TAF	0.33	0.39	0.49	0.44	0.36

*Mutually adjusted for one another, age, and marital status AF Attributable Fraction
sTAF Stratum-specific Total Attributable Fraction
TAF Total Attributable Fraction

Summary results for Studies III and IV

There still exist education- and income-related inequalities in modern contraceptive use, fertility rate, SBA, and ANC utilization. With regard to modern contraception and fertility, the education-related inequalities are very pronounced (Figs. 7 and 8) whereas in the case of ANC (Fig. 9) and skilled birth attendance utilization (Fig. 10), income inequalities are the most prominent.

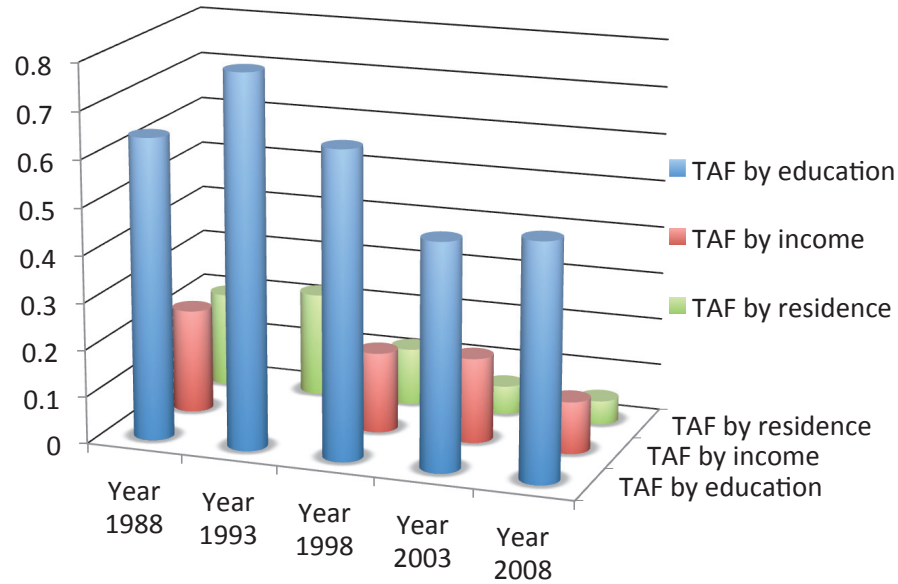

Figure 7. Inequality in non-use of modern contraceptives by education, income, and residence in Ghana, 1988 to 2008 [TAF = Total Attributable Fraction]

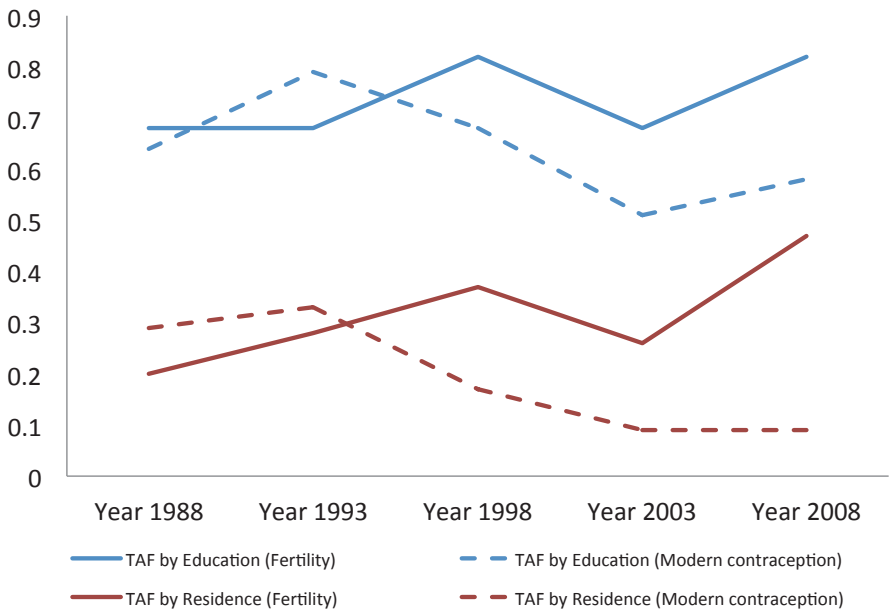

Figure 8. Inequality trends in non-use of modern contraception and fertility rate in Ghana, 1988 to 2008 [TAF = Total Attributable Fraction]

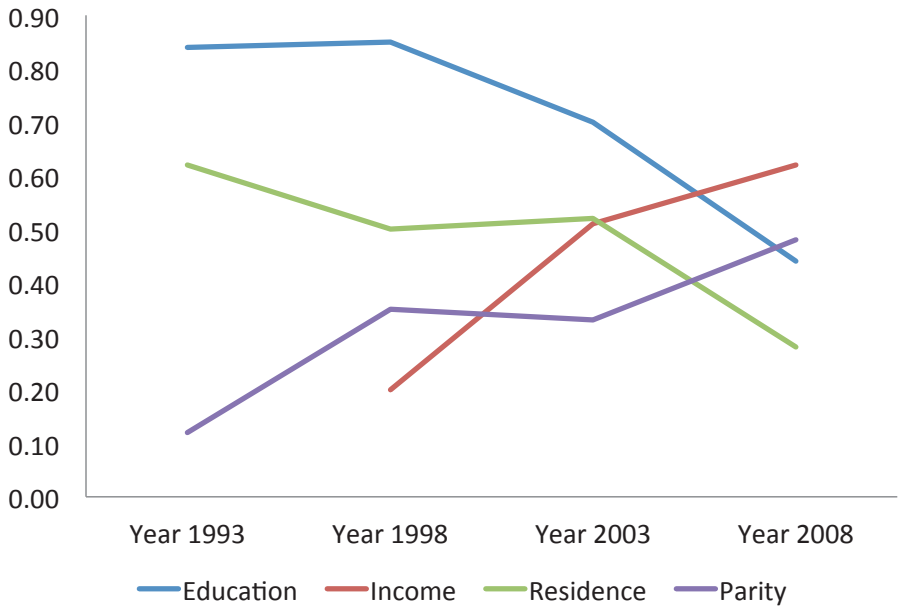

Figure 9. Inequality trends in attending at least four antenatal care visits in Ghana, 1993 to 2008 [TAF = Total Attributable Fraction]

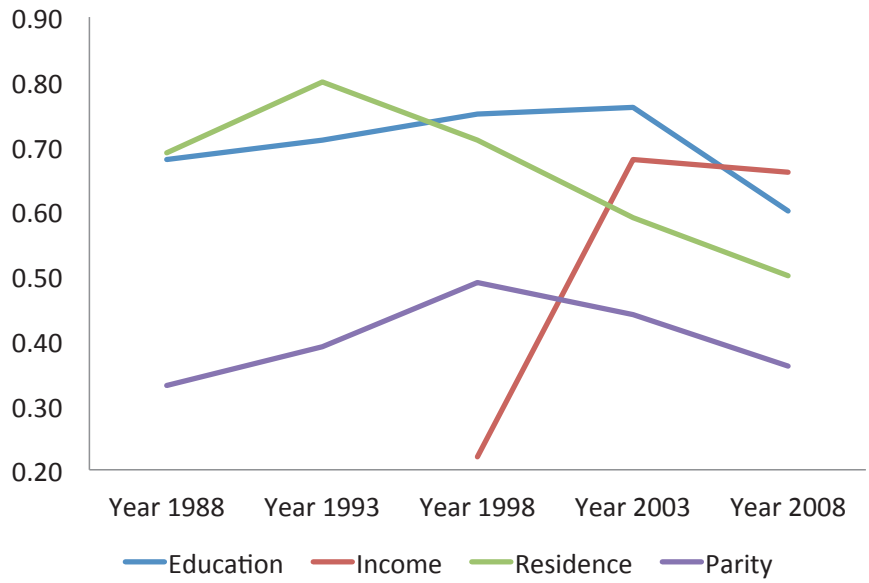

Figure 10. Inequality trends in utilization of skilled birth attendance in Ghana, 1988 to 2008 [TAF = Total Attributable Fraction]

Discussion

The findings of this thesis suggest that a high income is becoming increasingly necessary in order for women to utilize maternal health services in Ghana. The results also indicate that the risk of dying from a particular cause of maternal mortality differs across socio-demographic groups.

The high risk group for deaths due to obstetric haemorrhage were older and married women between the ages of 35 to 39, whereas the high risk group for deaths due to unsafe abortions were single women below 25 years of age. Consumption of alcohol was also found to be associated with deaths due to induced abortion. Being a young woman and having less than secondary level education was identified as a possible risk factor underlying alcohol consumption patterns. Both income and education-related inequality in modern contraceptive use show a declining trend, yet education-related inequality for the same outcome remains very high. Also, both income- and education-related inequality in fertility rates are increasing. While the latter is very pronounced, income-related inequalities in fertility also seem to be worsening at a rapid rate. This suggests that fertility rates in Ghanaian women are shifting from being more dependent on educational status to being predictable by the income level of women. Having access to effective modern contraception is becoming the privilege of high-income women in Ghana. Education-related inequalities in the use of ANC and SBA also seem to be declining while income-related inequality in ANC and SBA utilization has sharply risen. Meanwhile, the rate of decrease in education-related inequality in ANC utilization is disproportional to the declining trend in education-related inequality in SBA use.

Many interacting factors play a role in how women use maternal health services in Ghana and their maternal health outcomes (Figs. 1 and 2). Policy, social, health services, and individual factors play a major role in the high maternal mortality resulting from unsafe abortions in the country. As our results indicate, young unmarried women below age 25 are more vulnerable to succumb to induced abortions as a result of unwanted pregnancies. Deaths from induced abortions have also been correlated with alcohol consumption among a) younger women, especially those age 18 and younger, and b) women with low levels of education (i.e., less than secondary school).

We have identified four major policies in Ghana that play a role in unsafe abortion-related deaths, namely, the abortion law, family planning policy, education policy, and alcohol policy. In Ghana, abortion is legally permissible if conducted by a registered medical practitioner or a specialist gynaecologist in registered premises under the following conditions: 1) if pregnancy results from rape, 2) if pregnancy poses a risk to the life of the woman or her physical or mental health, and 3) if there is a substantial risk that the child will suffer from developmental abnormalities [108]. Even if the laws of Ghana permit abortion under certain circumstances, there are no concrete definitions of risk outlined in the country's criminal code [109]. Therefore, health practitioners [110-112] and the Ghanaian community interpret this law as abortion being simply illegal in Ghana [113]. This interpretation has not led to behavioural change in the Ghanaian community, but it has resulted in abortions being conducted in secrecy, under generally unsafe conditions, by unqualified practitioners. This is because abortion is highly stigmatized in Ghana [112, 114, 115] and those involved in such acts take action to leave no trace of their activities for the public to notice [115]. The revision of the abortion law in Ghana may be one option for preventing some unsafe abortions, but for effective interventions to take place, one must examine the crucial factors that play a role between having unprotected sexual intercourse and seeking induced abortion. A growing biosocial gap (early onset of menarche and late marriages) vs. increasing levels of sexual activity make the adolescent youth more susceptible to unwanted pregnancies. This calls for increased understanding of effective contraception to prevent unwanted or mistimed pregnancies. Other social factors such as a negative attitude toward contraception and the low uptake of effective modern contraception works against preventing unplanned pregnancies [116]. Moreover, in the young population, pregnancies are usually detected late, further increasing the chances of dying from complications of an unsafe abortion.

Alcohol consumption among young women, particularly teenagers [117], has also been found to play a role in unsafe abortions, mainly by enabling risky sexual behaviors that may result in unwanted pregnancies [118, 119]. Several other studies have found alcohol consumption to be an important lifestyle predictor of induced abortions both on the individual [117, 120-122] and group levels [123, 124]. One possible pathway that mediates this association is through impaired judgment caused by alcohol consumption that may lead to sexual intercourse without contraception and, consequently, abortion following an unwanted pregnancy [118, 119]. The impaired judgment caused by alcohol consumption directly affects the decision making power in young women [125]. Moreover, young women in their adolescent years are poorly equipped to bear the responsibilities of an unintended pregnancy and are therefore pressured into seeking abortions [126].

Another pathway through which alcohol may act is the effect of alcohol myopia. Here alcohol consumption leads to sufficient discounting of all future costs to the extent that consequences associated with pregnancy are perceived as negligible [123]. Although Ghana shows an increasing trend in alcohol consumption [127] and risky alcohol use among teenagers has been shown to be very detrimental to their health, there is a general disregard for the regulation of alcohol consumption in Ghana. The lack of strict alcohol policies needs to be addressed in order to prevent young women from exposure to the risk of unsafe abortions resulting from unwanted pregnancies.

Another factor that can successfully help reduce many pregnancy related deaths is to confront implementation challenges in the Ghana family planning policy, specifically, making sure effective modern contraception is easily accessible across all socio-economic strata. Policy makers need to be aware of the inequalities that characterize deaths due to induced abortion, lack of access to effective modern contraception, and fertility services. Although both income- and education-related inequality in modern contraceptive use is declining, that of fertility rate is increasing. Contraception awareness education is needed to improve effective modern contraceptive use in the general population, and close the knowledge gap between women with low levels of education and those with higher education regarding what effective modern contraception is. Costs associated with effective long-term modern contraception should be reduced to increase uptake among less-educated and low-income women.

Modern contraception clearly has a role in fertility control [128, 129]; inequality also plays a part in this association [85]. Our findings show that although less educated women increased their use of modern contraceptives over time, that did not result in fertility decline. Possible reasons for this include using modern contraceptives for spacing rather than limiting childbirth [78] and a high fertility preference among less educated women. There is also the possibility that less educated women lack access to information to prevent high-risk births in the case of unwanted fertility. Also, effectiveness of the method is another probable factor. Women with higher education may choose more effective hormonal/long-term strategies whereas less educated women may use more well known/less effective approaches like pills or condoms, both of which are classified as modern methods. Thus, reducing inequality in the use of modern contraception does not automatically reduce inequality in fertility rates contrary to what Gillespie and colleagues have suggested [78]. Instead, if the gap between using effective long-term modern contraception and more well known/less effective short-term contraception is bridged, equality in modern contraceptive use could translate into equality in fertility rates.

The next critical stage for improving maternal health outcomes and preventing maternal morbidities and mortalities is how women are cared for when they have accepted their state of pregnancy and express their willingness to carry the pregnancy to term and deliver safely. In this regard, WHO recommends focused ANC consisting of at least four visits and delivery with an SBA [40, 41]. ANC and SBA utilization are considered the least equitable maternal health services [39]. We found that education- and residence-related inequalities in ANC and SBA utilization have been decreasing over time, while income-related inequalities are sharply rising. Within education and residence strata, increased utilization of ANC over the 20-year period studied was mostly attributed to women with rural residency and low educational status (i.e. having no or only a minimum level), but for income strata, increased use of ANC was seen solely among high-income women. However, the growing use of ANC seen in low socio-economic groups was not reflected in their engaging an SBA during childbirth. Similarly, parity-related inequality in ANC and SBA utilization was seen to be increasing over time.

In terms of ANC and SBA utilization, the factors mentioned in Figure 1 (health services, policy, social, and individual) play very important roles. The rapidly growing income-related inequality in ANC and SBA utilization threatens the entire health care system in Ghana, especially in an era when governmental efforts and policies are trying to eliminate financial barriers to accessing maternal health care services [130].

Income-related inequalities in ANC and SBA utilization in Ghana were minimal more than two decades ago, unlike in other sub-Saharan African countries where income inequalities have persisted over several decades [131]. In Ghana, until 2003, low education and rural residence status almost solely contributed to non-use of ANC and SBA. This implies that although current policies targeting women's utilization of health services are in principle pro-poor, in practice they have failed to reach the poor [132], but are enabling the rich to increase their utilization of those services, to the detriment of poor women [133]. In reference to Figure 1, this is not only a policy issue: health services and societal factors play a role in blocking poor women from using maternal health services. In 2005, exemptions for delivery care were introduced nationwide as an extension of a 2003 policy that was tested in four regions in Ghana. Later in 2008, free coverage was given to all pregnant women under the National Health Insurance Scheme, which had begun in 2005 and overruled the previous exemption policy. The latter had aimed to reduce financial barriers to accessing maternal health services and hence reduce maternal mortalities [134, 135]; however, implementation challenges have hindered the realization of this goal [133, 136-138]. The free maternal health care policy lacks a clear source of funding [137, 139], relying on health care institutions to adjust for income inequalities in the use of maternal health services.

The lack of funds means that pregnant women who access free maternal care put pressure on existing resources within health care institutions, forcing them to improvise other means of financing [140] by charging fees to women. This is done by charging for medications that are not on the National Health Insurance Scheme approved drug list, collecting ward fees and toiletries. In certain instances, women who seek care under the "free" maternal health care policy are discriminated against because they do not bring any direct payments [141]. Although the plan is supposed to include all maternal and incidental causes, the package of care is interpreted differently by local health care institutions, resulting in pregnant women paying for services they ought to have received for free [133].

There are other factors on the provider side that tend to escalate the cost of maternal health services utilization for poor women, such as unavailability of critical equipment and drugs at the point of need, unavailability of skilled staff, and the poor attitude of providers [133, 142, 143], especially towards women who cannot afford the informal charges [144, 145]. Societal factors also drive informal payments and aid the rapidly increasing income inequalities in accessing maternal health care. One such factor is the culture of giving gifts to midwives, which come at a substantial cost to poor women [133]. Other indirect financial barriers include transportation costs to and from the health facility [146], and minor personal items required for delivery [133]. Some expectant mothers tend to be excessively delayed during antenatal visits, trading-off economic gains from the informal sector such as farming, petty trading, etc. [142, 145]. These factors adversely affect poor women's utilization of ANC and SBA but also enable high-income women to pay their way through the system, contributing to grossly widening the income inequality gap in maternal health services in Ghana.

Most of the demands made upon women come at a time when they are about to give birth [145]. This is one of the reasons why the increased ANC uptake among low socio-economic status women did not translate into utilization of skilled care during delivery [133]. We found the positive trend in equity related to education more pronounced in ANC utilization than SBA (Figs. 9 and 10), reinforcing the need to remove financial obstacles associated with SBA. Despite the huge potential for education to improve women's utilization of maternal health services [147], too much direct and indirect cost excludes the uptake of these services by some women who, although educated, lack financial resources [142]. Education improves a woman's ability to evaluate where and when to seek care [148], and makes her aware of health services [149]. Higher education beyond the basic level empowers women to broaden their social network within the health care system, positions them to approach health care staff on more equal terms (making them less likely to fear possible reprimands), and makes them cognizant of private health facilities [150]. This may explain the educational gradient seen in Table 8.

Parity-related inequality in ANC and SBA utilization appears to be increasing over time, similar to the trend seen in income inequalities. This is due to reduced utilization of these services by multiparous women and increased uptake by nulliparous women. Although individual [150], sociocultural [150-153] and health services factors [142] play a role in the differences between utilization of maternal health services by nulliparous and multiparous women, financial barriers [150, 152, 154] could also explain the persistent, widening gap between parity groups.

Methodological considerations

Strengths and limitations

Data representation and generalizability

This thesis comprises studies based on nationally representative data, which makes the results generalizable and applicable to nationwide interventions and policy options. The 2007 GMHS used for Studies I and II remains the only national survey that has extensively enquired into maternal deaths among women residing in Ghana. To the best of our knowledge, Study II is the only one of its kind in Ghana and one of the few worldwide that has analysed alcohol consumption patterns and deaths due to induced abortion. The broad data on maternal and reproductive health collected over the 20 year period enabled the analysis of different dimensions and trends of inequality related to maternal health over time. The level of participation was generally very high: the response rate for the verbal autopsy questionnaire was 70%, whereas the response to the Women's Questionnaire used in the 1988 to 2008 GDHS ranged from 96% to 99% over the study period. For questions related to ANC, responses varied from 95.6% to 98% and that of SBA ranged from 99.6% to 99.8%.

Verbal autopsies

A potential limitation of this thesis is the use of verbal autopsies to collect data on maternal mortalities. Verbal autopsy requires skilled personnel to collect data on the field, assess the cause of death, code the data, and analyse it. Also, when using verbal autopsy, there is the possibility of misclassification of causes of deaths due to a lack of strict record keeping and the absence of a detailed description of events leading up to the death in question. In addition, not all the causes listed on medical certificates can be captured [155]. Different steps that were taken to reduce such misclassification were: using a competent expert group to carry out the verbal autopsies, classifying causes of death by means of sensitive and specific ICD codes, and wherever possible cross-validating the cause of death determined

with that recorded on hospital cards, antenatal cards, maternity cards, burial certificates, and other records. The employment of verbal autopsies has been validated as a useful tool for capturing cause of maternal deaths in Ghana [156].

Non-response due to stigma

Of the 5931 female deaths identified during the first stage of the 2007 GMHS, verbal autopsy questionnaires were successfully completed by 4203 (70%). The high level of stigma attached to deaths from induced abortion and alcohol consumption, especially among young women, limits the reporting of such events by family members of the deceased. It is plausible that certain non-responses may be related to deaths from induced abortion or alcohol consumption. The fact that occasional alcohol consumption appeared in our findings to be at least as risky as frequent consumption may attest to the higher possibility of non-participation or misclassification of frequent consumers of alcohol with abortion-related deaths as compared to other types of maternal deaths.

Deceased controls

The use of deceased controls in Study II is another possible limitation. People who die may carry higher loads of most risk factors irrespective of the cause compared to the general population. The most probable effect of using deceased controls is that it may underestimate the impact of alcohol on the full population of pregnant women.

Recall bias

There was a potential for recall bias in reporting previous experiences of giving birth. The latest birth experiences were used in our analysis to limit this bias.

Fertility rate among women of low socio-economic status

Our study of inequality in fertility rates contained the possibility of underestimating fertility rates among women of low socio-economic status, since they have a higher rate of maternal mortality. Since women who died before the survey were excluded by the design of our study, the results may bias a true situation of higher fertility rates among lower socio-economic status women toward the null. This could mean that the true measure of inequality in fertility rate may have been underestimated. On the other hand, this would not have any gross effect on our findings in aggregate, since it is a trend analysis and the impact of change overtime is minimal. Also, this effect, if present, would be very low, since the lifetime risk of maternal deaths in Ghana is approximately 1.5%. Moreover, infant and under-5 mortality among low socio-economic status women is considerably higher, so any underestimation of the fertility rate in this subgroup because of the above has been eliminated by defining fertility not by the number

of living children a woman had at the time of the survey, but how many children she had ever born.

Income data

In Studies III and IV, there were high numbers of missing data on income in 1988 and 1998, and no income data in 1993. This could have potentially affected the income-related inequality estimations for 1988 and 1998 and also made it impossible to estimate income-related inequalities for 1993. However, comparing the income distribution for 1988, 1998, 2003, and 2008 suggests that there is a fair representation of women across different income strata. Therefore, the overall effect of the missing data on income-related inequality estimates should be minimal. Another limitation related to income was the difficulty of measuring income levels for low-income women whose economic earnings are mostly from selling food or other items, or from small-scale farming.

Residence-related inequality

The declining trend in rural/urban gap in the use of maternal health services may partly be attributed to changes in infrastructure and improved access to maternal health care services. The Community-based Health Planning and Services (CHPS) may be one such contributing factor [157-159]. It is a national health policy initiative adopted in 1999 that aims to reduce geographical barriers making access to health care difficult in Ghana by mainly focusing on deprived rural districts in remote areas . The CHPS strategy aims to transform the primary health care system in Ghana by establishing mobile community-based health care services provided by a resident nurse in deprived settings, contrary to traditional facility-based services [160]. However, issues related to how rural and urban settings are defined in Ghana need to be resolved. Urban areas are mainly defined in Ghana by population size [161]. Over the years, some rural areas have been reclassified as urban, although they still bear the unfavourable characteristics of rural areas, including poor infrastructure, inadequate transportation, low literacy levels, and low social status, among others. Also the growing migration of people from rural areas into the cities has created a subset of the urban population who live in slums where infrastructure and lifestyle factors are generally comparable to or worse than the places they left [89]. These factors may have confounded the true measure of inequality related to the health of the rural/urban population over time.

Implications for future research

This thesis has highlighted different dimensions of inequalities in maternal health in Ghana. However, in examining modern contraception, we did not differentiate between types of modern contraception, which may have helped to explain the discrepancy found in modern contraceptive use and fertility trends. Also, there was no data on the composition and quality of ANC being provided to women that might have given a more informed idea of the adequacy of care. The association between alcohol consumption and unwanted pregnancies or unsafe abortions among young women, and the role of social capital and social network upon the above association would be other areas into which this inquiry could be extended.

Conclusions and recommendations

Our findings indicate that inequalities in maternal health persist in Ghana and the trend is divergent. Education-related inequality in fertility and modern contraceptive use are currently more pronounced, whereas income-related inequalities are more pronounced in the case of maternal health care services such as ANC and SBA utilization. Income inequalities in fertility rates, ANC and SBA utilization are sharply rising as the government tries to remove financial barriers to accessing maternal health services.

In the last two decades educational differences alone accounted almost entirely for the inequality in the use of maternal health services and the subsequent outcomes. Recent trends however, show a shift from education-dependent inequality to more income-dependent inequality in maternal and reproductive health in Ghana. However, there still exist education- and income-related inequalities in modern contraceptive use, fertility rates, ANC and SBA utilization. We recommend that policy actions aimed at reducing inequality in maternal health in Ghana target both education- and income-related inequalities simultaneously. To do this effectively, we suggest the following: 1) address financial loopholes in Ghana's free maternal health care policy to eliminate all financial barriers, direct and indirect, that hinder the use of maternal health care services; 2) make sex education and family planning an essential component of basic education, so that women who do not go beyond that level are protected against adverse maternal health consequences; 3) Support informal education through popular mass media such as radio and television in order that women who lack formal education or those no longer in school can benefit from on-going interventions; and 4) provide youth-friendly services to make available modern methods of contraception that have been shown to decrease unwanted pregnancies and reduce deaths due to unsafe abortions, thereby ensuring that the most vulnerable population for unsafe abortions, young women ages 18 and younger, may be reached.

We also recommend that health workers at different levels in the health care system keep comprehensive records on the causes of maternal mortality previously labelled miscellaneous. Such records can include socio-demographic characteristics of patients who die from complications of anaesthesia, obstetric surgery, embolism, and uterine rupture. Inadequate documentation of these causes

of death, especially in most district hospitals, makes it difficult to investigate the root causes of such mortality.

Summary in Swedish

Avhandlingen utgår från förhållandet att mödradödligheten traditionellt varit en tungt vägande faktor för kvinnors totala sjukdomsbörda i låginkomstländer. Mödradödligheten är starkt knuten till såväl allmänna levnadsförhållanden i samhället som till tillgång och kvalitet av professionell hälsovård. Det är därför inte förvånande att mer än 99 av 100 mödradödsfall i världen sker i resursfattiga länder vilket gör detta till ett av de mest ojämlikt fördelade hälsoutfallen i ett globalt perspektiv.

Allmänt förbättrade levnadsvillkor i låginkomstländerna i världen har på ett mycket tydligt sätt förbättrat hälsan i dessa länders befolkningar under de senaste 50 åren och mödrahälsan utgör inget undantag, men den har inte förbättrats i samma takt som andra hälsomått i många av dessa länder. Detta har tolkats som att mödrahälsan till större del än många andra hälsotillstånd kräver relativt komplexa insatser från hälso- och sjukvårdssystemet. Ett annat mönster i dessa länder är indikationer på en ökande ojämlikhet i hälsa mellan olika grupper i befolkningen, vilket kan bidra till en långsammare genomsnittlig förbättring än vad man annars skulle förvänta sig av den allmänna utvecklingen. Detta förhållande mellan hälsans ojämlikhet och den allmänna hälsoutvecklingen har lett till att insatser mot hälsans ojämlikhet lyfts fram som ett av de viktigaste målen för den globala folkhälsopolitiken.

Eftersom mödrahälsa verkar vara mer beroende av hälso- och sjukvårdssystemets åtgärder än många andra aspekter på hälsa, så är sociala ojämlikheter avseende tillgången till kvalificerad mödrahälsovård av särskilt intresse att studera i de låginkomstländer där man ser en allmänt positiv ekonomisk utveckling. I många länder har denna utveckling parallellt dock medfört en ökande ekonomisk och social ojämlikhet, vilket riskerar att leda till att hela den potentiellt positiva utvecklingen av mödrahälsan inte kan realiseras.

Av denna anledning är det av särskilt strategiskt intresse att studera utvecklingen av tillgång och effekt av mödrahälsovård i ett land som Ghana, som är ett exempel på ett låginkomstland med en mycket gynnsam ekonomisk och allmän utveckling under de senaste årtiondena, och jämföra denna med de hälsopolitiska insatser som gjorts för att stävja en ökande ojämlikhet i tillgången till mödrahälsovård.

Avhandlingen består av fyra delarbeten. Det övergripande syftet är att beskriva utvecklingen av mödrahälsan i Ghana, med ett särskilt fokus på jämlikhet, under perioden 1988–2008 och relatera denna till utvecklingen av mödrahälsovårdssystemet under samma period. Delstudierna I och II är baserade på data från Ghana Maternal Health Survey (GMHS) 2007 och delstudierna III och IV på data från Ghana Demographic and Health Surveys (GDHS) 1988, 1993, 2003, och 2008 som erhållits från Ghana Statistical Service.

I det första delarbetet med titeln Distribution of causes of maternal mortality among different socio-demographic groups in Ghana; a descriptive study är syftet att beskriva och analysera den socioekonomiska fördelningen avseende de fall av mödradödlighet i Ghana insamlad av Ghana Maternal Health Survey 2000 – 2005. Resultaten av analyserna av denna grupp visar att blödningar i samband med förlossningen (en indikator på förlossningsvårdens kvalitet) var den största enskilda orsaken bakom mödradödlighet i den studerade gruppen. Inga statistiskt signifikanta resultat framkom avseende skillnader i risken att drabbas av denna förlossningskomplikation mellan kvinnor som bodde på landsbygden, jämfört med de som bodde i urbana områden, eller mellan kvinnor med olika utbildningsbakgrund. Däremot kunde man konstatera att gifta kvinnor hade en betydligt högre risk för detta jämfört med ogifta kvinnor. Ogifta kvinnor hade å andra sidan en betydligt högre risk att avlida i sviterna efter en abort, jämfört med gifta kvinnor. Studien visade att mödradödlighet hänger samman med sociodemografiska faktorer på ett komplext sätt där sociokulturella faktorer samspelar med mödrahälsovårdens kvalitet.

I det andra det andra delarbetet Alcohol consumption in relation to maternal deaths from induced-abortions in Ghana utvidgas analysen av bakomliggande faktorer till de mödradödsfall som orsakades av abort, i den första delstudien. Fokus sätts på alkoholkonsumtion som en möjlig orsaksfaktor, med tanke på rapporter om en påtagligt stigande alkoholkonsumtion bland unga män och kvinnor i Ghana under den aktuella tidsperioden. Resultatet av analysen stödjer hypotesen om ett samband mellan alkoholkonsumtionsmönster och risken att dö i sviterna av abort bland kvinnorna i studien. De kvinnor i studien som var alkoholkonsumenter hade en drygt fördubblad risk för en mödradöd på grund av genomgången abort, jämfört med kvinnor som inte var alkoholkonsumenter. Studien styrker att många olika detaljer i samspelet mellan olika levnadsförhållanden och interventioner inom mödrahälsovård/reproduktiv hälsa måste kartläggas närmare för att förbättra mödrahälsan i låginkomstländer.

I det tredje delarbetet med titeln Inequality in fertility rate and modern contraceptive use among Ghanaian women from 1988 – 2008 analyseras hur användningen av moderna preventivmedel bland kvinnor i Ghana utvecklats under

en 20-årsperiod. I denna studie användes data från fem undersökningsomgångar av Ghana Demographic and Health Survey under perioden 1988 – 2008.

Resultatet av analyserna visade på flera olika tidstrender av betydelse för användningen av moderna preventivmedel och fertilitet. Under den studerade tidsperioden utjämnades den ojämlikhet som fanns mellan kvinnor på landsbygden jämfört med kvinnor i urbaniserade områden. Däremot kvarstod under hela perioden en ojämlikhet i användandet av moderna preventivmedel avseende utbildningsnivå och hushållsinkomst, d.v.s. användandet var lägre bland kvinnor med låg utbildning eller låg hushållsinkomst. Detta visar att ambitionerna att öka jämlikheten i detta avseende bara lyckats delvis, även i en period med en betydande ekonomisk tillväxt och framgångsrikt genomförande av generella sociala reformer.

I det fjärde delarbetet med titeln The magnitude and trends of inequalities in antenatal care and delivery under skilled care among different socio-demographic groups in Ghana from 1988 to 2008 analyseras hur tillgången till mödrahälsovård och kvalificerad förlossningsvård, med särskilt fokus på jämlikhet, utvecklats i Ghana under perioden 1988 – 2008. Även i denna studie användes data från fem undersökningsomgångar av Ghana Demographic and Health Survey under perioden 1988 – 2008. Avseende tillgång till mödrahälsovård och kvalificerad förlossningsvård, noterades att den initiala ojämlikheten mellan landsbygd och urbana områden i stort sett hade försvunnit. Detta stod i kraftig kontrast till en starkt ökande ojämlikhetstrend när det gäller hushållsinkomst. Studien visade också att ojämlikheten avseende inkomst då det gäller tillgång till mödrahälsovård och kvalificerad förlossningsvård ökade betydligt mer markant än ojämlikhet avseende utbildning, vilket kan tyda på att materiella faktorer spelar en ökande roll för tillgänglighet/utnyttjande av denna typ av hälso- och sjukvårdsutbud, jämfört med kunskaper och attityder som ofta är starkt knutna till individens utbildningsnivå.

Dessa observationer är av betydelse för diskussionen om olika strategier för att göra mödrahälsan bättre och mer jämlik i Ghana.

Policies som strävar efter att minska mödradödligheten i Ghana bör inrikta sig på ojämlikheter beroende på utbildning såväl som på inkomst. För att göra detta så effektivt som möjligt rekommenderas följande: 1) Eliminera finansiella kryphål inom den kostnadsfria mödrahälsovården i Ghana för att avskaffa alla former av ekonomiska hinder, både direkta och indirekta, som försvårar användningen av mödra- hälsovården. 2) Utbildning och information om sexualitet och preventivmetoder bör införas på grundskolenivå, så att kvinnor som endast går ut grundskolan har kunskap om sexuell och reproduktiv hälsa. 3) Staten och andra intressenter bör stödja informell utbildning via massmedia, som exempelvis radio och TV så att kvinnor som saknar formell utbildning kan ta del av pågående

insatser. 4) Utveckla service, rådgivning och tillhandhållandet av preventivmetoder till ungdomar för att förebygga osäkra aborter och oönskade graviditeter hos den mest sårbara gruppen, unga kvinnor under 18 år.

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