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Determinants of maternal health and health-seeking behavior in sub-Saharan Africa:

The role of quality of care

A dissertation submitted in partial satisfaction of the
requirements for the degree Doctor of Philosophy
in Public Health

by

Patience Akelen-era Afulani

2015

ABSTRACT OF THE DISSERTATION

Determinants of maternal health and health-seeking behavior in sub-Saharan Africa:
The role of quality of care

by

Patience Akelen-era Afulani

Doctor of Philosophy in Public Health

University of California, Los Angeles, 2015

Professor Gail G. Harrison, Co-chair

Professor Anne R. Pebley, Co-chair

This dissertation advances understanding of how distal factors affect maternal health and health seeking behavior: by examining the links between place of residence and socioeconomic status (SES); quality of antenatal care (ANC); use of skilled birth attendants; and pregnancy outcomes. The dissertation is motivated by two main questions: Why are deliveries by skilled attendants low in most of sub-Saharan Africa, despite high antenatal attendance? And what accounts for the disparities in use of skilled birth attendants within countries? I hypothesize that differentials in quality of care partly explain the gap between antenatal attendance and use of skilled birth attendants, the rural/urban and SES differentials in the use of skilled birth attendants, as well as differentials in pregnancy outcomes. Data for the analysis are from the Ghana Maternal Health Survey and the World Health Survey for Ghana and Burkina Faso. I

employ multilevel linear and logistic regressions with mediation and moderation analyses to examine the intervening and conditional effects. The first three chapters present the introduction, background, and theory sections respectively; chapter 4 presents an overview of the data, variables, and sample distributions; and chapter 8 is the concluding chapter. The dissertation has three empirical chapters.

In the first empirical chapter (chapter 5), I examine the factors that affect the quality of antenatal care women receive—focusing on place of residence and SES (education and wealth); the interaction between these factors; and the mediating role of ANC timing, frequency, facility and provider. The results show that urban residence and higher SES are positively associated with higher ANC quality, but the urban effect is completely explained by sociodemographic factors. Specifically, about half of the urban effect is explained by education and wealth alone, with other variables accounting for the remainder. The effects of education are conditional on wealth and are strongest for the poorest women. Starting ANC visits early and attending the recommended four visits as well as receiving ANC from a higher-level facility and from a skilled provider, are associated with higher quality ANC. These factors partially explain the SES differentials in quality of ANC.

In the second empirical chapter (chapter 6), I examine the factors that influence the use of skilled birth attendants, focusing on the mediating role of quality of care. The results show that higher quality ANC, frequent ANC visits, and receiving ANC in higher level or private facilities increase the odds of using a skilled birth attendant. As expected urban residence and high SES are also associated with higher use of skilled birth attendants, but the rural/urban and SES differential in use of skilled attendants that is mediated by ANC quality is only marginally significant in most of the models. The rural/urban and SES effects are also not conditional on the

ANC quality. In the third empirical chapter (chapter 7), I examine the factors associated with pregnancy outcomes, focusing on the role of ANC quality. The results show that higher quality ANC decreases the odds of having a stillbirth by almost half, net of other factors including delivery provider and place. The other health service factor associated with lower odds of having a stillbirth in the multivariate analysis is attending at least four antenatal visits.

My findings suggest pregnant women in SSA experience significant disparities in the quality of ANC, with poor illiterate women receiving the worst care. Poor quality ANC is contributing to the low utilization of skilled birth attendants, despite high antenatal attendance, and to poor pregnancy outcomes. The differentials in quality of care are also potentially contributing to the differentials in use of skilled birth attendances by SES and place of residence, but this needs more research. Targeted efforts to increase quality of ANC could significantly improve maternal and fetal outcomes and reduce maternal health disparities in SSA.

The dissertation of Patience Akelen-era Afulani is approved.

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University of California, Los Angeles

2015

DEDICATION

To my children, Roselle and Joel: You walked this journey with me without knowing where I was headed and you gave me something to smile about every day—we accomplished this together. This dissertation is a sign for you that you will accomplish whatever you set your heart on.

TABLE OF CONTENTS

LIST OF TABLES	ix
LIST OF FIGURES	x
LIST OF APPENDICES	x
LIST OF ACRONYMS	xi
ACKNOWLEDGEMENTS	xii
CURRICULUM VITAE	xiv
CHAPTER 1: INTRODUCTION	1
Motivation: maternal and fetal deaths, antenatal care, and delivery care in Ghana	1
Overview of study aims and research questions	6
CHAPTER 2: BACKGROUND	9
Maternal mortality in sub-Sahara Africa in context	9
Recommendations to prevent maternal mortality	10
Literature review of the determinants of use of maternal health services	14
CHAPTER 3: THEORETICAL FRAMEWORK	26
An expanded 3 delays model by Gabrysch and Campbell (2009)	30
McCarthy and Maine’s framework for the determinants of maternal mortality	32
A comparison of the existing models – their strengths and weaknesses	34
CHAPTER 4: OVERVIEW OF DATA, VARIABLES, AND SAMPLE DESCRIPTION	43
The Ghana Maternal health survey (2007)	43
The World Health Survey (2003)	47
CONSTRUCTS AND VARIABLES	48
Operationalizing and measuring quality of maternal health (MH) care	49
Use of a skilled birth attendant	60
Socioeconomic status and Place of residence	61
Other variables	64
GENERAL ANALYTIC APPROACH	67
SAMPLE DESCRIPTION	68
Ghana Maternal Health Survey sample	68
World Health survey sample	75
CHAPTER 5: AIM 1	78
INTRODUCTION	78
METHODS	80
RESULTS	88
DISCUSSION	105
CHAPTER 6: AIM 2	120
INTRODUCTION	120
METHODS	122
RESULTS	128
DISCUSSION	145

CHAPTER 7: AIM 3	165
INTRODUCTION	165
RESULTS	174
DISCUSSION	185
CHAPTER 8: LIMITATIONS, STRENGTHS, IMPLICATIONS, RECOMMENDATIONS, & CONCLUSIONS.....	203
LIMITATIONS AND STRENGTHS	203
IMPLICATIONS AND RECOMMENDATIONS	207
CONCLUSIONS.....	212
TABLES AND FIGURES	214
APPENDICES	285
REFERENCES	332

LIST OF TABLES

Table 4G1: Sample Distribution, Ghana Maternal Health Survey (GMHS), 2003	218
Table 4W1: Sample Distribution, World Health Survey (2003), N=2,005	223
Table 5G1: Mean ANC quality of care for each group for women who attended at least one ANC, GMHS, N = 4,868	227
Table 5G2A: Random effects from multilevel linear regression of quality of antenatal care on education, place of residence and relevant confounders, GMHS, N=4,868	230
Table 5G2B: Multilevel linear regression of quality of antenatal care on place of residence, socioeconomic factors, and rival independent and control variables. GMHS, N=4,868	231
Table 5G3A: Random effect results from Multilevel Logistic Regression of Quality of Antenatal care (ANC) on Place of residence, Education and relevant confounders, GMHS, N=4,868	235
Table 5G3B: Multilevel Logistic Regression of Quality of Antenatal care (ANC) on Education, Place of residence and relevant confounders, GMHS, N=4,868	236
Table 5W1: Number and proportion in each group who received all 3 recommended services for women who had at least one ANC, WHS, N=1,621	238
Table 5W2A: Random effect results from Multilevel Binary Logistic Regression of Quality of Antenatal care (ANC) on Place of residence, Education and relevant confounders, WHS, N=1,671	240
Table 5W2B: Multilevel binary logistic regression of Quality of Antenatal care (ANC) on Place of residence, Education and relevant confounders, WHS, N=1,671	241
Table 6G1: Bivariate analysis: Proportion of women assisted a Skilled birth attendant, GMHS	245
Table 6G2: Multilevel Logistic Regression of use of SBAs on quality of ANC, Place of residence, SES and relevant confounders, GMHS, N=4,868	249
Table 6G3: Multilevel Logistic Regression of Quality of Antenatal care (ANC) on Education, Place of residence and relevant confounders, GMHS, N=4,868	251
Table 6G4.1: Multilevel Logistic Regression of use of SBAs and quality of ANC on Place of residence, SES and relevant confounders, GMHS.....	253
Table 6G4.2: Mediation analysis	254
Table 6G5: Weighted Single Level Logistic Regression of use of SBAs and quality of ANC on relevant predictors, GMHS, N=4,868	256
Table 6G6: Multilevel Logistic Regression of Health facility delivery on quality of ANC, Place of residence, SES and relevant confounders, GMHS	259
Table 6W1: Bivariate analysis: proportion of women assisted by a SBA for each, WHS, (2003), N=1,671	262
Table 6W2: Multilevel binary logistic regression of use of SBAs on Quality of ANC, Place of residence, Education and relevant confounders, WHS, N=1,671	264
Table 6W3: Multilevel binary logistic regression of Quality of Antenatal care (ANC) on Place of residence, Education and relevant confounders, WHS, N=1,671	266
Table 6W4.1: Binary logistic regression of Use of skilled birth attendants and quality of ANC on Place of residence, Education and relevant confounders, WHS, N=1,671	268
Table 6W4.2: Mediation analysis	269
Table 6W5: Logistic regression of health facility delivery on quality of ANC, Place of residence, Education and relevant confounders, WHS,	270

Table 7G1: Distribution of variables related to delivery, Ghana Maternal Health Survey, 2007	272
Table 7G2 : Proportion with a stillbirth for each predictor, GMHS	274
Table 7G3: Multilevel Bivariate regression of Pregnancy outcome on quality of Antenatal Care and relevant confounders, GMHS,.....	280
Table 7G4: Multilevel regression of Pregnancy outcome on quality of Antenatal Care and relevant confounders, GMHS, N=4868	283
Table 7G5: Average treatment effects (ATE) of quality of ANC (8/9 vs ≤ 7 services) on pregnancy outcome (stillbirth vs. life birth) for women attended ANC at least once during their last pregnancy, GMHS, N=4868.....	284

LIST OF FIGURES

Fig1: Conceptual model	214
Fig4G1: Flow chart for deriving analytic sample for GMHS.....	216
Fig4W1A: Flow chart for deriving analytic sample for pooled WHS sample	217
Fig4W1B: Flow chart for deriving analytic sample for WHS by country.....	217
Fig 5G1: Predicted quality of ANC by education and wealth	235
Fig 5W1A: ANC quality of care by country and rural/urban residence.....	242
Fig 5W1B: ANC quality of care by country and education.....	242
Figure 6.1: Illustrating approach to mediation analysis.....	243
Figure 6.2: Simplified conceptual model showing mediated pathways for the association between place of residence and use of skilled birth attendants.....	244

LIST OF APPENDICES

Appendix 1A: Definitions related to maternal death (ICD-10)	285
Appendix 1B: Definitions related to skilled attendance	287
Appendix 1C: Definitions for emergency obstetric care facilities.....	288
Appendix 3A: Thaddeus and Maine’s three delays model	291
Appendix 3B: Gabrysch and Campbell’s expansion of the three delays models	295
Appendix 3C: McCarthy and Maine’s framework	296
Appendix 4G1: Bivariate associations: Independent variables by Antenatal attendance, GMHS, N=5,042	299
Appendix 4G2: Crosstabs by place of residence, education and wealth, GMHS, N = 5,042.....	302
Appendix 4G3: Multilevel Logistic Regression of Antenatal attendance on relevant predictors , Ghana Maternal Health Survey, N=5,042.....	307
Appendix 5G1A: Questions for variables used to create ANC quality of care index, GMHS,..	308
Appendix 5G1B: Distribution of individual variables used to create ANC quality of care index, GMHS, N=4,868 ^a	309
Appendix 5G2: Distribution of Quality of ANC variable	311
Appendix 5G3: Weighted Linear Regression of Quality of Antenatal care (ANC) on Education, Place of residence and relevant confounders, GMHS, N=4,868	312

Appendix 5G4: Comparing fixed effects from the multilevel linear regression of Antenatal care (ANC) measure obtained from the summative index and from principal component analysis (PCA), Ghana Maternal Health Survey, N=4,868	315
Appendix 5W1: Distribution of individual variables used to create ANC quality of care index, World Health survey (N=1,671) ^a	318
Appendix 5W2: Multilevel binary logistic regression of Quality of Antenatal care (ANC) on Place of residence, Education and relevant confounders, Stratified by country, WHS	319
Appendix 6G1: Multilevel Logistic Regression of use of SBAs on quality of ANC, Place of residence, SES and relevant confounders for full sample, GMHS, N=5,042	320
Appendix 6G2: Weighted logistic regression of health facility delivery on quality of ANC, Place of residence, SES and relevant confounders, GMHS	322
Appendix 6W1: Logistic regression of use of SBAs on quality of ANC, Place of residence, Education and relevant confounders for full sample, WHS, N=2,005	325
Appendix 7G1: Final models from multivariate regression of Pregnancy outcome on quality of Antenatal Care and relevant confounders, GMHS,	327
Appendix 7G2: Full models from multivariate regression of Pregnancy outcome on quality of Antenatal Care and relevant confounders, GMHS,	329

LIST OF ACRONYMS

ANC – Antenatal Care
DHS – Demographic and Health Survey
GMHS – Ghana Maternal Health Survey
MH – Maternal Health
SBA – Skilled Birth Attendant
SES – Socioeconomic status
WHO – World Health Organization
WHS – World Health Survey

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HONORS AND AWARDS

2014 Delta Omega poster competition award, American Public Health Association conference
2011 Nominee, Teaching Assistant of the year, UCLA Public Health Students Association
2007 Best student in Gynecology; Best student in Clinical Obstetrics and Gynecology; & Best
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2003 Best female student in University of Ghana, University of Ghana Women’s Commission
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1995 Head of State award for best student in the Basic Education Certificate Examination,
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- 2012 Guest lecturer for the following courses in the UCLA Fielding School of Public Health
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 - Maternal and Child Health in developing countries, MPH students interested in Global Health in winter quarter of 2012
- 2010-2012 Teaching Assistant for the following core courses for masters students in the department of Community Health Sciences (CHS), UCLA Fielding School of Public Health
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- *Project*: Food Insecurity, Health and Disability in the National Health Interview Survey. *Role*: Data analysis and development of manuscripts for publication
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 - *Project*: WIC Infant and Toddler Feeding Study. *Role*: Literature review and writing of technical papers
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- *Role*: Conducted a preconception needs assessment for integration of preconception health education into existing services, and developed preconception health education materials for use at WIC sites
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- 2007-2009 House Officer. Eastern Regional Hospital, Koforidua. Ghana Health Service
- *Role*: Provision of emergency, outpatient, and inpatient care to patients. Completed training on management HIV/AIDS and was involved in the comprehensive management of HIV patients. Completed rotations in Internal Medicine, Surgery, Pediatrics, Obstetrics and Gynecology, to become a Medical officer
- 2003-2006 Health Outreach Organizer and Health Educator. Federation of Ghana Catholic Health Trainees and University of Ghana Medical Students Association
- *Role*: Organized and participated in outreach programs to various communities and churches in Ghana to provide health services, and education on a broad range of issues including HIV/AIDS, tuberculosis, malaria, hepatitis B virus infection, diabetes, hypertension, sickle cell disease, adolescent reproductive health, and maternal and child health
- 2003 Health surveillance participant. World Health Organization/ Ghana Health Service/ University of Ghana Medical Students Association collaboration
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PEER REVIEWED PUBLICATIONS

Afulani Patience A., Asunka Joseph. "Socialization, adaptation, transnationalism, and the reproductive behavior of sub-Saharan African migrants in France." *Population Research and Policy Review*, DOI: 10.1007/s11113-015-9360-2 (Forthcoming 2015)

Herman Dena R., **Afulani Patience A.**, Coleman-Jensen Alisha, Harrison Gail. "Food insecurity and cost-related medication underuse among non-elderly adults in a nationally representative sample." *American Journal of Public Health* (Forthcoming 2015)

Afulani Patience A. Rural/urban and socioeconomic differentials in quality of antenatal care in Ghana. *PloS One*. 2015;10(2):e0117996.

Afulani Patience A. Deconstructing rural/urban and socioeconomic differentials in quality of antenatal care in Ghana. *Ann Glob Health* 2015;81(1):106 (supplement for abstracts of the consortium of Universities for Global Health Annual Conference, Boston MA, March 2015)

Afulani Patience A., Awoonor-Williams John K., Opoku Ernest C., and Asunka Joseph. "Using community health workers in community-based growth promotion: what stakeholders think." *Health Educ. Res.* (2012) 27 (6): 1005-1017

PAPERS UNDER REVIEW

Afulani Patience A., Herman Dena R., Coleman-Jensen Alisha, Harrison Gail. “Food Insecurity and health outcomes among older adults: The role of Cost-related Medication Underuse” Submitted to *Journal of Nutrition in Gerontology and Geriatrics*, Jan 18, 2015 (Decision: Accept if revised)

Afulani Patience A. Determinants of birth outcomes in Ghana: Does quality of antenatal care matter? Submitted to *BMC Pregnancy and Child*, April 13 2015 (Awaiting initial decision)

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Afulani Patience A. “Deconstructing rural/urban and socioeconomic differentials in quality of antenatal care in Ghana?” Poster presentation, Consortium of Universities for Global Health Annual Conference, Boston MA, March 2015; and University of California (UC) Global Health Day Conference, UC Los Angeles, April 2015

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Afulani Patience A., Reinarts Chris, Myers Deborah. “Integrating preconception health education into existing WIC services: From needs assessment to implementation.” Oral presentation, Southern California Public Health Association Annual Conference, Los Angeles CA, Dec 2012

Afulani Patience A. “Distribution of health facilities and disparities in maternal health in Ghana: A GIS approach.” Poster presentation, American Public Health Association, San Francisco CA, Nov 2012

Afulani Patience A. “Using GIS to identify hotspots for interventions to improve maternal health in Ghana.” Poster presentation, UC Global Health Day Conference, UC Berkeley CA, Jan 2012

Afulani Patience A., Awoonor-Williams John K., Opoku Ernest C. “Implementing community-based health promotion projects: A case study of the Nutrition and Malaria Control for Child Survival Project, Ghana.” Oral presentation, American Public Health Association, Washington DC, Nov 2011

TECHNICAL PAPERS, REPORTS, AND OTHER PRESENTATIONS

Afulani Patience A., Harrison Gail, Boumediene Soraya. “Determinants of early childhood weight and the influence of maternal infant feeding decisions in the low-income US population.” Technical paper for the Food and Nutrition Service of the US Department of Agriculture.

Afulani Patience A. “Report of Needs Assessment for integrating preconception health education into existing WIC services.” Submitted to the Nutrition Education unit of the South Los Angeles Health Projects, LA Biomedical Research Institute, in September 2011

Afulani Patience A. “Report of a rapid appraisal of the Nutrition and Malaria Control for Child Survival Project in the Bongo District of the Upper East Region, Ghana.” Submitted to the Upper East Regional directorate of the Ghana Health Service in August 2010. Also presented orally to the Upper East Regional Health Management team, Bolga, Ghana; and to health workers in the Bongo District of the Upper East Region in August 2010

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1996-1997	<u>President.</u> Ghana Red Cross Society/head of state award scheme, Navrongo Senior Secondary school
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CHAPTER 1: INTRODUCTION

Motivation: maternal and fetal deaths, antenatal care, and delivery care in Ghana

Approximately 800 women die of pregnancy related complications every day. Ninety-nine percent of these deaths occur in developing countries, and sub-Saharan Africa alone account for about two thirds (62%) of these deaths (WHO et al. 2012, 2014). Like many sub-Saharan African countries, Ghana, which is the focus of this dissertation, is still grappling with high maternal mortality, despite efforts by the government and other organizations to improve maternal health. An estimated 3,100 maternal deaths occurred in Ghana in 2013, with a maternal mortality ratio (MMR) of 380 deaths per 100,000 live births –range of 210 to 720 deaths per 100,000 live births (WHO et al. 2014). Maternal deaths account for about 12% of deaths among women of reproductive age in Ghana; and the lifetime risk of maternal death among young women is about 1 in 66 (WHO et al. 2014). Ghana’s MMR decreased from about 760 per 100,000 live births in 1990 to the current rate of to 380. This change represents a 49% reduction since 1990, and a 2.9% average annual rate of decline (WHO et al. 2014). Since an average annual decline of 5.5% is needed to achieve the millennium development goal number 5 (MDG5) – to reduce maternal mortality ratio by three quarters between 1990 and 2015 – Ghana is clearly not on track to achieve the MDG 5, despite the progress made (Ministry of Health, Ghana, Ghana Health service, and UNDP 2011; WHO et al. 2012, 2014).

Closely related to maternal deaths are fetal deaths. Over two million stillbirths occur each year. Like maternal deaths, over 98% of stillbirths occur in developing countries. SSA has the highest stillbirth rates globally –28.3 per 1000 births, compared to 3.1 per 1000 births for the high income countries (Cousens et al. 2011). Though most regions observed a decline in stillbirth

rates in the last several years, SSA observed the smallest decline (together with Oceania) – at less than 10% compared to the average global decline of 14.5% (Cousens et al. 2011). The decline in the stillbirth rates has been slower than that for maternal, neonatal, and child health globally (Cousens et al. 2011; J. E. Lawn et al. 2009; Lawn et al. 2011). Stillbirths have been described as an “invisible problem” and a “hidden loss,” as they are usually not counted in local data collection systems, nor considered in national and global policy and program priorities (Joy E Lawn et al. 2009; Lawn et al. 2011). Like in many other developing countries, stillbirths are not adequately monitored in Ghana (Cousens et al. 2011); they are not routinely reported, and are hardly mentioned in the Ghana Health Service annual reports. Estimates of stillbirth rates in Ghana are therefore varied: ranging from about 14 per 1000 births to 32.4/ 1000 births from surveys and some district surveillance data (Engmann et al. 2012; Ghana Statistical Service, Ghana Health Service, and Macro International 2009; GSS 2008; Ha et al. 2012).

Most maternal and fetal deaths can be prevented with good quality maternal health care: antenatal, delivery, and postnatal care. But because most maternal deaths occur around the period of delivery, it is important that every birth is assisted by a skilled birth attendant (SBA) – a health professional who can manage normal labor and delivery and identify and manage complications or provide basic care and referral (UNICEF 2011; WHO 2004). In most of SSA, deliveries by SBAs are the same as deliveries in health facilities (Gabrysch and Campbell 2009; Moyer and Mustafa 2013). Unfortunately, only a little over half (estimates range from 56 to 68%) of pregnant women in Ghana use a SBA during delivery (Ghana Health Service 2013; Ghana Statistical Service 2011; WHO 2013b). This is despite significant progress in increasing coverage for antenatal care (ANC) visits: over 95% of pregnant women in Ghana go for at least

one ANC visit, and about 80% go for the recommended four or more visits (Ghana Health Service 2013; Ghana Statistical Service 2011; GSS 2008; WHO 2013b).

Because of the generally high ANC attendance, there are no significant disparities in ANC attendance by region of residence, rural/urban residence, or socioeconomic status (SES). On the other hand there are significant disparities in use of SBAs: only about 43% of births in rural areas are assisted by SBAs compared to 84% in urban areas; 27% in the Northern region compared to 84% in the greater Accra region; 46% among those with no education compared to 92% among those with secondary education; and 24% among women in the poorest wealth quintile compared to 95% among those in the richest wealth quintile (GSS 2008). Skilled attendance at delivery increased from 48% in 2003 to 94% in 2008 among the richest in the country, but only increased from 15% to 24% among the poorest (GSS 2008). The most recent estimates (from 2011) shows deliveries by SBAs is only 54% in rural areas compared to 88% in urban areas; 37% in the Northern region compared to 89% in the greater Accra region; 44% among those with no education compared to 95% among those with secondary education; and 39% among women in the poorest wealth quintile compared to 98% among those in the richest quintile (Ghana Statistical Service 2011). These statistics raise a number of questions motivating this dissertation: (1) Why is skilled delivery care low in Ghana despite the very high antenatal attendance? (2) What accounts for the disparities in use of skilled birth attendants by place of residence and socioeconomic status? (3) What accounts for the poor maternal and fetal outcomes in Ghana?

Given that over 90 percent of women go for at least one antenatal care visit, and about 80% complete the recommended four antenatal visits, but only about half seek delivery in health facilities, it is possible that women's experience with the health system partly accounts for the

lower proportion of women who seek skilled delivery care. This is keeping in mind that physical access to antenatal care is easier than skilled delivery, as antenatal care is sometimes provided at outreach points where deliveries cannot be conducted. It is also easier to plan for ANC visits than delivery. Nonetheless, antenatal care is an opportunity to help women plan for skilled care during delivery. Thus, when women go for ANC visits, but do not deliver with a skilled birth attendant, it may suggest a deficiency in the quality of ANC. Furthermore, qualitative studies suggest that poor quality of care is a deterrent to the use of skilled birth attendants (Bazzano et al. 2008; D'Ambruoso, Abbey, and Hussein 2005; Cheryl A. Moyer et al. 2013; Tunçalp et al. 2012); though there is little quantitative analysis on if and how quality of care influences the use of skilled birth attendants (Gabrysch and Campbell 2009; Moyer and Mustafa 2013).

Increasing coverage for use of maternal health services is very important, but, there is reason to believe that increasing coverage for utilization of maternal health services alone might not reduce maternal and fetal mortality. Close to half of maternal deaths in Ghana occur in health facilities. The institutional MMR (maternal deaths in health facilities) for Ghana was 216 per 100,000 live births in 1990, declining only slightly to 201 in 2008 and then to 170 per 100,000 live births in 2009. Since 2009 the decline has been slower: with a decrease to 163 per 100,000 live births in 2010, an increase to 174 per 100,000 live births in 2011, and then a decrease to 154 per 100,000 live births in 2012 (Ghana Health Service 2012, 2013; Ministry of Health, Ghana et al. 2011). The high institutional MMR suggest that perhaps poor quality of care within institutions may be contributing to the high maternal mortality in the country.

Recent suggestions that poor quality of care in health institutions is contributing to the persistent poor maternal and neonatal outcomes in developing countries has increased interest in assessing quality of maternal health care (van den Broek and Graham 2009; Friberg et al. 2010;

Graham, McCaw-Binns, and Munjanja 2013a; W. J. Graham and Varghese 2012; United Nations Secretary-General 2010; Wall et al. 2010) However, the emphasis has been on human and physical resources and technical quality at the level of health facilities (Ameh et al. 2012; Boulkedid et al. 2013; Filippi et al. 2004, 2005; Morestin et al. 2010; Parkhurst et al. 2005; Pirkle, Dumont, and Zunzunegui 2011; Spector et al. 2012; Twum-Danso et al. 2012). Such assessments are obviously important, but the lack of data on the quality of care individual women receive limits our understanding of the quality–coverage link (Bell, Curtis, and Alayon 2003; Graham, McCaw-Binns, and Munjanja 2013b).

Writing back in the 1980s, Donabedian wrote that knowledge about the relationship between technical care and outcomes come from the health care sciences; and while it is difficult to know for certain if an outcome can be attributed to an antecedent process because of the complexity of factors that influence the outcome, there is good evidence that good technical care does lead to improved outcomes. On the other hand he noted that: “Knowledge about the relationship between attributes of the interpersonal process and the outcome of care should derive from the behavioral sciences. But so far, these sciences have contributed relatively little to quality assessment. I cannot say whether this is because of a deficiency in these sciences or narrowness in those who assess quality” (A. Donabedian 1988). I think it is more of a disciplinary divide – health service researchers who assess maternal health quality and behavioral scientists who assess health seeking behavior with separate sets of data that preclude examining the relationship between quality of care and behavior; or even outcomes at the individual level. This dissertation is the beginning of a process to help bridge this gap.

The paucity of studies examining the quality of maternal health care women in SSA receive, either as an outcome or as a predictor, is due to the lack of data on quality of maternal

health care at the individual level. This is attributed to the multiple dimensions of quality, which defy capture in single or simple set of indicators; the weakness of routine systems for collecting health information; and the over-reliance on household surveys, which limit data acquisition for technical aspects of quality (W. J. Graham and Varghese 2012). While this is very true, researchers have not taken advantage of the limited variables in existing data to understand the predictors and effects of quality of maternal health care. In this dissertation, I use variables from existing data (the Ghana Maternal Health Survey data and the World health Survey data for Ghana and Burkina Faso) that can be used as measures for quality of care to examine the factors that affect the quality of care women receive, and how quality of care affects use of skilled birth attendants and pregnancy outcomes. In the process, I also identify the limitations of the existing measures to serve as initial evidence to guide the development of better measures to assess quality of maternal health services. This dissertation extends the maternal health literature in two areas: it addresses the dearth of studies on the determinants of *quality* of maternal health services as well as the dearth of studies on the mechanisms underlying the associations between distal factors such as SES and place of residence and *use* of maternal health services.

Overview of study aims and research questions

The overarching question I examine in this dissertation is: do disparities in quality of care from prior encounters with the health system explain disparities in use of skilled birth attendants? I focus on disparities by rural/urban residence and socioeconomic status (measured by education and wealth), and examine antenatal care visits as the main prior encounter with the health system. The main analysis is therefore restricted to women who went for at least one ANC visit during their last pregnancy, which is over 95% of women in Ghana. The full samples are used in supplementary analysis. Three conditions are needed for an affirmative response to the main

question: (1) rural/urban residence and socioeconomic status must be associated with quality of antenatal care; (2) rural/urban residence and socioeconomic status must be associated with use of SBAs; and (3) quality of antenatal care must be associated with use of skilled birth attendants.

My first aim addresses the first condition, by examining the determinants of quality of antenatal care. The key questions for this aim are

1. What are the determinants of quality of antenatal care?
 - a. Are education, wealth, and rural/urban residence associated with quality of antenatal care net of other factors?
 - b. Which factors mediate the effects of education, wealth, and rural/urban residence on quality of antenatal care?
 - c. Are the effects of education, wealth, and rural/urban residence conditional on each other?

My second aim addresses the second and third conditions, by examining the determinants of use of skilled birth attendants. The key questions here are:

2. What are the determinants of use of SBAs?
 - a. Is quality of antenatal care associated with use of SBAs net of other factors?
 - b. Does quality of antenatal care explain some of the rural/urban and SES differentials in use of SBAs?
 - c. Is the effect of quality of care on use of SBAs conditional on rural/urban residence, education, or wealth?

My third aim extends the research to examine the importance of quality of antenatal care beyond increasing use of skilled birth attendants, by examining the effect of quality of antenatal care on pregnancy outcomes – i.e., whether a woman has a live birth or stillbirth. I use birth

outcomes because I am unable to examine maternal mortality as an outcome. Birth outcome is however a good proxy for maternal mortality because they have similar determinants. In addition, birth outcome is an outcome measure of quality of maternal health care, hence useful for examining the effects of a process measure of quality of maternal care. The key questions here are:

3. What are the determinants of birth outcomes?
 - a. Is quality of antenatal care associated with birth outcomes net of delivery care?
 - b. Is the effect of quality of antenatal care conditional on the delivery place or provider?

The hypotheses, rationale for the hypotheses, results, and discussion for each of the three aims are presented in chapters 5, 6, and 7 respectively. The data used for all three aims, the variables, and the description of the samples are presented in chapter 4. The general limitations, strengths, implications, recommendations, and conclusion are presented in chapter 8. In the next two chapters, I present the literature (chapter 2) and theoretical models (chapter 3) guiding this work.

CHAPTER 2: BACKGROUND

Maternal mortality in sub-Saharan Africa in context

An estimated 289,000 maternal deaths occurred in 2013, with a Maternal Mortality Ratio (MMR) of 210 maternal deaths per 100,000 live births (WHO et al. 2014). Ninety-nine percent of these deaths occur in developing countries, with a MMR of 230 per 100,000 live births –14 times higher than the MMR in developed countries at 16 per 100,000 live births. The lifetime risk of maternal deaths in the developing world is 1 in 150, compared 1 in 3700 in developed regions (WHO et al. 2012, 2014). Sub-Saharan Africa (SSA) is the region with the highest MMR at 510 per 100,000 live births, followed by Southern Asia at 190 (WHO et al. 2014). SSA is home to just 11% of the world's population, but accounts for more than half (62%) of the global burden of maternal deaths (Friberg et al. 2010). The lifetime risk of maternal death in SSA is 1 in 38 (the highest), followed by 1 in 140 in Oceania, and 1 in 200 for Southern Asia (WHO et al. 2014). The difference in maternal mortality between rich and poor countries is one of the largest disparities of any public health statistic (Hogan et al. 2010).

The number of maternal deaths has reduced globally since 1990, but the decline has been below expectation for developing regions, especially SSA. Between 1990 and 2013, the global number of maternal deaths decreased from 523,000 to 289,000 – a decline of 45%. All regions experienced a decline; the highest reduction in Eastern Asia (65%) followed by Southern Asia (64%). The decline in Sub-Saharan Africa was among the slowest (49% reduction), with an average annual decline of 2.9%. Since an average annual decline of 5.5% is needed to achieve the MDG5 target –75% reduction in MMR between 1990 and 2015 – SSA as a region is not on track to achieving MDG 5 (WHO et al. 2014).

The exact magnitude and scope of maternal morbidity is unclear due to problems of definition and classification and poor reporting (WHO 2005b). But it is estimated that each year, over 20 million women experience some form of maternal disability (ranging from fever and depression to debilitating conditions like obstetric fistula and uterine prolapse) (WHO 2005b). For every woman that dies in childbirth, about 20 to 30 more are estimated to suffer long-lasting injury or illness (WHO 2011). This suggests very high levels of maternal ill health and disability in regions like SSA with high maternal mortality.

Recommendations to prevent maternal mortality

The inauguration of the Safe Motherhood Initiative in Kenya in 1987 marked the beginning of concerted international efforts to reduce maternal mortality (AbouZahr 2003). Family planning, antenatal care, clean/safe delivery, and essential obstetric care were identified as strategic interventions – the “four pillars” of safe motherhood. These subsequently became the core components of the World Health Organization mother baby package (Bergsjø 2000; WHO 1994). Though family planning is one of the safe motherhood strategies, it is usually not considered a maternal health service because it involves intervention before pregnancy. Thus it is not discussed in this dissertation. Maternal health services generally refers to interventions during pregnancy, delivery, and in the postpartum period: delivered through antenatal care, skilled attendance at delivery, and postnatal care, respectively (Bullough et al. 2005; The Partnership for Maternal, Newborn & Child Health 2011; WHO 2009).

Antenatal care(ANC): Even though ANC has always been one of the recommended safe motherhood strategies, its contribution to maternal mortality reduction has been challenged (Bullough et al. 2005; Guillermo Carroli, Rooney, and Villar 2001). Earlier approaches to ANC were based on a “risk approach”: identify risk factors for undesirable outcomes, and deliver care

based on individual needs (Bergsjø 2000; WHO 1994). This was based on the belief that early signs of complications, or risk factors for maternal morbidity and mortality could be detected and effective interventions implemented (Rooney and Maternal Health and Safe Motherhood Programme 1992). Evaluations of the effectiveness of formal risk assessment in pregnancy, however, suggested that the risk approach was neither effective in preventing maternal deaths, nor in ensuring rational use of resources. This is because complications of pregnancy tend to be unpredictable, and so risk assessment leads to too many false positive and false negatives (Bergsjø 2000; Rooney and Maternal Health and Safe Motherhood Programme 1992).

There is also a lack of consistency on the effectiveness of certain content, frequency, and timing of ANC visits. However, certain antenatal interventions such as serologic screening for syphilis, iron supplementation, malaria treatment and prophylaxis, diagnoses and treatment of asymptomatic bacteriuria, blood pressure monitoring, anti-tetanus immunization, and prevention of mother-to-child transmission of HIV have been shown to be effective especially with regards to neonatal survival (Bergsjø and Villar 1997; Campbell and Graham 2006; Villar and Bergsjø 1997; World Health Organization 2003). These interventions are therefore part of the recommended package of antenatal services. Furthermore, ANC offers an opportunity to educate women on danger signs of pregnancy and help them plan options for skilled care during delivery (Campbell and Graham 2006). This is especially so for regions like SSA where ANC coverage is high but skilled delivery remains low (Guliani, Sepehri, and Serieux 2012; Ouma et al. 2010). Recent evidence suggests the inconsistency in the effectiveness of ANC may be because many studies do not account for the content of antenatal services (Adjiwanou and LeGrand 2013).

Earlier on, the lack of evidence on the effective timing and frequency of ANC in developing countries resulted in the adoption of western a model, where women had to go for

ANC several times during the course of their pregnancy –with most going a minimum of eight times. Later work however showed that the ANC interventions can be effectively delivered in fewer visits –leading to a change in the schedule to four focused visits (referred to as focused antenatal care) for women with uncomplicated pregnancies (G. Carroli et al. 2001; Villar et al. 2001; WHO 2002).

Skilled Attendance at delivery and postnatal care: The recommendation for skilled delivery and postnatal care is based on evidence that: (1) most maternal deaths occur during labor, delivery, and the first 24 hours postpartum; (2) many pregnancy complications cannot be predicted and life-threatening situations can develop rapidly in previously uncomplicated pregnancies, even in women without any identifiable risk factors; and (3) the technology to address the leading causes of maternal deaths – hemorrhage, sepsis, preeclampsia/eclampsia, prolonged/obstructed labor, and unsafe abortion – are available to prevent deaths from these complications (Khan et al. 2006; Li et al. 1996; UNICEF 2011; WHO 2004). In addition, up to 40% of fetal deaths occur during labor and delivery (J. E. Lawn et al. 2009; Joy E Lawn et al. 2009). Thus, there is the need for an attendant who can identify and manage complications or provide basic care and referral at every delivery (Khan et al. 2006; Li et al. 1996; UNICEF 2011; WHO 2004).

Even though skilled attendance at delivery was captured under clean/safe delivery and essential obstetric care in the initial safe motherhood package, the emphasis was on “trained attendants,” which included trained traditional birth attendants (TBAs). However after years of implementing TBA training programs, the evidence suggested that training of TBAs had no significant effect on reducing maternal mortality: Training led to improved knowledge, but this knowledge did not translate to improved practices in many instances (Campbell and Graham

2006; Sibley et al. 2007; Sibley and Ann Sipe 2004). This evidence led to change in emphasis from “trained” to “skilled” birth attendants, to emphasize that while *trained* implied the acquisition of knowledge and ability, it did not guarantee *skill* – “the competent use of knowledge”(Graham et al. 2001; Starrs 1997; WHO 1999). The use of skilled birth attendants (SBAs) was subsequently expanded to “*Skilled attendance*” to emphasize the need for a SBA in an enabling environment: adequate infrastructure, supplies, and equipment, as well as efficient and effective systems of communication and referral within a working health system (Graham et al. 2001).

About 40% of all pregnant women will have some complication and up to 15% of pregnancies or deliveries need emergency obstetric care for life threatening complications to the mother or baby (WHO 2013a). Skilled attendance is therefore advocated as the "single most critical intervention to reduce maternal mortality" (WHO 2004, 2013c). Some estimates suggest SBAs alone can reduce maternal mortality by 16-33% (Graham et al. 2001). But, the effects are higher with SBAs in working health system, with estimates that up to 88-98% of maternal deaths can be averted with timely access to emergency obstetric care (WHO 1994). Emergency obstetric care has been referred to as the “keystone in the arch of safe motherhood” (Fortney 2001).

Direct evidence linking skilled attendance and maternal mortality is however lacking: the recommendation is mostly based on ecological studies that show strong associations between maternal mortality and skilled delivery rates at the country level (De Brouwere et al. 1998; Van Lerberghe and De Brouwere 2000). For example, delivery by SBAs is about 97 to 99% for upper middle and high income countries, with low maternal mortality, but about 47 to 60% for low and lower middle-income countries with very high maternal mortality (WHO 2013b). The coverage for use of SBAs is 66% globally; and 49% for SSA and South Asia (UNICEF 2013). Early

postnatal care is associated with skilled attendance at delivery, but where deliveries are not conducted by SBAs, early postnatal care with a SBA is still advocated.

Good quality antenatal, delivery, and postnatal care is essential not only for maternal health but to prevent the over two million stillbirths that occur each year (Cousens et al. 2011; J. E. Lawn et al. 2009; Lawn, Cousens, and Zupan 2005; Rajaratnam et al. 2010; Stanton et al. 2006). Unfortunately in many developing countries, coverage for these essential services remains low. Furthermore, *quality* has been left out of the picture until recently. The indicators for antenatal, delivery, and postnatal care are all based on coverage for *use* of the services. Though some data on quality of ANC is collected in the Demographic and Health Surveys, they are not used as monitoring indicators, and few studies have used them for any analysis. No information on quality of delivery care or the timeliness of delivery care is collected in these surveys. Some quality data is available from facility based surveys, but these are difficult to examine for individual outcomes. There are many studies on the determinants of *use* of maternal health services, but just a handful of studies have examined the determinants or the effects of *quality* of maternal health services. In the next section, I present and discuss the literature on determinants of use of maternal health services. I will discuss the few studies on determinants of quality of maternal health services in chapter 5.

Literature review of the determinants of use of maternal health services

The literature summarized here covers several countries in SSA, with a few from other regions with high MMR. It also draws from major reviews on this topic –from 1994 to the most recent one in 2013 (Thaddeus and Maine 1994; Say and Raine 2007; Gabrysch and Campbell 2009; Moyer and Mustafa 2013). All the reviews were focused on developing countries, with the one by Moyer and Mustafa (2013) specifically on SSA. Different categorizations of the determinants

are used in different studies and reviews. I group the determinants based on the constructs in my conceptual model, which is presented in the next chapter.

Socioeconomic factors:

Education, economic status, and women's status are the most commonly studied determinants of utilization of MH services (Gabrysch and Campbell 2009; Moyer and Mustafa 2013; Say and Raine 2007; Thaddeus and Maine 1994).

Education: But for a few studies, the education of mothers is consistently strongly associated with utilization of MH services, even with different classifications of educational levels (Gabrysch and Campbell 2009). In Africa, even just a primary education is associated with higher utilization compared to those with no education and much higher for those with secondary education (Adanu 2010; Addai 2000; Ensor et al. 2013; Gabrysch and Campbell 2009; Mrisho et al. 2007; Stekelenburg et al. 2004; Winfred A. Avogo 2011). The contextual effect of education (using percent of women or adults with secondary education in a cluster) has also been found to strongly predict a woman's use of SBAs (Gage 2007; Stephenson et al. 2006a). Few studies include husbands' education, but this has also been found to be positively associated with use of maternal services – though less so compared to mothers' education (Aremu, Lawoko, and Dalal 2011; Gabrysch and Campbell 2009).

Economic status: Most studies find that higher economic status is associated with higher use of MH services, but some find no association (Gabrysch and Campbell 2009; Say and Raine 2007). The differential findings are attributed to its interaction with other factors as well as how it is operationalized – as income, household wealth or assets, household expenditure, or ability to pay for service (Gabrysch and Campbell 2009; Say and Raine 2007). It is also thought that economic status may not play a big role in contexts where wealth gradients are shallow, services

are free, or where quality is the overriding concern (Bolam et al. 1998; Gabrysch and Campbell 2009; Gleib, Goldman, and Rodriguez 2003). Studies that use wealth quintiles generally find higher utilization with higher wealth (Adanu 2010; Addai 2000; Gage 2007; GSS 2008; Montagu et al. 2011; Mpembeni et al. 2007; Hyacinth Eze Onah, Ikeako, and Iloabachie 2006; Rai, Singh, and Singh 2012; Winfred A. Avogo 2011). The few studies that examine community or neighborhood-level poverty also find that poorer communities are less likely to use MH services (Babalola and Fatusi 2009; Mahmud Khan et al. 2006; Montgomery and Hewett 2005), though some do not find any effect of poverty concentration (Gage 2007).

A few studies use occupation or working status of the woman or her husband as a measure of economic status, with variable findings. Some find that women who are farmers are less likely to use MH services than women in other occupations; and formally employed women are more likely to do so (Addai 2000; Nwakoby 1994; Stekelenburg et al. 2004). Some studies find no effect of mothers' occupation, and few find that working women are less likely to use maternal services, suggesting that this may be the case when working is poverty induced (Chowdhury et al. 2007; D. V. Duong, Binns, and Lee 2004; Gabrysch and Campbell 2009). Few studies have also suggested that high status occupation of the husband is associated with higher utilization (Gabrysch and Campbell 2009; Pebley, Goldman, and Rodriguez 1996).

Women's status and autonomy: Autonomy is a complex construct with various dimensions (Furuta and Salway 2006; Gabrysch and Campbell 2009; Thaddeus and Maine 1994). Qualitative studies suggest an important role of women's autonomy, with many suggesting it is the lack of control of women in rural areas over the decision to seek care that leads to low utilization of SBAs (Abasiokong 1981; Harrison 1983; Jansen 2006; Cheryl A Moyer et al. 2013). Studies in SSA cite examples of communities where women cannot go to the

hospital without the permission of their husbands or other family elders; even when there is an obvious need for hospital care (Abasiokong 1981; Harrison 1983; Thaddeus and Maine 1994). Quantitative studies use various measures such as participation in household decision-making, freedom of movement, control over earnings, communication and sharing of housework with the husband, sex of household head, and presence of the mother-in-law in the household to examine the effect of autonomy. Most find significant associations for some measures though these vary between studies (Gabrysch and Campbell 2009; Mrisho et al. 2007; Nwakoby 1994; Stekelenburg et al. 2004). Findings related to women's autonomy and status is likely to be modified by age, marital status, parity, wealth, and education (Gabrysch and Campbell 2009). Furuta (2006) also cautions interpreting measures of autonomy out of context, as women who take decisions alone in certain settings may not really be autonomous, but "relatively isolated or unsupported individuals" (Furuta and Salway 2006).

Accessibility

Economic accessibility: Most qualitative studies mention cost as an important barrier to use of MH services (Amooti-Kaguna and Nuwaha 2000; Jansen 2006; Mrisho et al. 2007; Pell et al. 2013). In addition, the influence of wealth on utilization is usually taken to mean an important role of cost. The direct effect of cost is not commonly studied, but studies of payment systems suggest cost is important, as service utilization tends to increase with cost sharing systems and decrease with user fees (Blanchet, Fink, and Osei-Akoto 2012; Mensah, Oppong, and Schmidt 2010; Thaddeus and Maine 1994). A study in Nigeria also observed a decline in hospital births, but an increase in admissions for complications with the introduction of user fees; suggesting that costs deter poorer women from using services for normal deliveries but only delays use for complications (Gabrysch and Campbell 2009; Thaddeus and Maine 1994). Some studies and

reviews suggest that contrary to popular belief, cost is often not the most important factor in the use of MH services (Gabrysch and Campbell 2009; Montagu et al. 2011; Thaddeus and Maine 1994).

Physical accessibility: Physical access is thought to be one of the most important barriers to use of skilled delivery service. Measures of access commonly used are place of residence, distance, transport, and road conditions. Studies consistently find that women who live in urban areas are more likely to use services compared to those in rural areas; with an even bigger advantage for those living in large cities. There are also usually differentials by regions though these are not as big as the rural/urban differentials.(Addai 1998, 2000; Bell et al. 2003; Gabrysch and Campbell 2009; GSS 2008; Mekonnen and Mekonnen 2003; Montagu et al. 2011; Say and Raine 2007). Place of residence is used as a measure of access because service and social environments typically vary by region and rural/ urban residence (Bell et al. 2003) However, it may also be associated with other factors like education, ability to pay, parity, ethnicity/religion, beliefs, information availability, autonomy, availability, and quality of services; which can confound its effects (Addai 2000; Gabrysch and Campbell 2009). Thus place of residence reflects larger contextual factors than just access (Gabrysch and Campbell 2009). Distance and transport are more direct measures of access and are commonly mentioned in qualitative studies as important barriers (Amooti-Kaguna and Nuwaha 2000; Bazzano et al. 2008; D’Ambruso et al. 2005; Gabrysch and Campbell 2009; Pell et al. 2013). They are however, less commonly evaluated in quantitative studies; partly due to inadequate data (Gabrysch and Campbell 2009; Gage 2007; Thaddeus and Maine 1994). The few studies that examine the effect of distance (either as actual distance or time to reach the nearest facility) generally report less use of services with increasing distance to a health facility (Gage 2007; Magadi, Diamond, and Rodrigues 2000;

Pebley et al. 1996; Stekelenburg et al. 2004). While distance appears to be a good measure of physical access, some have argued that it also captures other aspects of remoteness, such as poor road infrastructure, poor communication, poverty, limited access to information, strong adherence to traditional values, and other disadvantages that are difficult to measure quantitatively (Hounton et al. 2008).

Quality of Care

Nearly all qualitative studies of MH service utilization mention quality of care as an important factor, with staff attitudes as a recurrent problem. Many women report rude, arrogant, and neglectful behavior of staff at health facilities as a reason for their preference for home delivery (Amooti-Kaguna and Nuwaha 2000; Bazzano et al. 2008; D'Ambruoso et al. 2005; Kyomuhendo 2003; Cheryl A. Moyer et al. 2013; Mrisho et al. 2007; Tunçalp et al. 2012). Others report culturally inappropriate care, not being allowed to openly express pain, and verbal and physical abuse from health workers during labor (D'Ambruoso et al. 2005; Kyomuhendo 2003; Cheryl A. Moyer et al. 2013). Some women also report poor hygiene (dirty facilities, lack of water), lack of necessary drugs, and too early caesarean sections as reasons for non-use of health facilities for delivery (Kyomuhendo 2003; MacKeith et al. 2003).

Very few quantitative studies assess quality of care as a determinant of MH service utilization, and the findings are varied (Gabrysch and Campbell 2009). Stekelenburg et al. (2004) found no effect of perceived quality of antenatal care on facility delivery in a rural district in Zambia, but this was attributed to generally high satisfaction levels (Stekelenburg et al. 2004). A study in Vietnam however found that women who delivered in a facility rated quality of "health care delivery" higher than those who delivered at home, but there was no difference in their ratings for "communication and conduct of personnel" (D. V. Duong et al. 2004). More macro

analysis examining structural aspects of quality have also produced mixed results with some finding a positive association with number of health workers, infrastructure, and supplies with facility delivery; and no associations in others (Gabrysch and Campbell 2009; Hotchkiss et al. 2003; Hounton et al. 2008).

Previous encounter with health system:

Previous facility delivery and ANC use are commonly examined.

Previous facility delivery: Quantitative studies generally find strong positive associations between previous and current use of facility delivery (Bell et al. 2003; Gabrysch and Campbell 2009; Moyer and Mustafa 2013; Stephenson et al. 2006a). Qualitative studies also suggest women tend to deliver with the same provider if a previous delivery went well but change providers if they were dissatisfied (Amooti-Kaguna and Nuwaha 2000; D'Ambruoso et al. 2005; D. V. Duong et al. 2004) Previous facility delivery is, however, thought to be a very heterogeneous variable, as it can reflect availability, accessibility, familiarity, and attitudes towards MH services, as well as various socioeconomic factors associated with the prior use of services (Bell et al. 2003; Gabrysch and Campbell 2009; Stephenson et al. 2006a). This is suggested by contextual studies that find significant positive associations between the proportion of women in a cluster who had at least one previous birth in a health facility and individual women's use of facilities for delivery (Stephenson et al. 2006a).

Antenatal care: Use of ANC is also generally found to be positively associated with subsequent skilled delivery though a few studies find no association (Gabrysch and Campbell 2009; Gage 2007; Mpembeni et al. 2007; Winfred A. Avogo 2011). The reasons for these associations are that ANC services are an opportunity to promote skilled birth attendant use; or give women information on the status of their pregnancy, which in turn informs their decisions

on where to deliver. Some qualitative studies however suggest that risk assessment during ANC visits can potentially reduce SBA use when women are told they have a normal pregnancy; especially when use of SBA is perceived to be for complicated deliveries (Bazzano et al. 2008; Magoma et al. 2010). Abuse of women without ANC cards when they go for delivery services has also been found to deter women who did not for ANC visits from seeking delivery services (Amooti-Kaguna and Nuwaha 2000). Level of Antenatal care uptake in an area is also predictive of individual women's use of SBAs net of individual ANC use, suggesting that ANC may signify availability MH services (Gage 2007).

Reproductive health factors:

The most popular reproductive health factors include ***maternal age, parity, and marital status***. The findings related to these factors are mixed. Some studies find no effect of age but others find higher utilization among older women (Adanu 2010; Burgard 2004; Gabrysch and Campbell 2009; Magadi, Agwanda, and Obare 2007; Hyacinth Eze Onah et al. 2006; Stephenson et al. 2006a). For parity, some studies find no association, but some find higher utilization with first and higher order births (Ensor et al. 2013; Gabrysch and Campbell 2009; Gage 2007; Stephenson et al. 2006a). Marital status also has no effect in some studies (Gyimah, Takyi, and Addai 2006; Mekonnen and Mekonnen 2003; Nwakoby 1994), but others find higher utilization among married or single women (Letamo and Rakgoasi 2003; H. E. Onah, Ikeako, and Iloabachie 2006; Stekelenburg et al. 2004; Stephenson et al. 2006a). There is usually an expectation of higher utilization for older women in relation to autonomy; and for first order births in relation to risk for complications and prior inexperience. But older women are also more likely to be multiparous. The mixed findings are attributed to these complex interactions which are not adequately examined in many studies (Gabrysch and Campbell 2009).

Sociocultural factors :

Qualitative studies identify beliefs about pregnancy and complications as determinants of skilled delivery use – e.g., labor as a sign of endurance, facility delivery as a sign of weakness; requirements around delivery position, warmth, and handling of the placenta; and cultural requirements of seclusion during the period of delivery (Bazzano et al. 2008; Kyomuhendo 2003; Mrisho et al. 2007; Senah 2003; Thaddeus and Maine 1994). Quantitative studies are however unable to directly to examine these, relying mostly on various proxies. For instance, Magadi et al. use prior use of family planning as a proxy for biomedical health beliefs; which they find is positively associated with use of MH services (Magadi et al. 2000). Stekelenburg uses sex preference of SBAs, and find that those who have no preference are more likely to use SBAs (Stekelenburg et al. 2004). Use of traditional medicines has also been used as a measure of sociocultural beliefs, with variable findings (Navaneetham and Dharmalingam 2002; S. Yanagisawa, Oum, and Wakai 2006). The commonly used measures, however, are ethnicity and religion which are not very good proxies, leading to mixed results (Addai 2000; Burgard 2004; Gabrysch and Campbell 2009; Gyimah et al. 2006).

Others factors studied related to perceived need

Complications: Qualitative studies find complications either in a previous birth or the index pregnancy to be an important determinant of use of MH services (Amooti-Kaguna and Nuwaha 2000; Bazzano et al. 2008; Gabrysch and Campbell 2009; Magoma et al. 2010). Few quantitative studies however investigate the role of complications. These studies find that some type of current or previous complication increases use of SBAs (Gabrysch and Campbell 2009; Gleit et al. 2003; S. Yanagisawa et al. 2006).

Knowledge of pregnancy complications and general health knowledge: Few studies consider health knowledge, and these find increased use of MH services with increasing knowledge of pregnancy complications and danger signs (Doctor et al. 2013; Ensor et al. 2013; Mpembeni et al. 2007; Stekelenburg et al. 2004). Being told about pregnancy complications during Antenatal care is also associated with higher use of SBAs (Gage 2007; Tweheyo et al. 2010; Winfred A. Avogo 2011). Some studies also find positive associations between exposure to health and family planning messages in the media and increased use of MH services (Babalola and Fatusi 2009; Navaneetham and Dharmalingam 2002; Pebley et al. 1996; Stephenson et al. 2006a).

Wantedness of pregnancy: Few studies have also considered whether or not the index pregnancy was wanted, with mixed results (Burgard 2004; Gabrysch and Campbell 2009; Magadi et al. 2000). The expectation is that women with unwanted pregnancies may be less likely to invest in MH services, but other researchers suggest women may seek care for their own health rather than for the child (Gabrysch and Campbell 2009).

Gaps in the literature on determinants of use of maternal health services

As noted earlier, the most commonly studied determinants of MH service utilization are socioeconomic factors, with income/wealth measures and place of residence as proxies for access. Further studies are however needed to adequately measure the effect of access and to answer questions like how far women are willing to travel for MH services, either on foot or by other means of transportation. A study in rural Zambia found that the effect of distance became significant beyond 12 km with no difference on use of facility delivery between those living 6-11 km from a basic emergency obstetric care facility and those living within 5km (Ensor et al. 2013). Tweyeho et al. in Uganda however found that living more than 5km from a health facility

decreased use of facilities for delivery (Tweheyo et al. 2010). Such findings suggest the effect of distance are context and outcome specific, hence the need for more of such studies for local program development.

In addition, while we know that women are concerned about quality from qualitative studies, (Amooti-Kaguna and Nuwaha 2000; Bazzano et al. 2008; D'Ambruoso et al. 2005; Kyomuhendo 2003; Cheryl A. Moyer et al. 2013; Mrisho et al. 2007; Tunçalp et al. 2012) there is a need for studies that measure how quality actually affects use of services, and also especially which aspects of quality are most predictive of service utilization. A major gap in the literature on the determinants of MH service utilization is studies that explore the mechanisms through which various distal determinants like socioeconomic status may affect service utilization. For instance how does education or economic status interact with cost of MH services, distance, and perception of quality? A study in Bangladesh found that among those living more than one hour travel time from a health center, employed women were more likely to seek care, but there was no difference by employment status for those living within one hour travel time, suggesting employed women are better equipped to overcome physical access barriers (Rahman et al. 2008). Such studies are needed in SSA. Furthermore, there is a deficiency of studies in SSA that adequately examine regional variability in use of SBAs (Moyer and Mustafa 2013).

Thaddeus and Maine noted the dearth of literature on service utilization and the role of women's informal power among women who are financially independent and autonomous in their decision-making about 20 years ago (Thaddeus and Maine 1994). This still appears to be the case in SSA as no published studies in SSA have examined this systematically. The rapidly evolving role women in SSA particularly call for research in this direction.

Pre-pregnancy health status increases the risk of developing pregnancy complications, but there is apparently not much evidence on how this is associated with utilization of MH service. Even though few studies examine prior pregnancy complications, none I have reviewed has examined how preexisting chronic conditions like diabetes and hypertension affect use of MH services. Such studies might help illuminate how contact with the health system affects use of MH services. Another relatively unexplored area is how migration (rural/urban and potentially international migration) affects use of maternal health services. Such studies may help illuminate contextual and individual level influences on use of maternal health services (if problems of selection can be addressed). Other limitations include the lack of longitudinal and interventional studies (Moyer and Mustafa 2013). A potential reason for most of the limitations enumerated is limited data – limited variables in the surveys that serve as the major source of data for many countries in SSA.

Finally, there is the question of whether utilization actually improves outcomes in all settings. There have been calls to examine quality of institutional care, as increased coverage for use of health facilities for delivery, in many countries, does not seem to be associated with proportionate reductions in maternal mortality (van den Broek and Graham 2009; Friberg et al. 2010; Wendy J Graham and Varghese 2012; United Nations Secretary-General 2010) A recent WHO study also found that high coverage for essential interventions within health facilities were not necessarily associated with reduced institutional maternal deaths; calling for a move beyond essential interventions (Souza et al. 2013). These findings suggest a need for research on the MH service utilization–quality–outcome cycle.

CHAPTER 3: THEORETICAL FRAMEWORK

The framework for my dissertation draws on three previous models for examining the determinants of use of maternal services and maternal mortality. In the following sections, I describe these models and discuss their strengths and limitations. I then present a more integrated model that guides my analysis.

The three delays model by Thaddeus and Maine (1994)

This is the most popular of the models to explain the determinants of use of maternal services and maternal mortality. It was developed from the work of the Prevention of Maternal Mortality Program, a collaborative effort of Columbia University's Center for Population and Family Health and multidisciplinary teams of researchers from Ghana, Nigeria, and Sierra Leone (Thaddeus and Maine 1994). The model focuses on the factors that affect the interval between the onset of an obstetric complication and its outcome. The justification for focusing on this period was that about 75% of maternal deaths result from five direct obstetric complications, which are difficult to predict, and can occur in women with no prior risk factors; but the technology to treat these complications are available. Thus most of the deaths from obstetric complications can be prevented with prompt medical care (World Health Organization 1986). The main premise of the model is that prompt adequate treatment will result in satisfactory outcomes, while delayed treatment will lead to adverse outcomes (Thaddeus and Maine 1994). The three delays model posits three phases of delays that contribute to adverse pregnancy outcomes, from the onset of complications to treatment. Each phase is influenced by one or more of three groups of factors: *socioeconomic/cultural factors*, *accessibility of health facilities*, and *quality of care* (Diagram in appendix 3A) (Thaddeus and Maine 1994).

Socioeconomic/cultural factors include women's status, economic and educational status (of the woman, her partner, or family), illness factors, and sociolegal factors. *Accessibility factors* include *physical accessibility* (availability and distance to health facilities; availability and type of transportation; condition of roads, and geography of the area); and *financial accessibility* (costs of transportation and health services). *Quality of care* include factors such as availability of competent and motivated personnel, essential drugs, supplies, and equipment, etc. Phase I delay is the delay in the decision to seek care, and is influenced by all three groups of factors. However, it is perceived (rather than actual) accessibility and quality of care that influences the decision to seek care. Phase II delay is the delay in identifying and reaching a health facility and is influenced by actual accessibility factors. Phase III delay is the delay in receiving adequate and appropriate care at the health facility and is influenced by the actual quality of care (Thaddeus and Maine 1994).

Posited relationships and underlying mechanisms for the key constructs

Socioeconomic/cultural factors.

Women's status: This is described as the educational, cultural, economic, legal, and political position of women in a given society (Thaddeus and Maine 1994). The decision to seek care is made by the individual woman and/or her family, but a woman's informal power in the household influences whether or not she has a say and can act on her preference (Thaddeus and Maine 1994). Women's status affects the first delay in specific ways. First, constraints on women's autonomy limit their access to care through decision making power – e.g., instances where women cannot go to the hospital without the permission of their husbands or other family elders, even when there is an obvious need for hospital care (Abasiokong 1981; Harrison 1983). Second, women's mobility may be limited by cultural restrictions on travel outside the

community (Kloos et al. 1987). Furthermore, women's status may be tied to access to transportation; and control over resources needed to pay for expenses (Furuta and Salway 2006; Stock 1983). The expectation is that higher status of women will decrease delays in the decision to seek care (Thaddeus and Maine 1994).

Economic status: Higher economic status is expected to reduce the first delay. The mechanism underlying this construct is unclear, but the following are suggested: Because care-seeking include costs of transportation; cost to receive care, and opportunity costs for lost time from work; higher economic status facilitates the decision to seek care by removing cost as a barrier (Thaddeus and Maine 1994). Also, households with higher economic status may be more "modern" hence more receptive towards modern health care services (Navaneetham and Dharmalingam 2002); and health facilities serving people of higher economic status may be more appealing, increasing their use (Thaddeus and Maine 1994).

Education: The mechanism underlying the effect of education is also unclear, though it is expected to reduce the first delay (Thaddeus and Maine 1994). Drawing on the work of Caldwell, Thaddeus and Maine suggest that education may facilitate the decision to seek care by increasing access to information and knowledge, which shapes their thought patterns in favor of medical care (as against fatalistic views). Education may also introduce people to a new 'modern' culture that favors use of medical services; and increase self-confidence and respect, which facilitates the decision to seek care (Caldwell 1979; Caldwell and Caldwell 1985). Education and economic status are intricately related, and also related to women's status making it difficult to parse out their individual mechanisms (Thaddeus and Maine 1994).

Illness factors: These refer to the woman's health condition (e.g. a pregnancy complication), ability to recognize a complication (knowledge of risk factors and danger signs in

pregnancy), and perceptions of the etiology and severity of the condition (Thaddeus and Maine 1994). These factors influence the perception of need which influences the decision to seek care. The expectation is that women and families are more likely to seek care if they recognize a complication, perceive it as severe, and its etiology as requiring biomedical intervention (Thaddeus and Maine 1994). These processes are however shaped by sociocultural factors. For instance, labor that lasts up to a day may be considered normal, and so is not recognized as dangerous in some communities (Sargent 1980, 1985). On the other hand prolonged obstructed labor may be recognized as abnormal, but taken to be a sign of the woman's infidelity, hence not requiring medical care, but rather a confession for labor to progress (Senah 2003; Thaddeus and Maine 1994).

Sociolegal issues: These refer to situations in which a health problem is recognized, but care is not sought because of fear of social or legal sanctions; or where a condition is viewed as shameful or stigmatizing such that, though recognized as serious, women do not seek appropriate care because of fear of punishment and ostracism. Delayed care seeking for complications due to induced abortion is a good example (Thaddeus and Maine 1994).

Accessibility factors

Physical accessibility: Distance and transportation to health services exert a dual influence on use: first as a disincentive to seeking care, and second as an actual obstacle to reaching care. Pregnant women may not attempt to reach a facility for delivery if they believe the facility is too far. This is especially so when labor sets in at night and there is no ready means of transport, which means walking several kilometers. For those trying to reach a far-off facility with poor transportation, they may reach facilities very late or fail to reach, as some with serious complications may die en route (Thaddeus and Maine 1994).

Economic accessibility: This includes the financial cost of transportation and services, and the opportunity cost from lost time at work (including that by people who accompany women to the facilities). Cost also has a dual role: as a disincentive to seeking care and as an actual obstacle to reaching and receiving care. Families may not seek care if they perceive the cost of transportation and care to be above what they can afford. The cost of good transportation may also lead to delays in reaching and receiving care after the decision to seek care is made (Thaddeus and Maine 1994).

Quality of care

Quality of care also plays a dual role. Perceived quality of care influences the decision to seek care, while actual quality of care affects the timely receipt of appropriate care once a woman reaches a health facility. Perceived quality is more subjective and is related to people's own assessment of service delivery, based on their own prior experience with the health system or that of people they know. The assessment of quality may be based on the service received, hospital procedures, availability of supplies, waiting times, staff attitudes; or the outcome of care based on effectiveness of treatments. Perceptions of quality may also be due to conflicts of the medical 'culture' with that of the woman's, in issues such as privacy, presence of family members during labor, and birthing position. The actual quality of care at the health facility determines the outcome and depends on the availability of competent personnel with sufficient drugs, supplies, and equipment, to adequately diagnose and provide timely treatment. Actual quality of care may only partly overlap with perceived quality (Thaddeus and Maine 1994).

An expanded 3 delays model by Gabrysch and Campbell (2009)

In more recent work, Gabrysch and Campbell (2009) attempt to provide a more comprehensive model for the determinants maternal health service utilization, focusing

specifically on skilled attendance. Their model expands on the three delays model to include preventive obstetric care –“precautionary seeking of a SBA as women go into labor for anticipated normal delivery” (Gabrysch and Campbell 2009). The main addition to the original model by Thaddeus and Maine is a separation of the phases of delays for preventive and emergency obstetric care-seeking (diagram in appendix 3B). This separation is to emphasize that the more important determinants of preventive care-seeking for delivery may not be the same as those for emergency care-seeking for complications. For instance, perceived accessibility may be more important in the decision to seek preventive care, while actual accessibility may be more important for emergency care-seeking (Gabrysch and Campbell 2009). Gabrysch and Campbell also group economic status under economic accessibility and the socioeconomic/cultural factors in the original model relabeled as sociocultural factors; to highlight that economic status affects both the decision to seek care and to reach care –this dual role of economic status is not explicit in the original model, though recognized. In addition, they include a category called perceived benefit/need: with contributing factors including health knowledge, perceived quality of care, antenatal care use, previous facility delivery, birth order, and complications, to illustrate that these factors affect the decision to seek care through perceived need. For quality of care, they separate out quality of emergency care from quality of preventive care to illustrate that different types of care are needed for preventive and emergency obstetric care. Gabrysch and Campbell also show that women can move from preventive to emergency care when they develop a complication in a facility; a good referral system is then necessary if women need to be referred to different facility.

The rest of the constructs are the same as in the original three delays model. The posited relationships and mechanisms by which the constructs are expected to influence the phases of

delays are also similar to that in the original model. The distinctions are that only the first and second phases (deciding to seek and reaching care) are relevant for receiving normal preventive care; the third phase (delays in receiving care) is not relevant for preventive care seeking, unless complications develop. There is also no phase 1 delay when complications develop at the health facility, as the expectation is that it will be diagnosed and treated promptly; and no phase 2 delays unless referral to a higher level facility is required (Gabrysch and Campbell 2009).

McCarthy and Maine's framework for the determinants of maternal mortality

The other common framework for analyzing the determinants of maternal mortality and morbidity is that by McCarthy and Maine (1992). This framework adopts a more comprehensive approach by including prepregnancy determinants of maternal mortality or disability (McCarthy and Maine 1992). The main premise of the framework is that pregnancy is a necessary precondition for a maternal death; and a complication must occur as a result of the pregnancy (or an existing condition worsened by pregnancy) to cause a maternal death. McCarthy and Maine draw from Bongaart's framework for the proximate determinants of fertility, which posits that socioeconomic, cultural, and environmental variables are indirect determinants of fertility whose effects are mediated by direct determinants referred to as the intermediate fertility variables (Bongaarts 1978). This framework is therefore organized around three stages leading maternal mortality/morbidity (McCarthy and Maine 1992).

Closest to the event of a maternal death are the outcomes that culminate in either disability or death – *pregnancy and pregnancy-related complications*. These are directly influenced by five sets of *intermediate determinants*: the health status of the woman; her reproductive status; her access to health services; her health care behavior (including use of health services); and a set of unknown factors. The intermediate factors are in turn influenced by

a set of *distal determinants*: women's status in family and community; family status in community; and community's status (diagram in appendix 3C) (McCarthy and Maine 1992).

Posited relationships and mechanisms for key constructs

Intermediate determinants

Health Status: The factors included here are nutritional status, infectious and parasitic diseases, chronic conditions, and prior history of obstetric complications. A woman's health status prior to and during a pregnancy affects her chances of developing and surviving a complication. For example, a woman with anemia is more likely to die from obstetric hemorrhage (McCarthy and Maine 1992).

Reproductive Status: These include age, marital status, and parity; which can affect a woman's chances of pregnancy, developing a complication, and developing disability from childbirth or dying of a complication. For instance age and parity are thought to have a "J-shaped" relation with maternal mortality – high risks for very young women, older women, women with no children, and those with many children, but are lower for women in between (Maine 1981). Younger women are also more likely to develop certain conditions such as prolonged labor; develop obstetric fistula or die from obstructed labor (McCarthy and Maine 1992).

Access to Health Services: Poor access to health services increases the risk of poor outcomes. The services should include: services for women who want to avoid pregnancy (family planning and abortion services); those for women who want to have a safe and successful birth (antenatal, delivery, and postnatal care); and primary health care (McCarthy and Maine 1992).

Health Care Behavior/Use of Health Services: Since availability does not ensure use, whether or not women use health services as well as other health seeking behavior directly affects their risk of maternal mortality or disability. The use of family planning services, antenatal, skilled delivery, and postnatal care is expected to reduce the risk of poor outcomes (McCarthy and Maine 1992).

Unknown or Unpredicted Factors: This acknowledges that pregnancy complications can occur in women with no known risk factors and unrelated to any of the identified determinants (McCarthy and Maine 1992).

Distal Determinants:

The distant factors are related to the *socioeconomic status* (SES) of the woman, her family, and community. Lower SES at any of the levels is predicted to increase the risk of poor outcomes indirectly through its effect on the intermediate determinants. Measures of women's status here include education, occupation, income, and social and legal autonomy. Family status includes family income, or wealth; and education and occupation of others in the family. Community status is measured by aggregate community resources such as distribution of health facilities and health workers in the community (McCarthy and Maine 1992).

Other models

Other models have been suggested but the determinants and underlying mechanisms are similar to those discussed here (Amooti-Kaguna and Nuwaha 2000; Wild et al. 2010). Also, the three models discussed above are the most developed.

A comparison of the existing models – their strengths and weaknesses

All three models have the prevention of maternal mortality or morbidity as the ultimate outcome. McCarthy and Maine's comprehensive framework consider pregnancy and

complications also as outcomes. The original and expanded three delays models, however, focus on women who are already pregnant, thus pregnancy is not an outcome of interest. The expanded three delays model has complications as an outcome, but the original model assumes a complication has already occurred, hence does not consider complications as an outcome. The three delays models both have utilization of skilled delivery services as the key determinant– an explicit mediator of maternal health outcomes; and identify factors that influence various stages leading to the use of skilled delivery service. In the comprehensive framework, use of health services is just one of the intermediate determinants, and so the focus is on how it affects the ultimate outcomes and less of the factors that affect utilization. All three models were developed following a review of the literature on the determinants of maternal mortality and morbidity. Thus, there is supporting evidence for most of the proposed relationships, though some inconsistencies remain (as discussed in the literature review). There is however less evidence for the proposed mechanisms.

The original three delays model has been widely used for programs aimed at preventing maternal mortality in developing countries. The expanded three delays model has not yet gained broad use but may also be useful for programs that seek to increase use of SBAs for all pregnant women –not just those with complications. But, both models have one weakness: they largely suggest linear relationships and do not account for the apparent interactions between the determinants and the phases of delay. Though some of these interactions are acknowledged and discussed by the authors, they are not highlighted in the models. For example, both frameworks imply that socioeconomic/cultural factors only influence the decision to seek care (arrow from sociocultural factors goes to only phase 1). But this is not necessarily so, as socioeconomic factors can also affect the delay to reach and receive care through a number of pathways:

First, socioeconomic status can affect time to reach care by moderating the effect of distance and transportation. For instance, women of higher socioeconomic status are more likely to live in areas with better access to health facilities, be more familiar with the health system, have their own transportation, or to be able to afford good transportation to the health facility. Thus, for women of different SES who make the decision to go to a health facility at the same time, the time to identify and reach a health facility can vary substantially. Gabrysch and Campbell attempt to address this by separating out economic factors from sociocultural factors. But the factors they classify under sociocultural factors may still affect other pathways. For example, women's autonomy can potentially affect the time to reach care when one considers examples of places where women are not allowed to use certain types of transportation, which may be the only or most readily available form of transportation (Stock 1983; Thaddeus and Maine 1994).

Second, socioeconomic status can affect the time to receive care and the quality of care (actual and perceived). In settings where patients are expected to buy supplies and drugs on reaching the health facility, higher SES women can afford and obtain these services in a timelier manner. Also, higher SES women may be more likely to go to facilities that offer better quality care (Boller et al. 2003; Hutchinson, Do, and Agha 2011; Montagu et al. 2011; Thaddeus and Maine 1994). In addition, they may be treated better by health personnel either because they can assert their preferences (because the power differential between them and health personnel is reduced) or because they are more likely have some relationship with health personnel (Andersen 2004; Gabrysch and Campbell 2009). These factors in turn will affect their perceptions of the quality of care. SES can also affect the assessment of quality care due to different expectations (Hulton, Matthew, and Stones 2000).

Third, the type of illness can potentially affect the time to reach and receive care. For instance in many rural areas in Ghana, motorcycles (and even bicycles) are used to transport pregnant women to health facilities. But for women with certain complications –e.g. eclampsia – alternate means of transportation are needed, which may be harder to find, hence longer delays to reach care. Furthermore, on reaching health facilities, the time to receive adequate care may be influenced by the type of complication. For example, a woman with hemorrhage will experience delays in receiving care if there is no blood available for transfusion – delays that might not be experienced for some other complication. The quality of interaction may also be influenced by the type of complication –e.g., verbal abuse of women with abortion complications.

Fourth, Thaddeus and Maine suggest that, while there is a complex interplay between phases, “one type of delay is not linked inextricably with another” (Thaddeus and Maine 1994:1092). This is a reasonable assumption: a delay in seeking care should not be associated with the delay in reaching care or receiving care. However, when one considers that in certain areas transportation is only available at certain times and days, then when the decision to seek care is made becomes important for the time to reach care. The time to reach is longer at night when vehicles are less available (Kumbani et al. 2013). The time to receive care on reaching the facility may also be longer as facilities tend to be understaffed at night (Issah et al. 2013). When labor sets in at night, the delay in reaching care will not be because of a delay in deciding to seek care. On the other hand, if one makes the decision to seek care at night after a failed home delivery, then the delay to seek care becomes important in the delay to reach and receive care.

These examples suggest a complex interaction between the determinants and the phases of delays which are not illustrated in the three delays models. In addition, the role of contextual factors is not explicit in the models, though acknowledged in the discussions. It is however

important to highlight these factors in the model, so that researchers using the models are cognizant of them. The attempt to expand the original three delays model to account for preventive use of skilled birth attendants is in the right direction. But the presentation of the model is not clear and it does not address many of the limitations of the original model. These models are useful for programmatic purposes, and for basic research to identify potential determinants of use of maternal health services. However, their presentations limit their application in research to understand potential mechanisms underlying the various relationships, including mediating and conditional effects.

The major strength of Campbell and Maine's framework is that it is more comprehensive, and highlights the influence of contextual factors. It also lays out a pathway from distal to intermediate factors to the biological outcomes. However, the intermediate determinants interact in complex ways as discussed above which are not illustrated in the framework. In addition because of the broad approach it takes, the relationships it posits are not very focused, and the expected direction of some of the associations are difficult to predict. For instance, poor health status prior to and during a pregnancy increases the risk of developing and dying from a pregnancy complication, but it is not clear how it affects the likelihood of pregnancy (and hence maternal mortality). Women with poor prior health status may be less likely to become pregnant; which will mean they are less likely to experience a maternal death (though more likely to die from other causes). This framework is useful for identifying points at which to intervene to prevent maternal mortality or disability. For research purposes it provides a detailed list of factors that can potentially influence maternal mortality and morbidity. However, to understand the "why" of the underlying relationships, it is more useful as a basis for developing explanatory models for specific outcomes.

Connecting the dots: An integrated framework for examining determinants of use of maternal health services and maternal health outcomes

The constructs, relationships, and suggested mechanisms for this framework (Figure 1) are derived from the preceding three models. In addition, I draw on two social behavioral theories – the health belief model and the Bandura’s social learning theory – to explain some of the suggested relationships (Bandura 2004; Glanz and Rimer 1997). The health belief model posits that people are more likely to act if they perceive a need (based on their perceived susceptibility, and perceived etiology and severity of the condition); perceive that benefits of the action outweigh the barriers; have cues to action; and reinforcements (Glanz and Rimer 1997). Bandura’s social learning theory posits that people learn through the experiences of credible others (Bandura 2004). Furthermore, I draw on the ecological perspective, which emphasizes the interaction and interdependence of factors within and across multiple levels of influence, to more adequately capture the contextual factors (McLeroy et al. 1988). I also learn from Anderson’s model of health services utilization which emphasizes the health care system, predisposing characteristics (demographic, social structure, and health beliefs), enabling resources (personal/family or community), and need (perceived or evaluated) as the factors that influence use of health services (Andersen 1995).

The main premise of the framework I propose is that: (1) Good quality maternal health care is essential for good maternal health outcomes (van den Broek and Graham 2009; Graham et al. 2013b; Wendy J Graham and Varghese 2012). (2) The decision to use maternal health (MH) services is based on three proximal factors: perceived need for care; perceived accessibility of health services (physical and financial); and perceived quality of care (Thaddeus and Maine 1994). (3) Once the decision to use care has been made, it is actual accessibility that

affects utilization (Thaddeus and Maine 1994). (4) Socioeconomic and sociocultural factors affect utilization of MH services indirectly through the three proximal determinants (McCarthy and Maine 1992). (4) Use of MH services and MH outcomes are influenced by factors at various levels: individual, family, community, health system, and larger context (McCarthy and Maine 1992; McLeroy et al. 1988). The other relationships I posit include the following: perception of need is directly influenced by illness characteristics (woman's current health status – complications (or not), type, and severity); which is in turn influenced by reproductive factors and prior health status, as well as unknown factors (Gabrysch and Campbell 2009; McCarthy and Maine 1992; Thaddeus and Maine 1994). Separating out illness factors from socioeconomic/cultural factors presents Gabrysch and Campbell's ideas for routine and emergency care seeking behavior in a more succinct way. Perception of need is also shaped by health knowledge (general and specific to pregnancy), past pregnancy and complication experience, or any prior health condition, as well as by socioeconomic and sociocultural factors; and knowledge is associated with education and specific health knowledge from health education (Gabrysch and Campbell 2009).

Perceived accessibility is influenced by actual accessibility and socioeconomic factors and may be modified by illness factors (McCarthy and Maine 1992; Thaddeus and Maine 1994). Perceived quality is based on an assessment of quality of care and the outcome of care from a personal previous experience, or the experience of others. It may also be modified by socioeconomic and sociocultural factors (Bandura 2004; Thaddeus and Maine 1994). The assessment can be based on any type of prior encounter with the health system. Illness characteristics can also influence perceived and actual accessibility, the quality of care, and the maternal outcomes (Gabrysch and Campbell 2009; McCarthy and Maine 1992). The quality of

care and accessibility are influenced by the characteristics of the health system; and all the factors are influenced by larger contextual factors in which the health system and sociocultural factors are embedded (McCarthy and Maine 1992).

In the discussion above, I emphasize factors related to skilled delivery care, however, the framework can be applied to utilization of other MH services –antenatal and postnatal care. In the model the orange color refers to individual and family level factors, green is community or other contextual factors, red health system factors, and blue is the outcomes in the model. The main constructs are in bold face. The variables listed for each set of factors are not exhaustive, but to provide examples of possible variables to operationalize the constructs. All the variables listed in the prior models for each construct are applicable here. A broad range of contextual variables can also be examined beyond place of residence (rural/urban, region). Some that have been used include mean number of children to represent “pronatalist” community attitudes; percent of husbands who approve of family planning and the percent of women with secondary or higher education to represent attitudes toward women’s roles; mean number of women who delivered at least one previous birth in a health facility as a measure of the presence of services and community attitudes toward the use of health services; mean distance to nearest clinic to measure availability of formal health service; and the existence of a sewer system to measure of community infrastructure (Pebley et al. 1996; Stephenson et al. 2006a). Poverty and literacy levels and media saturation have also been used (Gabrysch and Campbell 2009). Different levels of influence can also be considered including, clusters, districts, regions and even country depending on the nature of the study (Babalola and Fatusi 2009; Ensor et al. 2013; Gage 2007; Pebley et al. 1996; Stephenson et al. 2006a).

One limitation of this model is that it does not separate out family and individual level factors. Women's autonomy for instance is important in who makes the decision within the family and may be independent from family SES, but it is difficult to make such instances explicit in the model. The arrow from socioeconomic factors to decision to seek care is supposed to account for some of these factors. The numerous arrows may also be distracting, but these are necessary because of the attempt to identify all potentially important relationships between the variables including, direct, mediating, and moderating effects. Solid lines with single arrows in the model indicate a potential direct influence and broken lines with rounded ends are potential moderating effects. As seen in the literature review, there is some evidence of an association between most of the constructs in the model and utilization of MH services, and/or maternal mortality. What is lacking is quantitative studies examining the underlying mechanisms of the various associations including the intervening relationships and how the various factors interact to affect use of maternal services and maternal outcomes. This is an initial attempt to provide a framework to guide such analysis.

The proximal factors are expected to play a role in all settings, but their relative importance will vary in different settings. Not all pathways in this framework can be examined in a particular study, but the framework provides a way of thinking about any outcome that is being studied. This dissertation examines different points in the conceptual framework. The first aim has quality of care as the outcome with SES and place of residence as key predictors. The second aim has use of SBAs as the outcome with SES and place of residence as key predictors and quality of care as a mediating factor; and the third aim has the pregnancy outcome as the outcome, with both quality of care and use of SBAs as predictors. In all three aims, I examine for mediating and conditional effects.

CHAPTER 4: OVERVIEW OF DATA, VARIABLES, AND SAMPLE DESCRIPTION

In this chapter, I will provide an overview of the data used to examine the research questions outlined in chapter 1, describe the main constructs and variables used in the analysis, and describe the sample.

DATA

My ideal dataset is one that contains measures of quality of care that capture receipt of essential services and interpersonal experiences of women with the health system, and which has quality measures for antenatal and skilled delivery care as well as for general health services. It should also have good measures of actual and perceived accessibility and perceived need; as well as those on maternal health outcomes, maternal health service utilization, and sociodemographic variables. I have however not found a dataset that contains all of such information. The datasets I am using have some limitations, but are the best available to answer my research questions. I will use two survey data sets. The main data for this dissertation comes from the Ghana Maternal Health Survey. The World Health Survey is used for supplemental analysis.

The Ghana Maternal health survey (2007)

The Ghana Maternal Health Survey (GMHS) was the first (and still is the only) nationally representative population-based survey to collect comprehensive information on maternal health and mortality in the country. The survey was jointly conducted by the Ghana Statistical Service and the Ghana Health Service, with technical assistance from Macro International.¹ The main aim of the survey was to generate data on maternal health and mortality for policymakers and the research community involved in the Reducing Maternal Morbidity and Mortality (R3M) program. The R3M program was launched in 2006 by a consortium of organizations including

¹ The agency that conducts the Demographic and Health surveys

Engender Health, Ipas, Marie Stopes International, World Health Organization, and Willows Foundation and led by the Population Council. The objectives of the program was to provide the commitment and financial and technical resources to assist the government of Ghana to: increase the contraceptive prevalence rate by making contraceptive methods and comprehensive abortion care services more available and more highly utilized; and to reduce morbidity and mortality due to unsafe abortions in three regions – Greater Accra, Ashanti, and Eastern regions – to support progress towards the MDG-5. The R3M programs was launched following an in-depth review of maternal mortality in 2004 by the UNFPA, which gave two medium-term recommendations: (1) to conduct a national population-based maternal mortality survey, and (2) to conduct a sociocultural analysis of factors influencing the use of delivery care in Ghana and design region-specific interventions to reduce maternal mortality appropriately. The GMHS was intended to serve as baseline data for the R3M program. However, the data was collected from a nationally representative sample to allow an assessment of the level of maternal health and mortality for the country as a whole.

Data collection was conducted in two phases. In phase 1, a short household questionnaire was administered in 227,715 households to identify deaths to females age 12-49. The sample for Phase I was randomly selected from 1600 primary sampling units (half from the R3M regions and half from the other regions) selected within the 10 administrative regions of the country, across urban and rural areas. The primary sampling units consisted of wards or sub-wards drawn from the 2001 Population Census. A total of 5,931 female deaths were identified in Phase I. In phase II, 400 clusters were randomly selected from the 1600 clusters identified in phase I. Households with women age 15-49 were selected from these 400 clusters (half from the R3M regions and half from the other regions) stratified by region and urban-rural residence. These

households were selected randomly and independently from the households identified in the first phase as having experienced a female death. Institutional populations (those in hospitals, army barracks, etc.) and households residing in refugee camps were excluded from the GMHS sample

In phase II verbal autopsies were completed for 4,203 of the deaths identified in Phase I. A household questionnaire and women's questionnaire was also administered in a subsample of households in Phase II to collect information on key demographic and health indicators including antenatal, maternity, and emergency obstetric care in the event of a birth, abortion, or miscarriage. In addition, a sibling history was obtained in Phase II to provide direct estimates of maternal mortality. Interviews were conducted face-to-face in English, Akan, Ga or Ewe using previously translated questionnaires. The response rate was 99% at the household level and 98% for the individual women. The refusal rate was low in both urban and rural areas (about 2% in both). The principal reason for nonresponse was the failure to find anyone or women of reproductive age at home, despite repeated visits to the household. Phase II yielded 10,858 completed household interviews and 10,370 individual interviews for women aged 15-49 years (Ghana Statistical Service et al. 2009).

There has been no follow up survey to the baseline survey, but there have been a few more recent surveys like the Ghana demographic health survey (GDHS) in 2008 and the fourth UNICEF multiple indicator cluster survey (MICS4) for Ghana in 2011; which collected some of the information in the GMHS. The main advantage of the GMHS over these recent ones is that, unlike the other surveys that only asked the maternal health questions to women who had a live birth in the preceding five years, in the GMHS the questions on maternal health and especially quality of antenatal care was asked to all women with a birth (live or still birth) in the preceding five years.

Because this analysis focuses on the use and quality of maternal health services, the GMHS sample of women who had a birth in the preceding five years is the base sample for the analysis (N=5,088 =49.1% of all women interviewed). The analytic sample is however 5,042 women (99.1% of the base sample) because of missing values on 46 cases (18 cases missing delivery assistant, 34 cases missing on number of antenatal care (ANC) visits; 3 cases missing years of education, and 1 case missing marital status and age at first union). Since it is impossible to examine quality of care for women who did not have any encounter with the health system, the main sample for all three aims is restricted to women who attended at least one ANC visit during their pregnancy (N=4,868 = 96.6% of the full analytic sample), to be able to adequately examine the determinants and effects of quality of ANC. The full analytic sample is however used in supplementary analysis. See figure 4G1 for a flow chart on how the GMHS sample was derived.

All the descriptive statistics based on this data are weighted using sampling weights provided with the data set to account for the complex sample design. The weights provided with the datasets are only for the individual level and there is not enough information to deconstruct them for higher levels for use in multilevel analysis. The multilevel analysis based on this data is thus unweighted. However, I will conduct sensitivity analysis using the weights in single level analysis to determine if the results from the weighted and unweighted analysis differ. This is because unweighted analysis may underestimate standard errors leading to type 1 errors – significant associations when in fact there is no association. On the other hand, the weighting is not expected to be a problem in the multilevel analysis, because the multilevel analysis also tends to produce larger standard errors than single level analysis, hence has a lower chance of type 1 error.

====Figure 4G1 about here====

The World Health Survey (2003)

The second survey database used in the analysis is the World Health Survey conducted in 2003. Though my focus is on Ghana, I will pool data from the World Health Survey (WHS) for Ghana and Burkina Faso to increase the power of my analysis. Burkina Faso is the immediate northern neighbor of Ghana, and has maternal health indicators similar to Ghana. The WHS is a multicounty population-based survey which was conducted as part of a WHO project to assess health system performance in member countries. Nationally representative samples were drawn for each country using sampling frames that included all people living in the country (i.e. the de facto and not the de jure population). All adult members of the general population aged 18 years and older were eligible to participate. Households were selected using a multistage cluster design. One individual in each household was randomly selected using the Kish table method. Face-to-face paper and pencil interviews were conducted by trained interviewers using a standard questionnaire in English, French, or other major language in each country using previously translated and validated questionnaires. The surveys for Ghana and Burkina Faso were both conducted in 2003. The sampling design, questionnaires and methods of data collection were similar for the two countries (WHO 2005c, 2005d, 2005e).

A summary of the survey reports that, the response rates were: 73% (N=4,121) for households and 97% (N=3,873) for individuals for the Ghana sample; and 98% (N=4,933) for households and 99% (N=4819) for individuals for Burkina Faso (WHO 2005d, 2005e). This should give a combined sample of 8692, but the number of individual observations in the data set is 8,763 (3,938 for Ghana and 4,825 for Burkina Faso). Multiple inquiries about the inconsistency in the sample size in the survey documents and the dataset have yielded no

response. I therefore interpret findings from the WHS with a lot of caution. Of the 8,763 observations, 4715 are females. The questions on maternal health services were also restricted to women with a birth in the five years preceding the survey (N=2,267: 857 for Ghana and 1,410 from Burkina Faso). This is thus the base sample for the analysis. The analytic sample is however 2,005 women (703 for Ghana; and 1,302 for Burkina Faso) due to missing data on key variables for 262 observations. For the analysis on quality of care, the analytic sample is further restricted to those who attended at least one ANC (N=1,671 =83.3% of the full analytic sample). See figures 4W1A and 4W1B for a flow chart for how the WHS sample was derived and distribution of missing data for the combined sample and by country.

All analysis using this pooled dataset will examine country fixed and conditional effects. Weights are not used for the pooled data because the weights provided are country specific. Also the weights are provided for only individuals and there isn't enough information to deconstruct them for the higher levels to use in the multilevel analysis. Thus the multilevel analyses with this dataset are also unweighted. I will however conduct sensitivity analysis with single level analysis with robust standard errors for the pooled sample, and weighted single level analysis stratified by country.

===Figure 4W1A about here===

===Figure 4W1B about here===

CONSTRUCTS AND VARIABLES

In this section, I describe how I operationalize the key constructs in this dissertation. I also describe other variables which are used in more than one chapter. Non-key variables which are only used in specific chapters are discussed in those chapters

Operationalizing and measuring quality of maternal health (MH) care

A major reason for the dearth of studies on the role of quality of care on maternal health seeking behavior is the lack of data on it, which is due to the difficulty in measuring it using a single or simple set of indicators (Wendy J Graham and Varghese 2012). A good working definition of quality of MH care is needed to effectively operationalize it. Attempts to define quality of MH care have looked to the general health care quality literature, which provide no universal definition of quality of care (van den Broek and Graham 2009; Hulton et al. 2000; World Health Organization 2006). Quality of care is however widely acknowledged to embrace multiple levels and multiple dimensions (van den Broek and Graham 2009; World Health Organization 2006). In this section, I describe some of the proposed quality dimensions and how I use them to operationalize quality of maternal health care in this dissertation.

Donabedian (1966) defined quality of care as “the extent to which actual care is in conformity with present criteria for good care” (Donabedian 1966); and identified three dimensions of quality of care: structure, process and outcome (A. Donabedian 1988). *Structure* refers to the attributes of the settings in which care occurs. This includes the attributes of material resources (e.g. facilities, equipment), of human resources (e.g. number and qualifications of personnel), and of organizational structure (e.g. medical staff organization, and supervision). *Process* is what is actually done in giving and receiving care. It has two components – the technical and interpersonal aspects of care. The *technical aspect* is the knowledge, judgment, and skill used in making diagnoses, identifying appropriate treatments, and implementing them. An assessment of technical quality is based on the current best practice for the outcome of interest. The *interpersonal aspect* is said to be “the vehicle by which technical care is implemented.” It includes the interaction between patient and provider, the attributes of

the settings in which care is provided and whether these meet individual and social expectations and standards. It includes such things as privacy, convenience, comfort, concern, empathy, confidentiality, informed choice, honesty, respect, sensitivity, etc. *Outcome* refers to the effects of care on the health status of patients and populations. It also includes improvements in patients' knowledge and behavior and patient satisfaction. The assumption of this framework is that: good structure increases the likelihood of good process; and good process increases the likelihood of a good outcome; but this is not necessarily the case (A. Donabedian 1988). This framework has been applied in a few studies examining quality of MH care though not all the dimensions were captured (Nicholas N. A. Kyei, Chansa, and Gabrysch 2012; Naariyong et al. 2012).

Maxwell (1984) suggested six dimensions of quality - *Effectiveness, efficiency, accessibility, acceptability, equity, and safety* (see appendix 2A for definitions). These dimensions have been adopted by WHO and the Institute of Medicine (Institute of Medicine 2001; Maxwell 1984; World Health Organization 2006). Maxwell's dimensions are quite generic and identifying measures for the various dimensions is not as intuitive as Donabedian's dimensions. However careful selection of indicators for each dimension gives an even more comprehensive measure of quality, as structure, process, and outcome can be assessed under each of Maxwell's dimensions; in addition to *access* which is not captured in Donabedian's framework. These dimensions have informed WHO's indicators of health system responsiveness – the way in which individuals are treated and the environment in which they are treated (Peltzer 2009; Rice, Robone, and Smith 2008; Robone, Rice, and Smith 2011; WHO 2000; World Health Organization 2006). The emphasis in health system responsiveness is patient experience, thus all the indicators are based on the patient's assessment, and provide a holistic assessment of quality

from the patient's perspective. The limitation, however, is that it may not accurately reflect actual structure and technical quality of care. For studying the effect of quality on utilization of maternal health services, this limitation is likely not a major issue as a woman's assessment of quality of care, even if not accurate, is a better predictor of their behavior than technical quality assessed by an expert –if they are not recognized by women as relevant.

There have been many other proposed definitions and models for assessing quality, with an emphasis on clinical effectiveness, safety, and a good patient experience (Campbell, Roland, and Buetow 2000; De Geyndt, 1995; Godlee 2009; Heidemann 1993; Maxwell 1984, 1992; Mitchell, Ferketich, and Jennings 1998). Hulton et al. (2000) draw on the IOM definition – “quality of care is the degree to which health services for individuals and populations increase the likelihood of desired outcomes and are consistent with current professional knowledge” – and incorporate the concepts of effective and timely access and reproductive rights, to provide a working definition for quality of maternal health services: “the degree to which maternal health services for individuals and populations increase the likelihood of timely and appropriate treatment for the purpose of achieving desired outcomes that are both consistent with current professional knowledge and uphold basic reproductive rights” (Hulton et al. 2000:9). This definition is a bit problematic as it includes the presumed effect of the construct in the definition of the construct. However, based on this definition, and drawing on various recommendations for managing pregnancy Hulton et al. propose a useful framework with ten elements to operationalize quality of MH care. Six of the elements assess *provision of care*: human and physical resources; the referral system; management information systems; the use of appropriate technologies; internationally recognized good practice; and the management of emergencies. Four elements assess patient *experience of care* of: human and physical resources; cognition;

respect, dignity and equity; and emotional support (Diagram and definitions in appendix 2B).

This framework has been successfully applied by the developers in a developing country setting (Hulton, Matthews, and Stones 2007). Its comprehensiveness, however, makes it a little overwhelming to work with.

Other definitions and indicators of quality of MH care have been proposed but are either only focused on only service provision or do not provide clear pointers on what dimensions to measure quality on (Hussein et al. 2001; Pittrof, Campbell, and Filippi 2002). Other researchers have also suggested an assessment of quality of MH that incorporates determinants at multiple levels including the political environment, financing, sociocultural factors, health systems, training and education of health workers, and collaborations; and which considers the health of women throughout the lifecycle (Kwast 1998; Winnard 1995). This is laudable since the health of women prior to pregnancy affects their health during pregnancy, and the health system does not operate in isolation from other macro level factors. However attempting to operationalize quality of care based on such a broad perspective may lose sight of fundamental and basic aspects of care for women during pregnancy.

For this dissertation, I integrate Donabedian, Maxwell and Hulton et al's frameworks to provide a working definition. Quality of maternal health services is defined here as: *the extent to which maternal health services are provided in conformity with present criteria for good care, and meets women and families' expectation of care*. This implies that essential maternal health interventions based on current guidelines and recommendations are provided to all women in a way that leads to a good patient experience and a good health outcome. My ideal approach to measuring quality will thus be to examine the two broad dimensions of quality: that related to service provision and that related to patient experience of care – each of which should capture

structure, technical, and interpersonal aspects of the process of care, as well as the outcomes of care. Ideally these measures will be available for antenatal and delivery/postnatal care, and can be based on personal prior experience or the experience of others. Unfortunately, none of the datasets available to me has all such information. I am therefore working within the limitations of the current data for this dissertation.

The main measure of quality used in all three aims is based on services received during ANC. This measure of ANC quality captures service provision which is consistent with recommended practices. I also examine a measure of quality which captures patient experience using the health system responsiveness variables from the world health survey. Though the assessment of quality in the world health survey was not specifically on quality of MH care, it is assumed that the quality of any previous encounter with the health system will affect any future use of services. In addition, the quality of care experienced for general health services is expected to be similar to the quality experienced for MH services, considering that the same facilities offer both MH and general health services in many developing countries. A few community-based studies in other countries have examined perceived quality of care using similar measures (D. V. Duong et al. 2004; Stekelenburg et al. 2004). The final measure of quality is an outcome measure of pregnancy and delivery care – the pregnancy or birth outcome. The quality of care measures are described in detail below. There are limitations in how quality is operationalized because of the type of variables in the existing data, but the data used for this analysis are the best available in terms of representativeness and inclusion of relevant variables. A major goal in working with these datasets, despite their limitations, is to provide preliminary evidence on the determinants and effects of quality of MH care in SSA, as well as to identify the

limitations of the existing measures to guide the development of better measures of quality of MH care.

Quality of Antenatal care

With the GMHS, quality of ANC is operationalized by an index created from a count of nine binary variables from questions on services women received during their last pregnancy. The services are: being weighed, blood pressure checked; a urine sample taken, a blood sample taken; education received on signs of pregnancy complications; education received on where to go if they developed a complication; received or told to buy iron supplements; received an anthelmintic; and tetanus vaccination. Each question had a binary response (1=Yes; and 0=No). (Exact wording of questions are in appendix 5G1A). Women were also asked if they had a tetanus vaccination at any time before pregnancy, and how many times they had received it. Four tetanus injections are required for full protection (WHO Department of making pregnancy safer 2006). Thus, women who reported receiving at least four injections prior to the index pregnancy were coded as having received a tetanus injection even if they had not received it during the index pregnancy.

To create the index of quality of ANC the variables were summed using the ‘egen’ with “rowtotal” command in Stata. With this command, observations missing on one or more of the component variables are assumed to be zero; no observations were missing on all the component variables. This helps address the issue of differential missing information for the component variables as observations are not dropped because they are missing on one or more of the component variables. This approach may underestimate the quality of care as missing observations from people who did not know whether or not they received the service are counted as having not received it. It is however likely not a big issue here as the services examined are

services women can generally tell whether they received or not with good recall (Adjiwanou and LeGrand 2013; Nikiéma, Beninguisse, and Haggerty 2009). In addition only use of antihelminthics had a large amount (376 =7.7%) of missing values among the set of variables. There are no missing observations on weight taken and blood pressure measured. The distribution of missing on the other variables are: 1 case on urine sample taken, 2 cases on blood sample taken, 13 cases on whether she was educated on the signs of pregnancy complications, 15 cases on tetanus injection and 21 cases on iron tablets (appendix 5G1B).

Principal component analysis of the variables yielded one dominant factor (with two other factors with eigenvalues greater than 1). However, I decided to use the summative index because of the problems of PCA using binary variables (Kolenikov and Angeles 2009). The sum also provides greater ease of interpretation. The reliability (alpha) coefficient for the group of variables is 0.55. The index ranges from zero to nine with responses spanning the entire spectrum; the mean is 7.4. The untransformed variable had a more normal distribution than, squared, cubic, square root, and log transformations, hence the decision to use the index as a continuous variable in its original form for the analysis for the determinants of ANC quality. It is however also dichotomized and examined as a binary variable (coded: 0- received 0 to 7 services and 1- received 8 or 9 services). About 39% had a quality score of 7 or less out of 9, and 61% had a score of 8 or 9. The final models are also run using the ANC quality of care measure extracted from the principal component analysis as a robustness check.

With the WHS, fewer questions are available to measure of quality of ANC. I will use an index of quality of ANC based on a count of three binary variables: whether the respondent had her blood pressure checked; had a blood test done; and was educated on the signs of pregnancy complications and what to do if they should occur. The referent time period is during any ANC

visit during their last pregnancy in the preceding 5 years. A fourth variable – whether she was counselled on HIV during ANC for the last pregnancy was not used because it was asked of only those with a birth in the preceding two years. This scale therefore ranges from zero to three: Less than 5% had none of the services, 30% had only one service, 37% had two services, and 28 had all three services (appendix 5W1). Because there isn't enough spread to use as it as a continuous variable, I dichotomize it into a binary variable (coded: 0- received 0 to 2 services = lower quality; and 1- received all 3 services= higher quality). Quality of ANC is the dependent variable in aim 1 and an independent variable in aims 2 and 3.

Patient experience (only in the WHS):

As mentioned earlier, the measures of quality of ANC do not adequately capture women's interpersonal experience or their perception of the quality of care. The main reason for using the WHS data is because it includes the set of questions on health system responsiveness, which I use as measures of patient assessment of prior encounters with the health system (or interpersonal aspects quality of care) and perceived quality of care. The questions in the module include 15 items covering nine domains of health system responsiveness: ***access*** (travel time to hospital); ***prompt attention*** (wait time at facility); ***dignity*** (talked to respectfully; and privacy during physical examination); ***autonomy*** (told treatment information, involvement in care); ***confidentiality*** (talked to privately, confidentiality of records); ***health facility environment*** (cleanliness, space); ***choice*** (ability to choose health care provider); ***communication*** (clear explanation, time for questions); and ***social support*** (being allowed visitors of their choice, contact with outside world) (WHO 2005a). Respondents who received inpatient care in the five years preceding the survey (for themselves or their children) were asked to rate their experiences on a scale of 1 to 5: (1 = very good, 2 = good, 3 = moderate, 4 = bad, and 5 = very bad). For

example: “For your [child's] last hospital stay, how would you rate your experience of being greeted and talked to respectfully?” A similar set of questions, excluding those on social support, was asked to people who had not received inpatient care in the five years preceding the survey, but had received outpatient care in the one year preceding the survey. There is a significant positive correlation between all the items in the modules, with reliability coefficients of over 0.8 for both the inpatient and outpatient items.

However, with better understanding of the data, I have come to realize the data from these questions are not as useful for my analysis as I thought because of a number of reasons: First, the restriction of the questions to only those who reported an inpatient visit in the preceding five years (or an outpatient visit in the preceding one year), results in this information for just about a third of my analytic sample (accounting for other missing data). Second, the sample of women with an inpatient visit in the preceding five years (or an outpatient visit in the preceding one year) over represents women who were assisted by a SBA: delivery with a SBA would either be an inpatient or outpatient visit. About 50% of women who reported an inpatient visit reported the reason for the visit as childbirth, and 96% of these women reported using a SBA in the last birth. Third, because my analysis is restricted to women with a birth in the preceding five years, some of the encounters being reported would have occurred after the last birth, or the visit being reported refers to the visit for the last birth. Thus, the experience being reported is unlikely to have influenced the decision to use a SBA for the last birth, considering the temporal ordering of the events. This is particularly so for the outpatient encounter which was for a visit in the preceding one year. None of the key associations with the outpatient variables are significant, so I am not discussing the analyses based on them. I however describe

below the creation of the indices for the inpatient measures (the process was similar for the outpatient measures).

The reliability coefficient for the items in the inpatient module is 0.878, and most of the correlation coefficients are greater than 0.3 (least is 0.15). To create the scales, I reverse coded the variables so they went from 1 “very bad” to 5 “very good.” Principal component analysis (PCA) showed that, except for the question on access, the questions in the set hang well together: PCA with both orthogonal and oblique rotations yielded three factors with Eigenvalues of 5.60, 1.48, and 1.21. Since most of the items loaded on the first factor, I set the minimum Eigenvalue at 1.5, resulting in one factor being extracted with factor loadings ranging from 0.468 to 0.734. The reliability coefficient did not change with the exclusion of the only item with loading less than 0.5, and so I decided to keep all 14 items for the scale. I extracted the factors from the PCA based on the 14 items to create an interpersonal quality of care scale for inpatient services; and used the question on rating of travel time to the health facility separately as a measure of perceived accessibility (to the nearest inpatient facility). I also created another index by averaging and summing all the items to give an interpersonal quality of care scale ranging from one to five, which is easier to interpret. Based on this scale, most respondents rated the interpersonal quality of care for the inpatient visit as moderate to good (mean = 3.71, SD=0.032); although the ratings spanned the full spectrum from very bad to very good (range of 1.71 to 5). One in ten people rated the inpatient quality of care as very bad or bad, and one in five people rated it as very good. In addition, I created an index on patient assessment of the structure and technical aspects of care using three items on patient assessment of whether or not health providers’ skills, equipment, and drug supplies were adequate (binary variables with “yes” or “no” responses coded “1” and “0” respectively). This index therefore ranges from zero to three.

My initial intention was to also examine determinants of perceived quality of care in aim 1 using the perceived quality of care scales as dependent variables. But, I have not presented these results because this analysis could only be done for the third of the sample that had an inpatient visit in the five years preceding the survey (since I could not impute for the missing observations in the dependent variables). In addition, all the key associations were not significant beyond the bivariate models. I however examined the perceived quality of care measures as predictors of use of SBAs in aim 2. In order not to drop the two thirds of the sample that did not have an inpatient visit from the analysis, I initially coded all those who did not have an inpatient visit to “0” on the scales and then included an indicator variable for whether or not a person had an inpatient visit. But this did not work very well in the multivariate analysis because there were three variables with the same indicator variables, which resulted in two of the indicator variables being dropped out of the multivariate models. To address this issue, I recoded the scales into categorical variables. For the interpersonal quality scale, I dichotomized the PCA scores at the median score coded: 0 –bad quality – if below the median, 1 –good quality– if at or above the median, and 2 – No inpatient care/missing (includes all those who did not have an inpatient encounter). For the index on patient assessment of the structure and technical aspects of care, I recoded it into 0– inadequate – for score of 0-2, 1 – adequate – for a score of 3, and 2–No inpatient care/missing. The perceived access variable is also recoded into a categorical variable coded: 0 – bad perceived access (combines very bad to moderate – scores 1 to 3), 1 – good perceived access (combines good and very good – scores 4-5), and 3 – No inpatient care/missing. These variables are independent variables in aim 2 for the analysis based on the WHS.

Pregnancy outcome

Pregnancy outcome refers to whether a woman had a stillbirth or a live birth in her last pregnancy. It is a computed variable provided in the dataset, created from several questions including: “Was the baby born alive or born dead, or did you have a miscarriage or abortion? Did that baby cry, move or breathe when it was born? If born dead or lost before birth: How many months did this pregnancy last?” Babies born after 6 months (pregnancy duration of seven months or above) that were reported as born dead, or did not cry, move, or breath when it was born were coded as stillbirths. This is consistent with the WHO definition of stillbirth for international comparisons: $\geq 1000\text{g}$ birth weight or ≥ 28 completed weeks of gestation (Cousens et al. 2011). Because the questions on use of maternal health services were only asked of those who had a stillbirth or live birth in the last pregnancy in the preceding five years, pregnancies that ended in miscarriages and induced abortions are not included in this analysis. Pregnancy outcome is therefore a binary variable coded ‘1’ for stillbirths and ‘0’ for live births. Pregnancy outcome is the dependent variable in aim 3.

Use of a skilled birth attendant

Use of a SBA operationalizes maternal health seeking behavior – the actions taken by women to ensure the most optimum pregnancy outcomes for themselves and their babies – drawing on the general definition of health seeking behavior (Ward, Mertens, and Thomas 1997). The question on delivery attendant is worded as: “When you gave birth to [name of last child], who assisted in the delivery? Anyone else?” All persons mentioned are listed, and presented in the dataset as seven variables on whether the respondent mentioned a doctor, nurse or midwife, auxiliary nurse or midwife, traditional birth attendant (TBA), relative or friend, other, or no one. I combined these to create a binary variable “use of a SBA”: coded as 1 – delivered by a SBA – if doctor, nurse or midwife, or auxiliary nurse or midwife was mentioned; and 0 – not delivered

by a SBA – if otherwise. Technically, auxiliary nurse/midwives are not skilled birth attendants. However, they are considered as health workers in many parts of SSA and some studies have suggested that women identify health workers by their uniforms, which may not be accurate in discriminating between a nurse and an auxiliary nurse (Hussein et al. 2005). In my experience, women may even refer to male auxiliary nurses as doctors and to female doctors as nurses. In addition, it is the decision to go to the health facility for the delivery that is the woman's. Once a woman arrives at the health facility, she has no control over who assists in her delivery. It is also unlikely that an auxiliary nurse/midwife will be the only person assisting a delivery if more highly trained health workers are available. Categorizing deliveries by auxiliary nurses/midwives under deliveries by SBAs is, therefore, more likely to reduce misclassification. Moreover, deliveries by auxiliary nurses/midwives represent less than 10% of the deliveries by a SBA in this analysis. I also examine a variable on place of delivery (whether the respondent reported delivering in a health facility or not) as an outcome in the supplementary analysis. Delivery by a SBA and in a health facility are expected to yield similar results, as almost all deliveries by SBAs occur in health facilities, and deliveries in health facilities are mostly by SBAs. Use of a SBA is the dependent variable in aim 2 and an independent variable in aim 3.

Socioeconomic status and Place of residence

Socioeconomic status

Socioeconomic status (SES) refers to the hierarchical rank or social standing of an individual or family in their particular community or society. It incorporates economic status usually measured by income and/or wealth and social status usually measured by education and/or occupation (Adler et al. 1994). While some researchers use a composite measure of SES, others recommend specifying the individual measures, as they may have different effects for

different outcomes (Braveman PA et al. 2005). This is especially true for maternal health seeking behavior where the effect of education, wealth, income and occupation differ in different contexts. Using measures of the individual components of SES is also more useful for identifying plausible explanatory pathways and mechanisms by which SES affects outcomes (Braveman PA et al. 2005). Composite SES measures are rarely used in the maternal health literature, which would make comparisons with the existing literature difficult. Thus, I operationalize SES as education and wealth in the GMHS, and as education, wealth and occupation in the WHS (The GMHS has no question on occupation).

With the GMHS, I examine education both as a categorical variable (highest level of education attained by respondent) and as continuous variable (years of education attained). But, years of education is used in the multivariate models presented because both formulations of this variable produce similar results and the continuous/categorical variable interaction is easier to interpret than the categorical/categorical variable interaction. It is top coded at 12 years of education since there are very few women with more than 12 years of education in the sample; and centered at the mean years of education for the sample to reduce collinearity with the interaction terms and to aid interpretation (Aneshensel 2013; Krull 2014). Wealth is measured by wealth quintiles provided in the dataset. These quintiles are obtained from a wealth index based on principal component analysis of variables on household assets (Rutstein 2008). With the WHS, education is measured as a binary variable (no formal education and some formal education) because more than half of the sample has no formal education² and very few have higher education. The WHS does not come with a pre-constructed wealth index so I created a

² Formal education refers to education within recognized educational institutions. Non-formal education refers to education, learning and training which takes place outside recognized educational institutions (<http://infed.org/mobi/what-is-non-formal-education/>). Formal education is used in this survey to refer to any schooling.

wealth index from 17 household assets similar to those used for the wealth index in the GMHS. All are binary, but for four count variables which were dichotomized at their medians to have them on the same metric as the other variables so that they can be summed. Example questions are: Does anyone in your household have a television? –Yes/No; Does anyone in your household have a refrigerator? –Yes/No; How many rooms there are in your home? etc. I examine wealth index as both a continuous variable and a categorical variable (dividing it into tertiles). These variables produce similar results so the categorical variable is used to be consistent with the GMHS analyses. I created the wealth index from principal component analysis which drops cases missing on one or more of the component variables, and another using the ‘egen’ and ‘rowtotal’ command in stata which codes those missing on one or more variables to zero. The results are similar for both, so I use the latter which has fewer missing observations for the analysis.³ I also include occupation status from two questions on employment status and type of job in the WHS (coded: 0-Not working for pay, 1- professional occupation, 2-Service/sales occupation, and 3-agricultural worker). Education, wealth, and occupation are independent variables in all the analysis.

Place of residence

Place of residence refers to whether the respondent lives in a rural or urban area. Urban areas are defined as localities with 5,000 or more persons, while rural areas are localities with less than 5,000 persons. A locality is “a distinct population cluster (also designated as inhabited

³ Another approach to create wealth index, based on household assets is to weight each item owned by its rough monetary value in the place the respondent lives (either country or region of a country). The reason is that a refrigerator may be much more expensive than a bike or TV. This requires collecting information on the local or average national cost of each item. I may consider this in future work, but, because of the issues with the WHS data discussed, I don’t think it is worth the effort in this analysis. Furthermore, the wealth index based on principal component analysis is the most common approach used to measure wealth in developing settings.

place, populated center, settlement) which has a name or locally recognized status” (Ghana Statistical Service 2012:9). Place of residence is a contextual measure capturing the general quality and accessibility of health services in the area where each respondent lives as well as other factors. It is an independent variable in all the analysis. The other variable related to place of residence is the region where one lives, which is examined as a control variable in the GMHS and as the third level in the WHS analysis. The district is the third level in the GMHS and the cluster of residence is the second level in both the GMHS and the WHS.

Other variables

Antenatal care variables: timing, frequency, facility, and provider

Timing of first antenatal visit is from the question: “How many months pregnant were you when you first received antenatal care for this pregnancy?” It is recoded into the trimester of the first ANC visit: first trimester (0 to 3 months), second trimester (4 to 6 months), third trimester (7 or more months), and don’t know. WHO recommends that women start antenatal care in the first trimester and go for at least four visits (WHO 2002). *Number of ANC visits* is from the question: “How many times did you receive antenatal care during this pregnancy?” It is recoded into: ‘one to three visits’ and ‘four more visits. *Type of ANC facility* is from the question: Where did you receive antenatal care for this pregnancy? It is recoded by the type of facility into government facility, private facility (including maternity homes), and home/any place other than a health facility. Government facility is further divided by the level or tier of the facility into government hospital or polyclinic; and health center, health post, or other lower level facility. *Type of ANC provider* is from the question: “Did you see anyone for antenatal care during this pregnancy? IF YES: Who did you see?” The providers are grouped under doctor, nurse or midwife, and other (any provider other than a doctor, nurse or midwife)

Risk factors for adverse pregnancy outcomes

In the GMHS, I include three binary variables on prior adverse pregnancy outcomes based on the following questions: *Prior miscarriage*: “Some women lose their pregnancy spontaneously, that is they have a miscarriage. Have you ever had a miscarriage? That is have you ever lost a pregnancy spontaneously?” *Prior abortion*: “Women sometimes take steps to end their pregnancy, because they find themselves pregnant when they do not want to be, or when it is difficult for them to continue with their pregnancy because of opposition from their husband, partner, relatives or others. Have you ever been in a situation when you or someone else have had to do something to end your pregnancy” *Prior stillbirth*: “Some women have stillbirths, that is, they give birth in late pregnancy to a dead child. Have you ever had a still birth?” This variable is recoded to exclude the outcome for the last pregnancy. Prior miscarriage is combined with prior stillbirth in some analysis as prior miscarriage or stillbirth.

I also include three binary variables to assess complications in the index pregnancy. These are: *Any pregnancy complication*, from the question: “At any time just before, during or after the delivery of (NAME) did you suffer from any problems? List of problems include : headaches, blurry vision, edema, preeclampsia, convulsion, eclampsia, excessive bleeding, tetanus, foul smelling discharge, prolonged or obstructed labor, uterine rupture, placenta previa, retained placenta, high fever, fistula, babies movement was low, breech presentation (hands or feet came delivered first), and other. This list covers all the major causes of maternal deaths and responses are not mutually exclusive. Mention of any of the conditions is coded as having had a pregnancy complication. *Serious pregnancy complication* is a recoded variable from a follow up question to the above question: Did you see anyone about this (these) problems? A complication for which care was sought is considered a serious complication. *Reason for antenatal care* is from

the question: “The very first time you went for antenatal care when you were pregnant with (NAME), did you go because of problems with the pregnancy or just for a checkup?” *Sibling experienced maternal death*: this is a recoded variable based on responses to several questions on whether the respondent has lost a sister and the circumstances surrounding the death from the verbal autopsy

The WHS does not have questions on prior or current pregnancy complications, so to control for factors related to the woman’s health status, I include two variables: *Self-rated health status*: From the question “In general, How will you rate your health today? The responses range from 1 “very good” to 5”very bad.” And *any diagnosed chronic health condition*. This variable is created from six questions on whether the respondent has ever being diagnosed with diabetes, asthma, arthritis, heart disease, depression, or schizophrenia (coded 1 if diagnosed of any; 0 if not – separating out the mental health conditions did not change the results hence the decision to use the combined measure).

Familiarity and satisfaction with the health system

With the GMHS, I control for familiarity with the health system using a variable on knowledge of family planning source: “Do you know of a place where you can obtain a method of family planning?” I also include two questions on contraception: ever use – “Have you ever used anything or tried in any way to delay or avoid getting pregnant?” – and current use – “Are you currently doing something or using any method to delay or avoid getting pregnant?”

These variables are not available in the WHS; instead I assess satisfaction with the health system based on the question: “In general would you say you are very satisfied, fairly satisfied, neither satisfied nor dissatisfied, fairly dissatisfied, or very dissatisfied with the way the health care runs in your country” (ranges from 1 “very dissatisfied to 5”very satisfied).

Other control variables include:

Age: measured as age at last birthday. *Gravidity*: total number of pregnancies ever had
Parity: total number of children born alive. *Number of children alive*: total number of children born alive minus number of children born alive who are dead. *Marital status*: categorized as currently married, cohabitating, previously married, and never married. *Age at first union*: categorized as married before 19 years, after 19 years, and never married. *Sex of the household head*: categorized as female headed household or not. *Religion*: categorized as Catholic, Methodist or Presbyterian, Pentecostal or Charismatic, Other Christian, Moslem, Traditional/no religion/atheist/other. *Ethnicity*: Grouped into Akan, Ga/Dangme/Guan, Ewe, Mole-Dagbani/Hausa, Grussi/Gruma, and Other/missing (4missing).

GENERAL ANALYTIC APPROACH

Initial analysis involved descriptive statistics for the sample – means for continuous variables and proportions for categorical variables. Next I conducted bivariate analysis examining the associations between all the variables and the outcomes. T-test was used to examine the mean difference in quality of care and years of education for binary predictors; analysis of variance (ANOVA) for non-binary categorical variables; and correlations with continuous predictors. Chi-squared tests were used to examine differences in the categorical variables (Crosby and Salazar 2006; Davis 1971; Treiman 2009). I then used multilevel analysis with three levels in bivariate and multivariate regression analysis to account for the hierarchical nature of the data (Hox 2010; Rabe-Hesketh and Skrondal 2012). With the GMHS the levels are individual (level 1), cluster (level 2) and district (level 3). There are 400 different clusters (average number of observations per cluster is 12; minimum - 3, maximum - 38) and 110 different districts (average number of observations per district is 44; minimum -11, maximum-

347) in the sample. A potential fourth level is region. But there are only ten regions and there is very little inter-region variation left when inter-cluster and inter-district variations are accounted for. Further, because health services tend to be organized around districts in Ghana this is a potentially more useful level to account for than region. However, I examine region for fixed effects by including it as a set of dummy variables to account for differences in the quality of care in the various regions of the country. Thus the analysis is done with three levels to reduce the complexity of the model. (Two levels are used for the third aim and is discussed in chapter 7)

With the WHS, the data allows for individual (level 1), cluster (level 2) and strata (level 3). Strata is equivalent to region stratified by rural and urban in Ghana (18 strata) but larger blocks comprising of several regions in Burkina Faso (4 strata). There are 390 clusters (average number of observations per cluster is 4.3; minimum-1, maximum-76) and 22 strata (average number of observations per strata is 76; minimum -6, maximum-38). The descriptive statistics for the GMHS are all weighted. However no weights are used for the WHS analysis and all the multilevel analysis because of the reasons previously discussed.

===Table 4G1 about here ===

SAMPLE DESCRIPTION

Ghana Maternal Health Survey sample

Table 4G1 shows the weighted and unweighted sample distributions for the GMHS. The description of the results here is based on the weighted sample unless otherwise stated. Most women in the sample live in rural areas and have little formal education. The average woman is about 30 years old, currently married, with about three children. About two thirds (66%) of the sample live in rural areas. Of those living in urban areas, about two thirds (64%) live in a town

and a third (29%) live in a large city. Only about 2% live in small cities.⁴ Urban areas are defined as localities with 5000 or more persons while rural areas are localities with less than 5000 persons. A locality is “a distinct population cluster (also designated as inhabited place, populated center, settlement) which has a name or locally recognized status” (Ghana Statistical Service 2012:9). In the multivariate analysis, rural is compared to all urban.

Ghana is divided into 10 administrative regions with the national capital, Accra, located in the Greater Accra Region. All the regions are represented in the sample, each contributing between eight and 13% to the sample; except for the Ashanti region which makes up 19%, and the Upper East and Upper West regions which make up only about 5% and 3% respectively. About 40% of the sample are from the R3M regions – Greater Accra, Ashanti, and Eastern regions (the regions participating in the Reducing Maternal Morbidity and Mortality program initiated in 2006). These regions are all located in the southern part of the country. The Northern, Upper East and Upper West regions are the northern regions. Greater Accra region houses Accra, the national capital and Ashanti region houses Kumasi and the second major city in the country. These are the densest regions in the country, have the largest concentration on health facilities and health providers and are home to the two major teaching hospitals in the country (see appendix Figure1 for map of Ghana with population characteristics). The northern regions are more rural with fewer health facilities and providers (Ghana Ministry of Local Government and Rural Development website n.d.; Ghana Health Service 2012; Afulani 2012).

Sociodemographic variables

^A town (refers to small towns) is a locality with about 5000-49,000 people. A small city (also medium sized town) has 50,000 -249,999 people, and a large city (also large town or city) has over 250,000 people. The large cities are Accra, Kumasi, Tema, Sekondi-Takoradi, and Tamale (classification by Owusu (2008) based the 2000 Population Census for Ghana).

About a third of the women have no formal education; 22% have only a primary education and 37% middle or junior secondary school (JSS) education. Less than one in ten women (7%) have completed secondary or senior secondary school (SSS) or higher.⁵ The average number of years of education is about five years with a range of zero to 18 years. The household wealth index is based on household assets, and is divided into five quintiles (lowest quintile or poorest, second lower quintile or poorer than average, middle quintile, second highest quintile or richer than average, and highest quintile or richest). Thus there are about 20% in each group. About 25% of households are headed by females. Three quarters (73%) of the women identified as Christians (14% Catholic, 14% Methodist or Presbyterian, 28% Pentecostal, charismatic, or protestant and 18% other) and 18% as Moslems. Less than one in ten women (8%) identified as Traditional, spiritualist, no religion or other. Akans make up close to half of the sample (47%) with Ewes at 12% and Gas, Dangmes and Guans at 9%. These are all southern ethnicities. The northern ethnicities make up about a quarter of the total sample (13% Mole-Dagbani or Hausa and 10% Grussi or Gruma). About nine percent of the sample falls in the other group which is likely to be very heterogeneous. Since most southerners are part of one of the three main southern ethnicities, very few of the women in the “other” group are likely to be from the south. On the other hand, there are some northern ethnicities that are not classified, who will likely be in the other group. For instance, the main ethnicity in the Upper West region is the Dagabes, who are not in any of the listed categories and hence likely in the “other” category. The “other” category is, therefore, likely to include a disproportionate share of people from the northern part of the country.

Reproductive variables, pregnancy risk factors and complications

⁵ Middle and JSS are equivalent and secondary and SSS are also equivalent. The old educational system used middle and secondary school which were changed to JSS and SSS with educational reforms in the country. SSS is now referred to as senior high school.

The average woman in the sample is about 31 years old with a range of 15 to 49 years – the target group for the survey. Only 5% are between 15 and 19 years and 13% are between 40 and 49 years. The rest (82%) are distributed almost evenly in the five year blocks from ages 20 to 39. Most women are currently married (72%); with 14% cohabitating. Fourteen percent are currently not married or cohabitating – half of these were previously married and half never married. Among those who are married, cohabiting or ever married about half started living with a man before 19 years of age with an average age at marriage of about 19 years. The average number of pregnancies, children ever born, and children alive is about 4.0, 3.5 and 3.1 respectively, with a range of 1-16 for pregnancies, 0-14 for children ever born alive and 0-11 for children alive. About three quarters have between 1 and 4 children alive. On prior pregnancy outcomes, 15% have had an induced abortion, 16% have had a miscarriage, 6% have had a stillbirth, and 20% have had an unintentional adverse pregnancy outcome (stillbirth or miscarriage). Two percent had a sibling who experienced a maternal death. About two thirds (62%) have ever used some contraception and a quarter (25%) are currently using contraception. About half (53%) know where to get family planning. About 20% had some pregnancy complication during their last pregnancy (experienced some problem which includes headache, blurry vision, preeclampsia, eclampsia, convulsion, bleeding, vaginal discharge, prolonged or obstructed labor, uterine rupture, placenta previa, retained placenta, fever, fistula, tetanus, etc.). Seventeen percent had a potentially serious complication (a complication for which they sought help for.). Only 7% of the last births were by caesarian section and 2% had a stillbirth. About 8 in ten of the still births occurred between 8 and 10 months with two thirds at 9 months. About 55% were assisted by a skilled birth attendant (SBA) during their last birth. The same percentage delivered in a health facility, which is consistent with the fact that most births by skilled

providers in Ghana and other developing countries are in health facilities (Gabrysch and Campbell 2009).

ANC variables

About 96% of the total analytic sample (4868 out of 5042) had an antenatal care visit (ANC) at least once during their last pregnancy. The analysis for the determinants of quality of care is based on only this group (i.e. 174 =3.4% of the full sample is not included in the ANC quality of care analysis). While this choice leaves out a small proportion of the population, it is necessary because the quality of ANC questions and other ANC related variables were only asked of those who attended ANC at least once. The distribution of the variables for this sample is very similar to that for the full sample as shown in Table 4G1. Since the ANC related variables were only asked of those who attended ANC at least once, their distribution is only presented for this subsample. The average ANC quality score is about 7.4 with a range of 0 to 9 (details of this variable in aim1). About 40% received seven or fewer services and 60% received eight or nine services. About 80% had four or more ANC visits, with an average of about six visits. More than one in two women (55%) who received ANC started in the first trimester with most of the others starting in the second trimester. Only about four percent started in the third trimester. About eight in ten women (85%) received ANC at least once in a government operated health facility, with only 14% seeking ANC exclusively in a private facility including maternity homes. Of those who received some care in a gov't facility, about 98% (4040/ 4119) received care exclusively in a gov't facility. Also about half (2200/4119 =53%) of these received some care in a government hospital or polyclinic with the rest receiving care in some other government facility – mainly health centers, health post or clinics and a few mobile sites. ANC is also offered at outreach points in Ghana, but only 21 women reported receiving care in a mobile clinic (15

mentioned under public facility and 8 mentioned under private facility). Most women received ANC from a nurse or midwife (79%) with only 19% receiving some ANC from a doctor. Less than 3% received ANC from unskilled provider (auxiliary nurse or midwife, TBA and other). Also, most women sought ANC for a checkup (83%) with only 17% going because of a problem.

Key General Bivariate associations

There is very little variation in the proportion who attended ANC at least once by place of residence, sociodemographic and reproductive health variables with over 90% in all categories. The exception is among those who identify as Traditional/spiritualist/no religion/other where the proportion who attended at least one ANC is about 88%. The distribution of all the variables by ANC attendance is shown in Appendix 4G1.

Cross tabulations of each variable by place of residence, education, and wealth are shown in appendix 4G2. This shows that more educated and wealthier women are less likely to live in rural areas than more poorly educated and women with fewer assets. For example, the average years of education for rural women is about 4 years compared to 7 years for urban women. Also, only about 16% of rural women are in the top two wealth quintiles compared to 78% for those in urban areas. About eight in ten (82%) women with no education live in rural areas compared to 28% of those with a secondary education. Also 97% of those in the lowest wealth quintile live in rural areas compared to 13% of those in the highest wealth quintile. Higher education is also associated with higher wealth with only 16% of women with no education in the top two wealth quintiles compared to 81% of women with a secondary education. The average years of education are 2.3 years among the poorest women and 8.4 among the richest women. These differences are significant at $p < 0.001$. Female headed households are more likely to live in urban areas and have more education, but are not different from non-female headed households with

regards to wealth. Also, compared to other religious affiliations, a higher proportion of those reporting Traditional/spiritualists and other religions live in rural areas. They also have the lowest education together with Moslems; and are the poorest group. There are no big differences by age and marital status though younger (15-19years) and older (40-49 years) women are more likely to live in rural areas and older women have lower education. Women who married before 19 years are more likely to live in rural areas and have lower education and wealth than those who married after 19 years.

As expected, Greater Accra region has the lowest proportion of people living in a rural area (23%) and the Northern, Upper East, and Upper West regions (the 3 northern regions) have the largest proportion of people living in rural areas (80%, 80%, and 89% respectively). Women in the Greater Accra region also have the highest education (mean of 6.9 years) and wealth (80% in top wealth quintiles) and those in the Northern, Upper East, and Upper West regions have the lowest education (mean of 1.7, 1.6, and 1.9 average years of education respectively) and lowest wealth (15%, 19%, and 12% respectively are in the top two wealth quintiles). Except for Akans who are much more likely to live in urban areas, the rural/urban distributions for the other ethnicities are not significantly different. Also Akans have the highest education and wealth; the Mole-Dagbani/Hausas, Grussi/Gruma and other group have the lowest levels of education and wealth.

The distributions are consistent with the distribution of the various ethnic and religious groups by region (table not presented). Most Akans (29%) live in the Ashanti region though they are well represented in all the other regions (except in the Volta, Northern, and Upper regions, where they make up less than 1%). Ga and Dangmes are mostly in Greater Accra (43%) and Eastern regions (32%). Ewes are mostly in the Volta regions (43%) and Mole Dagbanis in the

Northern region (50%). The Grussi/Gruma group are mostly in the Upper East region (24%) with a good proportion also in the Brong Ahafo (15%), Northern (17%), and upper west region (17%). The groups classified under other are also mostly in the Upper regions (31%) and also Ashanti (17%) and Brong Ahafo region (13%). The northern and upper regions have the largest proportion of Moslems. The Mole Dagbani (64%) and ‘other’ ethnic group (59%) also have the largest proportion of Moslems (20% or less for other groups).

===Table 4W1 about here ===

World Health survey sample

The sample distribution for the WHS data is shown in table 4W1. Most women in the sample live in rural areas, have no formal education, and are unemployed or self-employed in a sales/service job or in agriculture (farming/fishing). The average woman is about 30 years old, currently married, and has about three children. About three quarters of the sample for both Ghana (65%) and Burkina Faso (63%) live in rural areas. Close to two thirds of the women have no formal education, but this is driven by the very high proportion on women in Burkina Faso with no education. About 83% of the women in Burkina Faso have no formal education compared to 35% for Ghana. Most of those with some education in Ghana however have just a primary education with only about 5% of women in both countries having some secondary education. Because of the little variation in education, a binary education variable (none or some formal education) is used in the WHS regression. The range of scores on the wealth index for the analytic sample is from 0 to 14. On average respondents live in households with less than five of the 17 listed assets and about nine in ten women live in households with less than ten of the assets. This puts over half of the sample in the poorer/poorest wealth quintile. However, there are more women in the poorer/poorest groups in Burkina Faso than Ghana – 43% for Ghana and

68% for Burkina Faso for women in the poorer/poorest groups; and 45% for Ghana and 18% for Burkina Faso for women in the richer/richest groups. About a third of women are not working for pay in Burkina Faso (66%) compared to 12% for Ghana; and the rest are mostly self-employed –engaged in farming, fishing, petty trading and other service occupations in both countries. Only about 6% of women in Ghana and 2% in Burkina Faso are engaged in professional occupations. The differences between Ghana and Burkina Faso for education, wealth and occupation are all significant at $p<0.001$.

The age distribution of the WHS sample ranges from 18 to 68 years though less than 0.1% is over 49 years and less than 5% is less than 20years. The average age is about 32 years for Ghana and 29 years for Burkina Faso. Over 80% of the sample in both countries is between 20 and 40years. Most of the women are currently married – 81% for Ghana and 93% for Burkina Faso. The rest is split almost evenly between previously married and never been married. The average number of children by women in both countries is about three, but ranges from 0 to 15. About 22% of the Ghana sample has no children compared to only 4% of the Burkina Faso sample, but most women in both countries have between 1 to 4 children with about 28% of both having over 5 children (mostly 5 to 7 children). The differences by age, marital status, and number of children are significant at $p<0.001$. Over three quarters of women (84% for Ghana and 78% for Burkina Faso reported no diagnosed chronic condition (diabetes, asthma, arthritis, heart disease, depression, or schizophrenia) and a similar proportion (77%) rate their health as good or very good. Less than 4% of the women in both countries rate their health as bad or very bad. About eight in ten women in both countries report being fairly satisfied or very satisfied with the way the health system in their country is run.

The analysis on quality of ANC is restricted to women who went for ANC visits at least once during their last pregnancy, so the distribution of ANC variables is presented for this group. The group comprised eight in ten women (83%) in the complete sample (92% for Ghana and 79% for Burkina Faso). Among women who attended ANC at least once during their last pregnancy, the average score on the quality index is about 2 (2.4 for Ghana and 1.6 for Burkina Faso). Three quarters of women who attended some ANC in Ghana attended at least four times compared to only 40% in Burkina Faso. The average number of visits for the sample is 4.4 (5.8 for Ghana and 3.5 for Burkina Faso). Most women in both countries receive most of their ANC from nurses (82% for Ghana and 72% for Burkina Faso). About 55% of women in both countries were assisted by a skilled birth attendant.

CHAPTER 5: AIM 1

Examine the determinants of quality of maternal health care

INTRODUCTION

Background

Evidence for the role of ANC in reducing maternal mortality is not consistent (Bullough et al. 2005; Guillermo Carroli et al. 2001). Some researchers suggest the inconsistent findings may reflect inadequate attention, by researchers, to the content of ANC, and to problems of endogeneity – i.e., where ANC is available, women who choose to use it may be those less likely to experience maternal mortality for other reasons (Adjiwanou and LeGrand 2013). ANC alone may be insufficient to reduce maternal mortality, but antenatal care visits (ANCVs) are an opportunity to reach women with interventions (e.g., blood pressure monitoring, iron supplementation, tetanus vaccination, and education about the danger signs of pregnancy) which are essential to both maternal and fetal health (Campbell and Graham 2006; N. N. A. Kyei, Campbell, and Gabrysch 2012; World Health Organization 2003). ANCVs are also an opportunity to identify women with pregnancy complications, and start the appropriate management. Furthermore, during ANCVs, women can be educated and assisted in planning ways to access skilled care during delivery [15–17]. This implies that high quality ANC can help improve maternal outcomes: directly through preventative measures as well as early management of complications, and indirectly through increased use of skilled birth attendants.

The factors associated with *use* of ANC services in SSA are well known, but, few quantitative studies have examined the determinants of the *quality* of ANC an individual woman receives (Edward 2011; Joshi et al. 2014; Tran et al. 2012). The paucity of studies on the quality of ANC is primarily due to the lack of data. Quality of care is difficult to measure – it has

multiple dimensions which are hard to capture in a few variables. Furthermore, the weakness of routine systems for collecting health information means that we have to rely on household surveys in which women are respondents. The nature of surveys, however, limits the detail and reliability of data on quality of care, because women are rarely able to assess and report on its technical aspects (W. J. Graham and Varghese 2012). Nonetheless, household surveys provide the best population-level source of information on ANC quality, but few researchers have taken advantage of them to examine social disparities. This paper uses data on antenatal service provision in the Ghana Maternal Health Survey (a special supplement to the Ghana Demographic and Health Survey (DHS)) and the World Health survey data for Ghana and Burkina Faso, to assess the factors associated with the quality of ANC individual women receive.

Study objectives

The aim of this study is to examine the role of social factors in determining women's quality of ANC. I focus specifically on the role of urban/rural residence and SES (education and wealth), as well as the interaction between them, and factors potentially explaining the social differentials. Based on existing literature, I hypothesize that higher SES and living in an urban area are associated with better quality of ANC. But, I expect that the rural/urban differential is partly accounted for by the fact that rural women are likely to have lower SES, on average. I also examine the reverse of this hypothesis – whether the SES differential in quality of care is accounted for by place of residence. If most of the rural/urban difference is explained by SES, it suggests higher quality services are more accessible to the higher SES women. On the other hand, if most of the SES difference is explained by place of residence, it suggests a general poor quality of care in rural areas, which is not greatly affected by a woman's SES. I also examine conditional effects: whether the effect of education and wealth differ by place of residence, and

whether the effect of education differs by wealth. This analysis will help identify women who are least likely to receive high quality ANC. Finally, I examine the timing and frequency of ANCVs and the type of ANC facility and provider seen as potential intervening factors. This part of the analysis will assess whether quality differentials by place of residence and SES are due to differential utilization of ANC or to use of different types of facilities and providers. This analysis will also provide the initial results to assess of whether differentials in quality of care contribute to the differentials in use of SBAs by place of residence and SES.

METHODS

Data: The main data for this analysis is the Ghana Maternal Health survey (GMHS). The World Health Survey (WHS) is used for supplementary analysis. These data have been described in the overview of data sources. The sample here is restricted to women who had at least one ANC visit during the last pregnancy, since it is impossible to examine quality of ANC for women who did not have any encounter with the health system during pregnancy. This represents 97% (N=4,868) of the sample from the GMHS and 83% (N=1,671) of the sample from the WHS.

Constructs and Variables

Dependent variable: Quality of Antenatal care

Quality of Antenatal care is operationalized by an index based on services received during ANC.

The indices for both the GMHS and the WHS are described in detail in chapter 4. The continuous index which ranges from zero to nine is the main dependent variable in this chapter for the GMHS analysis. The binary variable coded: 0- received zero to seven services and 1- received eight or nine services is however also examined in the sensitivity analysis. With the

WHS I use the, the binary ANC quality variable coded: 0- received zero to two services = lower quality; and 1- received all three services= higher quality.

Focal independent variables: Socioeconomic status and Place of residence

I operationalize SES as education and wealth in the GMHS, and as education, wealth and occupation in the WHS. I also include occupation status from two questions on employment status and type of job in the WHS. Place of residence refers to whether the respondent lives in a rural or urban area. These variables are described in detail in chapter 4. Place of residence is a contextual measure capturing the general quality of services in the area where each respondent lives as well as other factors.

Rival independent and control variables

There are other factors that can affect the quality of ANC a woman receives. The first of these factors is the frequency and timing of ANC, the type of facility in which ANC is received, and the type of ANC provider. Women who receive the recommended four visits for antenatal care and those who start antenatal care in the first trimester as recommended will be more likely to receive all the essential services because of the earlier and more frequent contact with the health system. There is also some evidence that private health facilities provide better quality of care than public facilities, though this is not consistent and depends on the dimension of quality on is examining (D. V. Duong et al. 2004; Hutchinson et al. 2011). In addition, the quality of care received may be different depending on whether it is provided by a doctor, nurse/midwife or other provider due to their different levels of training as well as the equipment and other essential amenities available to them (Harvey et al. 2007). Moreover, the same set of factors may influence the frequency and timing of ANC, the type of ANC facility and provider, and the quality of care a woman receives (Adjiwanou and LeGrand 2013; Joshi et al. 2014; Tran et al.

2012). Thus, number of ANC visits, the trimester of the first ANC visits, the type of facility ANC was received and the type of ANC provider are examined as rival independent or intervening variables to see if SES and place of residence matters when these factors are accounted for.

Another set of factors that may influence the quality of care a woman receives are those related to risk for adverse pregnancy outcomes. For instance, health care workers may pay greater attention to women with a complication in the index pregnancy or those with a risk factor such as previous adverse pregnancy outcomes (Gabrysch and Campbell 2009). People with these risk factors or those who have seen someone experience a bad pregnancy outcome may also actively seek better care. In addition, a woman's age, gravidity (number of pregnancies) and parity (number of births) may influence the type of care she receives either positively or negatively. So I control for age, parity (gravidity not used because of correlation with parity), prior stillbirth or miscarriage, having a sibling who experienced a maternal death, experience of any complication in the last pregnancy, experienced a serious pregnancy complication (refers to a symptom for which she sought care), and the reason for antenatal care (whether for checkup or for a problem). The WHS does not have questions on prior or current pregnancy complications, so to control for factors related to the woman's health status that may affect the quality of care she receives, I include two variables on self-rated health status and whether the woman has ever been diagnosed with a chronic condition.

Familiarity with the health system may also influence the care a woman receives through knowledge of where to seek quality care. So I include knowledge of where to get contraception and ever used contraception as proxies for familiarity with the health system. These variables are not available in the WHS; instead there is a variable on satisfaction with the health system which

I control for. The effect of education, wealth and age can be through women's status and autonomy which enables them to actively advocate for quality services. In addition, I control for marital status which is seen as a sign of status in many SSA countries; and age at first union and sex of the household head (female headed household or not) which may tap into women's autonomy (Gabrysch and Campbell 2009). Finally, I control for religion and ethnicity to capture sociocultural factors which may influence the quality of care a woman receives. Some of these variables are not in the WHS as shown in the table of results, but, unlike the GMHS, the WHS also has a variable on rating of travel time to an inpatient health facility which is used as a measure of perceived accessibility of health facilities. Perceived accessibility is controlled for because distance to the nearest facilities that can provide inpatient care (proxy for higher tiered health facility) may affect the quality of ANC a woman receives (Atinga and Baku 2013). The results are not different when self-rated health status and satisfaction with the health system are used as categorical variables, so only the results for continuous variables are presented. Some of the variables are not significant in the final models, but they are still included because there is a theoretical or empirical rationale for their inclusion in the model. In addition, their exclusion changed the size of the coefficient (slight increase for most) for the focal independent (and other) variables, suggesting they may be playing a role and their exclusion will increase the effect of unobserved heterogeneity (Aneshensel 2013).

Analytic approach

The main analysis which uses the continuous ANC quality of care measure from the GMHS uses the "xtmixed" command in stata to estimate multilevel linear regression models with random intercepts (Hamilton 2012; Rabe-Hesketh and Skrondal 2012). The equations for null model (the model with no predictors) for this analysis (in the multiple equations form) are:

Level 1: Individual: $Y_{ijk} = \pi_{0jk} + e_{ijk}$

Level 2: cluster: $\pi_{0jk} = \beta_{00k} + r_{0jk}$

Level 3: district: $\beta_{00k} = \gamma_{000} + u_{00k}$

Where:

Y_{ijk} is the mean quality of care for the i th woman in the j th cluster in the k th district

π_{0jk} is the mean quality of care for the j th cluster in the k th district and

β_{00k} is the mean quality of care in the k th district

γ_{000} is the mean quality of care for the sample (grand mean)

u_{00k} is the deviation from the grand mean = variation at the district level

r_{0jk} is the deviation from the district mean = variation at the cluster level

e_{ijk} is the deviation from the cluster mean = variation at the individual level

The single equation form for the null model is:

$$Y_{ijk} = \gamma_{000} + u_{00k} + r_{0jk} + e_{ijk}$$

The single equation form for the unconditional model with predictors is represented simply as:

$$Y_{ijk} = \gamma_0 + \gamma_1 \text{Edu} + \gamma_2 \text{Wealth} + \gamma_3 \text{Urban} + \dots + e$$

Where:

γ_0 is the mean quality of care when all the predictors are zero and accounting for inter-district and inter-cluster variation;

γ_1 is the average change in quality for each unit increase in education holding other factors constant and accounting for inter-district and inter-cluster variation;

γ_2 and γ_3 are the difference in quality between the rich and the poor and the difference in quality between those living in the urban and rural areas respectively, holding other factors constant and accounting for inter-district and inter-cluster variation;

e is the complex error term ($u_{00k} + r_{0jk} + e_{ijk}$).

There are two goals behind the multivariate analysis. The first goal is to examine the factors that influence quality of ANC net of other predictors in the model, after accounting for variation at the various levels. The results from the final model are used to assess these factors. The second goal is to examine how education, wealth, and place of residence interact with each other and with other predictors to affect quality of ANC using mediation and moderation analysis.

For the mediation analysis, I examine three focal relationships with quality of care as the dependent variable; and place of residence, education, and wealth as the three focal independent variables. For the first focal relationship, I start with place of residence – rural/urban (bivariate model) and then introduce the control variables (frequency and timing of ANC, ANC health facility and provider, characteristics of the pregnancy, familiarity with the health system, status and autonomy and the sociodemographic factors). This is the first partial unconditional model (PUM1 in table 3A) and the purpose is to rule out spuriousness – i.e. that the effect of place of residence is not merely an association that is due to its relationship with other factors (Aneshensel 2013). I then add education and wealth to obtain the full unconditional model in table 3. Education and wealth can be looked at as rival independent variables (that is SES independently predicts quality of care) or as intervening (mediating) variables– that the effect of place of residence is through education and wealth. I hypothesize that SES has an independent effect but also partially mediates the rural/urban effect. An alternative to this hypotheses is that place of residence mediates (or partially mediates) the effect of SES. To test this alternative hypothesis, I examine the two other focal relationships.

In the second focal relationship, I start with education as the only predictor (bivariate association), then sequentially add the control variables (PUM 2), wealth (PUM 4) and finally place of residence (full unconditional model). The third focal relationship starts with wealth as the only predictor (bivariate association), then sequentially adds the control variables (PUM3) and education (PUM4) and finally place of residence (full unconditional). In these two focal relationships, place of residence is examined as either a rival independent or intervening variables. That is, whether place of residence independently predicts quality of care or women with higher education are more likely to receive better quality care because they live in urban areas that offer better quality care. I also examine whether wealth and education independently predict quality of care; or their effects are through each other. That is whether women with higher education are more likely to receive better quality care because they are wealthier and can afford better-quality; or wealthier women receive better quality care because they are more educated and know what care to seek. I use the partial models which include all the covariates except frequency and timing of ANC visits (PUM5) and type of ANC facility and provider (PUM6) to examine how much of the effects of place of residence, education, and wealth may be through differential utilization of ANC and the type of facilities or providers women use, respectively.

I use the difference of coefficients (c-c') method by Mackinnon (2008) to calculate the mediated effects. This method involves first estimating the coefficient for the focal independent variable in the model with all control and rival independent variables but without the intervening variable (the partial models). The result is the total effect (the effect of that independent variable on the dependent variables net of control variables), referred to as c in Mackinnon's notation. Next we estimate the coefficient in the full model which includes the intervening model (the full

unconditional model). This is the direct effect (the effect of the focal independent variable net of the control and mediating variables), referred to as c' in Mackinnon's notation. The value of c should be significant with the control and rival independent variables in the model to suggest the focal relationship is not spurious or redundant. However, it should reduce with the addition of an intervening variable to suggest a mediation effect. The mediated or indirect effect is then calculated as the total minus the direct effect ($c - c'$). The likelihood ratio test is used to test if the mediated effect is significant. The magnitude of the mediated effect can be assessed by the proportion of the total effect that is mediated (indirect/ total effect = $(c - c')/c = 1 - c'/c$) or the ratio of total to direct effect (c/c') (Krull and Mackinnon 2001; MacKinnon 2008; Aneshensel 2013).

The purpose of the moderation analysis is to examine whether the effects of place of residence, education and wealth are conditional on each other. Three interactions were examined: the interaction between place of residence and education, that between place of residence and wealth; and that between education and wealth. Only the education and wealth interaction was significant, hence shown in the table (full conditional model).

In the supplemental analysis with the categorical ANC quality of care measures from both the GMHS and the WHS, I use the "xtmelogit" command in Stata to estimate multilevel binary logistic regression models (Hamilton 2012; Rabe-Hesketh and Skrondal 2012). The model building here is similar to that for the linear regression. However, because the addition of variables to a logistic model changes its scale, it is not accurate to directly use the change in the magnitude of the coefficients in nested models as the mediated effect (Aneshensel 2013; Mood 2010). There are methods for examining mediation effects with binary outcomes such as Mackinnon's product of coefficients (ab) method, which I will use for my second aim. But this is

not pursued for this aim, because it gets very complicated when there are several mediators and when the mediators are not continuous and or binary. Only the results from the full logistic models are therefore examined to identify the factors associated with quality of ANC after controlling for other factors and accounting for clustering. This analysis serves as a sensitivity analysis for the main analysis for AIM1. In addition, because the outcome variable for AIM 2 is dichotomous, it requires a dichotomous mediator to be able to accurately do the mediation analysis. Thus the binary logistic regressions become more important for AIM 2.

RESULTS

GMHS analysis

Univariate and bivariate results

The univariate statistics are presented in Table 4G1 (described under sample description). This table shows that about 96% of the women received ANC at least once during their last pregnancy. Further analysis (appendix 1A) also show that there is very little variation in the proportion who attended ANC at least once by place of residence, sociodemographic and reproductive health variables with over 90% in all categories. The exception is among those who identify as Traditionalist/spiritualist/no religion/other where the proportion who attended at least one ANC visit is about 88%. Regression of ANC attendance (binary variable on whether one attended ANC at least once or not) showed that net of other factors, the factors positively associated with ANC attendance are living in an urban area, higher education, having a serious pregnancy complication, ever used contraception, knowing source of family planning, increasing age, lower parity, currently married or cohabitating, being Moslem, and living in the Upper East region (appendix 1C). The analysis for the determinants of quality of care is restricted to those who attended ANC at least once during pregnancy. While this leaves out a small proportion of

the population, it is necessary because the quality of ANC questions and other ANC related variables were only asked of those who attended ANC at least once. The distribution of the variables for this sample is very similar to that for the full sample as shown in Table 4G1. In addition the results of the regression on use of ANC will be kept in mind while evaluating the findings on the analysis on quality of ANC.

The average number of services received by women who attended at least one ANCV is 7.4 (95% CI: 7.32 to 7.49), with a range of zero to nine; 10% received five or fewer services, and about a quarter received all nine services. About 39% had a quality score of 7 or less out of 9 and 61% had a score of 8 or 9. Most of the variation in quality of comes from the questions on education on the signs and symptoms of pregnancy complications (71% reported receiving some education on identifying pregnancy complications; 29% reported not receiving any education) and provision of anthelmintic (58% reported receiving an anthelmintic; 41% did not receive any; and 7.7% did not know or did not respond –missing recoded to no in the creation of the index). For the other variables, less than 12% responded no to each question ranging from 1.5% for blood pressure to 11.1% for blood sample. Details of these distributions are shown in Appendix 5G1B &5G2.

====Table 5G1 about here====

The bivariate statistics are shown in table 5G1. These show small but significant differences in ANC quality of care by place of residence, education and wealth. Those living in urban areas have a slight but significantly higher quality of care than those in rural areas (7.7 vs. 7.2). Quality of care also increases with education and wealth. The average quality score among those with no education is 7.0 compared to 7.4 for those with primary education and 7.7 for those with middle/Junior Secondary School (JSS) and secondary/Senior Secondary School (SSS) or

higher. The differences are significantly different at all levels except for the middle/JSS and secondary/SSS which are similar. The average quality score is 6.9 among those in the lowest wealth quintile (poorest), 7.2 in the second lowest (poorer), 7.5 in the middle, 7.6 in the second highest (richer) and 7.8 in the highest (richest) quintile. The differences between the poorest, poorer and middle are significant, but there are not significant differences between the middle, richer and richest.

The average quality of care score also differs significantly by number of ANC visits, trimester of first ANC visit, where ANC took place, the type of ANC facility and provider, presence of complications, and type of delivery (caesarean section or not), though the differences are not very large. The average quality score among those who had less than four ANC visits is 6.6 compared to 7.6 for those who attended four or more; and 6.3 for those who started ANC in the third trimester compared to 7.3 for those who started in the second trimester and 7.6 for those who started in the first trimester. The average quality score for those who received at least some ANC care in a government health facility is 7.4 (7.7 for a government hospital or polyclinic and 7.1 for other government health facility consisting mainly of health centers and health posts) compared to 7.3 for those who received all their ANC in a private health facility including maternity homes. Women who received ANC in a government hospital or polyclinic received significantly higher quality ANC than those who did so in other facilities, but there is no significant difference in ANC quality between women who received ANC in private facilities and those who received ANC in the lower level government health facilities. The ANC quality score is 4.9 for the few who reported receiving ANC in their homes, the provider's home or other sites and is significantly lower than that from any health facility. Also, those who received care from a doctor had a small but significantly higher quality of care (score of 7.7) than those who

were attended by a nurse or midwife (score of 7.4); and those who received care from a provider other than a doctor, nurse or midwife have a significantly lower quality score (6.6). There is no significant difference in quality of care by reason for seeking care.

The Western region has the highest quality of care (8.3) and the Northern and Volta regions the lowest (6.7). There are no major differences between the other regions except for the Greater Accra region which surprisingly has the second lowest quality of ANC – only higher than the Northern and Volta regions. The ANC quality is not significantly different in the R3M and other regions. By ethnicity, the Akans have the highest ANC quality score (7.8) and the Mole-Dagbani and Hausas the lowest, (7.0). This is consistent with the regional differences as most Mole-Dagbanis and Hausas live in the Northern region. However, only the Akans are significantly different from the other groups. By religion the Traditionalist/spiritualist/other and no religion group received the lowest quality of ANC followed by the Moslems, however the quality score for Moslems is not significantly different from that of Christians in the bivariate analysis. There are also no significant differences in ANC quality by age, marital status, age at first union, head of household type, gravidity, parity, number of children alive, prior abortion, miscarriage or stillbirth, sibling maternal death, any pregnancy complication, caesarian delivery and pregnancy outcome. But those who have ever used contraception, are currently using contraception, know a source of family planning and those who experienced a serious pregnancy complication received a small but significantly higher quality of care than those who did not.

====Table 5G2A about here====

====Table 5G2B about here====

Multilevel linear regression results for continuous ANC quality of care measure

Table 5G2A shows the variances from the random effects part of the multilevel analysis of quality of care for the null, full unconditional and full conditional models. The results from the null model shows that though more than half (58%) of the variation in quality of care is at the level of the individual ($1.361/(1.361+0.626+0.352) = 1.361/2.339 = 0.582$), there is a large variation at the district (Intraclass Correlation (ICC) at district level = $0.626/2.339 = 0.268$) and cluster (ICC at cluster level = $0.352/2.339 = 0.15$) levels. The large ICC at the district and cluster level supports the need for a multilevel analysis. Also model comparison shows a preference for the two level multilevel model (Likelihood ratio test for multilevel vs. linear regression gives $\chi^2(2)$ of 672.41 with $\text{Prob} > \chi^2 < 0.0001$) (Hox 2010; Krull 2014). The variances from the full models show that the predictors in the model explain much more of the group level variance than the individual level variance. About half of the inter-district variation ($(0.626-0.286)/0.626 = 0.543$) and a third of the inter-cluster variation ($(0.352-0.247)/0.352 = 0.298$) are explained by other variables in the final model; while most of the individual level variation remains.

The second column of Table 5G2B shows the multilevel linear regression results for the bivariate models. They show that after accounting for inter-cluster and inter-district variation, the individual factors positively associated with better quality of ANC care are living in an urban area, higher education, higher wealth, attending ANC four or more times, receiving the first ANC in the first trimester, receiving ANC from a doctor, receiving ANC in a government hospital or polyclinic, experiencing a serious pregnancy complication, prior use of contraception, knowing source of family planning, being Akan and living in the Western region. For example, those who live in urban areas score on average about 0.4 higher on ANC quality than those living

in rural areas. Each year of education increases quality of ANC by about 0.04 points and the wealthiest receive 0.6 more services than the poorest.

The multivariate results start from column 3 of Table 5G2B. The partial unconditional models (PUMs) refer to models with all the covariates except one or two independent variables of interest (potential mediating variables). The coefficients in the partial models give the total effects (c) for the particular focal independent variables; the coefficient in the full model gives the direct effects (c') of the independent variables; and the difference between the coefficients in the partial and full model for a particular variable (c-c') is the indirect or mediated effect. The LR test with the addition of each variable (or set of variables) assesses whether the indirect effect is significant or not. PUM1 includes all covariates except education and wealth and the coefficient for place of residence is its total effect net of relevant control variables. This shows that people who live in urban areas have significantly better quality of care net of relevant control variables including frequency and timing of first ANC visit. The coefficient however decreases by about 58% from the bivariate model $((0.36-0.0.15)/0.36 = 0.583)$, suggesting that more half of the urban effect in the unadjusted model is explained by the control factors. When education and wealth are added to the model (full unconditional model), the magnitude of the rural/urban difference is decreased by almost half $(0.15-0.08 = 0.07)$ and is no longer significant. This is the rural/urban effect mediated by SES and it is significant at $p < 0.001$; suggesting about half of the total effect of rural/urban residence (the proportion of the total effect that is mediated $= 0.15-0.08/0.15 = 0.467$) is mediated by SES, and rural/urban residence has no significant direct effect on quality of ANC net of socioeconomic and relevant control variables, and accounting for inter-cluster and inter-district variation.

PUM2 includes all covariates except place of residence and wealth and PUM3 includes all covariates except place of residence and education. They show a significant effect of education and wealth net of the control variables. PUM 4 which includes all covariates except place of residence shows only a very small change in the coefficient for both education and wealth with the other in the model, suggesting they have independent (or direct) effects net of each other. The indirect effects (that is the effect of education that is through wealth, and the effect of wealth that is through education) though small are significant at $p=0.002$. This suggests a small amount of the effect of education is through wealth and the reverse, but a larger amount of their effects are independent of each other. The full unconditional model also shows a strong residual effect of education and wealth when place of residence is added to the model. The coefficient for education and for the poorer/middle wealth quintile compared to the poorest does not change from PUM4; and that for the richest compared to the poorest only decreases by 13% ($0.24-0.21/0.24=0.125$) and this change is not significant ($p=0.206$). This suggests an insignificant amount of the effect of SES on quality of ANC is because of where people live. This mediation analysis therefore supports the hypotheses that SES partially accounts for rural/urban differences in quality of ANC and not the reverse (that SES differences are due to where women with different SES live). It also suggests a small proportion of the effect of education is through wealth and the reverse, but most of their effects are not through the other.

In PUM5 and PUM6, I examine how much of the rural/urban and SES effects are due to the frequency and timing of ANCVs, and to the type of ANC facility and provider, respectively. PUM 5 includes all covariates except of number of ANCVs and trimester of the first ANCV, and PUM 6 includes all covariates except type of ANC facility and provider. The coefficient for urban residence is not significant in both PUM 5&6. This implies net of demographic and

socioeconomic factors, urban residence has no significant direct effect on ANC quality, even when frequency and timing of ANCVs and the type of ANC facility and provider are not accounted for.⁶ There is a decrease in the coefficient for urban from PUM5&6 to the full unconditional model (from 0.11 and 0.13 to 0.084; implying 23.6% and 35.6% of the urban effect is mediated by the timing and frequency of ANVs, and by the ANC facility and provider, respectively). But, because the coefficients for urban in these models are all not significant, we cannot say (with at least 95% confidence) that the mediated effects are not due to chance.⁷

The differences in the coefficients for education and wealth from PUM5 to the final unconditional model, are their effects mediated by the frequency and timing of ANCVs. Frequency and timing of ANCVs account for about 18% of the effect of each additional year of education ($0.022-0.018/0.022=0.182$) on ANC quality; 11% of the quality difference between women in the poorest and middle wealth quintiles ($0.19-0.17/0.19=0.105$); and 30% of the quality difference between women in the poorest and richest wealth quintiles ($0.30-0.21/0.30=0.30$). These mediated effects are all significant ($p<0.001$). The differences in the coefficients for education and wealth from PUM6 to the final unconditional model are their effects mediated by the type of ANC facility and provider. The type of ANC facility and provider account for about 5% of the effect of each additional year of education ($0.019-.018/0.019=0.053$) on ANC quality; and 13% of the quality difference between women in the poorest and richest wealth quintiles ($0.24-0.21/0.24=0.125$). These mediated effects are significant ($p<0.01$). In summary, these results suggest some of the SES differentials in ANC quality are because higher SES women start ANCVs early, have more frequent ANCVs, and receive ANC in higher level

⁶ The coefficient for urban is still not significant when the ANC frequency, timing, facility and provider are all excluded from the model. But it is significant in all the models when wealth and education are not in the model.

⁷ The effect of rural/urban residence that is mediated by ANC timing and frequency, and ANC facility and provider are significant when wealth and education are not in the model.

facilities (government hospitals and polyclinics) and from skilled providers. But, there is a significant direct effect of SES on ANC quality that is not through these factors.

From the final unconditional model there is no significant rural/urban differential in quality of ANC when socioeconomic and other factors are accounted for, but each unit increase in years of education increases the ANC quality score by about 0.02. When the categorical education variable is used, it shows that those with any level of education receive on average higher quality of care than those with no education ($b=0.12$, $p=0.04$ for primary education, $b=0.21$, $p<0.001$ for middle/JSS and $b=0.17$, $p=0.053$ for those with secondary education; but the differences between the various levels of education are not significant). Also, those in the middle and richest wealth quintile receive higher quality of care than those in the poorest wealth quintile, but there is no difference in the quality of care for those in the richest compared to those in the middle wealth quintile ($b=0.043$, $p=0.469$)

====Figure 5G1 about here====

The full conditional model shows the interaction between education and wealth. The coefficient for education in the conditional model is the effect of education among the poorest women (the reference group for wealth). This shows that among the poorest women, each year of education increases the quality of care score by about 0.04 points. Further analysis using the linear combination command (“lincom”) in Stata however shows that there is no significant effect of education among those in the middle wealth group ($b=0.011$, $p=0.189$) but there is a marginal increase in quality with education among the richest ($b=0.016$, $p=0.049$). The coefficient for wealth in the conditional model is the effect of wealth at the average level of education (since education is centered at the grand mean). The insignificant coefficients suggest that at the average level of education, there is no difference in quality of care between the middle

and the poorest and between the richest and the poorest. Further analysis also shows that there is no significant difference between the middle and the richest wealth groups at the average level of education ($b= 0.054$, $p=0.36$). The coefficients for the interaction terms give the difference in the slopes for education between the middle and poorest group and that between the richest and poorest groups. The significant interaction terms show that the magnitude of effect of education on quality of care among the poorest differs from the middle and richest groups. Further analysis however shows that the effect of education is not different for the middle and richest groups ($b=0.004$, $p=0.706$). The plot of the interaction in figure 5G1 illustrates these results clearly. Figure 5G1 shows the significant increase in quality of care with education among the poorest, and the marginal and non-significant change for the richest and middle groups respectively. We also see the difference in quality of care between the poorest and richer and middle group at lower levels of education, but no difference by wealth at higher levels of education including at the average level (0 years of education for the centered variable); and the non-significant difference between the middle and richer wealth groups even at lower levels of education. This finding suggests education is most beneficial for the poorest and that poor women with no education receive the worst quality of care.

From the full models in Table 5G2B, we can identify the other factors besides those discussed above that are associated with quality of care net of other factors in the model, accounting for inter-district and inter-cluster variations. None of the pregnancy risk factors are significantly related to quality of ANC in the final model. Having a serious pregnancy complication is associated with better quality of ANC but this is only marginally significant ($b=0.22$, $p=0.051$). Age and parity are not significant determinants of quality of ANC, but those who were cohabiting are more likely to receive worse care than those currently married. Those

who had ever used contraception and those who knew a family planning source also received better quality of ANC than those who had never used contraception and those who did not know a family planning source respectively. On religious affiliation Moslems received better quality of ANC than all Christians and also than those in the Traditionalist/other religious affiliations. The analysis also shows that after accounting for other factors women in most regions (except Volta and Northern region) receive better quality of care than those in the Greater Accra region. Women in the Western region receive the highest quality of care ($b= 0.43$, $p=0.037$ for Western region compared to the Upper East region which has the next highest coefficient) but there are no differences between the other regions with better quality of ANC than Greater Accra.

====Table 5G3Aabout here====

====Table 5G3B about here====

Supplementary analysis with the GMHS

Multilevel logistic regression results for binary ANC quality of care measure

The results from the multilevel logistic regression for the binary ANC quality of care variable from the GMHS are shown in tables 5G3. Table 5G3A shows the inter cluster and district variations. Because of the fixed residual term in logistic regression it is a little more complicated to calculate the ICC. Given a fixed level 1 variance of 3.29, a close approximation of the ICC at the district level (level3) is 0.21 ($0.99/(3.29+0.56 +0.99)=0.099/4.817 = 0.206$); and that at the cluster level is 0.11 ($0.536/4.817=0.11$) (Krull 2014). These support the results from the linear regression that there is some variation between clusters and districts, but most of the variation is between individuals.

The fixed effects are shown on Table 5G3B. The effect sizes obtained from the linear and logistic regressions on the quality of care measure cannot be compared, but generally, the

significance and direction of the associations for the variables are consistent. Of note, however, is that the interaction between education and wealth are not significant in the logistic model. Also, the difference between Moslems and Christians is no longer significant. On the other hand, we see a more prominent effect of ethnicity, with the predominantly northern ethnicities (Mole-Dagbani/Hausa, Grussi/Gruma and other) receiving lower quality of care than the southern ethnicities (Akans, Ga Dangmes and Ewes). The regional differences are similar to that from the linear model

Weighted linear regression (single level) with the continuous ANC quality of care measure

I also carried out the analysis using weighted linear (single level) regression (shown in Appendix 5G4), since the weights could not be applied in the multilevel analysis. The results from this are similar to the unweighted multilevel analysis in direction and significance of the association for most variables. The effect sizes for some of the predictors in the weighted linear regression are, however, slightly larger than that from the multilevel analysis. In addition a few variables such as having a pregnancy complication or a serious pregnancy complication that are not significant in the multilevel analysis are significant in the single level analysis. This is not surprising since single level analysis may underestimate standard errors when there is clustering (Hox 2010; Krull 2014). The results from this model also shows the predictors in the model explain about 23% of the variation in quality of ANC.

To examine the difference in individual level factors when quality of care within a person's community is accounted for in the weighted single level analysis, I included a variable on mean quality of ANC in one's cluster as a contextual measure of quality. This increases the proportion of variance explained by the predictors to about 30%. As expected, the quality of care in one's cluster is significantly associated with individual level quality of care. The other results

are similar with the addition of this variable, though some of the effect sizes are slightly reduced. The effect of place of residence is however reversed when mean quality of care in a cluster is controlled for, with those in urban areas receiving slightly worse quality of ANC ($b = -0.11$, $p < 0.001$). This model is however a poor model because of the strong correlation between the contextual quality variable and the individual quality variable (from which the former is created). The contextual quality variable could not be used in the multilevel analysis because the models did not converge when it was included.

Multilevel linear regression using the ANC quality measure extracted from principal component analysis

These results are shown in appendix 5G5. They show that the results from the additive index and the principal component analysis are generally consistent in direction and significance of associations for the key variables. The exceptions are: seeing a doctor for ANC and having a pregnancy complication are significantly associated with higher quality ANC in the final model when the ANC quality from PCA is used (these are not significant with the additive measure); and cohabitating and knowing a family planning source, which are significant in the final model with the additive measure are not significant in the model with the PCA measure.

World Health survey results

Univariate and bivariate results

The sample distribution for the WHS is shown in table 4W1 (described fully under sample description). This shows about eight in ten women (83%) attended ANC at least once during their last pregnancy (92% for Ghana and 79% for Burkina Faso). The analysis on quality of ANC is restricted to women who attended ANC at least once during their last pregnancy. Among these women, the average score on the ANC quality index is 1.9 (2.4 for Ghana and 1.6

for Burkina Faso). That is, on average women receive about two out of the three recommended services used to create the scale – about 4% received no service, 30% received one, 37% received two, and 28% received all three services. The difference in the quality scores are driven mainly by two of the variables used to create the quality score. Over 90% of women in both countries had their blood pressure checked. On the other hand, 81% of women in Ghana reported giving a blood sample compared to only 38% for Burkina Faso; and 62% of women in Ghana were told about pregnancy complications compared to 27% in Burkina Faso (See appendix 5W1 for details on the distribution of the variables used to create the ANC quality score for the WHS).

====Table 5W1 about here====

The cross tabulations of the proportion receiving high quality ANC by each of the predictors for Ghana, Burkina Faso and the total sample is shown in Table 5W1. The quality of ANC is significantly higher in urban areas; and among those with some education in both Ghana and Burkina Faso. But the differences are much larger for Burkina Faso than Ghana. For example, for the total sample, 24% of women in rural areas received all three services compared to 35% of women in urban areas. For Ghana, 50% of women in rural areas received all 3 services compared to 59% in urban areas; but in Burkina Faso, only 5% of those in rural areas received all 3 services compared to 22 % in urban areas. For education 18% of those with no formal education received all three services compared to 45% of those with some formal education. This is 51% and 54% respectively in Ghana and 9% and 26% respectively in Burkina Faso. There are also differences by wealth and type of occupation which are more pronounced in Burkina Faso. Quality of ANC is also higher among those who attended ANC more than 4 times and those whose most frequent provider was a doctor in both countries? There are no significant associations with the other variables except for parity and which is only significant for Burkina

Faso. The differences in the distribution of the variables for Ghana and Burkina Faso are significant at $p < 0.01$.

====Table 5W2A about here====

====Table 5W2B about here====

Multilevel regression results

Table 5W2 shows the regression results of quality of ANC on place of residence, SES and relevant control and rival independent variables for the WHS, using the sample of women who attended ANC at least once during pregnancy. Table 5W2A shows the inter regional (strata) and cluster variations from the random effects parts of the multilevel model. The approximate ICC at the regional level (level3) is 0.21 ($1.08 / (3.29 + 1.08 + 0.87) = 1.08 / 5.24 = 0.206$); and that at the cluster level is 0.17 ($0.87 / 5.24 = 0.17$). The variance at the cluster level is not significant, but both levels were preferred over a two or single level model. These results though different from the results from the GMHS, also support the conclusion that that there is some variation in quality of ANC between clusters and districts, but most of the variation is between individuals.

The first column of results in Table 5W2B shows the bivariate results. They show that when between cluster and regional differences are accounted for, only country, education, occupation, number of ANC visits and ANC provider are significantly associated with quality of ANC. On average quality of care is much higher in Ghana than Burkina Faso, with an almost eight times higher odds of receiving all three services in Ghana than Burkina Faso. Those with some education, those who attended ANC at least four times and those who received ANC mostly from a doctor received better quality of ANC than those with no education, those who attended less than four times and those who received most of their ANC from a nurse respectively. Farmers and those who received ANC from a provider other than a nurse or a

doctor received worse care than those who are unemployed and those who received most care from a nurse/midwife respectively. There is no significant rural/urban difference in quality of ANC after cluster and regional differences are accounted for.

====Figure 5W1A about here====

====Figure 5W1B about here====

The full unconditional model is the adjusted model with all the covariates but without any interaction terms. The relationships are similar to that in the bivariate model. Controlling for other factors, the odds of receiving all three services in Ghana is even higher than in the bivariate analysis (OR= 9.1, $p<0.001$). Those who have some education have about 42% higher odds of receiving all 3 services than those with no education. Also women are farmers have 55% lower odds of receiving all three services than the women who do not work. Those who attended ANC at least four times have about 87% higher odds of receiving all three services than those who attended less than four times; and those who mostly saw a doctor for ANC have a 62% higher odds of receiving all three services than those who saw a nurse. Those who saw some other provider have 66% lower odds of receiving all three services than those who saw a nurse. The full conditional model includes interaction terms to account for differential effects of education and place of residence in Ghana and Burkina Faso. Other interactions were examined, but these were the only two that were significant in the final model. The coefficients for the urban and education are the effects of place of residence and education in Burkina Faso (the reference group). This implies in Burkina Faso women in urban areas have more than four times higher odds of receiving higher quality ANC than those in rural areas and those with some education have about two times higher odds of receiving higher quality ANC than those with no formal education. Further analysis shows that education ($b=0.033$, OR=1.03, $p= 0.883$) and place of

residence ($b=0.176$, $OR=1.19$ $p=0.593$) have no significant effects on quality of ANC in Ghana for this sample. This is consistent with the small differences we see by education and urban residence in the bivariate analysis for the WHS Ghana sample. The coefficients for the interaction terms are the differences between Ghana and Burkina Faso in the effect of education and place of residence on quality of care. These are significant implying the magnitude of the effect of education and place of residence in Burkina Faso is different from that in Ghana. The interactions are illustrated in figure 5W1A&B. The plots show the higher level of quality in Ghana than Burkina Faso for both levels of education and in rural and urban areas; and the significant effects of education and place of residence on ANC quality in Burkina Faso but not Ghana. It also shows the differences by country are lower among those with some education compared to those with no education; and among those living in urban areas compared to those living in rural areas. The odds ratio for Ghana in the conditional model is the effect of country among in rural women and those with no education. The very high odds ratio for Ghana (32.5) therefore implies rural women with no education in Ghana have an over thirty times higher odds of receiving all three services than similar women in Burkina Faso.

To examine the differential country effects more carefully the multilevel regression is stratified by country. This confirms the findings in the pooled sample. Only frequency of ANC and ANC provider is significant for Ghana, while these together with place of residence, education and occupation are significant for Burkina Faso (this is shown in appendix 5W2). The direction of association between quality of ANC and place of residence and education in the Ghana sample are however in the expected direction. Further analyses stratified by country and using single level weighted logistic regressions are similar to that for the multilevel analysis. However, in the weighted single level logistic regression, parity is also positively associated with

quality of ANC in Burkina Faso. When unweighted single level binary logistic regression is used for the pooled sample a lot more predictors become significant including age and marital status. This is consistent with the expectation of smaller standard errors when weights are not used for complex samples and clustering is not accounted for (Aneshensel 2013; Hox 2010). The insignificant effects for Ghana could be because the sample for Ghana is underpowered to detect a difference. The findings from the WHS however need to be interpreted cautiously because of the various problems with the data including insufficient documentation related to sampling and the large amount of missing data especially for Ghana.

DISCUSSION

Most women in Ghana and Burkina Faso go for an antenatal care visit at least once during pregnancy, but many are not (or at least do not remember) receiving the full components of ANC. The results of the main analysis based on the GMHS show the factors significantly associated with higher quality ANC (controlling for other factors and clustering) include: higher SES (education and wealth), starting ANCVs in the first trimester, attending four or more ANCVs, receiving ANC from a government hospital or polyclinic, and receiving ANC from a doctor, nurse, or midwife. Urban residence is associated with higher quality ANC in the bivariate and partial models, but this effect is fully explained by the variables in the model. SES accounts for a significant proportion the rural/urban affect it. The SES effect is partly due to early initiation of ANCVs, more frequent ANCVs, use of higher level health facilities, and use of skilled providers, but there is a significant direct effect of SES net of these factors. Wealth and education have independent effects on ANC quality, but there is a moderation effect, with education most beneficial for the poorest. The other significant factors in the adjusted models are living in regions other than Greater Accra, Northern, and Volta regions, ever used contraception,

knowledge of where to get contraception, and being Moslem. Women who are cohabiting receive lower quality ANC than those currently married. The supplementary analysis generally supports these results. In addition, the results from the WHS show ANC quality of care in Ghana is higher than that in Burkina Faso.

The non-significant effect of place of residence on quality of ANC for Ghana is unexpected. This is because I expected SES and the other factors to explain some but not all of the rural/urban difference in quality of ANC. In the analysis based on the WHS, the rural/urban difference is present in the final model but only for Burkina Faso. This may be because of the fewer control variables in that model which leaves a lot of the variance unexplained. On the other hand, it may be that the strength of the rural/urban effect is different for different countries as shown in the interactions with country in that model. Joshi et al. using a similar measure of ANC quality found living in an urban area to be associated with better quality of care net of other factors in Nepal. Of important note however is that this study did not control for frequency and timing of ANC (which were examined as separate study outcomes). Thus, it is difficult to tell if the rural/urban difference they found is due to the differential ANC utilization in rural and urban areas. However, it is plausible to have a persistent rural/urban difference in quality of ANC due to the lower level of infrastructural development as well as inadequate health personnel in rural areas. Andersen (2004), in a qualitative study in Ghana, also suggests rural women are treated poorly and referred to as “villagers” even when they seek care in urban facilities.

The positive association between SES and quality of ANC are consistent with findings in other studies on quality of primary health care services and family planning (Andersen 2004; D. V. Duong et al. 2004; Hutchinson et al. 2011), as well as those from qualitative studies on delivery services quality (D’Ambruoso et al. 2005; Cheryl A. Moyer et al. 2013; Tunçalp et al.

2012). The few quantitative studies on ANC quality also found significant positive associations between SES and ANC quality – despite some methodological differences (Adjiwanou and LeGrand 2013; Joshi et al. 2014; Tran et al. 2012). Possible reasons for quality of care differentials by SES include the fact that women with higher SES: live in areas where quality of care is generally higher; use health facilities that offer higher quality of care; can physically access and afford high quality care; know what type of care to seek and are able to advocate for it; have higher expectations of care and insist on it; and are more likely have a relationship with health personnel which helps them acquire high quality services. The narrower social power gap between high SES women and health personnel also allows higher status women to assert their preferences to obtain high quality care (Andersen 2004; Boller et al. 2003; D. V. Duong et al. 2004; Gabrysch and Campbell 2009; Hutchinson et al. 2011; Thaddeus and Maine 1994). For quality of ANC based on services received, the differential in quality of care by SES may also be due to differential use of ANC services. These hypotheses have generally not been empirically examined, or even critically evaluated, because data on most of the intervening factors are usually not available. Nevertheless, by carefully examining the associations, and how they vary in the presence of other factors, we may be able to tell which factors are predominant.

First, that the rural/urban difference in ANC quality is explained by SES, and not the reverse, reduces support for the hypotheses that high SES women receive better quality of care because of where they live. This does not mean the quality of care in one's place of residence is unimportant; it means a woman's SES, if high, may enable her to obtain better quality of care above what is available in her immediate community. Women of higher SES are not limited to seeking care where they live: they can go outside of their communities to access higher quality of care. Women are willing to travel long distances to seek better health care if it is within their

means (Thaddeus and Maine 1994; Tunçalp et al. 2012). The finding may also mean that the quality of care received by women in the same communities, and potentially within the same health facilities, is not uniform; such that women of higher SES are able to obtain higher quality care than lower SES women in the same communities and facilities. This can be because higher SES women know what services are needed, and ask for these services. Higher quality care may also be more financially accessible to higher SES women. For example, women may have to pay for lab tests during ANCVs, and poorer women in the same facility may not get this service because of costs. This was the case in Ghana up till 2007 when the free maternal health policy was introduced. Since the implementation of the policy was very slow many women participating in both the GMHS and the WHS survey for Ghana were subject to some financial cost for ANC services (Witter, Arhinful, et al. 2007; Witter et al. 2009). These costs are still present as some health facilities still refer women out to commercial laboratories for some tests which women may have to pay for out of pocket. The persistent rural/urban difference in quality of ANC in Burkina Faso, on the other hand, may be due to the generally low quality of ANC in the country and particularly in rural areas; such that even high SES women in rural areas can only receive certain maximum that is still below optimum.

Second, if we assume that most of the effect of education is through knowledge of what to receive and being able to ask for it, and that of wealth mostly through financial access. Then the independent effects of education and wealth on ANC quality suggest independent roles of knowledge, assertiveness, and financial access. But the steep increase in quality of ANC with education among the poorest women, with little effect of education among those in the higher wealth groups, also suggest knowledge and assertiveness are more important for the poorest women. A reason for this may be that, in some facilities and among some providers, certain

services may be offered to all wealthier women, but not to poorer women, assuming that they cannot pay. Education becomes important in this instance because, poor but educated women may be more likely to know what to expect and so can actively seek it. Poor women with no education are thus most vulnerable, because they may not be offered certain services because it is assumed they cannot pay for it, and they do not ask for it because they do not know they are required to receive it. Also, because of the wide power gap between health providers and poor women with no education, they may be unable to assert their preferences even if they know what to ask for (Andersen 2004). On the other hand, the higher effect of wealth at very low levels of education suggests wealthier women use facilities and providers that provide higher quality care, and so it does not require any effort on their part to receive higher quality care. In this case, educated but poor women may know where to seek high quality, but affordable care. The non-significant interaction of education and wealth in the binary logistic regression (in sensitivity analysis) is potentially because, the buffering by education is important for small changes in quality, but unimportant for bigger changes –whether one received the highest quality of care or not –as cost may be a bigger barrier to receiving the best care.

Third, the findings support the hypotheses that women of higher SES receive higher quality of care partly because they use facilities and providers that provide higher quality care. In this analysis, women who received all of their ANC care from private facilities in Ghana had lower quality of ANC than those who received some care in government hospitals and polyclinics, but the quality of care in private facilities was not significantly different from that from other government facilities (comprising mainly the health centers and health posts). This is not consistent with other studies that suggest women who go to private facilities receive better quality of care. But the evidence for this has generally been inconsistent with the findings

depending on the dimension of quality one is examining (Basu et al. 2012; Boller et al. 2003; D. van Duong et al. 2004; Hutchinson et al. 2011). The bivariate analysis shows that more educated and wealthier women are as likely to receive care from government hospitals and polyclinics as from private health facilities, but less likely to receive care from health centers and health posts and non-health facilities. (The average years of school among those receiving care from hospitals and polyclinics, other government facilities, private facilities, and other are 6.1, 3.8, 6.1 and 3.4 respectively. About 51% of those who receive care in government hospitals and polyclinics and private health facilities are in the highest wealth quintile compared to less than 30% in the other facilities). This finding suggests some selection by wealth into facilities that offer or are thought to offer better quality of care. Also more educated and wealthier women are more likely to receive care from a doctor or nurse/midwife and least likely to receive care from an unskilled provider (33% of women in the wealthiest quintile saw a doctor for ANC compared to only 7.3% of those in the poorest quintile). The difference in quality of ANC provided by doctors and nurses is not significant in the final model for the GMHS, but is significant in the WHS. Both analyses also show lower quality of ANC among those receiving care from providers other than doctors, nurses or midwives. The mediation analysis shows that the type of ANC facility and provider accounts for a small but significant amount of the differential quality by SES. This may be due to the opposite effects of the facilities that more educated and wealthier women are likely to use, but it is also likely because other factors play a bigger role in the SES differential. That low educated but wealthier women may be receiving better quality of care because of the type of facilities and providers they use is suggested by the higher mediated effect of the difference in quality of care between the richest and poorest women, than that by education. Wealth and type of ANC facility and provider interactions were explored to see if the effects of ANC facility and

provider were conditional on wealth, but these were not significant. The effect of education is more consistent across the samples than wealth. This may be because for the measure of quality being examined knowledge of what is required as well being able to advocate for it is more important than being able to pay for it. However, we cannot rule out differential recall-bias and a woman's education being a better measure of her status than household wealth.

Fourth, the mediation analysis with frequency and timing of ANC show some, but not the entire, SES differential is due to differential use of ANC services. Women who go for the first ANCV in the first trimester and go for the recommended number of ANCVs receive higher quality. This may be because, even though the ANC quality measure only captures basic services that can be provided during the first ANCV, the services may not be available at all times, such that those who start early and go more frequently have a higher chance of receiving them. Higher SES women are also more likely to start ANC early and attend more frequently, partly because the services are more accessible to them (Thaddeus and Maine 1994; Gabrysch and Campbell 2009; N. N. A. Kyei et al. 2012; Joshi et al. 2014). Thus, if the entire SES differential in ANC quality was explained by differential utilization, then the SES differential in ANC quality could be attributed mostly to differential access. The results however show that though frequency and timing of ANCVs account for some of the SES differential in ANC quality, there is a direct effect of SES net of these factors. This implies factors other than those related to reaching ANC sites (as discussed above) are also contributing to the SES differences in ANC quality. This finding is important because, it suggests factors operating within the health system may be causing the disparities in quality of ANC. The few prior studies on quality of ANC have, however, not made this distinction.

For example, in Nepal, Joshi et al (2014) found higher education, higher wealth, and urban residence to be associated with higher quality ANC (based on a similar measure of ANC quality), and higher frequency of ANCVs. But they did not include frequency and timing of ANCVs as a predictor of ANC quality. Tran et al (2012) in Vietnam also found a positive association between education and wealth, and ANC adequacy –created from a combination of frequency, timing, and content of ANCVs; thus, did not account for the effect of the timing and frequency on the content of ANC. This analysis was stratified by rural and urban, and so did not assess rural/urban differences, and wealth was only significant for rural areas. Because frequency and timing of ANC were not controlled for in these studies, it is unclear how much of the SES and rural/urban differences in quality of ANC was due to differential utilization of ANC. Also, combining frequency, timing, and content of ANCVs into a composite measure does not enable identification of the potentially different underlying reasons for differences in each of those factors. Adjiwanou and Legrand (2013) included frequency of ANC as a determinant of quality of ANC in rural Ghana, Kenya, Uganda and Tanzania and found differences by education and wealth in Ghana and Tanzania, but they did not include timing of first ANC.

One other notable finding from the GMHS analysis is that women in all regions of Ghana (except Volta and Northern regions) received higher quality of care than those in the Greater Accra region; and women in the Western region received the highest quality of care. This is unexpected because, the Greater Accra region which houses Accra –the national capital of Ghana, has one of the two big teaching hospitals in the country, and has more health facilities and health personnel than any other region in the country (Appiah-Denkyira et al. 2013; Ghana Health Service 2012). Utilization of maternal health services including use of skilled birth attendants is also higher than that in the other regions (GSS 2008). Furthermore, it is more urban,

hence has greater ease of reaching health facilities, and has a larger proportion of high SES women (GSS 2008). The lowest quality of ANC in Northern region can be easily explained: it has the lowest density of health workers and health facilities in Ghana, and tend to have the poorest maternal health indicators in the country (Appiah-Denkyira et al. 2013; Ghana Health Service 2012; GSS 2008). That Western region has the highest quality of ANC on the other hand is more difficult to explain, considering that it has the second lowest density of health workers in the country (Appiah-Denkyira et al. 2013). A potential reason for the higher quality of ANC in the other regions compared to Greater Accra region, when other factors are accounted for is that: because access to health services are worse in the other regions, those who attend ANC in these regions are a select group who are able to overcome the barriers to receiving better quality care. This is however not very likely since over 95% of women in all regions go for ANC least once. Also supplementary analysis (appendix 1C) showed that only the Upper East region differs from the Greater Accra region in attendance of ANC with women in the Upper East region having a higher odds of going for at least on ANC visit than women in the the Greater Accra region (OR=12.5, p<0.01). Another potential reason is the large number of private health facilities in the Greater Accra region, which may be providing less than optimal ANC. This is plausible considering that Western, Upper East, and Upper West regions which have fewer private facilities appear to be doing better. The lower quality of ANC in Accra may also point to poor quality ANC in the peripheral health facilities, which are overshadowed by the presence of the teaching hospital in the region. This is plausible considering the number of mismanaged cases that are referred to the teaching hospital.⁸ To my knowledge no study has examined regional variations on quality of ANC in multivariate analysis for Ghana, thus there are no studies to

⁸ From personal experience working in Ghana.

compare this to.⁹ This finding presents an area for further studies to identify the factors that account for the regional variations in ANC quality by region.

Experiencing complications from prior pregnancies and the index pregnancy was added to the model because providers may pay greater attention to women who have pregnancy risk factors, or women with complications may actively seek higher quality of care. The lack of an association found may be because the antenatal services examined here are basic services all women going for ANC should receive (WHO 2009). Furthermore, the risk based approach to ANC has been found to be ineffective, requiring that all women receive the basic ANC services, with additional services for those with identifiable complications (Bergsjø 2000). The non-significant effect of age and parity are consistent with findings from the few other studies examining quality of ANC (Adjiwanou and LeGrand 2013; Joshi et al. 2014; Tran et al. 2012). This is potentially due to the fact that the extremes of both –i.e. very young and older women and primiparous and grandmultiparous women are all considered high risk and so may receive greater attention from health providers or actively seek good quality ANC. But, younger and primiparous women who may be more motivated to actively seek good quality care, because of inexperience with childbirth, may be less likely to know where to obtain it. On the other hand, older and multiparous women who may know where to obtain high quality care may be less motivated to actively seek it (unless they had a prior bad outcome) because of their greater experience with childbirth. Using categorical age and parity variables, however, did not change the results. The non-significant effect of these factors may also be because their effects are potentially mediated by other factors in the model like education and wealth (Gabrysch and

⁹ To evaluate the region effects further, I examined the interaction terms for region and education, region and wealth, region and urban, and region and religion. None of these were significant ((region and wealth interaction is significant as a group but none of the individual effects significant and region and education interactions not significant as a group but Ashanti and education interaction term is significant)

Campbell 2009). The positive effects of use of contraception and knowledge of where to get contraception on ANC quality are likely due to familiarity with the health system (Gabrysch and Campbell 2009). People who use contraception in a country where contraception uptake is still low are also likely a select group who will actively seek good quality ANC. Joshi et al (2014) however found a negative association between modern use of contraception and quality of ANC in Nepal, though this was only marginally significant ($p=0.045$).

It is unclear why Moslem women receive higher quality ANC than Christians (when other factors are controlled for); and why women who are cohabiting receive lower quality ANC than those currently married. A possible reason is that Moslem women are more able to advocate for themselves for better quality of care, but this effect is suppressed because of their lower SES, and emerges when SES is accounted for. This is especially because we find no difference between Moslems and Christians in the bivariate analysis, but the effect emerges when other factors are added to the model; suggesting some factor that is related to both religion and quality of ANC is suppressing the effect in the bivariate analysis (Aneshensel 2013; Rosenberg 1968; Treiman 2009). The prior studies that controlled for religion did not find a significant difference between Moslems and Christians (Adjiwanou and LeGrand 2013; Atinga and Baku 2013). For the effect of cohabiting, a potential reason is stigmatization, in a country where unmarried women who are pregnant are often frowned upon. This explanation is however more plausible for interpersonal quality of care, which is not adequately captured by the measure of ANC quality used in this analysis. There are no major differences in place of residence, wealth and education between those cohabiting and those currently married suggesting some other factors may be accounting for this difference. The other studies on determinants of quality of ANC did not include marital status in the final models. One included a variable on whether or not the

woman was living with a partner which was not significant (Adjiwanou and LeGrand 2013). Prior studies on quality of ANC have not adequately examined marital status and religion. Further studies are needed to understand the findings from this analysis.

The higher quality of ANC in Ghana than Burkina Faso is not very surprising since Ghana is better off than Burkina in several areas including economic development and health infrastructure. Women from Burkina Faso are known to crossover to Ghana especially in the Upper East region to seek care due to better access and likely higher perceived quality. The magnitude of the difference is, however, even larger than I expected. The differential effect of place of residence and education in Ghana and Burkina Faso was also not expected. But as mentioned earlier, the effects are likely stronger in Burkina Faso because of the generally poor quality of ANC. This result would suggest the effects of rural/urban residence and SES are different at different levels of quality. Also, because of the very low number of women with some education in Burkina Faso, education may be more important. The effect of frequency of ANC and type of ANC provider is, however, consistent across samples. I am unable to explore regional differences with the WHS because the regions in the dataset are not identified. Examining regional differences would have been useful to determine whether the northern regions are similar to Burkina Faso. From the analysis with the GMHS however, this is likely not so.

Limitations and strengths

There are a number of limitations to this study. The first is the measure of quality of ANC which only captures service provision. While it gives a feel of whether or not women are receiving the essential ANC services, it does not capture the experience of women with the health system – how they are treated and the nature of the interactions with health providers. To

my knowledge only one study in Ghana has attempted to examine the factors that influence the patient experience dimension of quality of ANC (Atinga and Baku 2013). This study, while a good attempt, is limited by several issues including how quality was assessed, the sampling approach, the sample size, and the omission of important predictors in the multivariate model. Patient experience of care has generally not been examined because the big national surveys do not collect data on it. An initial motivation to use the WHS was because the information collected to measure health system responsiveness could be used to measure patient experience of care. However, examination of the data showed the skip pattern in the question resulted in too many missing observations with too few cases for the analytic sample. Examining patient experience is important because qualitative studies suggest that poor attitudes of health workers are a major barrier to use of maternal health services. These studies have also suggested differential quality of patient experience of care by education and place of residence, which I am inclined to think may even be bigger than those related to services received (D'Ambruoso et al. 2005; Cheryl A. Moyer et al. 2013; Tunçalp et al. 2012).

The measure of quality of ANC also has some limitations even as a measure service provision. For instance we expect it to capture some dimensions of structure (human and physical resources) and process (mostly the technical aspects), as a minimum of these is required to provide services. But the questions asked are limited in discriminating between basic and more advanced infrastructure. For example, whether or not a woman gave a blood sample for a blood test during her entire pregnancy may be very limited in measuring the structural aspects of health services as a blood test does not discriminate against simple test like estimating Hemoglobin (Hb) or a sickling test, and even slightly more advanced test like Hb electrophoresis, which are needed for proper management of pregnancy in places like Ghana,

where sickle cell disease is a major cause of indirect maternal deaths. In my experience as a clinician, I have seen women come in labor with a positive sickling test that was never followed up with an Hb electrophoresis to assess if they have a sickling trait or sickle cell disease. There are also instances where a blood sample is taken for one test, for example an HIV test, and the woman does not have a Hb test during the whole pregnancy; or an initial Hb test with diagnoses of mild anemia, which is not followed up till she is seen in labor with severe anemia. These problems also apply to urine tests. Even for a simple assessment such as having a blood pressure taken, women with preeclampsia are still missed because an initial normal or borderline BP may not be followed up. Thus, just asking if a woman had the services listed at least once during pregnancy is limited in discriminating between different levels of quality of care. These limitations are, however, difficult to address as most women may not know what type of test a blood or urine sample was taken for. Recall is also easier for whether a test was done or not than how many times it was done. Thus, the limitations discussed should not undermine the findings presented here but suggest that the high score on the quality index should not be taken as an indication of high quality of ANC in Ghana. It should also raise even more concerns for Burkina Faso where these basic services are more limited. In addition, the women who are more likely to receive an inadequate amount of the slightly more advanced services are the rural and low SES women – this result implies that the findings of this analysis underestimates the magnitude of the disparities in quality of care. There is, therefore, a need for the evaluation and incorporation of better measures of quality of maternal health care, including the interpersonal dimensions of quality into the major health surveys in developing countries. Other limitations which apply to the whole dissertation are discussed in chapter 8. The study has several strengths, which are also discussed in chapter 8. Of note however that: it addresses a gap in the maternal health literature,

which is the dearth of quantitative studies that examine the determinants of quality of maternal health services in SSA.

Conclusions

This study finds that many women come into contact with the health system at least once during pregnancy, but the quality of ANC they receive is below optimum, especially for women of low SES. Differential utilization of ANC services accounts for some of the SES disparities in ANC quality, but there is a significant effect of SES net of ANC utilization. Health system factors partly account for the SES disparities in ANC quality, including differential quality of care in different types of health facilities, and potentially within health facilities, for different groups of women. In addition, the finding that most of the differentials in quality of care by place of residence are explained by SES, but not the reverse, suggests that while quality of care may be generally low, higher quality of care is available to certain groups of women. This analysis also adds voice to calls to improve women's SES especially through education. Finally, that, there are SES disparities in quality of ANC, suggest these may be contributing to the low use and large disparities in the use of skilled birth attendants, despite high antenatal attendance. Targeted efforts to increase ANC quality will help improve maternal health and reduce maternal health disparities in SSA. These findings have a number of other implications which are discussed in chapter 8.

CHAPTER 6: AIM 2

Examine the determinants of use of skilled birth attendants (SBAs); and if quality of antenatal care mediates the rural/urban and socioeconomic differentials in use of SBAs

INTRODUCTION

Background

Skilled attendance at delivery is advocated as the “single most critical intervention” to reduce maternal mortality (WHO 2004, 2013c). This is because about three quarters of maternal deaths occur from complications during labor, delivery, and the first 24 hours postpartum. These complications are difficult to predict, but can be effectively managed and deaths averted if they are recognized and treated promptly. Thus, there is the need for a *skilled birth attendant* (SBA) – a health professional who can identify and manage normal labor and delivery; and identify and treat complications or provide basic care and referral – at every delivery (Khan et al. 2006; Li et al. 1996; WHO 2004). Unfortunately, deliveries by SBAs continue to be low in the regions with high mortality, with only about half of births in SSA being assisted by a SBA (WHO 2013b). Ghana and Burkina Faso – the study countries – are just two examples from SSA.

Both countries have over 90% of women going for at least one ANC visit during pregnancy, but only about 63% of births in Ghana and 65% of births in Burkina Faso are assisted by SBA (WHO 2013b, 2014; WHO et al. 2012). There are also wide disparities in use of SBAs within both countries, raising the question: What accounts for the disparities in use of SBAs by place of residence and Socioeconomic Status (SES)? Differential access and perception of need for skilled delivery assistance are potential reasons. But in this paper I focus on quality of care, and examine if differential quality of care may be playing a role.

For quality of care to explain differentials in use of skilled birth attendants by place of residence and SES, these factors must also be associated with both quality of care and use of

SBAs, and quality of care must be associated with use of SBAs: a variable must be associated with both the dependent variable and the focal independent variable to be able to function as a mediating or intervening variable (Aneshensel 2013; Rosenberg 1968).

The first aim of this dissertation showed that SES and place of residence are significant predictors of quality of antenatal care, though a significant part of the rural/urban effect is explained by SES. This finding is supported by the few other quantitative studies that examined the determinants of quality of maternal health care, as well as findings from qualitative studies (Andersen 2004; D. van Duong et al. 2004; Hutchinson et al. 2011; Joshi et al. 2014; Cheryl A. Moyer et al. 2013; Tran et al. 2012). Most qualitative studies also mention quality of care as an important determinant of use of SBAs, though there is less consistent qualitative evidence on it (Gabrysch and Campbell 2009). Thus, if higher quality of care increases use of SBAs, and urban and high SES women are more likely to receive higher quality, then it is plausible to think that part of the reason why urban and high SES women are more likely to use SBAs is because they received higher quality of care in previous encounters with the health system.

Study objectives

The purpose of this study is to (1) examine the factors that influence use of SBAs; and (2) examine if quality of care explains some of the rural/urban and SES differentials use of SBAs. I hypothesize that urban residence, higher SES, and higher quality of care will be positively associated with use of SBAs; and quality of care will partly mediate the effects of place of residence and SES on use of SBAs. I will also examine if the effect of place of residence and SES on use of SBAs is conditional on the level of quality of care. This conditional effect is based on suggestions that awareness of poor quality in health facilities and higher confidence in self-

care may reduce the use of SBAs among educated women at low levels of quality of care (Gabrysch and Campbell 2009).

METHODS

Data: The data for this analysis are from the Ghana Maternal Health survey (GMHS) and the World health survey (WHS) described in chapter 4. Because quality of care can only be assessed for women who came into contact with the health system during pregnancy, the main analysis is restricted to women who had at least one ANC visit during their last pregnancy – 97% (N=4,868) of the GMHS sample and 83% (N=1,671) of the WHS sample. The full sample (N= 5,042 for the GMHS; and N= 2,005 for the WHS) will however be used for supplementary analysis for the determinants of use of SBAs.

Constructs and Variables

Dependent variable: Use of a skilled birth attendant

Use of a SBA refers to whether a woman's last delivery assisted by a SBA –doctor, nurse or midwife, or auxiliary nurse or midwife (coded 1) – or not (delivery by anyone other than a doctor, nurse or midwife, or auxiliary nurse or midwife (coded 0). It is described in detail in chapter 4.

Intervening variable: Quality of care

Quality of antenatal care is operationalized by the index based on services received during ANC. The indices for both the GMHS and the WHS are described in detail in chapter 4. For this analysis it is used as a dichotomous variable coded: 0 - lower quality (received zero to seven services) and 1- higher quality (received eight or nine services), for the GMHS analysis; and coded 0- lower quality (received zero to two services); and 1- higher quality (received all three services), for the WHS analysis. The use of a binary mediator is necessary because the

dependent variable (use of a SBA) is binary: the coefficients for the mediator and the dependent variable need to be in the same metric to be able to accurately assess the mediated effect for non-continuous outcomes with the product of coefficients method (Krull 2014; MacKinnon 2008).

Patient experience (in only the WHS) is measured by the two indices on patient assessment of interpersonal quality of care and the structure and technical aspects of care, from the health system responsiveness questions in the WHS on. *Perceived accessibility*, measured by the rating of travel time to an inpatient facility, and coded as bad access, good perceived access, and No inpatient care/missing, is considered a *rival intervening variable*.

Focal independent variables: socioeconomic status and place of residence.

I operationalize socioeconomic status in this analysis as education and wealth. I also include occupation status for the WHS analysis. Place of residence refers to whether the respondent lives in a rural or urban area. I also examine the effects of region of residence in the GMHS. These variables are described fully in chapter 5.

Rival independent and control variables

These include the various factors potentially related to quality of ANC, use of SBAs, and or the focal independent variables. Factors directly related to quality of ANC include frequency and timing of ANC visits, and the type of ANC facility and provider. Those related to use of SBAs include those that may influence perceived need for using a SBA – age, parity, prior stillbirth or miscarriage, having a sibling who experienced a maternal death, experience of a complication in the index pregnancy, and the reason for seeking ANC. The WHS does not have the variables on prior or current pregnancy complications, so to control for factors related to the woman's health status that may affect her perception of need for using SBA; I include two variables on self-rated health status and whether the woman has ever been diagnosed with a

chronic condition. I also control for familiarity with the health system using knowing where to get contraception and ever used contraception, which have also been used in prior studies as measures of biomedical beliefs (Gabrysch and Campbell 2009). These variables are also not in the WHS data; instead there is a variable on satisfaction with the health system in the WHS which I include. In addition, I control for marital status which is seen as a sign of status in many SSA countries; and age at first union and sex of the household head (female headed household or not), which may tap into women's autonomy (Gabrysch and Campbell 2009). These variables are described in detail in chapter 5.

Contextual factors can also influence the decision to use a SBA and this has been shown in other studies (Gage 2007; Pebley et al. 1996; Stephenson et al. 2006b). The data for this analysis do not include contextual variables, and so I created a number of contextual variables from the individual level variables to examine contextual effects. These variables include: the proportion of women with a high school degree in a cluster, the proportion of women who use contraception in a cluster, the average number of children delivered by women in a cluster, the average score on the ANC quality index by women in a cluster, and the proportion of women who were assisted by a SBA in a cluster. These variables serve as proxies for attitudes towards female education, biomedical beliefs, pronatalist beliefs, the level of quality, and availability of health services in one's immediate neighborhood, respectively (Gage 2007; Pebley et al. 1996; Stephenson et al. 2006b). These variables were all associated with use of SBAs in the bivariate models though only the average quality of care and proportion assisted by a SBA was significant in the multivariate (weighted single level) models. However, because the contextual variables are strongly correlated with the individual level variables from which they were created (which are already in the model), it was difficult to achieve convergence in the multilevel multivariate

models. The contextual variables were therefore dropped from subsequent analysis. Rural/urban residence and region of residence capture contextual factors in the absence of specific contextual variables (Montagu et al. 2011).

Analytic approach

Because the outcome measures are binary, the “xtmelogit” command in Stata is used to estimate multilevel binary logistic regression models (Hamilton 2012; Rabe-Hesketh and Skrondal 2012). To examine the determinants of use of SBAs, the single equation form for the unconditional model with the key predictors is represented simply as:

$$\ln\text{SBA}_{ijk} = \gamma_{000} + \gamma_1\text{Edu}_{ijk} + \gamma_2\text{Wealth}_{ijk} + \gamma_3\text{Urban}_{ijk} + \gamma_4\text{Ancqoc}_{ijk} + \dots + \zeta_j + \zeta_k$$

where:

$\ln\text{SBA}_{ijk} = \text{logit} \{ \text{Pr}(\text{SBA}_{ijk}=1 | x_{ijk}, \zeta_j, \zeta_k) \}$: the logit of the probability (or log odds) of using a SBA for the i^{th} woman in the j^{th} cluster, in the k^{th} district; and ζ_j and ζ_k are the variance at the cluster and district level (strata in the WHS) respectively (there is no error term for level 1 because the logistic model is heteroskedastic).

γ_{000} is the log odds of using a SBA when all the predictors are zero (reference group for categorical variables) and accounting for inter-district and inter-cluster variation;

γ_1 is the change in the log odds of using a SBA for each unit increase in education holding other factors constant and accounting for inter-district and inter-cluster variation;

γ_2, γ_3 and γ_4 are the difference in the log odds of using a SBA between the rich and the poor, between those living in the urban and rural areas, and between those who receive good and poor quality of ANC respectively; holding other factors constant and accounting for inter-district and inter-cluster variation.

The models are built starting with the null model, then adding the focal independent variables, the control and rival independent variables, and finally the intervening variable.

However, because the addition of variables to a logistic model changes its scale, it is not accurate to directly use the change in the magnitude of the coefficients in the nested models as the mediated effects (Aneshensel 2013; Mood 2010). Thus, only the bivariate and full models are presented. The coefficients in the full model with all the relevant predictors are used to assess the determinants of use of SBAs and quality of ANC.

To assess if quality of ANC mediates the effect of each of the focal independent variables, I do a mediation analysis using the ‘**ab**’ product of coefficients method described by MacKinnon (2008). Mediation with the product of coefficient method involves estimating two models. The first model is the full model for the regression of the focal dependent variable (use of SBAs) on the full set of predictors – focal independent variables (education, wealth and place of residence) and all relevant predictors including the potential mediator (quality of care) to give ‘**c**’ – the direct effect of the focal independent variables on the dependent variable. For example, for the mediation for education, the coefficient for education in this model is ‘**c**’ – the direct effect of education on use of SBAs net of relevant control and rival independent variables and the intervening variable. The coefficient for the quality of ANC in this mode gives ‘**b**’ – the direct effect of quality of ANC on use of SBAs, net of relevant independent and control variables. The second model is the regression of the intervening variable (quality of ANC) on the focal independent variables and all the relevant predictors. The coefficient for the focal independent variables in this regression gives ‘**a**’ – the direct effect of the focal independent variables on the mediating variable. For the mediation for education the coefficient for education is ‘**a**’ – the direct effect of education on quality of ANC net of relevant control and rival independent variables. The mediated or indirect effect for a particular focal independent variable is then calculated as the product of ‘**a**’ and ‘**b**’. The ratio of the indirect to direct effect (ab/c) or

the proportion of the total effect mediated ($ab/(ab+c')$) is used to assess the magnitude of the mediated effect (Aneshensel 2013; Krull and Mackinnon 1999; MacKinnon 2008). In linear regression, ab is equal to $c-c'$ (from the difference of coefficients method described in chapter 5), where c is the total effect –the coefficient of the focal independent variable full model with all the predictors except the intervening variable. The product of ab is however not equal to $c-c'$ with logistic regression because of the fixed error term and the resulting change in scale of the equation with the addition of more variables; hence the recommendation to use the product of coefficients method for non-continuous outcomes.

The mediation analysis for education, wealth, and place of residence involves the same models, with the coefficient for each in the regression for ANC quality of care giving ‘a’ and the coefficient in the regression for use of SBAs giving ‘c.’ The coefficient for quality of ANC in the regression for use of SBAs (‘b’) is the same for the mediation for each focal independent variable. The approach to the mediation analysis is illustrated in figure 6.1. Using Mackinnon’s notation, the two equations are represented as:

$$\ln\text{SBA} = k_1 + b\text{Ancqoc} + c_1'\text{Edu} + c_2'\text{Wealth} + c_3'\text{Urban} \dots + x_{i+}\text{X}_{i+}$$

$$\ln\text{Ancqoc} = k_2 + a_1\text{Edu}_{\text{edu}} + a_2\text{Wealth} + a_3'\text{Urban} \dots + x_{i+}\text{X}_{i+}$$

Where ‘k’ is the constant in each regression; the prefix for the coefficients are used to distinguish the coefficients for the different focal independent variables; and X represents the other predictors in the models. Figure 6.2 illustrates the mediation analysis with place of residence as the focal independent variable. It also shows that there are other potential or rival intervening variables (accessibility and perceived need) that are not examined in this analysis because of lack of data. Thus, the effect mediated by quality of ANC is expected to be partial and not complete mediation.

There are various methods to assess the significance of the mediated effect. In this analysis I use the Sobel test, which is recommended for mediation for binary outcomes (Aneshensel 2013; Sobel 1982). The p-values for the mediated effects are obtained from the coefficients and standard errors for ‘a’ and ‘b’ using the interactive website for the Sobel test: <http://quantpsy.org/sobel/sobel.htm>, based on the following equation: $z\text{-value} = a*b/\text{SQRT}(b^2*s_a^2 + a^2*s_b^2)$; where s is the standard error. I also check the results against that of the Goodman test which is another version of the Sobel test based on a slightly different equation: $z\text{-value} = a*b/\text{SQRT}(b^2*s_a^2 + a^2*s_b^2 - s_a^2*s_b^2)$. The Sobel test is said to work well in large samples and therefore appropriate for this analysis (Aneshensel 2013; Sobel 1982).

====Table 6G1 about here====

RESULTS

GMHS analysis

Factors affecting use of SBAs

Bivariate results: The bivariate statistics are presented in table 6G1. About 56% of women in the full sample, and 57% of women who had at least one ANC visit were assisted by a SBA during delivery, though these percentages are not significantly different – seen in the overlap of the confidence intervals. The proportion of women assisted by a SBA during delivery for each of the predictors do not also differ significantly for the full sample and the sample restricted to women with at least one ANC visit. As expected almost all deliveries in health facilities are assisted by SBAs (99%). About 40% of women in rural areas were assisted by a SBA compared to 87% for urban women. The greater Accra region has the highest proportion of women assisted by SBAs – about 80% – followed by the Ashanti region at about 68%. Less than 50% of women in the Volta, Northern, and Upper regions are assisted by SBAs, with the lowest

in the Northern region, where less than 30% of women are assisted by a SBA. Use of SBAs increases with education and wealth –33 % among those with no education compared to about 90% among those with secondary education; and 28% among the poorest compared to 92% among the richest. Women in female headed households are slightly more likely to use SBAs (65%) than women in male headed households (53%). Women in the Traditional religion/other group are least likely to use a SBA (24%); followed by Moslems (47%). There is no significant difference in use of SBAs between the Christian denominations (range from 55 to 65%). By ethnicity, Akans have the highest proportion of women using a SBA – 68% compared to less than 60% for all the other ethnicities. The Grussi/Gruma group has the lowest proportion using a SBA at 32%. There is however wide overlap in the confidence intervals for each of the ethnicities. Use of SBAs also appears to increase with media exposure –about 75% among those who reported watching television at least once a week compared to 56% and 40% respectively among those who watched television less than once a week or not at all. Women aged 40 to 49 years are less likely to use a SBA than younger women – 46% compared to over 52% for the other age groups, but there is no significant difference between the other age groups. Those who have never married and those previously married are more likely to use SBAs than those currently married or cohabitating. Also those who married before 19 years are less likely to use SBAs (48%) than those who married after 19 years or never married (62%). Women with five or more children are less likely to use SBAs than women with fewer children. Women who have ever used or are currently using contraception are also more likely to use SBAs than those who have not, but there is no difference by knowledge of source of family planning. There is also no difference in use of SBAs by prior miscarriage and having a sibling who died from maternal causes, but women who have had an induced abortion and women who have had a prior still

birth are more likely to use SBAs than those who have not had these experiences. Furthermore, women who experienced a pregnancy complication in the index pregnancy are more likely to use a SBA than those who had no problem – 66% for some complication compared 52% for no complication and 72% for serious complication compared to 52% for no serious complication.

For attendance at ANC, 57% of women who had at least one ANC visit used a SBA compared to 7% of those who did not have any ANC visit. Among women who had an ANC visit, those who received higher quality care (8-9 services), had four or more visits, started ANC in the first trimester, received ANC in a government hospital or polyclinic or in a private facility, and those who received ANC from a doctor were more likely to use a SBA. About 65% of women who received higher quality ANC and those who attended ANC more than four times were assisted by a SBA, compared to 45% of those who received lower quality ANC and 27% of those who attended less than four times. Also, close to 70% of women who received ANC in a government hospital or polyclinic or a private facility were assisted by a SBA compared to just about 40% for those who received ANC from a government health center or health post. Furthermore, about 77% of women who saw a doctor for ANC were assisted by a SBA compared to 53% of those who saw a nurse or midwife and 30% of the few who saw a provider other than a nurse or midwife.

====Table 6G2 about here====

Multilevel logistic regression results: The results from the multilevel logistic regression for use of SBAs are shown in tables 6G2. The random effects at the bottom of the table show evidence of clustering at the cluster and district level, though there is more variation between individuals. Given a fixed level 1 variance of 3.29 ($\pi^2/3$), an approximation of the Intra class correlation (ICC) at the district level is 0.17 (variance at the district level/total variance =

$(0.936/(3.29+0.936 +1.316)) = 0.936/ 5.541 = 0.169$); and that at the cluster level is 0.24 (variance at the cluster level/ total variance = $(1.315/5.541=0.237)$ (Krull 2014). The final model explains about 62% of the variation between districts ($(0.94 -0.36)/0.94) = 0.617$) and about 58% of the variation between clusters ($(1.32-0.56)/1.32= 0.576$)).

The second column of table 6G2 shows the multilevel logistic regression results for the unadjusted models. This shows that when only clustering is accounted for, the individual factors positively associated with use of a SBA are: receiving higher quality of ANC, living in an urban area, higher education, higher wealth, attending four or more ANC visits, receiving the first ANC in the first trimester, receiving ANC from a doctor, receiving ANC in a government hospital or polyclinic or in a private facility, experiencing a pregnancy complication, prior use of contraception, being Akan, and living in the Greater Accra, Ashanti or Central regions. Those who received higher quality ANC (8 or s9 services) have 68% higher odds of using a SBA than those who received lower quality ANC (less than 8 services). When the continuous ANC quality variable is used, each unit increase in the quality score increases the odds of using a SBA by 23%. Women who live in urban areas have about 11 times higher odds of using a SBA than those living in rural areas. Each year of education increases the odds of using a SBA by about 13%. When the categorical education variable is used the odds of using a SBA is 1.3, 2.4 and 6.1 times higher for primary, JSS/middle school, and SSS/secondary, respectively, compared to women with no education. Also, compared to women in the lowest wealth quintile, those in the second lower/middle wealth quintiles have about 75% higher odds of using a SBA, and those in the upper quintiles have over six times higher odds. When the detailed wealth quintiles are used the ORs are 1.3, 2.5, 5.4, and 16.8 respectively for second lowest to highest wealth quintile, all compared to lowest wealth quintile. Receiving ANC from a health center or health post,

cohabiting, marrying before 19 years, higher parity, belonging to the Traditional religion, and watching television less than once a week are associated with lower use of SBAs. Women who received ANC from a government health center or health post and at a home, have about 50% and 77% lower odds respectively of using a SBA, compared to those who received ANC from a government hospital or polyclinic, but there is no difference in the odds of using a SBA for those who received ANC in only a private facility compared to those who did so in a government hospital or polyclinic. Also, compared to women who received ANC from a nurse or midwife, those who received ANC from a doctor have about 80% higher odds of using a SBA, and those who received ANC from a provider other than a doctor or nurse have about 60% lower odds of using a SBA.

The multivariate regression results include one model with only the individual level predictors and another model with region. While it is not useful to compare odds ratios across logistic models, this separation is made because region captures several factors and is particularly related to quality of ANC, such that its inclusion in the model masks the quality of care effect. The mediation analysis is therefore based on the model with no region in the model. Except for trimester of first ANC, the significant predictors, net of other factors, are the same as those in the bivariate models, though the effect sizes are lower. But the significance and effect sizes for most of the predictors are similar in the two multivariate models (except for quality of care).

After adjusting for clustering and other factors excluding region, women who received higher quality ANC have about 21% higher odds of using a SBA than those who received lower quality ANC. When region is included in the model, we still see the positive association, but this is only marginally significant ($p=0.09$). Women who live in urban areas have about four times

higher odds of using a SBA than those living in rural areas; and each year of education increases the odds of using a SBA by about 8%. Compared to women in the lowest wealth quintile, those in the middle wealth quintiles have about 22% higher odds of using a SBA and those in the upper quintiles have over 100% higher odds of using a SBA. Women who attended ANC at least four times have over two times higher odds of using a SBA compared to those who attended less than four times –other factors held constant. Also, compared to women who received ANC from a nurse or midwife, women who received some ANC from a doctor have about 30% higher odds of using a SBA, and women who received ANC from a provider other than a nurse or doctor have about 60% lower odds of using a SBA. Furthermore, women who received ANC from a government health center or health post, have about 20% lower odds of using a SBA, compared to those who received ANC from a government hospital or polyclinic. As in the bivariate models, there is no difference in the odds of using a SBA for those who received ANC in only a private facility and those who did so in a government hospital or polyclinic.

In addition, women who had a serious pregnancy complication in the index pregnancy have more than two times higher odds of using a SBA compared to those who had no serious complication. The other factors positively associated with use of SBAs in the multivariate model are increasing age and prior use of contraception. Cohabiting, higher parity, belonging to the Traditional/other religion group, and lower media exposure are associated with lower use of SBAs net of other factors. Without region in the model, being of Mole-Dagbani or Hausa ethnicity is associated with lower odds of using a SBA compared to the other ethnicities, but the other ethnicities do not significantly differ from the Akans. However when region is added to the model, we no longer see the ethnicity effect, but rather a regional effect, where women in the Northern region have the lowest odds of using a SBA – 64% lower odds of using a SBA

compared to women in the Greater Accra region; but no difference between Greater Accra region and the other regions. This is likely because Northern region has the largest concentration of Mole-Dagbani and Hausas.

To examine if the effect of place of residence and SES on use of SBAs differ by the level of quality of care, interaction terms for quality of care and education, wealth, and urban residence were included in the models, but these were all not significant. The interaction between region and quality of care was also examined, but only the interaction with Upper West was significant suggesting the effect of quality of care on use of SBAs in this region may be different from that in the other regions. The interactions are not shown in the final models.

====Table 6G3 about here====

Factors affecting of quality of ANC: The results of the multilevel logistic regression for quality of ANC are presented in Table 6G3. This model includes all the covariates important for both quality of ANC and use of SBAs. Including the same set of predictors in the regressions for the focal dependent variable and potential mediator (with the only difference being the mediator in the regression for the focal dependent variable) is essential to accurately estimate the mediated effect. The results here are the same as that discussed in chapter 5. After accounting for inter-cluster and inter-district variation and controlling for other factors, the factors positively associated with higher quality ANC are higher education, higher wealth, attending ANC four or more times, receiving ANC in a government hospital or polyclinic, prior use of contraception, knowing source of family planning, being Akan, and living in the Western region. Receiving the first ANC in the third trimester and cohabiting are associated with lower quality care compared to ANC in the first trimester and being married. Urban areas show higher quality of care in the

bivariate model but this difference becomes only marginally significant ($p=0.05$) when other factors are accounted for.

====Table 6G4.1 about here====

====Table 6G4.2 about here====

Mediation analysis: For a variable to serve as a mediator, it must be associated with both the focal dependent and independent variable. In this analysis quality of ANC is significantly associated with use of SBAs (when regional effects are not accounted for), thus meets one criterion for serving as an intervening variable for use of SBAs. Though living in an urban setting is associated with higher odds of using a SBA, the association between urban/rural setting and quality of ANC is not significant when other factors are accounted for. Thus the mediated effect will not be significant and there is no need to proceed with the formal mediation analysis for place of residence. Education and wealth on the other hand are both associated with use of SBAs and quality of ANC; thus quality of ANC qualifies as a potential mediator of the effect of education and wealth on use of SBAs. The formal mediation analysis using the Mackinnon's product of coefficients method uses the unstandardized coefficients shown in table 6G4.1. The results for the mediation are shown in table 6G4.2. These results show that quality of ANC mediates a small amount of the effect of education on use of SBAs – ratio of the indirect to direct effect is about 8% – but this is only marginally significant ($p=0.08$). Because only the difference between the richest and poorest is significant for quality of ANC in the final model, this is the only difference that is potentially mediated by quality of care. The formal mediation analysis shows that the mediated effect is not significant – ratio of the indirect to direct effect is also about 8% ($p=0.1$).

To explore the role of region further, the mediation was also done to check if quality of care may be accounting for the non-significant difference between the Western and the Greater Accra region, considering quality of ANC is much higher in Western region than the Greater Accra region. This showed that the indirect effect – i.e. the effect of living in the Western region that is through quality of ANC – was larger than the direct effect (ratio of indirect to direct effect = 1.5). However, because the effect of quality of ANC is only marginally associated with use of SBAs when region is included in the model, this indirect effect is also only marginally significant ($p=0.08$).

Supplementary analysis with the GMHS

Weighted single level logistic regression for women who attended ANC at least once:

Mediation for categorical variables has generally been examined for single level analysis. I have not come across a paper specifically discussing how multilevel mediation with categorical variables compares to single level mediation with categorical outcomes. But there are papers comparing multilevel and single level mediation with continuous outcomes. Krull and Mackinnon (1999) found that multilevel models tend to have larger standard errors for the mediated effect than OLS models for the same mediators, especially when the mediated effect is small and in multiple mediator models, resulting in larger p-values in the multilevel models than the OLS models. To check if these findings apply to the logistic models in this analysis, the mediation analysis was performed using weighted logistic regression. The results for the regressions for both quality of ANC and use of SBAs are presented in table 6G5.

====Table 6G5 about here====

But for a few exceptions, the weighted single level regression results are similar to that from the multilevel models. The main exceptions are that the effect of quality of ANC on use of

SBA is significant even in the single level model which includes region; and the effect of rural/urban residence on quality of ANC is significant in the single level regression model which includes region. (These associations are not significant in the multilevel models.) Thus, quality of ANC qualifies as a potential mediator for the effects of place of residence, education, and wealth on use of SBAs in this analysis. However, like the multilevel mediation, none of the mediated effects for these variables are significant at $p < 0.05$ in the formal mediation analysis. The effect of living in the Western on use of SBA that is mediated by quality of care is however significant ($p = 0.046$) when the coefficients from the weighted single level regression is used for the mediation analysis.

Regression of use of SBAs using full analytic sample: The results from the multilevel logistic regression for use of SBAs using the full sample are shown in appendix 6G1. In this model, quality of care is scored zero for those who did not attend ANC and an indicator variable is included in the model for whether or not the person received any ANC. The results here are essentially the same as that for the sample restricted to only women who had at least one ANC visit. The mediation analysis is not done with this sample because we cannot examine the determinants of ANC quality for people who did not go for any ANC.

====Table 6G6 about here====

Determinants of place of delivery: Most births by SBAs in Ghana in most of SSA are in health facilities (Moyer and Mustafa 2013). This is confirmed by the finding in this analysis that 99% of births by SBAs occurred in health facilities. Thus delivery in a health facility and delivery by a SBA attendant are often used interchangeably. Many studies also show they have the same set of determinants. To check if the predictors of use of SBAs are the same as those of delivery in a health facility for this sample, the variable on place of delivery (health facility or

not) was regressed on the same set of predictors as for assistance by a SBA. The results for the multilevel regression are shown in table 6G6 and the weighted single level regression shown in appendix 6G2. The results are similar to that for the regression for use of SBAs. The main difference is that quality of ANC though positively associated with delivery in a health facility is not significant in all the final models, including the weighted single level regression without region ($p=0.07$).¹⁰ Also women who had a prior miscarriage or still birth are significantly more likely to deliver in a health facility than those with no prior miscarriage or still birth (this is not significant for delivery by a SBA). The results here are also essentially the same for the full sample and the sample restricted to those who attended ANC at least once; and for the multilevel and weighted logistic regressions. The mediation analysis is not done for the place of delivery because of the non-significant association with quality of ANC in the final model.

====Table 6W1 about here====

World Health Survey results

Factors influencing use of SBAs

Bivariate analysis: Table 6W1 shows the distribution of the predictors by use of SBAs for the WHS. Among women who had an ANC visit at least once, about two thirds were assisted by a SBA during their last delivery (57% in Ghana and 68% in Burkina Faso). As expected, there is a significant positive association between living in an urban area, higher education, and higher wealth with use of SBAs. Eighty seven percent of women in urban areas were assisted by a skilled provider, compared to only 47% of women in rural areas. Also, 58% of women with no formal education were assisted by SBAs, compared to 72% for women with some education; and 55% of women in the lowest wealth tertile were assisted by a SBA, compared to 77% for those

¹⁰ ANC quality is however significant when type of ANC facility is not included in the weighted single level regression models

in the highest wealth tertile. By occupation, almost all women in the professional occupations (98%) were assisted by SBAs, compared to less than half of those engaged in farming. Women in professional occupations however represent a very small proportion of the sample. Other factors positively associated with use of SBAs are four or more ANC visits, seeing a doctor for ANC, being between 20 and 39 years, never married or cohabiting, and having one to two children.

Only 37% of the women who attended ANC at least once during pregnancy reported receiving in-patient services in the preceding five years, and about half of these reported the reason for the visit being childbirth. The proportion with an inpatient visit is less than that for those who were assisted by a SBA, suggesting some of the deliveries assisted by SBAs were not in an inpatient setting (women did not stay overnight), but inaccurate reporting cannot be ruled out. About 80% of women who reported an inpatient encounter in the preceding five years also reported the last birth being assisted by a SBA, compared to 54% of those who reported no inpatient visit in the preceding five years. In addition, over 90% of the women who reported the reason for their inpatient encounter being childbirth were assisted by a SBA, compared to about 60% for the other reasons. For perceived accessibility, about 83% of those who rated the travel time to the inpatient health facility as good were assisted by a SBA, compared to 72% for those who rated it as bad. This is consistent for both Ghana and Burkina Faso. A larger proportion of women who rated interpersonal and technical quality highly used a SBA in Ghana, but it is the reverse in Burkina Faso. For example, 76% of women who reported technical quality to be adequate in Ghana used a SBA compared to 65% for those who reported it as inadequate. But in Burkina Faso, it is 87 and 84% respectively.

====Table 6W2 about here====

Multilevel regression results: Table 6W2 shows the multilevel regression results of use of SBAs on quality of ANC, place of residence, SES, and relevant control and rival independent variables, based on the WHS sample of women who attended ANC visits at least once during pregnancy. The random effects at the bottom of the table show a significant amount of clustering, though the variation between individuals is larger. The approximate ICC at the strata level is 0.25 ($1.66/(3.29+1.58+1.66)=1.66/6.53=0.25$); and that at the cluster level is 0.24 ($1.58/6.53=0.24$). The final multivariate model explains about 51% ($0.86/1.66$) of the variation between strata, but most of the variation between clusters is still present.

The bivariate results show that when only inter cluster and regional differences are accounted for there is a positive but marginal association between quality of ANC and use of SBAs ($p=0.051$). Consistent with the prior analysis, urban residence, higher education, higher wealth, professional occupation, four or more ANC visits, seeing a doctor for ANC, and lower parity are positively associated with using of a SBA. Women who rated accessibility as good and those who had an inpatient visit are more likely to use a SBA than those who rated accessibility as bad, but there is no significant difference in use of SBAs between women who rated accessibility as good and those who did not have an inpatient visit.

Other results not shown in the regression tables are that the difference in use of SBAs by the ratings on the perceived interpersonal and technical quality scales are not significant in the regression models, but those who did not have an inpatient visit are less likely to use a SBA. The differences in these variables are mainly between those who had an inpatient visit and those who did not, which is not surprising because of the timing issues discussed earlier and because most deliveries by SBAs are inpatient visits. When the perceived accessibility, interpersonal quality,

and technical quality scales are all entered in the multivariate model, the dummy variables for “No inpatient care/missing” category which is similar for all inpatient encounter measures, is dropped for two of the variables. Furthermore, the two quality of care measures are not significant and do not improve the models in the multivariate analysis, even when entered separately in the model. I have therefore included only the measure of perceived access to inpatient services in the final multivariate model.¹¹

The multivariate model shows that when other factors are adjusted for, ANC quality is still positively associated with use of SBAs, but this is only marginally significant ($p = 0.085$). The positive effects of education and wealth are also not significant in the multivariate models in this sample. But we still see a significant positive association between use of SBAs and urban residence, professional occupation, more ANC visits, lower parity, and higher perceived accessibility. Net of other factors, women in urban areas have about seven times higher odds of using a SBA than those in rural areas. Also, women in professional occupations have about 33 times higher odds of using a SBA than those not working; but those in sales/service and farming/fishing jobs do not differ significantly from those not working in use of SBAs.

Women who attended four or more ANC visits have about two times higher odds of using a SBA than those who attended less than four times. There is no significant difference in use of SBAs between women who saw a doctor or nurse when other factors are accounted for, but those who saw a provider other than a doctor or nurse have about 60% lower odds of using a SBA than those who saw a nurse. In addition, women who report being very satisfied with the

¹¹ I intend to pursue the analysis involving the interpersonal measures of quality and perceived quality after I collect better data on this in the very near future. I believe it will be more useful to collect such data from every one interviewed for their most recent encounter with the health systems (and/or for their most memorable encounter) before their last delivery and then collect information on the timing of that encounter. Even for people who report no personal visit to the health facility, they can still be asked to answer the questions based on the experiences of others.

health care delivery system in their country have about 70% higher odds of using SBA than those who report being dissatisfied. Women who perceive access as good have over two times higher odds of using a SBA than those who perceive access as bad. Women who did not have any inpatient visit also have over three times higher odds of using a SBA than those who perceived access as bad. Of note is that there are no significant country differences in use of SBAs in the bivariate model (adjusted for only clustering), however when other factors are adjusted for, women in Ghana are significantly less likely to use SBAs than those in Burkina Faso – over four times higher odds of using a SBA in Burkina Faso than Ghana. I examined the interactions between country and place of residence, education, wealth, and quality of care, but these were all not significant.

====Table 6W3 about here====

Factors influencing quality of care: The multilevel logistic regression for quality of ANC is presented in Table 6W3. This is discussed more fully in chapter 5. After accounting for clustering and controlling for other factors, the factors associated with quality of ANC are country, education, occupation, number of ANC visits, and ANC provider. On average quality of care is much higher in Ghana than Burkina Faso, with over nine times higher odds of receiving all three services used to create the scale in Ghana than Burkina Faso. Women with some education, those who had at least four ANC visits, and those who received ANC mostly from a doctor received better quality of ANC than those with no education, those who had less than four ANC visits, and those who received most of their ANC from a nurse, respectively. Women engaged in farming and those who received ANC from a provider other than a nurse or a doctor received lower quality care than those who are unemployed and those who received most care

from a nurse/midwife respectively. As discussed in chapter 5, the effects of education and wealth are conditional on country (shown in the conditional model).

Mediation analysis: Because the association between quality of ANC and use of SBAs is not significant in the final model ($p = 0.085$) for this sample, it is pointless to proceed with the mediation analysis as quality of ANC does not meet the criterion for a mediator in this analysis.

Supplementary analysis with the WHS

Single level analysis of WHS data

As discussed earlier, multilevel models tend to have larger standard errors for the mediated effect in than OLS models for the same mediators, especially when the mediated effect is small and in multiple mediator models. Thus to check if this applies in this sample, the mediation analysis was performed using single level logistic regression with robust standard errors to account for clustering. The coefficients from these regressions are presented in table 6W4.1. This shows that those who received higher quality of ANC have 43% higher odds of using a SBA than those who received lower quality of ANC. Also, both place of residence and education are associated with quality of ANC and use of SBAs. Wealth is however only associated with use of SBAs. Thus quality of ANC qualifies here as a potential mediator of the effects of education and place of residence on use of SBAs in this analysis. The mediation analysis is shown in table 6W4.2. This shows that quality of ANC does mediate some of the effect of place of residence on use of SBAs, with a magnitude of up to about 17% of the direct effect (coefficient for mediated effect = 0.234, $p = 0.046$; and ratio of mediated to direct effect = 0.167). Quality of ANC also mediates some of the effect of education on use of SBAs with a magnitude of up to about 35% of the direct effect, though this is only marginally significant (coefficient for mediated effect = 0.144, $p = 0.096$, and ratio of mediated to direct effect = 0.35).

These findings are consistent with the analysis by Krull et al for continuous outcomes, which showed that the conclusions on mediated effects could be different using single level and multilevel analysis; with a higher likelihood of finding non-significant effects in multilevel analysis when the effects may be significant in single level analysis.

When the analysis is stratified by country, we find that quality of ANC, urban residence and education are all associated with use of SBAs in Ghana, but only urban residence is significant for use of SBAs for Burkina Faso. On the other hand, the effect of urban residence on quality of ANC is not significant for Ghana, but is significant for Burkina Faso; and the effects of education and wealth on quality of care are not significant for both countries. The results of the mediation analyses for the stratified samples are therefore not significant. This is potentially because of the small samples in the stratified analysis – the reason why I decided to pool the samples from the two countries.

====Table 6W4.1 about here====

====Table 6W4.2 about here====

Regression for use of SBAs for full sample: The results of the multilevel and single logistic regression (with robust standard errors) on use of SBAs for the full sample for the WHS are shown in appendix 6W1. The findings here are similar to that for the sample of women who attended ANC.

====Table 6W5 about here====

Regression for place of delivery: The same set of predictors were regressed on place of delivery for the sample restricted to women who attended ANC at least once and the full sample using multilevel models and single level models with robust standard errors. These are presented in table 6W5. The results are consistent with the results from the regressions for use of SBAs.

DISCUSSION

This study examined the factors that influence the use of SBAs; and whether ANC quality mediates the effects of place of residence, education, and wealth on the use of SBAs among women who had at least one ANC visit during their last pregnancy. The analysis of the GMHS data shows that the factors associated with use of SBAs are place of residence, education, wealth, frequency of ANC visits, the type of ANC provider and facility, experiencing a serious complication, age, parity, marital status, prior use of contraception, higher media exposure, and region of residence – net of other factors. For the WHS, urban residence, occupation, ANC frequency and provider, marital status, satisfaction with the health system, and perceived accessibility of health facilities are the significant predictors of use of SBAs, when other factors are accounted for. Education and wealth are also positively associated with use of SBAs in the singles level analysis with the WHS data, but they are not statistically significant in the final multilevel multivariate models. There is a positive association between quality of ANC and use of SBAs in both the GMHS and the WHS, but this association is not significant in some of the multilevel models.

Education and wealth are both associated with quality of ANC and use of SBAs in the GMHS analysis; quality of ANC therefore qualifies as a potential mediator of their effects on the use of SBAs. The mediation analysis however shows a small mediated effect, which is marginally significant for education and not significant for wealth. For the WHS, the effect of quality of ANC on use of SBAs is only significant in the single level analysis. The mediation analysis based on the coefficients from the single level analysis suggests quality of ANC partially explains the effects of place of residence and education on the use of SBAs; the mediated effect is significant for place of residence, but only marginally significant for

education. Even though ANC quality is higher in Ghana than in Burkina Faso, use of SBAs is higher in Burkina Faso than in Ghana net of other factors, including quality of ANC.

This study is different from previous studies on use SBAs, in that it focuses on women who came into contact with the health system during pregnancy, by restricting the main sample to women who had an ANC visit at least once during pregnancy. This represents over nine in ten women for both Ghana and Burkina Faso (WHO 2013d). The supplementary analysis however shows that the factors that influence use of SBAs in this sample are about the same as that for all women. The findings are also consistent with that from prior studies on use of SBAs and health facility deliveries, which have focused on all births or all women with a birth in given period (Gabrysch and Campbell 2009; Moyer and Mustafa 2013; Say and Raine 2007; Thaddeus and Maine 1994). The first half of the discussion is on the determinants of use of SBAs; the second half will be on the mediating role of quality of care.

Determinants of use of SBAs

Place of residence and accessibility: Like in this analysis, almost all studies find higher use of SBAs among women living in urban areas. There are also usually differentials by regions though these are not as big as the rural/urban differentials (Addai 1998; Bell et al. 2003; Gabrysch and Campbell 2009; Montagu et al. 2011). Place of residence is usually examined as a measure of physical accessibility due to limited data on actual or perceived accessibility (Bell et al. 2003). It is however recognized that place of residence is a contextual measure that may capture other determinants of use of SBAs, such as education, ability to pay, parity, beliefs, information availability, autonomy, and availability and quality of services (Gabrysch and Campbell 2009). Many studies also find a rural/urban effect even after controlling for accessibility, though these tend to be imperfect measures of access. The finding of higher use of

SBAs with higher perceived accessibility in this study is consistent with findings from the few studies that examine actual or perceived accessibility (Gabrysch and Campbell 2009; Gage 2007; Stekelenburg et al. 2004).

Socioeconomic status: As in this analysis, many studies also find a positive association between use of SBAs and education, wealth, and formal employment (Adanu 2010; Addai 2000; Ensor et al. 2013; Gabrysch and Campbell 2009; Gage 2007; Montagu et al. 2011). The theories behind these associations have been previously discussed and include: access to information and knowledge; a culture that favors use of medical services; self-confidence and respect, which facilitate the decision to seek care; and economic status, which removes cost as a barrier to use of health services (Caldwell 1979; Caldwell and Caldwell 1985; Gabrysch and Campbell 2009; Thaddeus and Maine 1994). A few studies have also found that working women are less likely to use maternal services, suggesting that this may be the case when working is poverty induced (Chowdhury et al. 2007; D. V. Duong et al. 2004; Gabrysch and Campbell 2009). In this analysis, we find that only women engaged in professional occupations are significantly more likely to use SBAs than women not working; and there is no significant difference in use of SBAs between those not working, those engaged in service occupations, and those engaged in farming or fishing. This finding may be because farming, fishing, and sales occupations are more likely to be poverty induced than being in a professional occupation. Education and economic status are also related to women's social status and autonomy making it difficult to parse out their individual mechanisms.

Autonomy: Qualitative studies suggest an important role of women's autonomy, with many suggesting it is the lack of control of women in rural areas over the decision to seek care that leads to low utilization of SBAs (Abasiokong 1981; Harrison 1983; Jansen 2006; Cheryl A

Moyer et al. 2013; Thaddeus and Maine 1994). Early marriage and female headed households have been used to measure autonomy and the findings are mixed (Gabrysch and Campbell 2009; Mrisho et al. 2007; Nwakoby 1994; Stekelenburg et al. 2004). In this analysis early marriage is associated with use of SBAs in the bivariate analysis, but not when other factors were adjusted for. This is potentially because the effects of early marriage is mediated by other factors in the model, including education, such that when these factors are accounted for it has no direct effect (Gabrysch and Campbell 2009). Living in a female headed household has no significant effect on use of SBAs in this analysis; potentially because living in a female headed households in Ghana relates more to a lack of support than autonomy (Furuta and Salway 2006); women living in female headed households are more likely to be unmarried (never married or previously married).¹² The effect of women's autonomy and status are also likely to be modified by age, parity, and marital status (Gabrysch and Campbell 2009).

Age, parity, marital status: In this study as we find higher use of SBAs with increasing age; lower uses with increasing parity; and lower use among women are cohabiting. These findings are consistent with the expectation of higher utilization for older women because of greater autonomy; and for first order births because of their higher risk for complications and lack of experience with childbirth (Gabrysch and Campbell 2009). The lower utilization among women who are cohabiting may also be due to lower autonomy. The associations between use of SBAs and age, parity, and marital status from prior studies are generally mixed (Adanu 2010;

¹² 25% of women live in female headed households; 76 and 59% of previously married and never married women live in female headed households, compared to 16% and 26% of those currently married and cohabitating respectively. Taking female headed households out of the model does not change the results.

Gabrysch and Campbell 2009; Magadi et al. 2007; Hyacinth Eze Onah et al. 2006; Stephenson et al. 2006b).

Pregnancy complications: Pregnancy complications are thought to increase use of SBAs because people who have previously experienced a complication or have a complication in the index pregnancy may feel a greater need to use a SBA (Gabrysch and Campbell 2009). In this analysis having a serious pregnancy complication in the index pregnancy was associated higher use of SBAs and delivery in a health facility. Having experience a prior miscarriage or still birth was also associated with delivery in health facility, though not with use of SBAs. These findings are consistent with the findings of qualitative studies and the few quantitative studies that have investigated the role of complications (Amooti-Kaguna and Nuwaha 2000; Bazzano et al. 2008; Gabrysch and Campbell 2009; Gleit et al. 2003; Magoma et al. 2010; Satoko Yanagisawa, Oum, and Wakai 2006). That the findings on the the effect of complications in the index pregnancy are more consistent than complications in prior pregnancies may also suggest a complication in the index pregnancy has a bigger influence on perceived need than complications in prior pregnancies. One limitation of this study and most studies on use of SBAs is the absence of information on when a woman went to see a SBA – i.e, whether they sought care at the onset of labor or after prolonged labor or the development of some other complication at home. Such information will be useful to examine the role of complications in the decision to seek a SBA.

Sociocultural factors: These are a set of factors that are difficult to examine in quantitative studies. Qualitative studies identify beliefs about pregnancy and complications – e.g. labor as a sign of endurance, facility delivery as a sign of weakness; requirements around delivery position, warmth, and handling of the placenta; and cultural requirements of seclusion in the household during the period of delivery as determinants of skilled delivery use (Bazzano et

al. 2008; Gabrysch and Campbell 2009; Kyomuhendo 2003; Mrisho et al. 2007; Senah 2003; Thaddeus and Maine 1994) Quantitative studies are however unable to directly to examine these, relying mostly on imperfect proxies like religion and ethnicity, which produce mixed results (Addai 2000; Burgard 2004; Gabrysch and Campbell 2009; Gyimah et al. 2006). In this analysis we find that those who belong to the Traditional religion are least likely to use SBAs, which might point to a bigger influence of sociocultural factors in this group. Ethnicity however has no significant effect when other factors are accounted for. The finding for prior use of family planning is consistent with that by Magadi et al. who use prior use of family planning as a proxy for biomedical health beliefs, which they find is positively associated with use of MH services (Magadi et al. 2000). The finding of lower use of SBAs among women in the Northern region of Ghana may also reflect the role of sociocultural factors that affect use of SBAs, which have been found to be predominant in this region, though poor access to health facilities is also a major problem in this region (Bazzano et al. 2008; Cheryl A Moyer et al. 2013).

ANC attendance and frequency: As in this study, going for an ANC visit and higher frequency of ANC visits are generally found to be positively associated with use of SBAs (Adjiwanou and LeGrand 2013; Ensor et al. 2013; Gabrysch and Campbell 2009; Gage 2007; Mpembeni et al. 2007). The reasons for this association include: ANC visits leads to a habit of use of formal health services; ANC visits increase maternal knowledge of pregnancy risk factors; and ANC is an opportunity to promote use of SBAs or give women information on the status of their pregnancy, which in turn informs their decisions on where to deliver (Ensor et al. 2013; Gabrysch and Campbell 2009). Some qualitative studies however suggested that risk assessment during ANC can potentially reduce use of SBA, when women are told they have a normal

pregnancy; especially when use of SBA is perceived to be for complicated deliveries (Bazzano et al. 2008; Magoma et al. 2010).

Type of ANC facility and provider: Prior studies find that receiving ANC in a health facility (compared to receiving ANC at home) and receiving ANC from a skilled provider (compared to receiving ANC from an unskilled provider) is positively associated with the use of SBAs (Ensor et al. 2013). The findings from this analysis are consistent with these findings. However, most studies on use of SBAs do not examine the type of health facility and type of health provider for ANC. This analysis shows a higher likelihood of using a SBA among women who received some ANC from a government hospital or polyclinic or a private facility compared to those who received it from a government health center or health post. Also, women who received ANC from a doctor have higher odds of using a SBA than those who receive it from a nurse or midwife. There are a number of potential reasons for this.

One reason is that women who use hospitals or polyclinics for ANC have better access to delivery facilities. This is because hospitals and polyclinics tend to be located in urban areas, and health centers and health posts in rural areas. In addition, hospitals and polyclinics are generally equipped to assist women during delivery, but this is not so for health centers and health posts. Doctors, who can perform essential obstetric procedures including caesarian sections, are also more likely to be working in the hospitals than in health centers. This implies some women receiving ANC in health posts may need to seek delivery care in a different facility that may be less accessible. This is especially so in Ghana with the implementation of the Community-based Health Planning and Services (CHPS) program. With the CHPS program, most communities have a Community Health Officer (CHO; a community health nurse who has been given additional training to provide primary health care services such as immunizations, family

planning, antenatal/postnatal care, treatment of minor ailments and health education) providing ANC in their communities in health posts known as CHPS compounds (Nyonator et al. 2005). However, many CHOs have no midwifery skills and so cannot provide skilled delivery care. This means that even in communities with CHPS compounds women have to travel to the nearest health center or hospital for delivery; a distance of at least 8kms for over 70% of Ghanaians and much further for those in rural areas (Ghana Ministry of Health et al. 2011; Nyonator et al. 2005). Furthermore, many health centers that provide delivery services are not adequately equipped to handle even basic obstetric emergencies, and so frequently refer women to the district and regional hospitals (Ghana Ministry of Health et al. 2011). With awareness of the poor referral system in the country, the fear of referrals may deter women who receive care from these health posts and health centers from seeking care there during delivery.

The second reason is that women who seek care in hospitals and polyclinics may be women who have a higher perceived need for using a SBA. This is especially considering that hospitals tend to be referral units where those with complications are referred to; and doctors usually do not provide routine ANC, but only see women with some complications. The third reason is that quality of care offered in hospitals and polyclinics are better than that offered in health centers and health posts, as shown in chapter 5.

Quality of care: Poor quality of care, especially poor attitudes of health workers is a recurring theme in qualitative studies in Ghana and most of SSA on use of maternal health services (Bazzano et al. 2008; D'Ambruso et al. 2005; Cheryl A. Moyer et al. 2013; Tunçalp et al. 2012). Even in studies that do not specifically ask about staff attitudes, it usually comes up (and from my experience working in a health facility and specifically in an obstetric unit I know this is a problem) (Afulani et al. 2012; Cheryl A. Moyer et al. 2013). Very few quantitative

studies assess quality of care as determinant of maternal health service utilization and these have had rather mixed results – likely due to different approaches to measuring quality of care (Gabrysch and Campbell 2009). For example, Stekelenburg et al. (2004) found no effect of perceived quality of ANC (measured as binary variable on satisfaction with antenatal care or not) on facility delivery in a rural district in Zambia, and attributed it to a generally high satisfaction level. Duong, et al. (2004) however found women who delivered in a facility rated quality of "health care delivery" higher than those who delivered at home, though there was no difference in their ratings for "communication and conduct of personnel." The measures of quality in these studies are different from that used here, which makes it difficult to compare. But the positive association between higher ANC quality and use of SBAs in this analysis, albeit marginally significant in some models, provides support for the role of quality of care. The marginal significance of ANC quality in some of the models is also potentially due the high scores on the ANC quality index for most women in the sample; not because of high ANC quality, but because the questions used to measure ANC quality do not adequately discriminate between different levels of quality. Furthermore, in this analysis there is no direct measure of women's assessment of delivery care, but the finding from the WHS that women who are very satisfied with the health system are more likely to use a SBAs point to the role of women's assessment of the health system in their decision to use SBAs. It may also be the reverse– that women who use a SBA are more likely to rate the health care system in their country as satisfactory; since the analysis is based on cross-sectional data. The measures of patient experience could not be used in the multivariate analysis for the reasons discussed earlier. But the bivariate analyses suggest a positive association between use of SBAs and rating of both interpersonal and patient assessment

of technical quality; more so for the especially for the Ghana sample, which may suggest different emphasis on interpersonal quality in different settings.

Country differences: There are no differences in the use of SBAs by country in the bivariate model, but when other covariates are added women in Burkina Faso are much more likely to use SBAs than those in Ghana. This may be because of a suppressive effect when place of residence and SES are not accounted for, considering that Burkina Faso has a larger proportion of women with no education and in the lowest wealth groups. Also, women in Ghana are much more likely to receive the recommended four visits and receive better quality of care, than women in Burkina Faso, and so the lower use of SBAs in Ghana is only seen when these are held constant. This implies improving uptake of the recommended four ANC visits as well as the quality of care has a potential to increase use of SBAs even further in Burkina Faso. Though this data is quite old, recent data suggests Burkina Faso still has higher coverage for use of SBAs than coverage for at least four ANC visits (about 95% of women had at least one ANC, 34% had the recommended four visits, and 67% were assisted by SBA in Burkina Faso; where as 96% had at least one ANC, 89% had the recommended four visits, and 67% were assisted by SBA in Ghana). There are no indicators based on the content of ANC but the caesarian section rate is only 1.9% in Burkina Faso compared to about 11 % in Ghana, which suggests more shortcomings in the quality or availability of emergency obstetric care in Burkina Faso (data for Burkina Faso is from 2010 and that for Ghana is from 2011) (WHO 2013d).

From my discussions with colleagues from Burkina Faso, these findings reflect the situation in Burkina Faso. They mention that even though women are required to have four ANC visits, many women receive only three because, they start ANC late and deliver before the fourth visit. Also the quality of care may be lower because of inadequate logistics. For instance, health

facilities in rural areas may not take women's blood pressure because the only sphygmomanometer in the facility may not be functional. Also, many ANC facilities are not able to run laboratory tests, and usually just write a lab request for the woman, whose responsibility then it is to find a laboratory and pay for the cost of the tests. Thus, many women end up not getting these tests done. This is similar in Ghana, though many facilities can provide the basic laboratory services, and so the difference becomes more apparent with slightly more advanced tests. Also, until recently women in Ghana were encouraged to attend ANC almost every month till delivery. Thus most women far exceed the recommended four visits.

The higher use of SBAs in Burkina Faso despite the lower frequency and quality of ANC services point to other factors in Burkina Faso that facilitate use of SBAs. Better physical accessibility is not likely to be a reason, as health facilities are more accessible in Ghana than in Burkina Faso; and women from the border villages in Burkina Faso are known to cross over to the neighboring villages in Ghana for health care. Better financial accessibility is a plausible reason, as delivery care appears to have been more subsidized in Burkina Faso than in Ghana at the time of the WHS (2003). Delivery care is now technically free in Ghana because of the National Health Insurance Scheme (NHIS), which was established in 2003 but had very low initial uptake till 2007, when the free maternal health policy was introduced and integrated with the NHIS (Witter, Arhinful, et al. 2007; Witter et al. 2009; Witter, Kusi, and Aikins 2007). Even then, less than half of the total population (about 47%) were registered with the NHIS in 2007 – the time of the GMHS (Mensah et al. 2010). The significant effect of wealth on use of SBAs from the GMHS analysis suggests the important role of cost in Ghana –at least at the initial period of the free maternal health policy. In addition, there are many hidden costs for delivery care which are not covered by the NHIS which makes cost still important in Ghana. For instance,

in many health facilities, women presenting for delivery care are expected to bring soap, disinfectant, clean receiving cloths for delivery, cloth or disposable diapers, night gowns, and sometimes they have to pay for certain supplies in the hospitals. These become major costs for many women – not counting the cost of transportation of a woman in labor. Prior studies and reports show the NHIS has contributed to an increase in utilization of ANC and other health services in Ghana, but there has being only a small increase in use of SBAs over the period (Blanchet et al. 2012; Ghana Health Service 2008; GSS 2008; Mensah et al. 2010). Also, women in the lowest wealth quintile recorded the smallest increase in skilled delivery rates between 2003 and 2008 (GSS 2008).

Discussions with colleagues from Burkina Faso, suggest better interpersonal quality of care and sensitivity to cultural factors may be accounting for the higher use of SBAs in Burkina Faso, despite lower quality of ANC service provision. For instance, some studies suggest how the placenta is handled in health facilities may be a deterrent to the use of SBAs for some women (Gabrysch and Campbell 2009). In Burkina Faso, women are said to be given the option of taking the placenta home for any rituals they need to perform, and to bury it at home. This hardly occurs in Ghana and women may even be afraid to ask for it because of the way health workers may respond to such a request. In addition, relatives are almost never allowed in the labor wards in Ghana, whereas female relatives, especially the mothers of women who are having their first births are said to be allowed in the labor ward to support their children during labor in Burkina Faso. Also, poor attitude of health workers towards women in labor appears to be less in Burkina Faso than in Ghana. This appears to be due to a greater sense of being sued by relatives for poor outcomes in Burkina Faso than Ghana, though this awareness has increased in Ghana more recently. Colleagues from Burkina Faso mention an emphasis on updating relatives of every

stage of labor, delivery, and in the immediate postpartum period (in the national hospital), to ensure they are not being blamed for poor outcomes. While some of this is done in Ghana, there isn't a big emphasis on it. The important role of interpersonal factors in Ghana than Burkina Faso is seen in the bivariate analysis where the interpersonal quality of care measure is positively associated with use of SBAs in Ghana but not in Burkina Faso.

The mediating role of quality of care

Few studies have suggested that the content of ANC and knowledge of pregnancy complications mediates the effect of ANC attendance on use of SBAs (Adjiwanou and LeGrand 2013; Ensor et al. 2013). But no prior studies to my knowledge has examined if quality of care mediates the effects of more distal factors like place of residence or SES on use of SBAs. Thus, there is little in this regards to compare to from prior studies. The theory behind the hypothesized mediated effect was that if poor quality reduces utilization and urban and higher SES women are more likely to experience good quality, then it is plausible that one reason why these women are more likely to use SBAs is because they are more likely to have had a prior good experience with the health system (i.e. received better quality care). The findings from the analysis regarding this hypothesis are however mixed. Though the analysis based on the GMHS and the WHS both suggest some evidence of the role of quality of care, only the mediation analysis from the single level analysis of the WHS data showed a significant mediated effect by quality of ANC for the relationship between place of residence and use of SBAs. The analysis from both the GMHS and the WHS also show that some of the effect of education on use of SBAs is through quality of care, but the mediated effect is only marginally significant. The findings from this analysis therefore do not provide very strong support for the hypotheses. It will however be premature to

dismiss quality of care as a potential reason for some of the place of residence and SES differentials in use of SBAs for several reasons.

First, it is important to note that there are many dimensions of quality that were not measured in this study. For example, most qualitative studies suggest it is poor attitudes of health workers, hence interpersonal quality that deters women from using SBAs. Also most of the complaints about quality with regards to use of SBAs is quality of care during delivery – from women’s own prior experience or based on the experience of others (D’Ambruoso et al. 2005; Cheryl A. Moyer et al. 2013; Tunçalp et al. 2012). These are not captured by the measure of ANC quality used in this analysis. Second, even as a measure of the service provision dimension of quality, the ANC quality index fails to adequately discriminate between different levels of service quality. For example having one blood pressure measured during pregnancy is not the same as having a blood pressure taken during every ANC visit, which still does not tell if any actions are taken based on the blood pressure readings. Third, it is the perception of quality that is hypothesized to directly influence use of SBAs; and while the quality of services received is expected to influence the perception of quality, this is not necessarily a linear process. Perception of quality is influenced by several other factors including socioeconomic factors and the experiences of others; and the perceptions of service providers may be different from that of those on the receiving end (Hulton et al. 2000; Thaddeus and Maine 1994). Thus, the marginal mediated effect in this analysis is likely because of the inadequacy of the measure of quality used. Even so, we still find evidence of an intervening role of quality based on this measure, when we examine the effects of other predictors.

The first of these other set of findings is related to the type of facility in which ANC was received. The analysis shows that women who received ANC from private facilities and lower

tiered government facilities like health centers and health posts are more likely to receive poorer quality ANC than women who received ANC from government hospitals and polyclinics. But, the odds of delivering with a SBA are similar for those who for received ANC from private facilities and government hospitals and polyclinics, and lower for those who received care from health centers and health posts. To examine if quality of ANC could be accounting for the differences in use of SBAs by type of ANC facility, I did a formal mediation analysis. This showed that there is a negative indirect effect of receiving ANC in a health center on the use of a SBA; with a ratio of the indirect to direct effect of about 25% when the coefficients from the multilevel regression are used and up to 43% when the coefficients from the single level regression are used, albeit marginally significant ($ab = -0.061$, $p = 0.05$; and $ab = -0.05$, $p = 0.06$ respectively). This finding suggests that part of the reason why women who use health centers are less likely to use SBAs is because of the lower quality of ANC they receive, which will imply that if quality of ANC was improved in health centers and other lower tiered facilities, women who receive ANC from these facilities will be more likely to use SBAs. Also, since rural and low SES women are more likely to use these lower level facilities, improving the quality of care in them may increase use of SBAs among rural and low SES women. These findings should be interpreted in light of the fact that what is used to measure quality of ANC in this analysis are basic services that do not require expensive infrastructure or equipment, and which can be provided by even auxiliary health workers –with a little additional training.

The non-significant difference in use of SBAs between women who use private facilities and those who use government hospitals (though quality of ANC is lower in private facilities than in the government hospitals and clinics) is a little more complicated to explain. The mediation analysis here showed that there is a significant negative indirect effect of receiving

ANC in a private facility on use of SBAs that is through quality of care ($ab = -0.11$, $p = 0.04$, ratio of indirect to direct effect = 0.79). The interpretation here is that part of the reason why women who receive ANC in private facilities have similar odds of using a SBA as those who received care in a government hospital is because of the lower quality of ANC they receive. In other words, if quality of ANC was higher in private health facilities, women who receive ANC in these facilities will be more likely to use SBAs than those who did so in a government hospital. This interpretation implies the role of other factors among those who receive ANC in private facilities that make them more likely to use SBAs. These factors include selection: women who use private facilities are also more likely to use SBAs for several reasons, including higher perception of the need to use a SBA and higher perceived and actual accessibility. In addition, since the measure of quality of ANC used in this analysis only captures service provision, it may be that interpersonal quality of care is higher in private facilities (though the technical quality of services may be lower). This has been suggested by other studies which suggests women are treated better in private facilities than in public facilities (Hutchinson et al. 2011). Thus, though women may be receiving lower quality of ANC with regards to the services they receive in private facilities, they may be having a better experience, which makes them more likely to use SBAs. Another reason for the very small indirect effect of place of residence and SES on use of SBAs through quality of ANC is, therefore, that the final models contain other predictors like the type of ANC facility, which are potential mediators for their effect on quality of care. For example, when the type of ANC facility and provider are excluded from the models, we see a bigger effect of place of residence, education, and wealth on quality of ANC, and a bigger effect of quality of ANC on use of SBAs. This potential mediation pathway is plausible, as the most common type of health facilities in rural areas are the lower tiered health facilities; and the

bivariate analysis also shows rural women and low SES women are more likely to use these lower level health facilities.

Further support for the mediating role of quality of care is provided by a supplementary analysis of the WHS. I did a mediation analysis to check if quality of ANC accounted for the difference in use of SBAs in Ghana and Burkina Faso. This showed a significant positive indirect effect of living in Ghana on use of SBAs, which was through quality of ANC ($ab = 0.76$, $p = 0.03$; and $ab/c' = -0.64$). Since use of SBAs is lower in Ghana than Burkina Faso net of other factors, this finding suggests that if quality of care was not higher in Ghana, the difference in the use of SBAs between Ghana Burkina Faso would have been bigger. A hypothetical extension of this interpretation is that if quality of ANC was higher in Ghana, there will be a smaller or no difference between Ghana and Burkina Faso in the use of SBAs. Alternatively, if quality of care were higher in Burkina Faso, then the difference in use of SBAs between Ghana and Burkina Faso will be much bigger. The higher use of SBAs in Burkina Faso than Ghana net of quality of ANC service provision (based on the current measure) also point to the importance of other factors that facilitate use of SBAs in Burkina Faso. As discussed above, this difference is likely due to better interpersonal quality of care and better sensitivity of the health system to sociocultural factors in Burkina Faso.

Other studies have also suggested the mediating role of quality of ANC on the effect of ANC attendance on use of SBAs. For example, Ajiwanou and LeGrand (2013) using DHS data estimate that if all women received high content of antenatal services, the probability of using a SBA for the most recent birth would increase on average by 7% in Ghana, 38% in Kenya, 25% in Uganda, and 27% in Tanzania. They also find that except for Ghana, the gain far exceeds that estimated for four antenatal visits among the other countries, showing that not only the

frequency, but also the content of antenatal ANC matters. Their measure of ANC content is similar to that used in this study, hence likely also underestimates the actual effect of quality of ANC compared to if other dimensions of quality are considered. Ensor et al. (2013) examined knowledge of pregnancy complications, which can be thought of as an outcome measure of quality of ANC, and found that knowledge of pregnancy complications partly explained the effect of receiving ANC from a skilled provider on use a skilled attendant at delivery.

Though the evidence for the indirect effect of place of residence and SES on use of SBAs through quality of care is not very strong in this analysis; that SES and place of residents are associated with both quality of care and use of SBAs suggests quality of care is a plausible intervening factor that needs to be examined with better measures. The analysis also does not find conditional effects of place of residence and SES by quality of care. However, this may be because the measure of quality used fails to accurately distinguish between different levels of quality. The discussion of the weakness of the measure of quality is to highlight the limitations of the questions used to assess quality of ANC in the major health surveys for many developing countries. What this analysis calls for is the development and incorporation into surveys better measures of quality of maternal health care that are able to discriminate different levels of quality with regards to service provision, and measures that capture the interpersonal dimensions of quality of care based on women's experiences. In addition, it is important to assess the different dimensions of quality because the determinants and effects of the different dimensions may be different for different populations. Some dimensions are also more amenable to change than others; hence information on the different dimensions will guide prioritization of interventions in the face of scarce resources. Such measures could also serve as monitoring and

supervision tools to improve the quality of maternal care provided to individual women at the district, subdistrict, community, and even health facility level.

The conceptual model guiding this analysis posits three proximal factors that influence the use of maternal health services - perceived need, perceived accessibility (physical and technical), and perceived quality of care. Thus quality of care is expected to mediate only some of the effect of place of residence and SES. The effects mediated by perceived need and perceived accessibility were not examined in this analysis because of the lack of data to do so. Even for the WHS, because the question on perceived accessibility was only asked to those who reported use of in-patient care in the preceding five years (which is a subset of the analytic sample over represented by those who were assisted by SBA), a formal mediation analysis could not be conducted. However, other supplementary analysis showed that place of residence and wealth were significantly associated with perception of travel time to a health facility suggesting, perceived accessibility is also a plausible intervening factor. There is no measure to directly assess perceived need, but that variables like complications in prior or the index pregnancy influence use of SBAs also support perceived need as a plausible intervening factor (Gabrysch and Campbell 2009). To adequately examine the mechanisms by which more distal factors like SES and place of residence affect use of maternal health services, we also need to develop and incorporate more direct measures of need for maternal health services as well as accessibility (both physical and economic) into surveys that have maternal health seeking behavior as an objective.

Studies on the determinant of use of SBAs have focused on distal factors that are not very amenable to change. This is likely because the routine data collection systems in developing countries do not collect information on the more proximal intervening factors. Collecting data to

examine proximal factors is however important because these proximal factors are more amenable to change, but may be different in different populations, and it is by knowing which intervening factors are important in a particular population that we can develop better interventions to reduce disparities and increase use of SBAs. Moreover, the more intervening factors we know, the more avenues we have for change.

Limitations and strengths

The limitations of this study include the limitations in the measures and data discussed above. Other limitations are discussed in chapter 8. The study also has several strengths discussed in chapter 8. A notable strength is that it addresses a gap in the maternal health literature, which is the dearth of quantitative studies that examine the potential mechanisms by which more distal determinants affect use of SBAs. This study will be among the first studies in Ghana, and potentially Burkina Faso, to examine if quality of ANC mediates the effects of place of residence and SES on use of SBAs, using nationally representative population based data.

Conclusions

The study finds some disparities in both quality of ANC and use of SBAs by place of residence and education suggesting quality of a care is a potential mediator of the rural/urban and SES differential in use of SBAs, though the support for this is not very strong from the mediation analysis. I therefore cautiously suggest that improving quality of care provided to rural and low SES women could be a potential point of intervention for reducing the rural/urban and SES differences in use of SBAs. This is a potentially more feasible approach in the short term than increasing accessibility. Moreover, women may be willing to travel a little further to obtain higher quality care.

CHAPTER 7: AIM 3

Examine quality of antenatal care as a determinant of pregnancy outcomes in Ghana

INTRODUCTION

Background

The recommendations for use of health services during pregnancy and delivery are as important for fetal outcomes as for the mother (Bhutta et al. 2009; Friberg et al. 2010). Because it is difficult to directly examine maternal outcomes (e.g., compare women who die to those who did not because of data limitations, and the relatively small proportions) examining the outcome of the birth or pregnancy outcome is a useful alternative to monitoring adequacy of care during pregnancy and delivery (Bhutta et al. 2011; Frøen et al. 2009; J. E. Lawn et al. 2009; Joy E Lawn et al. 2009; Say et al. 2006). Antepartum or macerated stillbirths reflect quality of antenatal care, while intrapartum or fresh stillbirths reflect quality of delivery care (Joy E Lawn et al. 2009).¹³ Studying the factors associated with having a stillbirth is therefore important, not only for the sake of saving the close to three million stillbirths that occur each year, but for preventing maternal deaths and disability.

Few studies in Ghana have examined the factors associated with pregnancy outcomes and none to my knowledge has done this at the national level (Engmann et al. 2012; Ha et al. 2012; Yatich et al. 2010). In addition, while these studies speculate quality of maternal health services may be a contributing factor to pregnancy outcomes, none have explicitly examined the effect of quality of care. The lack of national level studies on the association between service utilization and quality factors, and pregnancy outcomes is likely because the GDHS and the UNICEF

¹³ Intrapartum stillbirths refer to stillbirths that occur after the onset of labor and also sometimes referred to as fresh stillbirths. Stillbirths that occur before the onset of labor are referred to as antepartum stillbirths, or sometimes as macerated stillbirths.

multiple indicator cluster survey (MICS), which are the major sources of national maternal health data do not collect health service utilization data for pregnancies that did not result in a live birth. This study takes advantage of the GMHS, which had a special focus on maternal health, and so collected health service utilization data for all women who had a birth (live birth or stillbirth) in the five years preceding the survey.

Study objectives

The purpose of this study is to identify the factors associated with pregnancy outcomes in Ghana. The study examines the effect of distal factors like place of residence and socioeconomic status (SES) and more proximal factors like maternal risk factors, health service utilization (both antenatal and delivery care) and quality of care. The focus of the analysis is however on quality of care; and I examine if quality of ANC has an effect on pregnancy outcomes net of maternal risk factors and health service utilization during delivery.

The measure of ANC is based on services received during ANC and so is a process measure of quality –what is done in providing service (A Donabedian 1988). Though process measures do not necessarily result in good outcomes, this is usually the expectation. Thus, while there are other factors that can influence the outcome of a pregnancy, we expect that all things being equal, good quality of care during pregnancy and delivery should increase the chances of having a live baby. I therefore hypothesize that higher quality of ANC will be associated with a lower risk of having a stillbirth net of other factors. I also examine if the effect of quality of ANC is mediated or moderated by the use of a skilled birth attendant (SBA) during delivery. Other questions I examine are whether quality of care mediates the effect of distal factors like place of

residence and SES on birth outcomes; or if the effect of quality of care is moderated by these factors.¹⁴

METHODS

Data: The data for this analysis are from the Ghana Maternal Health survey (GMHS) described in chapter 4. Because quality of care can only be assessed for women who came into contact with the health system during pregnancy, the main analysis is restricted to women who had at least one ANC visit during their last pregnancy. This represents 97% (4,868 out of 5,042) of the analytic sample. The full analytic sample will however be used for supplementary analysis as a sensitivity check to the main analysis.

Constructs and Variables

Dependent variable: pregnancy outcome

Pregnancy outcome refers to whether a woman had a stillbirth or a live birth in her last pregnancy. It is described in detail in chapter 4.

¹⁴ An initial intention of this study was to also examine the effect of use of SBAs on pregnancy outcomes as the second focal relationship; and assess if quality of care mediated the effect of use of SBAs on birth outcomes. The relationship between use of SBAs and pregnancy outcomes is however no longer considered a focal relationship in this paper because I am not able to adequately address selection effects – where women who have complications or risk factors associated with having a stillbirth are more likely to use a SBA. This is because the data does not include information on whether the stillbirth is antepartum or intrapartum, when the stillbirth was first diagnosed, or when care during delivery was sought – i.e. before or after fetal movements ceased. Even though there are a number of variables to capture women with risk factors for stillbirths, these may not be enough to address the selection problems. It is thus likely that use of SBAs will be associated with higher chances of having a stillbirth; but the poor outcomes for women who use SBAs cannot be attributed to the use of a SBA because this will be a case of reverse causation. Quality of care was proposed as a mediator for use of SBAs because use of services will not directly lead to better outcomes if the quality of the care provided is not good. However, I do not have data on the quality of delivery care. One approach to deal with this is using quality of ANC as a proxy for delivery care under the assumption that the quality of care during ANC reflects the quality of care during delivery. This is however problematic, given that the temporal ordering of quality of ANC and delivery care makes a mediation of the effect of quality of ANC on pregnancy outcome through use of SBA more plausible than the reverse. Future studies that collect information regarding timing of stillbirths and seeking care, and quality of delivery care are needed to adequately examine the role of use of SBAs on pregnancy outcomes.

Key independent variable: Quality of antenatal care

Quality of ANC is the additive index of responses to nine questions on ANC services women received during the last pregnancy, described in detail in chapter 4. For this analysis, it is used as a dichotomous variable coded: 0 - received zero to seven services (lower quality); and 1 - received eight or nine services (higher quality). About 39% of the women had higher quality ANC and 61% had lower quality ANC.

Other independent/control variables

Health service utilization: These include *ANC services* – frequency of ANC visits, trimester of first ANC visit, type of ANC provider, and type and level of ANC facility; and *delivery services* – the type of delivery provider (doctors, nurse/midwife, and others), whether delivery was assisted a SBA or not, where delivery took place (a government hospital/polyclinic, a government health center/health post/other lower tiered health facility, a private clinic/maternity home or not a health facility), and whether delivery occurred in a health facility or not.

Maternal risk factors for adverse birth outcomes: These include age, gravidity (number of pregnancies), experiencing a pregnancy complication in the index pregnancy, a multiple gestation in the index pregnancy, and a prior stillbirth. These are based on the literature on the determinants and risk factors for stillbirths (Edmond et al. 2008; Engmann et al. 2012; Ha et al. 2012; Joy E Lawn et al. 2009). Past miscarriage and induced abortion were also included as risk factors (Yatich et al. 2010). Having a sibling who experienced a maternal death was found to be an important determinant in preliminary analysis, hence included. Other important determinants that are not directly examined in this analysis include maternal conditions (including chronic conditions, body weight, malaria, and anemia during pregnancy) and risk factors such as

smoking, alcohol, drug use, and exposure to environmental toxins (Addo 2010; Joy E Lawn et al. 2009; Stringer et al. 2011; Yatich et al. 2010). Also, fetal conditions such as presence of congenital anomalies, prematurity, intrauterine growth restrictions are not directly assessed. Though these are not directly entered as predictors, most are captured by the other predictors in the datasets as they tend to have indirect effects. For example, the variable on experiencing a complication in the index pregnancy is based on a question whether the woman reported having several symptoms, signs, or specific conditions during the index pregnancy: headaches, blurry vision, edema, preeclampsia, convulsion, eclampsia, excessive bleeding, tetanus, foul smelling discharge, prolonged or obstructed labor, uterine rupture, placenta previa, retained placenta, high fever, fistula, babies movement was low, breech presentation (hands or feet came delivered first), and other. These conditions capture most of the maternal conditions associated with having a stillbirth or other adverse outcome. In addition, I include a variable on reason for ANC to capture preexisting conditions; and also receipt of any intervention during delivery to capture maternal conditions that may have required some intervention during labor.

The variable on receipt of any intervention is from four binary variables on whether the delivery was by caesarian section or not, forceps delivery or not, receipt of blood transfusion or not, and receipt of intravenous (IV) fluids or not. These variables are all strongly associated with the pregnancy outcome, and also correlated with one another, as most women who had one of these interventions are also likely to have had some other intervention. They are therefore combined to create a binary variable coded: 1 –receipt of any intervention during delivery if the respondent had at least one of the interventions; and 0–no intervention if they did not receive any of the interventions. This variable will likely capture maternal conditions as anemia and diabetes as the management of these in labor will minimally involve IV fluids. It also specifically

captures severe anemia which will require blood transfusion, and other maternal and fetal conditions that will require a caesarian section or assisted vaginal delivery.

Sociodemographic factors: I also controlled for distal factors that have been found to be associated with pregnancy outcomes, use of maternal health services, or quality of care. These include place of residence, education, wealth, religion, ethnicity, marital status, age at first union, sex of the household head, familiarity with the health system (knowledge of where to get contraception, use of contraception), and media exposure. These are distal determinants that could potentially affect birth outcomes through their effect on utilization and quality of maternal health services. They are thus examined as antecedent factors to quality of ANC.

Analytic approach

Initial tests for the multilevel analysis for this chapter showed that only the variation between individuals and clusters was significant for pregnancy outcomes. The LR test also showed that a simple logistic regression was preferred to a three level (individual, cluster, and district) multilevel regression (LR test vs. logistic regression: $\chi^2(2) = 4.35$ $p = 0.1138$), but a two level (individual and cluster) multilevel regression was preferred to a single level logistic regression (LR test vs. logistic regression: $\chi^2(1) = 4.35$, $p = 0.0185$). A two level model with district was also not significant (LR test vs. logistic regression: $\chi^2(1) = 0.57$, $p = 0.2246$). Thus, only two levels – individual (level 1) and cluster (level 2) are used for the multilevel analysis for pregnancy outcomes. There are 400 different clusters (average number of observations per cluster is 12; minimum-3, maximum-38).

Because the outcome measure is binary, the “xtmelogit” command in Stata is used to estimate multilevel binary logistic regression models (Hamilton 2012; Rabe-Hesketh and

Skrondal 2012). To examine the determinants of birth outcomes, the single equation form for the unconditional model with the focal independent variable is represented simply as:

$$\ln SB_{ij} = \gamma_{000} + \gamma_1 \text{Anc}_{ij} + \dots + \zeta_j \quad \text{where:}$$

$\ln SB_{ij} = \text{logit} \{ \text{Pr}(SB_{ij}=1 | x_{ij}, \zeta_j) \}$: the logit of the probability (or log odds) of having a stillbirth for the i^{th} woman in the j^{th} cluster, and ζ_j is the variance at the cluster level.

γ_{000} is the log odds of having a stillbirth when all the predictors are zero (or reference group for categorical variables), with inter-cluster variation accounted for.

γ_1 is the difference in the log odds of having a stillbirth between women who received high quality ANC and those who received low quality ANC; holding other factors constant and accounting for inter-cluster variation.

For the multivariate analysis, the model was built sequentially starting with quality of ANC and then sequentially adding the other covariates. A final model was then selected which included only the predictors that were significant or improved the model by the likelihood ratio test. Some variables like education and wealth, which are not significant even in the bivariate model, are still included in the model because of their associations with the key predictors, and to allow for comparisons with prior studies. Other variables are excluded from the final multivariate model because of collinearity. Because the delivery variables are consequent to quality of ANC, and some may have occurred after the outcome (because I don't have information on the timing of the stillbirth relative to seeking delivery care), two sets of multivariate models are presented. The first model excludes all the delivery variables and the second includes them. I examined interaction terms for quality of ANC and delivery provider, delivery facility, place of residence, education, and wealth, but none was significant, and so not shown in the final models.

Additional analysis: Propensity score matching

A major problem in trying to examine the effect of use of SBAs on birth outcomes is selection bias. Selection is also a potential problem in examining the effect of quality of ANC on birth outcomes; less so than for delivery care. Women who received higher quality of ANC may be different from those who received lower quality care. For example, the analysis in the previous chapters shows that women who received higher quality ANC are more likely to be more highly educated and wealthier. They may also be more likely to have pregnancy complications. Thus, it will be problematic to directly compare the birth outcomes for women who received high quality ANC and those who received low quality ANC. Multivariate regression allows one to control for the baseline characteristics and estimate the effect of quality of ANC, net of these factors. However, other methods like propensity score matching are thought to be better for making causal inference based on observational data (Austin 2011; Little and Rubin 2000; Morgan and Winship 2007; Rosenbaum and Rubin 1983). The propensity score is the “probability of treatment assignment conditional on observed baseline characteristics” (Austin 2011:399). Propensity score matching allows one to control for baseline characteristics that may differ for the treated (in this case –those who received higher quality) and untreated groups (those who received lower quality care); by mimicking some of the characteristics of a randomized control trial (RCT) (Austin 2011).

To examine the effect of quality of ANC (the treatment) on birth outcomes (the outcome), each woman in the sample has a pair of potential outcomes: $Y_i(0)$ – the pregnancy outcome under high quality of ANC; and $Y_i(1)$ –the pregnancy outcome under low quality of ANC. The effect of quality of ANC for each woman is thus $Y_i(1) - Y_i(0)$. However, given that each woman can only receive high or low quality of ANC, only one of the outcomes can be

observed for each woman (Austin 2011). In propensity score matching two approaches are used to define the treatment effect. The first is the average treatment effect (ATE) – which is the effect of moving the entire population from untreated (low quality of ANC) to treated (high quality of ANC). The second is the average treatment effect for the treated (ATT) – which is the average effect of treatment (high quality of ANC) on those subjects who ultimately received the treatment (high quality of ANC) (Austin 2011). These two measures are similar in an RCT because randomization removes systematic differences between the treated and the overall population. But this is not so in observational studies because subjects often differ systematically from untreated subjects (Austin 2011). In observational studies, the decision on how to define the treatment effect is based on the context of the research. Austin (2011) suggests that the ATT may be more useful for estimating the effect of a treatment with potentially high barriers to participation and completion; whereas, the ATE may be more useful for estimating the effect of a treatment with minimal barriers to treatment and completion. In this analysis I use the ATE, because the variables used to measure quality of ANC are very basic services that are easy to implement, with minimal effort, and it is useful to examine the average effect of improving quality of ANC at the population level.

I run the propensity score models using the two sets of predictors in the final multivariate logistic models. The propensity score matching was implemented using the “teffects psmatch” command in Stata 13 with the default options (Logit model; ATE estimate; nearest neighbor with one to one matching; and Abadie–Imbens robust standard errors). There are no standard guidelines on how to use sample weights in propensity score matching (personal communication with Andrew Hicks, California Center for Population Research statistician, 06/25/2014), so the sample weights are not used in this analysis.

RESULTS

Weighted Descriptive statistics

The distribution of the sample for the GMHS is presented in table 4G1 and discussed in chapter 4. Table 7G1 presents the distribution of the variables for birth outcomes, delivery care, and risk factors for adverse outcomes relevant to this chapter. The proportion of women who experienced a stillbirth in their last birth is 1.7% for the full sample (85 out of 5042), and 1.5% for women who had at least one ANC visit (77 out of 4,868). A crude stillbirth rate for the GMHS sample is therefore about 17 per 1000 pregnancies. The distribution of stillbirths for the full sample and the sample of women who received some ANC are not significantly different for most of the predictors, shown by the overlap of the confidence intervals. The rest of the description is based on the restricted sample, unless otherwise specified.

Over two thirds (69%) of the stillbirths occurred in the ninth month of pregnancy; about 25% at seven to eight months and five percent at 10 months. About 5% of the women have had a prior stillbirth and 16% a prior miscarriage – 21% have had a prior adverse outcome (stillbirth or miscarriage). Fifty-seven percent of deliveries were assisted by a SBA – 9% by doctors, 45% by nurses or midwives and 1% by auxiliary nurses or midwives. Of the 45% of births not assisted by a SBA, about 45% were by trained TBAs and the rest by untrained TBAs, relatives, and friends. About 4% reported not being assisted by anyone. Similar to deliveries by SBAs, 56% of the women reported delivering in a health facility. Of these, about half were in a government hospital or polyclinic, 26% in a government health center or health post, and 20% in a private clinic or maternity home. Eighty percent of births in health facilities were assisted by a nurse or midwife, 17% by a doctor, and less than two percent by an auxiliary nurse or midwife. Forty two out of the 53 births assisted by auxiliary nurses occurred in a health facility. About one percent

of women (34) delivering in health facilities also reported being assisted by a trained TBA, with a very small proportion (8 women) reporting being assisted by an untrained midwife, relative, friend, or other in a health facility. About a third of women who delivered in a health facility were discharged within a day of delivery, and 29% within two to three days. Twenty-two percent reported staying for about a week or longer in the health facility. Forty percent of women delivering in a health facility received some kind of intervention –mostly intravenous fluids. About 12% of women delivering in health facilities (about 7% of all women in the sample) had a caesarian section; with about 3% each having a forceps delivery and blood transfusion.

Weighted bivariate results

The proportion of women with a stillbirth for each of the predictors is shown in table 7G2. The stillbirth rate is higher among the small group of women who did not attend any ANC at about 5.6% (8 out of 174), compared to the 1.5% among women who attended some ANC. There is however an overlap in the confidence intervals – likely due to the very small proportions. This overlap in confidence intervals applies to most of the other bivariate distributions, implying most of the differences shown in the cross tabulations are not statistically significant. Differences of greater than 0.5% are however considered important, hence described. The bivariate discussion is also based on the restricted sample, though these are not significantly different from that for the full sample.

Among women who attended ANC the stillbirth rate is slightly higher for those who received lower quality ANC – 1.8% compared to 1.3% for those who received higher quality ANC. It is also higher among those who had less than four ANC visits – 2.1% compared to 1.4% for those who went four or more times. Women who received ANC in a private facility were also less likely to have a stillbirth than those who did so in a government facility – 0.7% compared to

1.9% and 1.4% for care in a government hospital or polyclinic and in a lower tiered government facility respectively. In addition, women who received ANC from a doctor had a higher percentage of stillbirths than those who received ANC from a nurse (2.3% and 1.3% respectively). About two percent (2.1%) of women assisted by a SBA reported a stillbirth, compared to 0.7% for those who were not assisted by a SBA. This was the same for births in a health facility and those not in a health facility and the difference here is significant ($p < 0.05$). Still births were higher for births assisted by doctors at 5.1%, compared to 1.6% for those assisted by nurses, and 1% for other providers. The difference between doctors and nurses is significant, but that between nurses and other providers is not. Stillbirths are also significantly higher among births in government hospitals and polyclinics – 3.1%, compared to about 1% in other government facilities and private facilities.

Among the risk factors for adverse pregnancy outcomes, having a prior miscarriage and prior induced abortion are associated with a slightly higher percentage of still births. There is however a bigger difference by prior stillbirth, with 5.4% of those reporting a prior stillbirth delivering a stillbirth compared to 1.5% of those with no prior stillbirth ($p < 0.001$). Also women who reported some complication had a higher percentage of still births – 3.9% percent compared to 0.9% percent for women with no complications ($p < 0.001$). In addition, women with a multiple pregnancy had a significantly higher proportion of stillbirths – 8.5% compared to 1.3% for singleton pregnancies. Women who reported a sibling dying from pregnancy complications had a significantly higher proportion of stillbirths – 7.7% compared to 1.4% of those not reporting this event. Having some intervention during pregnancy is positively associated with having a still birth – 4.7% among those with a caesarian delivery; 8.0% among those with a forceps delivery; 6.3% among those who had a blood transfusion; 3.4% among those who received an intravenous

infusion; and 3.8% among those with any intervention, compared to about 1.4% or less for their reference group. But for the association with blood transfusion, all the differences are significant. The stillbirth rate is also higher for women who spent one day or less in the health facility after delivery – 3.2% compared to 0.8 for those who spent a week or more. This difference is significant.

By age stillbirths are highest among the oldest women (40 to 49 years), followed by the youngest (15-19 years) and lowest among those 30 to 34 years – 2.8%, 2.0%, and 1.0 % respectively. Women who have never married are more likely to have a stillbirth – 3.9% compared to 1.4% or less for the other marriage categories. Also women with five or more pregnancies have a larger proportion of still births – 2.2% compared to about 1.3% and 1.4% for 1-2 and 3-4 pregnancies respectively. But there is no major difference by number of children, except that all women who reported no child born alive and about 27% of those with no children currently alive had a stillbirth in the last pregnancy. This is expected as women with no children alive were only interviewed if they had a stillbirth or had lost a child. No major differences are present by use of contraception and knowledge of family planning source.

Surprisingly, stillbirths are higher in urban areas than rural areas (2.3% compared to 1.3%). The Brong Ahafo region has the highest proportion of stillbirths, followed by the Eastern region (2.8% and 2.6% respectively), with the lowest rates in the Upper East and Western regions at 0.4%. The stillbirth rate appears to increase with education and wealth -1.0% among those with no education and 2.2% among those with a secondary education; and 1.6% among the poorest, compared to 2.4% among the richest; but these differences are not significant. There are no significant differences by religion and ethnicity, though the lowest stillbirth rate is among those in the Traditional religion groups and among the Grussi/Gruma ethnicity. Women with

higher media exposure also have a higher percentage of stillbirths (2.1% for watching television at least once a week compared to 1.1% for not at all).

Multilevel logistic regression results

Bivariate adjusted for clustering: The results from the multilevel logistic regression for pregnancy outcomes are shown in table 7G3 and 7G4. The random effects at the bottom of the tables show evidence of clustering at the cluster level. For the sample of women who had at least one ANC visit, the approximate intra class correlation (ICC) is 0.21 (variance at the cluster level/total variance = $(0.863/(3.29+0.863)) = 0.863/ 4.153 = 0.208$). Most of the variation is however between individuals. The final model explains about 34% of the variation between clusters ($((0.86 - 0.57)/0.86) = 0.337$).

Table 7G3 shows the bivariate regression models. The results show that when clustering is accounted for, receiving higher quality of ANC is associated with lower odds of delivering a stillbirth. Compared to women who received lower quality of ANC (less than 8 services), those who received higher quality ANC (8 or all services) have about 40% lower odds of delivering a stillbirth. When the continuous quality of ANC measure is used, each unit increase in quality of ANC score is associated with a 15% decrease in the odds of delivering a stillbirth. The unadjusted models based on the full sample also shows that when only clustering is accounted for, attending any ANC and attending ANC four or more times are negatively associated with delivering a stillbirth, but frequency of ANC visits is not significantly associated with the pregnancy outcomes in the unadjusted model for the sample of women who had at least one ANC visit.

Deliveries in health facilities and deliveries assisted by SBAs are associated with over two times higher odds of having a stillbirth, compared to deliveries outside health facilities and

those not by SBAs. Also deliveries in a government hospital or polyclinic and deliveries assisted by a doctor are more likely to result in stillbirths compared to deliveries in health centers, health posts, private facilities, and at home; and deliveries by nurses and non-skilled providers; respectively. This is similar for ANC provider and facility.

Not surprisingly reporting a pregnancy complication in the index pregnancy, having a past stillbirth, having a multiple gestation in the index pregnancy, and having any intervention during delivery (C/S, forceps delivery, blood transfusion and IV fluid) are all associated with higher odds of having a stillbirth –accounting for only clustering. Women who reported having a sibling who experienced a maternal death also have about six times higher odds of having a stillbirth, compared to other women. There is a small positive association between age and having a stillbirth. This difference is mainly for the older groups, with women 40 to 45years having about two times higher odds of delivering a stillbirth compared to those who are 25 to 29years old. Women who have never married have over two times higher odds of having a stillbirth compared to those currently married. There is no significant association by number of pregnancies.

The higher stillbirths in urban regions are still seen when only clustering is accounted for, with urban residence being associated with about two times higher odds of delivering a stillbirth compared to rural residence in the unadjusted model. However, there is no significant difference by region when only clustering is accounted for. The associations between education and wealth with pregnancy outcome are also not significant; though still generally positive – higher odds of having a stillbirth with higher education and wealth.

Multivariate adjusted for clustering: The results of the final multivariate models for women who attended ANC at least once are shown in table 7G4. Some variables related to health

service utilization are omitted from the final multivariate models because of strong correlations between them. For example, delivery by a SBA, the type of delivery provider, delivery in a health facility, and type of delivery health facility are very strongly correlated (about 99% of deliveries by SBAs occur in a health facility; and about 80% of deliveries by doctors are in government hospitals or clinics). Also, type of delivery facility and provider includes a dummy variable for delivery not by a doctor or nurse/midwife; and delivery not in a health facility which is collinear with the delivery in a health facility variable. To examine each of these in multilevel analysis, separate models were run with each of the delivery provider and facility variables and with them in two pairs – delivery by a SBA and type of delivery facility; and the delivery in a health facility and type of the delivery provider variables. In all cases, there was no significant difference for delivery by a SBA and delivery in a health facility in the full multivariate models, but the difference by type of delivery provider and type of facility were still present. When these two are included together only the difference by type of delivery facility was still present. For type of ANC provider and facility, none was significant in the final model and some observations were dropped because of perfect prediction for the other category (ANC outside a health facility category), so this was also dropped from the final multivariate model. Days spent in the health facility after delivery is not included because it is consequent to the outcome. Also, the only difference in the multivariate model is for those who did not deliver in a health facility compared to the others.

The second column of table 7G4 shows the unadjusted multilevel logistic regression results for the variables included in the final models. The bivariate models are presented here for ease of comparison, but are the same as those for the sample restricted to women who attended had at least on ANC visit in table 7G3. The first set of multivariate results excludes the delivery

provider and place, as well as whether the woman had any intervention during delivery. These are included in the second multivariate model. Because these are logistic models, the change in the size of the coefficient for quality of care in the two models cannot be examined as the effect of quality of care mediated by the delivery care, as part of the change is due to the change in the scale of the logit equation with the additional variables (Aneshensel 2013; Mood 2010). The two models are however presented to show the effect of quality of care in the two instances as well as the effect of the delivery variables. An intervening model which excludes the variable on whether the woman had an intervention during delivery is not shown because the results are essentially the same as that in the model including it.

Net of other factors, higher quality of ANC is still significantly associated with better birth outcomes. Women who had higher quality of ANC have about 50% lower odds of delivering a stillbirth than those who received lower quality of ANC – even when the delivery factors are accounted for. There is no difference in the odds of delivering a stillbirth for deliveries by skilled and unskilled providers when other factors are accounted for. However, the difference by type of delivery facility is still present; with 64% and 75% lower odds of having a stillbirth for deliveries in a government health center/health posts and that in private facilities, respectively, compared to deliveries in government hospitals and polyclinics. Net of other factors, the odds of delivering a stillbirth is not different for deliveries in a government health center or health posts compared to that in private facilities; and for deliveries at home compared to deliveries in a government hospital or polyclinic. Having some intervention during delivery is associated with about two times higher odds of having a stillbirth.

When other factors are accounted for, women who attended ANC four or more times have about 60% lower odds of having stillbirth compared to those who attended less than four

times, but the association with the type of ANC provider is not significant. Reporting a complication in the index pregnancy, a past stillbirth, and a multiple gestation are all associated with higher odds of delivering a stillbirth –controlling for other factors. Also when other factors are controlled for, women who reported having a sibling who experienced a maternal death still have over five times higher odds of having a stillbirth, compared to other women. Age and gravidity are both not significant in the multivariate models. These were initially entered as categorical variables, but because none of the dummy variables was significant, the continuous variables were included just to capture any unmeasured characteristics related to them. Being never married is associated with about three times higher odds of having a stillbirth compared to currently married.

A significant difference between the two multivariate models is seen in the effect of urban residence. Net of other factors including quality of ANC, urban residence is still associated with about two times higher odds of having a stillbirth. However, this difference is no longer significant when we include the delivery variables. The effect is also not significant when we exclude only the intervention during delivery variable. Education and wealth are not significantly associated with the pregnancy outcome in all the models. The odds of having a stillbirth do not also differ for most of the regions. The exceptions are the Eastern and Brong Ahafo regions, where women have over two and four times higher odds, respectively, of experiencing a stillbirth compared to women in the Greater Accra region.

Mediation and moderation analysis: This analysis sought to answer a number of questions. The first question, whether quality of ANC will be associated pregnancy outcomes net of other factors, is addressed by the results above. The second question, whether the effect of quality of ANC will be mediated by delivery by a SBA, requires a formal mediation analysis

using Mackinnon's 'ab' product of coefficient method described in chapter 6. However, since use of SBA is not significant in the final model, it does not qualify as a potential mediator; the mediation analysis results in an insignificant mediated effect. Also, that the effect of quality of ANC is present net of type of delivery provider and facility, suggests that at least some of the effect of quality of ANC on pregnancy outcome is independent of delivery care. A third question, whether the effect of quality of care on pregnancy outcomes differs for women who use and those who do not use a SBA, was examined by including two interaction terms: ANC quality with delivery by a SBA, and ANC quality with type of delivery facility. Both interactions were not significant, suggesting the effect of ANC quality on pregnancy outcomes is not moderated by use of SBAs or the type of delivery facility.¹⁵

Another question of interest is whether quality of ANC mediates the effect urban residence and SES on birth outcomes. This question is irrelevant for SES in this analysis because the effects of these factors are not significant even in the bivariate models. It is however relevant for urban residence, which is significant in the bivariate models and the models excluding the delivery variables. The mediated effect by quality of care is however not significant. It is difficult to do the mediation analysis that involves all the delivery variables using the product of coefficients method which is suitable for binary mediators. When the mediation is done using the

¹⁵ If we assume that the quality of care a woman receives during ANC reflects the care she will receive during pregnancy then we could use the quality of ANC as a proxy for quality of delivery care and do the mediation analysis that was initially intended. This involves regressing SBA and the other predictors in the final model on quality of ANC and then using the coefficients for this and the model for pregnancy outcomes to do a mediation analysis with the 'ab' method. The regression on quality of ANC however shows that SBA is only marginally positively associated with quality of care ($b=0.408$ $p=0.063$) when the place of delivery is included in the model, and differences by type of provider are mainly between those who used a hospital and those who did not. When delivery facility is removed from the model, we find a positive association between delivery by a SBA and quality of ANC which gives a significant indirect effect of SBA through quality of care ($ab=-0.152$, $p=0.0077$, $ab/c=-0.218$). This is however not presented because while the assumption, may hold, it is problematic when one considers the temporal ordering of quality of ANC and use of SBA which makes a mediation of the effect of quality of ANC on pregnancy outcome through use of SBA more plausible than the reverse.

coefficients for each of the dummy variables, none of the individual mediated effects are significant. However, if we ignore the change in the scale of the logistic model with the addition of variables to the model and examine the change in the coefficients and the LR test when the delivery variables are added to the model (together), we find a significant amount of the urban effect is explained by the type of delivery provider and facility. Also, that the urban difference is not significant when the delivery variables are included together suggests they together explain at least some of the rural/urban difference.

A related question is whether the effect of quality of care differs by place of residence and SES. The interaction terms for quality of ANC, with urban residence, education, and wealth were however all not significant. To examine if the effect of the socioeconomic factors differ by place of residence (used here as a proxy for health service availability), both education and wealth were interacted by urban residence and region, but none of these were significant.¹⁶ An interaction between wealth and education was also only marginally significant ($p < 0.1$). This showed that the odds of having a stillbirth decreased with education among the poorest, but increased with education among the middle and richer women. There is however wide overlap in the confidence intervals.

Propensity score results: The results from the propensity score analysis for the effect of quality of ANC are shown in table 7G5. The average treatment effects (ATE) from the model without and with the delivery variables are both significant at $p < 0.05$, though the coefficients are both very small. This suggests that among women with similar measured characteristics, receiving higher quality ANC does confer some benefit on the pregnancy outcome, albeit small.

¹⁶ When the regions are divided into rural and urban and entered as dummy variables, some are dropped out of the model because there are no observations in many of the categories and the rest are not significant

The propensity score analysis was also done for the effect of use of SBAs, but these are not presented because the effect was not significant for the final model, which is expected from the results of the logistic regression. The non-significant effect of use of SBAs in the final model is however important considering that women with complications that increase the risk of stillbirth are more likely to use SBAs.

Additional sensitivity analysis

Multilevel logistic regression for full sample and weighted single level logistic regression

I also run the multilevel multivariate regression of pregnancy outcomes using the full sample. Here women who did not attend ANC are given a quality score of zero and the variable on ANC attendance (going for at least one ANC visit –coded 0 and 1) is included as an indicator variables. In addition, I run weighted single level logistic regressions on the pregnancy outcome using the restricted and full samples. These are all presented in appendix 7G1 for the final models and appendix 7G2 for the models containing all the predictors including those that do not improve the models. In the regression for the full sample attending ANC at least once is not significantly associated with pregnancy outcomes when other factors are accounted for, but attending four or more times is associated with lower odds of having a stillbirth, as in the sample restricted to women who attended some ANC. The rest of the results are generally consistent across the various models, samples, and analytic approaches.

DISCUSSION

This analysis examined the factors associated with stillbirths in Ghana using a nationally representative sample of women. A key question was whether quality of ANC has an effect on women's pregnancy outcome, net of other factors. The results show that higher quality of ANC decreases the odds of having a stillbirth by almost half – after accounting for other factors

including delivery place and provider. The other health service factor associated with lower odds of having a stillbirth in the multivariate analysis is attending at least four ANC visits. As expected a complication in the index pregnancy, a multiple gestation, and a past stillbirth are all associated with a higher odds of having a stillbirth. These findings are generally consistent with findings from other studies including studies in Ghana (Engmann et al. 2012; Ha et al. 2012; Stringer et al. 2011).

Even though ANC has always been one of the recommended strategies to improve maternal and perinatal health, its contribution to maternal mortality reduction has been challenged (Bullough et al. 2005; Guillermo Carroli et al. 2001). There is, however, evidence that certain antenatal interventions such as serologic screening for syphilis, iron supplementation, malaria treatment and prophylaxis, diagnoses and treatment of asymptomatic bacteriuria, blood pressure monitoring, anti-tetanus immunization, and prevention of mother-to-child transmission of HIV are effective, especially with regards to neonatal survival (Bergsjö and Villar 1997; Campbell and Graham 2006; Villar and Bergsjö 1997; World Health Organization 2003) This analysis provides additional evidence for the role of not just attending ANC, but good quality ANC in reducing stillbirths. The findings imply that if every woman who comes into contact with the health system during pregnancy is provided with the basic package of ANC services, it could substantially reduce the number of stillbirths in the country. Butta et al project that a basic package of antenatal interventions including periconceptional folic acid supplementation or fortification, prevention of malaria, and improved detection and management of syphilis during pregnancy; and basic and comprehensive emergency obstetric care could avert up to 45% of stillbirths; these are cost-effective interventions (Bhutta et al. 2011).

No national study in Ghana has examined the effect of quality of ANC on pregnancy outcomes. Some of the few studies with stillbirths as an outcome have however examined some of the antenatal services. One study based on surveillance data in the Brong Ahafo region, which had receipt of two tetanus doses during ANC as the only measure of ANC quality; found that women in lower wealth quintiles who were more likely to have a stillbirth were also more likely to receive lower quality ANC (two tetanus injections). They suggested the higher risk of stillbirths among the poor may be due to lower quality ANC, but did not directly model quality of ANC as a predictor of the pregnancy outcome (Ha et al. 2012). Another study, based on a survey of women presenting for antenatal care at a health facility in the Ashanti region, found that women who were not given malaria prophylaxis during ANC had higher odds of having a stillbirth in unadjusted models, but this was not significant in multivariate models. This study, however, also had biological markers including laboratory diagnoses of malaria and intestinal helminthes and folate and hemoglobin concentrations; and found higher odds of stillbirths with low folate, anemia, and malaria infection (Yatich et al. 2010). Another facility based study examined the effects of some components of ANC, including screening for anemia and helminthes, tetanus vaccination, and nutritional supplements on adverse birth outcomes (which included stillbirths, preterm delivery, low birth weight, or small for gestational age). Some of the services were significant in bivariate models, but none was significant in their multivariate models. In this study only frequency of ANC attendance was significant in the final multivariate model (Asundep et al. 2013). Because they included several individual ANC content variables in the multivariate models, multicollinearity may have been a problem in this analysis, as the ANC content variables are likely to be correlated.

Like in this study, other studies did not find a significant effect of the trimester of first ANC visit, when other factors were accounted for (Asundep et al. 2013; Yatich et al. 2010). Other studies have however found lower odds of having a stillbirth with greater frequency of ANC visits (Asundep et al. 2013), though some find no effect, net of other factors (Yatich et al. 2010). Ha et al found that higher frequency of ANC was associated with lower risk of antepartum stillbirth, but not intrapartum stillbirth, but did not account for quality of the ANC. The finding from this analysis that higher frequency of ANC is associated with lower risk of having a stillbirth may therefore be because the sample includes a higher proportion of antepartum stillbirths. We are however unable to draw this conclusion because the data does not include timing of the stillbirth in relation to the onset of labor.

In unadjusted models in this analysis, delivery by a SBA or delivery in a health facility is significantly associated with higher odds of having a stillbirth compared to deliveries by non-SBAs and deliveries outside a health facility, respectively. These associations are however not significant when other factors are accounted for. However, compared to deliveries in private facilities and lower tiered health facilities, deliveries in government hospitals or polyclinics are associated with higher odds of having a stillbirth, controlling for other factors. This finding is similar to that from another study that found higher odds of having a stillbirth among women who delivered in district and regional hospitals compared to those who delivered at home (Ha et al. 2012). These findings are not because delivery in health facilities or hospitals leads to poor outcomes, but because of selection: women at risk of stillbirths are more likely to deliver in health facilities, and even more likely to deliver in the higher tiered facilities and to be assisted by doctors during delivery. In Ghana doctors hardly assist in uncomplicated deliveries, and it is women with complications who are usually referred to the higher tiered health facilities, thus it is

difficult to ascertain the effect of these factors on pregnancy outcomes. However, if we assume that skilled delivery should improve outcomes even for women with complications (which is the expectation for maternal outcomes), then the non-significant effect of delivery by SBAs and in health facilities, net of other factors raise a number of questions: Are women with complications presenting so late that not much can be done for their babies and potentially themselves? Are health facilities not doing enough for these women? These are questions that cannot be answered with this analysis, but from my clinical experience in Ghana, discussions with colleagues, and review of health reports in Ghana, I can say it is a bit of both.

The first reason for this assertion relates to the quality of ANC, the adequacy of the referral system, and delays in seeking skilled attendance. The measure of quality of ANC used in this analysis gives the impression that many women are receiving high quality ANC, but this is not so. For instance, a woman may have only one blood pressure measurement taken during ANC with no subsequent follow up, which results in women with preeclampsia not diagnosed until they present in labor with full blown eclampsia and a stillbirth. This applies to diagnoses of anemia and sickle cell disease, which are also risk factors for stillbirth. An initial blood test may not be followed up during antenatal visits until a woman has developed severe anemia or sickle cell crises with a stillbirth, at which stage she is referred to a higher level facility, where not much can be done for the fetus. Even when a fetus is alive at referral, the poor referral system increases the chance that the fetus will be dead by the time she reaches the referral facility. In a recent assessment of health facilities in Ghana, 46% of facilities reported not making any transportation arrangements for clients referred to higher facilities (Ghana Ministry of Health et al. 2011). This implies the burden of finding appropriate transportation is on the woman and her family, which further increases delays to reaching a facility where adequate care for the mother

and baby may be available. Some of these factors explain the higher stillbirths in government hospitals and polyclinics, which are the referral points for lower tiered government health facilities and private facilities. In addition, some women stay at home when they go into labor, and only go to the health facility when they have developed a complication like hemorrhage or even eclampsia; or have been in labor for so long that maternal exhaustion and fetal death is imminent because of obstructed labor. At this point health facilities may not be able to offer much, especially with regards to saving the fetus. These suggest the broad indicator for coverage for use of SBAs may be misleading if we do not know at what point in time women decide to seek skilled attendance; and with too many of the situations described above health outcome indicators will continue to lag behind the coverage indicators. A useful question for the major national health surveys will be a question on at which point – from the onset of labor – women decide to go to a health facility for delivery.

The second reason is based on the fact that many health facilities in Ghana including referral facilities are understaffed, underequipped, and lack basic drugs and supplies needed to avert maternal, fetal, and early neonatal deaths. Many maternal deaths that occur in facilities can be linked to delays in receiving timely adequate care even after arrival in health facilities; and this also applies to stillbirths (Issah, Nang-Beifubah, and Opoku 2011; Knight, Self, and Kennedy 2013). The population-to-doctor ratio in Ghana is about 10,032-to-1 nationally, but ranges from 3,712-to-1 in Accra, the national capital, to about 38,267-to-1 in the Upper West region. The population-to-midwife ratio though better is still inadequate –about 1,478-to-1 nationally, but ranges from 1,160-to-1 in Accra, to 2,050-to-1 in the Northern region (Ghana Health Service 2012). The minimum threshold of health workers to deliver essential maternal and child health services is 23 doctors, nurses and midwives per 10 000 population (Kinfu et al.

2009). There is also substantial shortage of adequately trained surgeons who can perform obstetrical procedures at first level-referral facilities (Abdullah et al. 2011). There has been a slight improvement in the population to doctor and midwife ratios in the past few years; however patient loads have increased with the introduction of the National Health Insurance Scheme – without a corresponding increase in health workers and capacity of health facilities (Ghana Health Service 2008, 2012; Witter, Kusi, et al. 2007).

The 2011 Emergency Obstetric and Neonatal Care (EmONC) assessment found that only 13 facilities in the country qualified as basic EmONC facilities (i.e. have the capacity to perform seven signal functions needed to manage the leading direct causes of maternal mortality); and 76 qualified as comprehensive EmONC facilities (i.e. has the capacity to perform seven signal functions in addition to surgery and blood transfusion) (Ghana Ministry of Health et al. 2011; World Health Organisation et al. 2009). Health centers are supposed to function as basic EmONC facilities. But of the 509 health centers in the country providing delivery services, only two qualified as basic EmONC facilities (Ghana Ministry of Health et al. 2011). Essential drugs like antibiotics and Magnesium Sulphate and blood transfusion services, which are needed for managing the leading causes of maternal and fetal deaths in the country are lacking in many health facilities (Ghana Ministry of Health et al. 2011; Gumanga et al. 2011; Issah et al. 2013) There are also deficits in the management of labor including inadequate use of partographs and non-use of recommended treatments (Gans-Lartey et al. 2013; Ghana Ministry of Health et al. 2011). For example, while the recommended treatment for eclampsia is Magnesium Sulphate, the EmONC assessment found that only 16% of facilities had exclusively used Magnesium Sulphate for the treatment of eclampsia in the three months prior to the survey; 60% used diazepam which is not the drug of choice.

There are instances where women in labor are admitted with a live fetus and deliver a stillbirth after several hours because the only midwife on duty was inundated with too many cases and could not monitor each woman carefully, and so did not detect when the baby went into distress; or the only fetal monitor in the unit was broken hence women could not be adequately monitored. Worse still, a diagnoses of fetal distress can be made, but it takes several hours before the mother is able have a caesarian section in the referral hospital because there are several other emergency cases waiting to have a caesarian section in the only theatre in the hospital, with one doctor and one anesthetist on duty. Stillbirths caused by negligence and incompetence of health providers cannot be ruled out. Though fresh stillbirths are more common than one will expect, they are hardly mentioned in health service reports.

The other factors positively associated with having a stillbirth – a complication in the index pregnancy, multiple gestation, and a past stillbirth are the known risk factors for stillbirths (Edmond et al. 2008; J. E. Lawn et al. 2009; Joy E Lawn et al. 2009; Di Mario, Say, and Lincetto 2007; McClure et al. 2009). Prolonged and obstructed labor, hypertensive disorders, diabetes, anemia, and infections are major risk factors for stillbirths in developing countries (Joy E Lawn et al. 2009; McClure et al. 2009). These are all captured under the variable on reporting a complication during the pregnancy. Multiple gestations also tend to increase the risks for both maternal and fetal complications. Though the exact mechanisms for past stillbirths are not clear, placental insufficiency is thought to play a role. An adverse pregnancy outcome increases the chances of adverse outcomes in subsequent pregnancies. Prevention of stillbirths is therefore said to have a multiplicative effect, as it not only ensures the survival of the fetus in the index pregnancy, but also reduces the chances of future stillbirths (Joy E Lawn et al. 2009). A past miscarriage was not associated with having a stillbirth in this analysis, likely because the

etiologies of early pregnancy losses are different from that of late pregnancy losses. Prior abortion was only positively associated with having a stillbirth in the unadjusted model –the association is not significant when other factors are controlled for. A facility based study in Ghana also found higher odds of having stillbirth among women who had a prior induced abortion –net of other factors (Yatich et al. 2010). This association was attributed to the fact that dilation and curettage, which is the common abortion method used in Ghana, including by unqualified personnel, may lead to cervical incompetence, hence higher risk of late pregnancy losses.

Other identified risk factors for still birth are age and gravidity (Joy E Lawn et al. 2009; Di Mario et al. 2007; McClure et al. 2009). Maternal age younger than 18 years is thought to increase the risk factors of having a stillbirth because of increased risk of complications like obstructed labor; and age greater than 35 years through increased risk of congenital anomalies (Joy E Lawn et al. 2009). The effect of primigravidity (first pregnancies) and grand multiparty (> 4 prior pregnancies) are also thought to be through increased risk of complications (Joy E Lawn et al. 2009). In this analysis, both age and parity are not significant when other factors are accounted for. The effect of older age is seen in the bivariate analysis, but disappears in the multivariate model. This may be because some of the variables like a complication in the index pregnancy explain all of its effects. Among the few studies in Ghana that have looked at stillbirth, the effects of age and parity have not been consistent. Ha et al found a higher risk of both antepartum and intrapartum stillbirths among women older than 35 years, compared to those 25 to 29 years but no increased risk for those younger than 20 years in multivariate analysis (Ha et al. 2012). Most however found no effect of age (Asundep et al. 2013; Engmann et al. 2012; Yatich et al. 2010). Like this study, other studies did not find an effect of gravidity or

parity on pregnancy outcomes (Asundep et al. 2013; Yatich et al. 2010); though some found higher odds of stillbirths among primigravid women (Engmann et al. 2012; Ha et al. 2012).

Marital status is not a known risk factor for stillbirth, but in this analysis, being never married is associated with higher odds of having a stillbirth, compared to those currently married. One other study had similar findings (Yatich et al. 2010). Age and parity are potential explanatory factors in unadjusted models; but the effect is also significant in the multivariate models that control for age and parity, suggesting the role of other factors, including access and quality of delivery care, which are not adequately captured by the models. Yatich et al (2010) found that women who were single had fewer ANC visits, were less likely to receive malaria prophylaxis, and more likely to have low folate and hemoglobin levels.

The strong significant association between reporting a sibling who experienced a maternal death and having a stillbirth is one that to my knowledge has not been reported elsewhere. It is unclear what may be accounting for this association, but possible reasons include the familial component of some risk factors for both maternal deaths and stillbirths like hypertension. It may also be a factor of poor access to good quality health care by women with siblings who may have been affected by similar contextual factors. In addition, since a woman has to have a female sibling for her to experience a maternal death, women reporting siblings who experienced a maternal death may over represent women from large families, who may be more likely to have large families themselves – a risk factor for stillbirths. The number of women in this sample with a sibling who experienced a maternal death is small; but the consistent strong effect in the multivariate models suggest this association is likely not spurious. More studies are needed to understand the underlying process, but this finding adds to the

evidence on the strong relationship between risk factors for adverse maternal and fetal outcomes and the utility of examining stillbirths as a measure of adequacy of maternal care.

Studies in high income countries show socioeconomic differentials in stillbirths, but these differentials are more common for intrapartum stillbirths than antepartum stillbirths (Flenady, Koopmans, et al. 2011; Guildea et al. 2001; J. E. Lawn et al. 2009; Joy E Lawn et al. 2009; Sutan et al. 2010). Few studies have however explicitly examined socioeconomic differentials in low income countries (Ha et al. 2012). Like this study, none of the studies in Ghana found an effect of education. But for one, none also found an effect of wealth. Even the univariate distributions from the DHSs which report perinatal mortality find no clear relationship between perinatal mortality and women's level of education or household wealth status. The only study that found some socioeconomic differentials in stillbirths was that by Ha et al. This is also the only study that examined antepartum and intrapartum stillbirths separately. They found that women in the poorest wealth groups had the highest risk for intrapartum stillbirths, but there was no association between antepartum stillbirths and wealth. The non-significant effect of SES in this and the other studies in Ghana may therefore be because we were unable to distinguish between antepartum and intrapartum stillbirths. The stronger effect of wealth on intrapartum than antepartum stillbirths is said to be because antepartum stillbirths have more multifactorial causes that may have a genetic component and may be unrelated to use of health services (Flenady, Koopmans, et al. 2011; Flenady, Middleton, et al. 2011; Guildea et al. 2001; Ha et al. 2012; Spong, Reddy, and Willinger 14; Sutan et al. 2010). However, recent evidence suggests better access to quality antenatal and delivery care has the potential to decrease both antepartum and intrapartum stillbirths (Bhutta et al. 2011, 2014).

There are other potential reasons for the non-significant effects of SES. One of these is that their effects may be suppressed by the opposite effects of their intervening factors. For example, higher education may be associated with older age at first birth which increases the odds of having some complication that may result in a stillbirth. On the other hand, women with more education are more likely to use and receive higher quality care which decreases the risk of having a stillbirth. This is suggested by the effect of wealth: In the unadjusted model the richest group of women has higher odds of having a stillbirth than the poorest; however when other factors are accounted for the estimate is reversed. The estimates for wealth are however not significant for all the models which limits any strong inference based on this. Another hypothesis is that the effect of SES depends on health service availability. I tried to examine this by including interaction terms for place of residence with education and wealth. None of these interactions were however significant, decreasing support for this last hypothesis. Better measures of access are however needed to fully test this hypothesis.

The association between place of residence and birth outcomes is another finding worth noting. Rural areas are said to account for a larger proportion of stillbirths globally, and especially in SSA (Cousens et al. 2011). The findings from the GMHS however shows that while rural areas have a larger absolute number of stillbirths (potentially because of higher fertility), the proportion of all births that result in a stillbirth is higher in urban areas than rural areas (Ghana Statistical Service et al. 2009). For example using all births in the preceding five years in the GMHS gives a SBR of 30.6 per 1000 pregnancies (68/2222) for urban and 16.5 per 1000 pregnancies (78/4,738) for rural areas. This is reflected in this analysis which is restricted to the last birth in the preceding five years, with a crude stillbirth rate of 23 per 1000 for urban areas and 13 per 1000 for rural areas. In the bivariate models accounting for only clustering, we also

see urban residence is significantly associated with a higher risk of stillbirth than rural residence. However, when delivery provider and place of delivery are added to the model the urban effect is no longer significant. When the model is built sequentially starting with urban residence, the odds ratio for urban residence changes slightly with the addition of the ANC variables to the model, but remains significant. While this change suggests some effect of ANC, the magnitude of this change cannot be taken directly as the amount of the effect that is mediated by ANC because of the change in the scale of a logistic model with the addition of variables to the model. Also, since the urban effect is still significant, any mediated effect will only be partial; and the formal mediation analysis here showed the effect of urban residence that was through quality of care was not significant. However, that the urban effect is no longer significant with the addition of the delivery variables suggest the type of delivery assistant and place of delivery accounts for a significant effect of the urban difference. This is the same even when we do not account for intervention during delivery. From the last chapter and from other studies we know women in urban areas are more likely to use skilled providers and health facilities for delivery. The result here therefore suggest that women in urban areas may have higher biological or other risk factors for having a stillbirth, but this is completely explained by care during delivery. The effect of delivery by a SBA is not significant by itself in the final model, but together with the type of health facility, they explain away the urban difference. One interpretation of this is that if deliveries in health facilities were not as high as they are in urban areas, the risk of stillbirths will have been much higher.

The regional differences are more difficult to explain. In the bivariate analysis, Brong Ahafo and Eastern region have the highest rates of stillbirths. The difference from the other regions is however not significant when only clustering is accounted for; but become significant

when we control for various factors including quality of ANC and place of delivery. This also suggests some factors in the model may be suppressing the regional effect such that the differences are only seen when these factors are controlled for. These factors include quality of ANC and delivery provider as the regional differences are seen with only these variables in the model with region. Nonetheless, that the regional differences are still present with all the predictors in the model also suggest some other factors not included in the model, but which differ between regions are important for pregnancy outcomes. Quality of delivery care and accessibility to health facilities are potential factors, though I have no evidence to suggest quality of delivery care or access to health services are worse of in Brong-Ahafo and Eastern region than the other regions. The prior chapters suggest a complex interplay of factors at the level of the region. For example, net of other factors, both Eastern region and Brong Ahafo region do not significantly differ from Greater Accra region in use of ANC and SBAs. The differences are therefore unlikely to be due to differential use of maternal health services. Differential quality is however plausible, since we find some regional differences in quality of ANC, but better measures of quality for both antenatal and delivery care are needed to adequately examine this. These regional differences present an area for further research.

Limitations and strengths

This analysis has a number of limitations. The first relates to the accuracy of reporting for still births. Stillbirths rates from surveys are said to be underestimates due to misreporting (Cousens et al. 2011; Ghana Statistical Service et al. 2009). Also, the definition of stillbirths used in the GMHS (and also the DHSs) includes only pregnancies that are of seven months duration or more. This excludes very early stillbirths which further underestimates the proportion of stillbirths in the sample. The different classifications used for stillbirths is a recognized problem

in analysis of stillbirths and there have been recent calls on the need to count every stillbirth starting at 22 weeks gestation, as is done in more developed countries (Cousens et al. 2011; Lawn et al. 2014). Counting only pregnancy losses from seven months is however consistent with the 28 week cut off recommended for international comparisons (Cousens et al. 2011). In addition, the still birth rate from this analysis, which looks at only the last birth (because the quality of ANC questions were only asked of this birth) of about 17 per 1000 pregnancies is an underestimate, when compared to 21 per 1000 births when all births in the preceding five years are used (Ghana Statistical Service et al. 2009). This is because all live births in the preceding five years will include multiple births for some women especially those with short interpregnancy intervals, who are also more likely to have stillbirths (Ghana Statistical Service et al. 2009). This should however not significantly affect the results as the purpose of the analysis is not to provide estimates of the stillbirth rate, but to examine associations, and controlling for past stillbirths helps account for other pregnancies in the survey period that may have resulted in stillbirths.

The other limitations relates to the lack of data on some variables that are related to the pregnancy outcomes and the dependent variables. The first of these is the lack of data on whether the stillbirth was antepartum or intrapartum. The proportion of antepartum and intrapartum stillbirths from other studies range from about 40% to 60% and 15% to 40% respectively in different settings (Joy E Lawn et al. 2009). A study in the Brong Ahafo region in Ghana found about 53% of stillbirths were antepartum, 38% intrapartum, and 9% unclassified from missing data (Ha et al. 2012). Thus, this sample likely includes a good mix in antepartum and intrapartum still births. Examining antepartum and intrapartum stillbirths separately is important because some of the determinants are different, with more antenatal determinants for antepartum

stillbirths and delivery determinants for intrapartum stillbirths (Ha et al. 2012; J. E. Lawn et al. 2009). The findings regarding the effect of ANC utilization and quality from this analysis are more consistent with findings for antepartum stillbirths, which may be an indication of a larger proportion of antepartum stillbirths in the sample.

Data on pregnancy duration is also available for only stillbirths, thus pregnancy duration is not examined as a predictor in the analysis. This should however not be a major problem because, though prematurity is a risk factor for stillbirths, it is an intervening factor; there are usually other factors antecedent to prematurity, which indirectly affect the occurrence of stillbirths. Thus prematurity by itself is not a cause of stillbirths, and accounting for the antecedent factors (captured by the variables on pregnancy risk factors) may be more important. Sex of the infant is also not controlled for in this analysis because it is missing for all the stillbirths. Other studies have found a higher rate of stillbirths for male infants (Ha et al. 2012), though others find but no effect (Engmann et al. 2012). Other risk factors missing from this data are use of alcohol and smoking during pregnancy. Studies in Ghana have however suggested these are very rare (Ha et al. 2012; Yatich et al. 2010). For instance, Yatich et al found none of the women in their sample smoked and less than two percent consumed alcohol – they did not state if this included during pregnancy. Another limitation is the problem of selection for place and type of delivery assistant, which could not be addressed in this analysis. Selection is also a potential problem for receipt of good quality care; less so than the delivery care. The propensity score analysis however showed that even when women are matched on observed characteristics, there is still a significant effect of quality of ANC, albeit smaller. This small effect is potentially due to the limited ability of the measure of quality of ANC to discriminate on different levels of

quality – discussed in detail in chapter 5. Other limitations that apply to all the analysis in the dissertation are discussed in the next chapter.

The study has several strengths. Notable among them is that it is the first study to examine the factors associated with pregnancy outcomes in Ghana using nationally representative data. Because, only women who had a live birth are asked the maternal health questions in the usual DHS, such analysis is not possible with the DHS data. But it is possible with the GMHS, and though the GMHS data has been around for a while, not many researchers have taken advantage of it. The restriction of the sample to women who had at least one ANC was necessary to examine the effect of quality of ANC. While this restriction may decrease the generalizability of the study, this represents over nine in ten women in Ghana. Understanding the determinants of birth outcomes in this population is important because this is a potentially more accessible population hence will be easier to target for interventions. Furthermore, the sensitivity analysis suggests the findings are not significantly different for the full sample and are potentially generalizable to all women of childbearing age in the country. This study addresses a gap in the maternal health literature, which is the dearth of quantitative studies on the relationships between process and outcome measures of quality of maternal health care. Other strengths that apply to all the analysis are presented in the next chapter.

Conclusions

This study finds that quality of ANC is important for pregnancy outcomes in Ghana, net of use of delivery services. It adds to the evidence that good quality ANC is essential for good pregnancy outcomes. Pattinson et al projected that if by 2015, 99% coverage is reached in 68 priority countries with a package of interventions, including advanced antenatal care and emergency obstetric care “up to 1.1 million (45%) third-trimester stillbirths, 201,000 (54%)

maternal deaths, and 1.4 million (43%) neonatal deaths could be saved per year...”(Pattinson et al. 2011:1610). Ghana is close to achieving the 99% coverage for use of ANC, but has a long way to go in terms of delivering the essential package of antenatal interventions and providing emergency obstetric services. The recent lancet stillbirth series called for countries “with third trimester stillbirth rates of less than five per 1000 total births to eliminate all preventable stillbirths and close equity gaps by 2020, and for all other countries to reduce stillbirth rates by at least 50% by 2020”(Goldenberg et al. 21; Lawn et al. 2014:5). The priority conditions identified for interventions include pregnancy induced hypertension, antepartum hemorrhage, maternal infections such as syphilis, malaria, and HIV; and obstetric risk conditions such as multiple pregnancy and abnormal lie (Lawn et al. 2014). These can be effectively addressed through good quality antenatal and delivery care. Thus countries in SSA, which bear the greatest burden of stillbirths, need to step up efforts to improve quality of ANC to reduce the burden of stillbirths.

CHAPTER 8: LIMITATIONS, STRENGTHS, IMPLICATIONS, RECOMMENDATIONS, & CONCLUSIONS

LIMITATIONS AND STRENGTHS

Limitations and strengths that are specific to particular chapters have been discussed in the relevant chapters. In this section, I discuss general limitations of the dissertation.

The first limitation is that the analyses are based on cross-sectional data, which limits causal inference. Also, the data, especially for the WHS, are missing important variables that may be related to the dependent and some of the independent variables. Of note is the absence of data on objective measures of physical and financial accessibility which were discussed in chapter 6. The omission of these variables from the analysis may lead to omitted variable bias, hence problems of endogeneity and unobserved heterogeneity (Aneshensel 2013; Treiman 2009). This is likely a bigger problem with the WHS analysis than the GMHS. The other source of endogeneity – simultaneity or reverse causation may be less of a problem for the focal relationships as it is highly unlikely that quality of ANC will lead to one's SES or place of residence; or use of SBAs (or the pregnancy outcome) will cause the quality of ANC for the index pregnancy or lead to one's SES or place of residence. The reverse are however more plausible, which increases confidence in causal inference based on the temporal ordering of the events. Simultaneity may be more of a problem for other variables such as frequency of ANC, as the quality of care one receives during an initial visit may influence the decision to go for subsequent visits (Adjiwanou and LeGrand 2013).

Recall and social desirability bias are also potential limitations since the variables are all based on self-report. The period of recall, which may be up to five years for some, could affect the precision of reporting the maternal health services received, as well as other experiences during pregnancy. Other studies have however suggested that women have relatively good recall

of maternal health events in this time window (Nikiéma et al. 2009). On the problem of social desirability women may report they received the services because they know they are expected to have received them, which may lead to overestimation of the ANC quality and use of SBAs – potentially more for some groups of women than others. For instance, the higher quality of ANC and use of SBAs with education could be because more highly educated persons are more likely to remember whether or not they received antenatal services or used a SBA; or report they received the services because they know they should have received them. This is a limitation that cannot be ruled out, but the consistency of the effects of education suggests it has some important influence beyond differential recall. There are also potentially problems in even identifying who provided antenatal care or assisted the delivery as some have suggested women identify providers by their uniforms, which may not be accurate in discriminating, for example, a male doctor from a male nurse or even a male auxiliary nurse (Hussein et al. 2005).

Another limitation of the dissertation is that the datasets used are quite old and may not accurately reflect current conditions. These datasets were however chosen because of their advantages over other available national data sets. I used the WHS dataset was because it is the only dataset available for Ghana that contains measures of maternal health as well as those related to patient experience of care. These variables however did not turn out as useful as expected. The GMHS also has an advantage over most other data with maternal health indicators. As discussed earlier, the GMHS collects information on use of maternal health services from all women with a birth (live or otherwise) in the preceding five years, unlike the other surveys that collect this information from only women with a live birth. This restriction is important to note because excluding women with stillbirths may lead to excluding women who are least likely to use antenatal and delivery services and to receive good quality care. The

limitations of the datasets for this dissertation point to the limitations of most studies based on nationally representative data for developing countries. Furthermore, the purpose of the study is to examine theoretically informed relationships, which should not be substantially different at different time points for the same population. Moreover, other data show the maternal health indicators have not changed substantially from the time of these surveys. In addition, the use of data based on a nationally representative sample of women from Ghana and Burkina Faso at two different time points, helps to validate and improve the generalizability of the findings.

The restriction of the main samples to women who had at least one ANC visit could potentially reduce the generalizability of the findings. But this was necessary to examine the determinants and effects of quality of ANC. It also enabled me to assess the determinants of use of SBAs and pregnancy outcomes among women who come into contact with the health system during pregnancy, and if these were consistent with findings for the general population of women of reproductive age. Understanding the significant factors in this population is important because this is a more accessible population, which will be easier to target for interventions. In addition, this restricted sample represents over 90% of pregnant women in Ghana and about 80% of pregnant women in Burkina Faso. Furthermore, most of the factors that predict the quality of ANC and use of SBAs also predict attending ANC at least once. Thus, the effects found in the analysis with the restricted samples may be larger in a sample that also includes women who did not attend ANC. Few of these larger effect sizes are seen in the supplementary analysis with the full sample; the significance and direction of the associations are, however, generally consistent across the two samples, implying the findings from the restricted sample are potentially generalizable to women of reproductive age with at least one past pregnancy in Ghana and Burkina Faso.

Other strengths of the dissertation are that, the analyses are based on rigorous methods, with several supplemental analyses as sensitivity tests to check the robustness of the findings. The analysis uses multilevel modeling to account for the hierarchical nature of the data. Since most of the few prior studies on quality of ANC and pregnancy outcomes, and most of the many studies on the determinants of use of maternal health services do not account for the clustering in their data, the non-significant effects of predictors in this analysis that have been found to be significant in other analyses may be due to underestimation of the standard errors in those analysis (Hox 2010; Stephenson et al. 2006b). Though the multilevel regressions are unweighted, the results are consistent with the weighted single level regression results (and at worst underestimate the significance and effect sizes in the population) – more so for the GMHS data and less for the WHS datat. The findings therefore apply well to at least the over 9 in 10 women in Ghana who attend ANC at least once during pregnancy. The GMHS also has more maternal health related variables which allows for several factors to be accounted for, hence reducing omitted variable bias and unobserved heterogeneity. In addition, unlike other analysis that examine predictors without examining how the predictors may be related to each other in the causal pathway, this analysis starts with some theories of how the predictors interact to produce the final outcome and uses mediation and moderation analysis to examine total, indirect, direct and conditional effects. Each chapter addresses a specific gap in the maternal health literature, and they together extend the literature on quality of care and maternal health seeking behavior and pregnancy outcomes. The strengths of analysis specific to particular chapters have been addressed in those chapters.

IMPLICATIONS AND RECOMMENDATIONS

First, that most women come into contact with the health system (i.e., go for at least one ANC visit) during pregnancy implies there is a window of opportunity for reaching women with the relevant information and services to improve maternal and fetal health. This includes helping them to prepare for skilled delivery care. The gap in ANC and use of SBAs therefore suggests a failure in the system to maximize the contact with women during pregnancy.

Second, that the disparities in quality of ANC by SES are not all due to differential utilization of health services implies women of lower SES attending the same amount of ANC may be receiving lower quality care – potentially even within the same health facilities. This lends support to problems within the health system causing the disparities in maternal outcomes. In addition, that most of the differentials in quality of care by place of residence are explained by SES, but not the reverse suggests that while quality of care may be generally low, higher quality of care is available to certain groups of women.

Third, that quality of ANC is a significant predictor of use of SBAs suggests improving quality of antenatal is a potential approach to increasing use of SBAs. Although, the mediation analysis does not provide strong support for the hypotheses that quality of ANC mediates the rural/urban and SES differentials in use of SBA, that SES and place of residence (when SES is not accounted for) are both associated with quality of care and use of SBAs makes them potential mediators. Considering the weaknesses in the quality of ANC measure, the mediating role of quality of ANC for the effect of SES and place of residence cannot be ruled out. In addition, there is other support for the mediating role of quality of ANC in the differentials by the type of ANC facility and provider, and even for the country differences. These findings suggest reducing disparities in quality of ANC could potentially reduce disparities in use of SBAs.

Fourth, the significant positive effect of quality of care on pregnancy outcomes net of the delivery provider and facility implies: improved quality of ANC will not only increase coverage and reduce disparities in use of SBAs, but it will also have direct impact on fetal and potentially maternal outcomes. In addition, increasing use of SBAs may not result in the expected improvement in maternal and fetal outcomes if it does not go concurrently with an increase in the quality of antenatal and also delivery care.

Fifth, the non-significant effect of use of SBAs on pregnancy outcomes suggests that the broad indicator for coverage for use of SBAs may be misleading, if we do not know at what point in time women decide to seek skilled attendance (considering the issues of selection). If a large number of women are seeking skilled care only after complications develop, and are not presenting early enough, such that not much can be done for them, the health outcome indicators will continue to lag behind the coverage indicators. While survey questions asking women who assisted their delivery and where it occurred are useful, it will also be useful to know at what point women seek and receive skilled assistance.

There has been a big emphasis on improving coverage for maternal health services, with relatively less emphasis on the quality of care women receive. Increasing coverage for use of services is obviously important, and this partly involves increasing access to maternal health services. But use of services will not result in the desired outcomes if it is not associated with receipt of good quality services. Thus, there is a greater need to maximize the quality of the encounter women have with the health system during pregnancy. In addition, good quality care from prior encounters with the health systems will increase the likelihood of future use of services, when there is the need. The findings from this dissertation therefore calls for more similar or more efforts to improve quality of maternal health services as for improving coverage

for use of maternal health services. Interventions to improve quality of care should include efforts to increase general quality of maternal health care as well as targeted efforts to increase quality of maternal health care for rural, poor, and illiterate women. Improving quality of ANC will help increase early identification and management of pregnancy complications as well as timely use of skilled delivery services, which will help reduce maternal and fetal mortality and morbidity. Improving basic quality of care provided to rural, poor, and low educated women is also a potential point of intervention for reducing the rural/urban and SES differences in use of SBAs. In addition, improving the quality of care provided at the existing facilities is a potentially more feasible approach in the short term than increasing accessibility. This is not to say improving access should not be a priority. However, a little more distant facilities that provide good quality care may be more useful than many facilities providing poor care. As others have suggested, women are willing to travel a little further to access good quality care.

The analysis shows that women who receive ANC from the health centers and other lower level government health facilities are more likely to receive low quality of ANC. Since low SES women are more likely to use the health centers and other lower level health facilities, improving the quality of care provided in these facilities will help reduce the SES disparities in quality of care. A first step towards improving quality of care in these lower level facilities is to provide the basic equipment needed to provide the essential services. A second step is refresher trainings for providers at these facilities to remind them of the essential components of ANC, why they need to provide specific antenatal services, and how they can provide these services efficiently. Training should be followed by effective monitoring and supervision. Monitoring and supervision should also be extended to private facilities to ensure they are providing effective ANC. These strategies will help ensure women do not present late in labor with unsalvageable

conditions that could have been managed. In addition, there should be efforts within health facilities to ensure lower SES women are not receiving lower quality of care because of cost, lack of knowledge, lack of assertiveness, or other reasons. Other things that should be high on the country's priorities include better approaches to attract, retain, and motivate health workers, especially in the rural areas, and the development of better health infrastructure.

That the timing and frequency of ANC visits explain some of the differentials in quality of ANC imply efforts to encourage women to start ANC visits early and attend the recommended number of times should be continued. It is however frustrating to health workers, when women who have gone for several ANC visits present in labor in very bad conditions due to complications that were present early in the pregnancy, but were not picked up during antenatal care. To paraphrase the words of a colleague working in one of the regional hospitals in Ghana who was very frustrated at the fact that women who had attended ANC presented in labor with eclampsia with their blood pressure checked only once: ANC has become a social obligation where women go to say hello to health workers and go home. Furthermore, many health workers spend more time filling out their reports at ANC visits (to show that they have reached all eligible women in their target areas); than actually interacting with the women. Such attitudes and behaviors need to change if coverage gains are going to translate into health gains for women. While documentation is important, a shift from monitoring focused on coverage indicators to actually examining the quality of care women receive, will go a long way to reduce the rural/urban and SES differentials in use of SBAs and also improve maternal and fetal outcomes. This analysis did not have the required data to examine the role of quality of delivery care. But there is evidence elsewhere to suggest poor quality of delivery care is also contributing to high intrapartum stillbirths and maternal deaths (Friberg et al. 2010; J. E. Lawn et al. 2009). A

call for greater efforts to improve quality of maternal health services from antenatal through delivery to postnatal care is therefore not out of place.

A final recommendation from this dissertation relates to the limited data required to fully understand maternal health seeking behavior. The measure of quality of ANC used in this analysis is based on the variables used to assess quality of ANC in the major national surveys; and these are the only variables that can be used as proxies for quality of maternal health care in these surveys. This measure however has many limitations including not capturing other dimensions of quality, and even as a process measure. In addition, other intervening factors like perceived need and perceived accessibility could not be adequately examined due to the lack of data. These suggest the need for the development and incorporation of better measures of actual and perceived quality of maternal health services, and perceived need and accessibility (both physical and economic) of health services, into surveys that have maternal health seeking behavior as an objective, including the Demographic and Health Surveys. Such data will enable better assessment of the intervening processes to better understand the mechanisms by which more distal factors like SES and place of residence affect use of maternal health services. The development and incorporation of these measures in surveys will provide the data to examine why we continue to have disparities in use of SBAs. Knowing the mediators of the distal determinants is important because these are more amenable to change. In addition, the important intervening factors may be different in different populations. Thus, it is by knowing which intervening factors are important in different context that we can develop better interventions to reduce disparities and increase use of SBAs and improve maternal health outcomes.

CONCLUSIONS

Three gaps have been identified in the efforts to reduce maternal mortality in SSA: a coverage gap for skilled attendance at delivery; a quality gap for institutional delivery; and an equity gap for coverage for skilled attendance (Friberg et al. 2010). These also apply to fetal deaths. But, the equity gap is not just with respect to coverage, but also to quality. This equity gap in quality may be driving both the low coverage for skilled attendance, and high maternal mortality. For ANC, there is a very small coverage gap in SSA, as many women go for an ANC visit at some point during pregnancy. But there is a gap in quality of ANC, which may be easier to address, and could potentially decrease the coverage and equity gaps for skilled attendance at delivery. Reducing the quality gap for both antenatal and delivery care is essential to preventing the large number of maternal and fetal deaths in SSA. Most countries in SSA are not on track to achieve the MDG5, and will need to set new targets and deadlines for reducing maternal mortality. There are also new targets to reduce stillbirths by half and close equity gaps by 2020 (Goldenberg et al. 21; Lawn et al. 2014). If countries in SSA are to achieve the goals of reducing maternal deaths and stillbirths, improving quality of both antenatal and delivery care needs to be given greater priority on their agendas.

This dissertation aimed to advance understanding of how distal factors affect maternal health and health seeking behavior: by examining the links between place of residence and SES, quality of care, use of skilled birth attendants, and pregnancy outcomes. It also sought to extend the evidence to advocate for and develop targeted interventions to improve quality of maternal health services, as a means of reducing disparities and improving maternal outcomes. Even though the analysis does not provide conclusive evidence for the relationship between place of residence and SES; quality of care; use of skilled birth attendants; and maternal and fetal

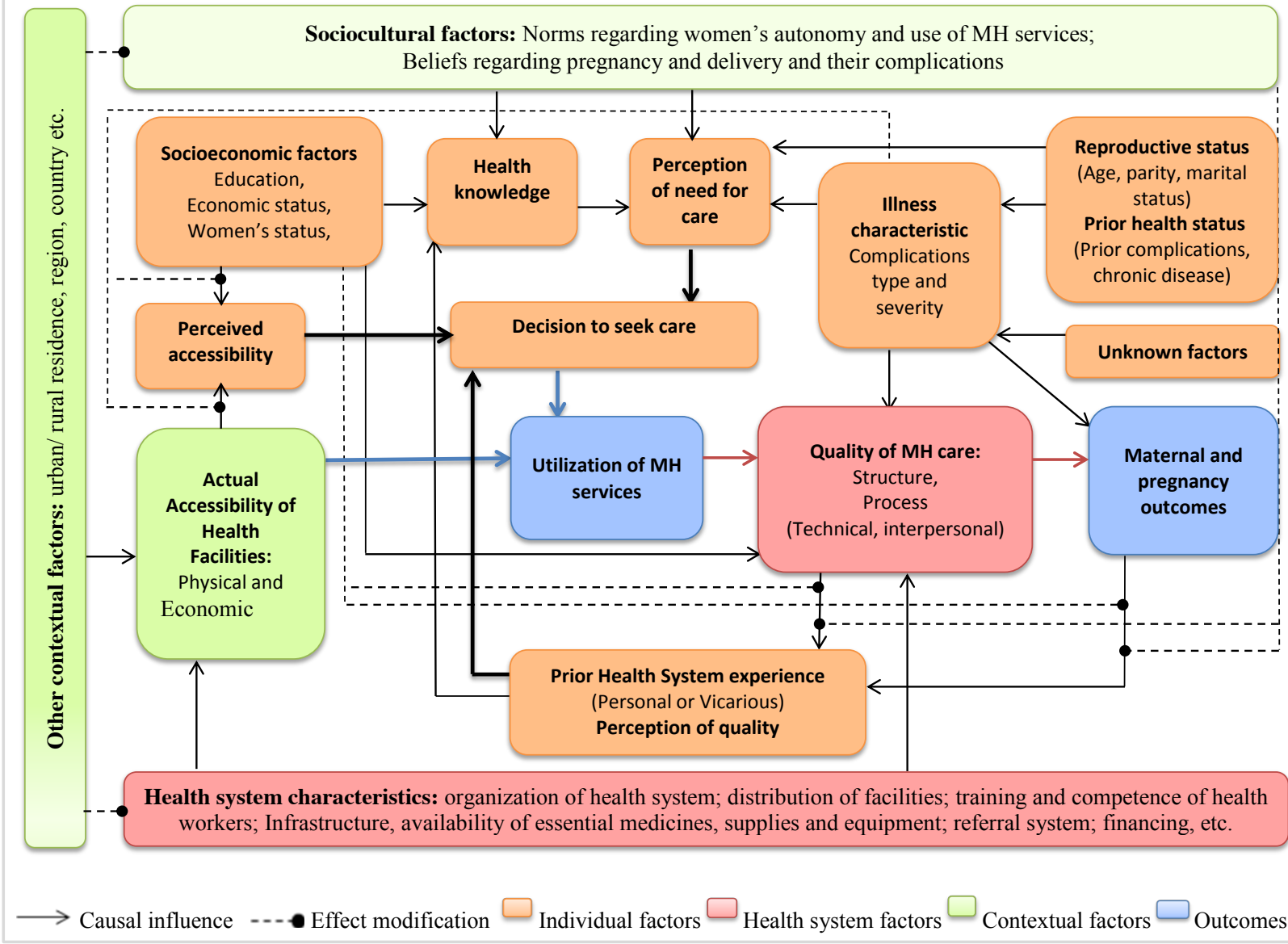
outcomes; it shows that quality of ANC is important for skilled attendance and fetal outcomes; and adds to the little research we have on the topic. Hopefully, this work will help stimulate more research to understand the important and changeable factors mediating the effects of the distal determinants of use of maternal health services. I also hope that it will extend the conversation from one of general poor quality of maternal health care in SSA, to that of disparities in quality of maternal health care. I have come up with more questions than answers in working on this dissertation: this work is just the beginning of greater enquiry into these issues.

TABLES AND FIGURES

Figures and tables are numbered by chapter and data set. The first number refers to the chapter. The first letter refers to data set –G for GMHS and W for WHS; subsequent number and letters refers to their sequence in a chapter

Fig1: Conceptual model

Fig 1: An integrated framework for examining determinants of use of maternal health services and pregnancy outcomes



Chapter 4 figures and tables

Fig4G1: Flow chart for deriving analytic sample for GMHS

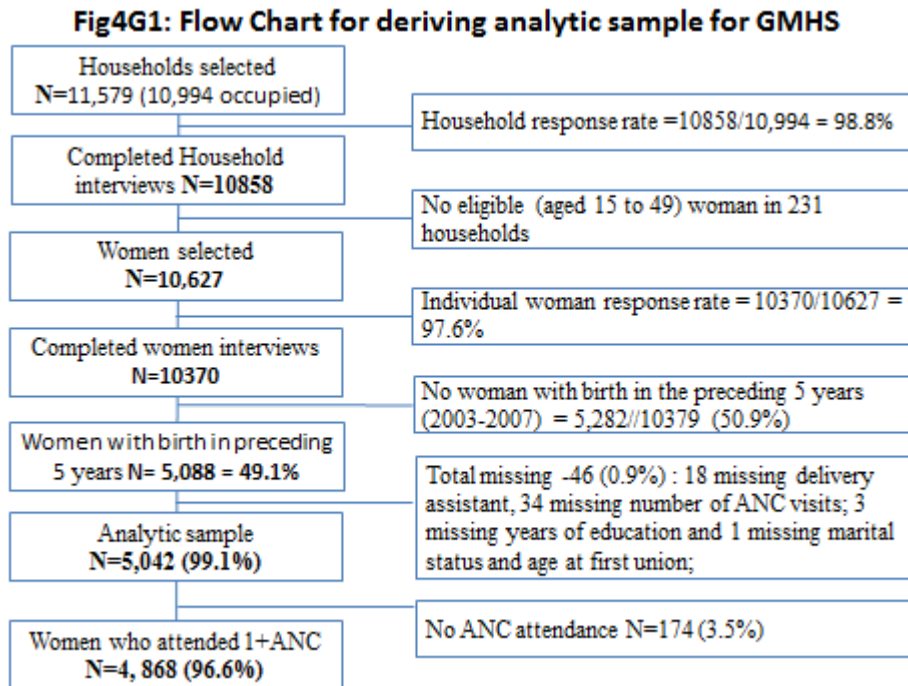


Fig4W1A: Flow chart for deriving analytic sample for pooled WHS sample

Fig4W1A: Flow Chart for deriving analytic sample for pooled WHS sample

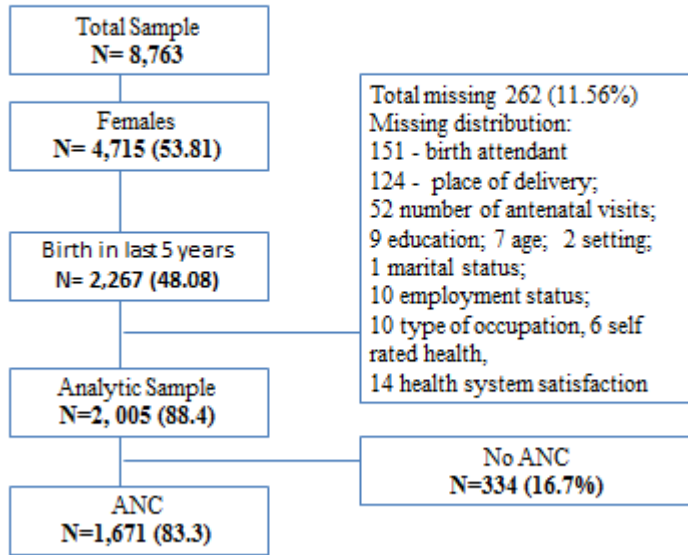


Fig4W1B: Flow chart for deriving analytic sample for WHS by country

Fig4W1B: Flow Chart for deriving analytic sample for WHS by country

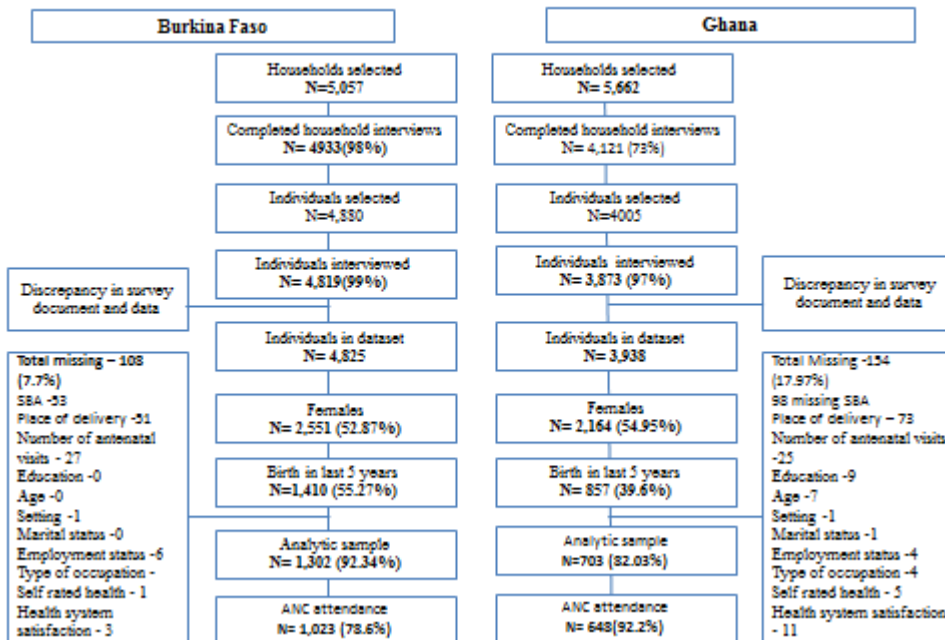


Table 4G1: Sample Distribution, Ghana Maternal Health Survey (GMHS), 2003

Variables	Full analytic sample, N=5,042					Women with at least one antenatal care visit, N=4,868				
	Unweighted		Weighted			Unweighted		Weighted		
	N	%	Proportion	[95% C.I]		N	%	Proportion	[95% C.I]	
<i>Geographic location</i>										
Setting										
Rural	3,115	61.8	0.657	0.627	0.687	2,967	61.0	0.648	0.617	0.679
Urban	1,927	38.2	0.343	0.313	0.373	1,901	39.1	0.352	0.321	0.383
Large city	664	13.2	0.100	0.081	0.120	654	13.4	0.103	0.082	0.123
Small city	115	2.3	0.023	0.007	0.039	113	2.3	0.024	0.007	0.040
Town	1,148	22.8	0.220	0.187	0.253	1,134	23.3	0.226	0.192	0.259
Region										
Greater Accra	636	12.6	0.095	0.079	0.111	619	12.7	0.095	0.080	0.111
Central	441	8.8	0.099	0.082	0.116	429	8.8	0.099	0.083	0.116
Western	382	7.6	0.082	0.063	0.100	371	7.6	0.082	0.064	0.101
Volta	407	8.1	0.092	0.068	0.116	389	8.0	0.092	0.067	0.117
Eastern	744	14.8	0.116	0.102	0.130	724	14.9	0.117	0.103	0.131
Ashanti	855	17.0	0.186	0.162	0.211	837	17.2	0.189	0.165	0.214
Brong Ahafo	496	9.8	0.115	0.097	0.133	486	10.0	0.117	0.099	0.135
Northern	541	10.7	0.137	0.104	0.171	491	10.1	0.131	0.097	0.165
Upper east	303	6.0	0.047	0.036	0.057	298	6.1	0.048	0.037	0.058
Upper west	237	4.7	0.030	0.021	0.039	224	4.6	0.030	0.021	0.038
R3M regions										
Other regions	2,807	55.7	0.602	0.571	0.633	2,688	55.2	0.598	0.567	0.629
R3m region	2,235	44.3	0.398	0.367	0.429	2,180	44.8	0.402	0.371	0.433
<i>Socioeconomic variables</i>										
Highest Education										
None	1,697	33.7	0.341	0.307	0.375	1,588	32.6	0.330	0.296	0.364
Primary	1,109	22.0	0.220	0.203	0.238	1,072	22.0	0.221	0.202	0.239
Middle/JSS	1,830	36.3	0.366	0.338	0.395	1,804	37.1	0.375	0.345	0.404
Secondary/SSS/ higher	406	8.1	0.072	0.061	0.083	404	8.3	0.075	0.063	0.086
Mean years education (SD)	5,042	5.1 (4.39)	5.021	4.711	5.330	4,868	5.2 (4.39)	5.130	4.815	5.444
Household wealth index										
Poorest	1,097	21.8	0.214	0.183	0.245	1,024	21.0	0.207	0.177	0.236
Poorer	994	19.7	0.215	0.190	0.239	943	19.4	0.210	0.186	0.235
Middle	951	18.9	0.202	0.180	0.224	930	19.1	0.204	0.182	0.227
Richer	995	19.7	0.198	0.177	0.220	976	20.1	0.203	0.181	0.224
Richest	1,005	19.9	0.171	0.151	0.191	995	20.4	0.176	0.155	0.197

Table 4G1 continued

<i>Variables</i>	N	%	Proportion	[95% C.I.]		N	%	Proportion	[95% C.I.]	
Household head Female										
No	3,790	75.2	0.751	0.730	0.772	3,650	75.0	0.749	0.727	0.771
Yes	1,252	24.8	0.249	0.228	0.270	1,218	25.0	0.251	0.229	0.273
Religious affiliation										
Catholic	686	13.6	0.136	0.115	0.157	661	13.6	0.136	0.115	0.158
Methodist/Presbyterian	662	13.1	0.140	0.124	0.157	652	13.4	0.144	0.127	0.161
Pentecostal/Charismatic	1,476	29.3	0.280	0.261	0.299	1,444	29.7	0.283	0.264	0.302
Other Christian	832	16.5	0.167	0.151	0.184	810	16.6	0.168	0.152	0.185
Moslem	886	17.6	0.183	0.149	0.217	863	17.7	0.183	0.150	0.217
Traditional/other	500	9.9	0.093	0.075	0.112	438	9.0	0.085	0.069	0.101
Ethnicity										
Akan	2,238	44.4	0.463	0.425	0.501	2,197	45.1	0.471	0.432	0.509
Ga/Dangme/Guan	521	10.3	0.091	0.071	0.112	504	10.4	0.092	0.071	0.112
Ewe	641	12.7	0.121	0.098	0.144	615	12.6	0.120	0.097	0.143
Mole-Dagbani/Hausa	604	12.0	0.130	0.095	0.165	583	12.0	0.131	0.096	0.166
Grussi/Gruma	580	11.5	0.109	0.076	0.141	534	11.0	0.103	0.072	0.134
Other/4missing	458	9.1	0.086	0.064	0.107	435	8.9	0.084	0.063	0.105
<i>Reproductive variables</i>										
Age in years										
15-19yrs	247	4.9	0.049	0.042	0.056	236	4.9	0.049	0.042	0.056
20-24	915	18.2	0.183	0.169	0.196	891	18.3	0.185	0.171	0.198
25-29	1,176	23.3	0.229	0.216	0.243	1,138	23.4	0.230	0.216	0.244
30-34	1,115	22.1	0.225	0.213	0.237	1,082	22.2	0.226	0.213	0.238
35-39	913	18.1	0.182	0.171	0.194	881	18.1	0.182	0.171	0.194
40-49yrs	676	13.4	0.132	0.121	0.142	640	13.2	0.128	0.118	0.139
Mean (SD)	5,042	30.5(7.37)	30.487	30.242	30.732	4,868	30.5 (7.34)	30.426	30.183	30.670
Marital status										
Currently married	3,633	72.1	0.718	0.697	0.738	3,510	72.1	0.718	0.697	0.739
Cohabiting	687	13.6	0.141	0.125	0.156	666	13.7	0.141	0.125	0.157
Previously married	364	7.2	0.071	0.062	0.079	347	7.1	0.070	0.061	0.078
Never married	358	7.1	0.071	0.062	0.079	345	7.1	0.071	0.062	0.080
Age at first union ^a										
Less than 19years	2,445	48.5	0.493	0.473	0.514	2,337	48.0	0.488	0.467	0.509
19 or more years	2,239	44.4	0.436	0.416	0.455	2,186	44.9	0.441	0.421	0.461
Never in a union	358	7.1	0.071	0.062	0.079	345	7.1	0.071	0.062	0.080
Mean (SD)	4,684	18.9(4.03)	18.808	18.614	19.002	4,523	19.0 (4.03)	18.871	18.674	19.069

Table 4G1 continued

<i>Variables</i>	N	%	Proportion	[95% C.I.]		N	%	Proportion	[95% C.I.]	
No. of pregnancies (Gravidity)										
1-2	1,669	33.1	0.323	0.307	0.339	1,629	33.5	0.327	0.311	0.343
3-4	1,549	30.7	0.312	0.297	0.327	1,506	30.9	0.316	0.301	0.332
5plus	1,824	36.2	0.365	0.348	0.382	1,733	35.6	0.357	0.340	0.374
Mean (SD)	5,042	4.0(2.44)	3.989	3.903	4.075	4,868	3.9 (2.42)	3.945	3.864	4.026
No. of children born (Parity)										
No children born alive	22	0.4	0.004	0.002	0.006	19	0.4	0.004	0.002	0.005
1-2	2,072	41.1	0.405	0.388	0.421	2,028	41.7	0.410	0.393	0.427
3-4	1,513	30.0	0.303	0.289	0.317	1,471	30.2	0.306	0.292	0.320
5plus	1,435	28.5	0.289	0.272	0.306	1,350	27.7	0.280	0.264	0.296
Mean (SD)	5,042	3.5 (2.26)	3.509	3.419	3.599	4,868	3.4 (2.23)	3.458	3.374	3.543
No. of children alive										
No children alive	78	1.6	0.015	0.012	0.019	71	1.5	0.015	0.011	0.018
1-2	2,246	44.6	0.439	0.422	0.457	2,200	45.2	0.446	0.429	0.463
3-4	1,573	31.2	0.316	0.302	0.331	1,526	31.4	0.319	0.304	0.334
5plus	1,145	22.7	0.229	0.214	0.244	1,071	22.0	0.221	0.206	0.236
Mean (SD)	5,042	3.1(1.98)	3.131	3.057	3.204	4,868	3.1 (1.96)	3.089	3.019	3.159
Ever used contraception										
No	1,899	37.7	0.385	0.356	0.414	1,780	36.6	0.374	0.345	0.403
Yes	3,143	62.3	0.615	0.586	0.644	3,088	63.4	0.626	0.597	0.655
Currently using contraception										
No	3,792	75.2	0.757	0.740	0.774	3,638	74.7	0.752	0.734	0.769
Yes	1,250	24.8	0.243	0.226	0.260	1,230	25.3	0.248	0.231	0.266
Know family planning source										
No	2,376	47.1	0.470	0.447	0.494	2,270	46.6	0.465	0.441	0.489
Yes	2,666	52.9	0.530	0.506	0.553	2,598	53.4	0.535	0.511	0.559
<i>Prior pregnancies</i>										
Ever had a miscarriage										
No	4,233	84.0	0.845	0.833	0.858	4,077	83.8	0.844	0.831	0.856
Yes	809	16.1	0.155	0.142	0.167	791	16.3	0.156	0.144	0.169
Ever induced abortion										
No	4,265	84.6	0.852	0.837	0.866	4,101	84.2	0.848	0.833	0.864
Yes	777	15.4	0.148	0.134	0.163	767	15.8	0.152	0.136	0.167
Ever had a stillbirth										
No	4,748	94.2	0.943	0.935	0.950	4,585	94.2	0.943	0.936	0.951
Yes	294	5.8	0.057	0.050	0.065	283	5.8	0.057	0.049	0.064

Table 4G1 continued

<i>Variables</i>	N	%	Proportion	[95% C.I.]		N	%	Proportion	[95% C.I.]	
Ever had stillbirth/miscarriage										
No	4,000	79.3	0.800	0.787	0.814	3,853	79.2	0.799	0.785	0.813
Yes	1,042	20.7	0.200	0.186	0.213	1,015	20.9	0.201	0.187	0.215
Sibling had a maternal death										
No	4,956	98.3	0.981	0.977	0.986	4,783	98.3	0.981	0.977	0.985
Yes	86	1.7	0.019	0.014	0.023	85	1.8	0.019	0.015	0.023
<i>Index(last) Pregnancy</i>										
pregnancy complication										
No	3,956	78.5	0.797	0.783	0.810	3,818	78.4	0.796	0.782	0.810
Yes	1,086	21.5	0.203	0.190	0.217	1,050	21.6	0.204	0.190	0.218
Serious preg. complication										
No	4,149	82.3	0.834	0.822	0.846	3,996	82.1	0.832	0.820	0.844
Yes	893	17.7	0.166	0.154	0.178	872	17.9	0.168	0.156	0.180
Caesarian delivery										
No	4,694	93.1	0.934	0.926	0.943	4,522	92.9	0.932	0.923	0.941
Yes	348	6.9	0.066	0.057	0.074	346	7.1	0.068	0.059	0.077
Pregnancy duration										
Born Alive	4,957	98.3	0.983	0.979	0.988	4,791	98.4	0.985	0.981	0.989
7 months	13	0.3	0.002	0.001	0.003	13	0.3	0.002	0.001	0.004
8 months	10	0.2	0.002	0.001	0.003	7	0.1	0.001	0.000	0.002
9 months	58	1.2	0.012	0.008	0.015	53	1.1	0.011	0.007	0.014
10 months	4	0.1	0.001	0.000	0.002	4	0.1	0.001	0.000	0.002
<i>Main outcomes</i>										
Delivery by SBA										
No	2,147	42.6	0.445	0.413	0.477	1,992	40.9	0.427	0.395	0.459
Yes	2,895	57.4	0.555	0.523	0.587	2,876	59.1	0.573	0.541	0.605
Delivery in health facility										
No	2,186	43.4	0.45	0.42	0.487	2,029	41.7	0.437	0.404	0.469
Yes	2,856	56.6	0.55	0.51	0.578	2,839	58.3	0.563	0.531	0.596
Pregnancy outcome										
Born alive	4,957	98.3	0.983	0.979	0.988	4,791	98.4	0.985	0.981	0.989

Born dead(Stillbirth)	85	1.7	0.017	0.012	0.021	77	1.6	0.015	0.011	0.019
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Table 4G1 continued

<i>Variables</i>	N	%	Proportion	[95% C.I.]		N	%	Proportion	[95% C.I.]		
<i>Antenatal Care (ANC) variables</i>											
ANC attendance											
No	174	3.5	0.036	0.026	0.045						
Yes	4,868	96.6	0.964	0.955	0.974	4,868	100.0				
ANC quality of care score											
7 or less						1,901	39.1	0.391	0.364	0.418	
8 or 9						2,967	61.0	0.609	0.582	0.636	
Mean (SD)						4,868	7.4 (1.52)	7.406	7.322	7.490	
No. of ANC visits											
1-3 visits						990	20.3	0.202	0.184	0.221	
Four or more						3,878	79.7	0.798	0.779	0.816	
Mean(SD)						4,868	5.8 (2.75)	5.756	5.626	5.885	
Trimester of first ANC visit											
First trimester						2,688	55.2	0.549	0.529	0.568	
Second trimester						1,992	40.9	0.413	0.396	0.431	
Third trimester						181	3.7	0.036	0.030	0.042	
Don't know						7	0.1	0.002	0.000	0.003	
Where ANC took place											
Gov't health facility ^b						4,119	84.6	0.853	0.829	0.877	
Gov't hospital or polyclinic						2,200	45.2	0.453	0.413	0.492	
Other Gov't facility						1,919	39.4	0.400	0.361	0.439	
Only Private facility/maternity home						703	14.4	0.140	0.116	0.164	
Home/other/DK						46	0.9	0.007	0.005	0.010	
Highest trained ANC provider											
Doctor						1,006	20.7	0.194	0.176	0.213	
Nurse						3,743	76.9	0.785	0.766	0.803	
All others						119	2.4	0.021	0.015	0.026	
Reason for seeking ANC											
For checkup						4,044	83.1	0.831	0.817	0.846	
For a problem/9missing						824	16.9	0.169	0.154	0.183	

Notes: ^a This is for only women who have been in a union so does not add up to the full sample

JSS= Junior secondary School. SSS=Senior Secondary School

^b refers to people who had some ANC from a government facility but 98% were exclusively in a government facility.

Table 4W1: Sample Distribution, World Health Survey (2003), N=2,005

<i>Variables</i>	Ghana		Burkina Faso		Total		p-value for country diff.
	N	Percent	N	Percent	N	Percent	
Total	703	100	1,302	100	2,005	100	
<i>Geographic location</i>							
Setting							
Rural	457	65.01	826	63.44	1,283	63.99	
Urban	246	34.99	476	36.56	722	36.01	
<i>Socioeconomic variables</i>							
Education							
No formal schooling	244	34.71	1,080	82.95	1,324	66.03	***
Some formal schooling	459	65.29	222	17.05	681	33.97	
Less than primary sch.	108	15.36	88	6.76	196	9.78	
Primary school completed	315	44.81	72	5.53	387	19.30	
Some Secondary sch.	36	5.12	62	4.76	98	4.89	
Mean years of education(SD)	703	4.75 (4.84)	1,302	1.26 (3.31)	2,005	2.48 (4.25)	
Wealth index							
Poorest	116	16.50	297	22.81	413	20.60	***
Poorer	186	26.46	591	45.39	777	38.75	
Middle	86	12.23	173	13.29	259	12.92	
Richer	164	23.33	147	11.29	311	15.51	
Richest	151	21.48	94	7.22	245	12.22	
Mean score on index (SD)	703	5.25 (2.71)	1,302	4.01 (2.20)	2,005	4.44 (2.46)	
Type of occupation							
Not working for pay	85	12.09	856	65.75	941	46.93	***
Professional	40	5.69	26	2.00	66	3.29	
Service/sales	242	34.42	203	15.59	445	22.19	
Agricultural worker	336	47.80	217	16.67	553	27.58	
<i>Reproductive Health variables</i>							
Age in years							
18-19	9	1.28	87	6.68	96	4.79	***
20-29	283	40.26	687	52.76	970	48.38	
30-39	287	40.83	402	30.88	689	34.36	
40-49yrs	124	17.64	126	9.68	250	12.47	
Mean (SD)	703	31.52 (7.09)	1,302	28.54 (7.15)	2,005	29.58 (7.27)	
Marital status							
Currently married	572	81.37	1,211	93.01	1,783	88.93	***
Never married/Cohabiting	63	8.96	46	3.53	109	5.44	
Separated/widowed/divorced	68	9.67	45	3.46	113	5.64	

Table 4W1 continued

Number of births									
None	153	21.76		50	3.84		203	10.12	***
1-2	186	26.46		531	40.78		717	35.76	
3-4	163	23.19		360	27.65		523	26.08	
5 or more	201	28.59		361	27.73		562	28.03	
Mean (SD)	703	3.04	(2.61)	1,302	3.34	(2.30)	2,005	3.24	(2.41)
<i>Health status</i>									
Diagnosed with a chronic condition									
No	591	84.07		979	75.19		1,570	78.30	***
Yes	112	15.93		323	24.81		435	21.70	
Self-Rated Health Status									
Very good(1)	261	37.13		308	23.66		569	28.38	***
Good	283	40.26		685	52.61		968	48.28	
Moderate	133	18.92		259	19.89		392	19.55	
Bad	23	3.27		48	3.69		71	3.54	
Very bad(5)	3	0.43		2	0.15		5	0.25	
Mean (SD)	703	1.90	(0.85)	1,302	2.04	(0.77)	2,005	1.99	(0.80)
<i>Other</i>									
Satisfaction with Health system									
Very dissatisfied (1)	11	1.56		27	2.07		38	1.90	***
Fairly dissatisfied	44	6.26		55	4.22		99	4.94	
Neither satisfied	107	15.22		140	10.75		247	12.32	
Fairly satisfied	310	44.10		852	65.44		1,162	57.96	
Very satisfied (5)	231	32.86		228	17.51		459	22.89	
Mean (SD)	703	4.00	(0.93)	1,302	3.92	-0.790	2,005	3.95	-0.85
Any health system encounter									
Yes	569	80.94		780	59.91		1,349	67.28	***
Outpatient visit in the last five years	326	46.37		376	28.88		702	35.01	
Inpatient visit in the last five years	243	34.57		404	31.03		647	32.27	
No	134.00	19.06		522	40.09		656	32.72	
<i>For those with a health system encounter</i>									
Rating of travel time to health facility									
Inpatient									
Very bad(1)	22	9.36		14	3.69		36	5.86	***
Bad	34	14.47		34	8.97		68	11.07	
Moderate	41	17.45		85	22.43		126	20.52	
Good	100	42.55		211	55.67		311	50.65	
Very good (2)	38	16.17		35	9.23		73	11.89	
Mean (SD)	235	3.42	(1.19)	379	3.58	(0.91)	614	3.52	(1.03)

Table 4W1 continued

Outpatient									***
Very bad(1)	47	14.33		37	9.05		84	11.40	
Bad	59	17.99		70	17.11		129	17.50	
Moderate	54	16.46		126	30.81		180	24.42	
Good	118	35.98		149	36.43		267	36.23	
Very good (2)	50	15.24		27	6.60		77	10.45	
Mean (SD)	328	3.20	(1.30)	409	3.14	(1.07)	737	3.17	(1.18)
<i>Main outcomes</i>									
Skilled birth attendant									
No	318	45.23		590	45.31		908	45.29	
Yes	385	54.77		712	54.69		1,097	54.71	
Health facility delivery									
No	337	47.94		605	46.47		942	46.98	
Yes	366	52.06		697	53.53		1,063	53.02	
ANC attendance									
No	55	7.82		279	21.43		334	16.66	***
Yes	648	92.18		1,023	78.57		1,671	83.34	
<i>ANC variables</i>									
ANC quality of care score									
0	10	1.54		63	6.16		73	4.37	***
1	69	10.65		440	43.01		509	30.46	
2	226	34.88		391	38.22		617	36.92	
3	343	52.93		129	12.61		472	28.25	
Mean (SD)	648	2.39	(0.74)	1,023	1.57	(0.79)	1,671	1.89	(0.87)
No. of ANC visits									
1-3 visits	156	24.07		618	60.41		774	46.32	***
Four or more	492	75.93		405	39.59		897	53.68	
Mean (SD)	648	5.83	(3.02)	1,023	3.52	(2.24)	1,671	4.42	(2.80)
Most frequent ANC provider									
Doctor	103	15.90		196	19.16		299	17.89	***
Nurse	529	81.64		738	72.14		1,267	75.82	
All others	16	2.47		89	8.70		105	6.28	

Notes: The ANC variables are for those who attended ANC at least once, hence sum up to 1,671

Chapter 5 figures and tables

Table 5G1: Mean ANC quality of care for each group for women who attended at least one ANC, GMHS, N = 4,868

<i>Variable</i>	N	Mean	[95% C.I.]	
Overall	4,868	7.41	7.32	7.49
<i>ANC variables</i>				
No. of ANC visits				
1-3 visits	990	6.60	6.41	6.79
Four or more	3,878	7.61	7.54	7.68
Trimester of first ANC visit				
First trimester	2,688	7.59	7.51	7.68
Second trimester	1,992	7.26	7.16	7.36
Third trimester	181	6.31	5.97	6.66
Don't know	7	5.97	4.92	7.02
Where ANC took place				
Gov't health facility only/combine	4,119	7.44	7.35	7.53
Gov't hospital or polyclinic	2,200	7.73	7.65	7.81
Other Gov't facility	1,919	7.12	6.96	7.27
Only Private facility/maternity home	703	7.33	7.16	7.49
Home/other/DK	46	4.91	3.96	5.85
Highest trained ANC provider				
Doctor	1,006	7.73	7.63	7.83
Nurse	3,743	7.35	7.25	7.44
All others	119	6.59	6.10	7.08
Reason for seeking ANC				
For checkup	4,044	7.37	7.28	7.46
For a problem/9missing	824	7.57	7.45	7.70
<i>Geographic location</i>				
Setting				
Rural	2,967	7.24	7.13	7.36
Urban	1,901	7.71	7.62	7.79
Large city	654	7.65	7.49	7.81
Small city	113	7.40	7.22	7.57
Town	1,134	7.77	7.65	7.88
Region				
Greater Accra	619	7.19	6.99	7.39
Central	429	7.63	7.44	7.82
Western	371	8.25	8.07	8.44
Volta	389	6.73	6.33	7.13
Eastern	724	7.35	7.15	7.55
Ashanti	837	7.72	7.56	7.88
Brong Ahafo	486	7.68	7.43	7.93
Northern	491	6.67	6.43	6.90
Upper east	298	7.54	7.29	7.78
Upper west	224	7.27	7.05	7.49
R3M regions				
Other regions	2,688	7.35	7.23	7.47
R3m region	2,180	7.49	7.38	7.60
<i>Socioeconomic variables</i>				
Highest Education				
None	1,588	7.03	6.88	7.17
Primary	1,072	7.36	7.24	7.47
Middle/JSS	1,804	7.71	7.61	7.80
Secondary/SSS/higher	404	7.74	7.58	7.89

Table 5G1 continued

Household wealth index				
Poorest	1,024	6.85	6.65	7.05
Poorer	943	7.26	7.12	7.39
Middle	930	7.53	7.41	7.65
Richer	976	7.63	7.50	7.75
Richest	995	7.84	7.75	7.93
Household head Female				
No	3,650	7.36	7.26	7.45
Yes	1,218	7.55	7.44	7.66
Religious affiliation				
Catholic	661	7.43	7.22	7.64
Methodist/Presbyterian	652	7.58	7.43	7.72
Pentecostal/charismatic	1,444	7.57	7.47	7.67
Other Christian	810	7.38	7.24	7.52
Moslem	863	7.27	7.12	7.42
Traditional/other	438	6.89	6.59	7.18
Ethnicity				
Akan	2,197	7.77	7.68	7.86
Ga/Dangme/Guan	504	7.10	6.89	7.31
Ewe	615	7.09	6.89	7.30
Mole-Dagbani/Hausa	583	6.96	6.77	7.16
Grussi/Gruma	534	7.06	6.73	7.39
Other/4missing	435	7.26	7.05	7.46
<i>Reproductive Health variables</i>				
Age in years				
15-19yrs	236	7.34	7.12	7.56
20-24	891	7.47	7.33	7.60
25-29	1,138	7.44	7.31	7.57
30-34	1,082	7.38	7.25	7.51
35-39	881	7.49	7.36	7.62
40-49yrs	640	7.20	7.06	7.35
Marital status				
Currently married	3,510	7.42	7.34	7.51
Cohabiting	666	7.18	6.95	7.41
Previously married	347	7.52	7.27	7.77
Never married	345	7.58	7.39	7.76
Age at first union				
Less than 19years	2,337	7.35	7.24	7.46
19 or more years	2,186	7.44	7.35	7.53
Never in a union	345	7.58	7.39	7.76
No. of pregnancies ever had (Gravidity)				
1-2	1,629	7.46	7.35	7.57
3-4	1,506	7.41	7.29	7.53
5plus	1,733	7.35	7.25	7.45
No. of children ever born (Parity)				
No children born alive	19	7.26	6.52	8.01
1-2	2,028	7.51	7.41	7.61
3-4	1,471	7.39	7.28	7.50
5plus	1,350	7.28	7.15	7.40
No. of children alive				
No children alive	71	7.09	6.59	7.58
1-2	2,200	7.51	7.41	7.61
3-4	1,526	7.38	7.27	7.48
5plus	1,071	7.25	7.13	7.38

Table 5G1 continued				
Ever used contraception				
No	1,780	7.01	6.88	7.15
Yes	3,088	7.64	7.57	7.71
Currently using contraception				
No	3,638	7.30	7.21	7.39
Yes	1,230	7.73	7.62	7.83
Know family planning source				
No	2,270	7.27	7.16	7.38
Yes	2,598	7.52	7.43	7.62
<i>Prior pregnancies</i>				
Ever had a miscarriage				
No	4,077	7.40	7.31	7.49
Yes	791	7.42	7.28	7.56
Ever induced abortion				
No	4,101	7.37	7.27	7.46
Yes	767	7.63	7.52	7.75
Ever had a stillbirth				
No	4,585	7.41	7.32	7.49
Yes	283	7.35	7.17	7.54
Ever had stillbirth/miscarriage				
No	3,853	7.41	7.32	7.50
Yes	1,015	7.40	7.28	7.53
Sibling had a maternal death				
No	4,783	7.40	7.32	7.49
Yes	85	7.57	7.25	7.89
<i>Index Pregnancy</i>				
Pregnancy complication				
No	3,818	7.38	7.29	7.47
Yes	1,050	7.51	7.39	7.63
Serious pregnancy complication				
No	3,996	7.36	7.27	7.45
Yes	872	7.64	7.53	7.76
Caesarian delivery				
No	4,522	7.38	7.30	7.47
Yes	346	7.71	7.55	7.87
Pregnancy outcome				
Born alive	4,791	7.41	7.33	7.50
Born dead(Stillbirth)	77	7.11	6.73	7.48
Pregnancy duration				
Born Alive	4,791	7.41	7.33	7.50
7 months	13	7.49	6.86	8.11
8 months	7	6.68	4.65	8.71
9 months	53	7.04	6.61	7.46
10 months	4	7.61	6.24	8.98
Delivery by a SBA				
No	1,992	7.03	6.90	7.16
Yes	2,876	7.69	7.61	7.76
Delivery in health facility				
No	2,029	7.05	6.92	7.18
Yes	2,839	7.68	7.61	7.76

Table 5G2A: Random effects from multilevel linear regression of quality of antenatal care on education, place of residence and relevant confounders, GMHS, N=4,868

<i>level</i>	<i>Quality of ANC : variance (se)</i>			No. of groups	Mean observations per group
	Null model	Full unconditional model	Full conditional model		
district level	0.626*** (0.056)	0.276*** (0.039)	0.275*** (0.039)	110	44.3
cluster level	0.352*** (0.0336)	0.238*** (0.036)	0.239*** (0.036)	400	12.2
Individual level	1.361*** (0.014)	1.305*** (0.014)	1.305*** (0.014)		
N	4,868	4,868	4,868		

Table 5G2B: Multilevel linear regression of quality of antenatal care on place of residence, socioeconomic factors, and rival independent and control variables. GMHS, N=4,868

<i>Independent variables</i>	<i>Quality of ANC : b(se)</i>								
	Bivariate	Partial unconditional models (PUM)						Full unconditional	Full conditional
		PUM1	PUM2	PUM3	PUM4	PUM5	PUM6		
Place of residence:									
Rural (ref)									
Urban	0.36*** (0.068)	0.15* (0.061)				0.11 (0.069)	0.13 (0.068)	0.084 (0.066)	0.084 (0.066)
Years of sch. centered									
	0.04*** (0.0054)		0.02*** (0.0058)		0.018** (0.0059)	0.022*** (0.0060)	0.019** (0.0060)	0.018** (0.0059)	0.043** (0.013)
Household wealth Index									
Poorest (ref)									
Poorer/Middle	0.26*** (0.062)			0.18** (0.059)	0.17** (0.059)	0.19** (0.061)	0.17** (0.061)	0.17** (0.060)	0.073 (0.074)
Rich/Richest	0.55*** (0.073)			0.27*** (0.072)	0.24*** (0.072)	0.30*** (0.079)	0.24** (0.079)	0.21** (0.077)	0.13 (0.086)
Interaction of wealth and Education									
Poorer/Middle*years of sch. centered									-0.031* (0.015)
Rich/Richest*years of sch. centered									-0.027 (0.015)
Number of ANC visits (ref=1-3)									
Four or more ANC visits	0.78*** (0.051)	0.62*** (0.055)	0.62*** (0.055)	0.61*** (0.055)	0.60*** (0.055)		0.59*** (0.056)	0.60*** (0.055)	0.60*** (0.055)
Trimester of first ANC									
First trimester (ref)									
Second trimester	-0.24*** (0.041)	-0.087* (0.042)	-0.086* (0.042)	-0.084* (0.042)	-0.085* (0.042)		-0.097* (0.042)	-0.086* (0.042)	-0.088* (0.042)
Third trimester	-1.01*** (0.11)	-0.50*** (0.11)	-0.49*** (0.11)	-0.50*** (0.11)	-0.50*** (0.11)		-0.53*** (0.11)	-0.50*** (0.11)	-0.50*** (0.11)
DK trimester	-2.26*** (0.52)	-1.77*** (0.50)	-1.76*** (0.50)	-1.77*** (0.50)	-1.76*** (0.50)		-1.95*** (0.51)	-1.76*** (0.50)	-1.76*** (0.50)
ANC provider									
Nurse (ref)									
Doctor	0.17** (0.054)	0.056 (0.053)	0.051 (0.053)	0.057 (0.053)	0.050 (0.053)	0.074 (0.054)		0.049 (0.053)	0.051 (0.053)
All others	-0.58*** (0.14)	-0.37** (0.13)	-0.38** (0.13)	-0.38** (0.13)	-0.37** (0.13)	-0.29* (0.14)		-0.37** (0.13)	-0.36** (0.13)

Table 5G2B continued	Bivariate	PUM1	PUM2	PUM3	PUM4	PUM5	PUM6	Full unconditional	Full conditional
Type of health facility									
Gov't hospital or polyclinic (ref)									
Other Gov't facility	-0.34*** (0.051)	-0.25*** (0.051)	-0.26*** (0.050)	-0.24*** (0.050)	-0.24*** (0.050)	-0.23*** (0.052)		-0.23*** (0.051)	-0.22*** (0.051)
Only Private/maternity home	-0.29*** (0.065)	-0.30*** (0.061)	-0.31*** (0.061)	-0.31*** (0.061)	-0.31*** (0.061)	-0.30*** (0.063)		-0.31*** (0.061)	-0.31*** (0.061)
Home/other/DK	-2.20*** (0.21)	-1.86*** (0.21)	-1.86*** (0.21)	-1.86*** (0.21)	-1.85*** (0.21)	-1.93*** (0.21)		-1.84*** (0.21)	-1.85*** (0.21)
Reason for ANC (ref=checkup)									
Other (for problem/9DK)	0.095 (0.054)	0.058 (0.052)	0.053 (0.052)	0.060 (0.052)	0.059 (0.052)	0.061 (0.053)	0.074 (0.053)	0.061 (0.052)	0.058 (0.052)
Any pregnancy complication									
	0.060 (0.049)	-0.16 (0.10)	-0.16 (0.10)	-0.16 (0.10)	-0.16 (0.10)	-0.23* (0.11)	-0.15 (0.10)	-0.16 (0.10)	-0.16 (0.10)
Serious pregnancy complication									
	0.14** (0.053)	0.22 (0.11)	0.22* (0.11)	0.22* (0.11)	0.22 (0.11)	0.30** (0.11)	0.21 (0.11)	0.21 (0.11)	0.22 (0.11)
Prior miscarriage or still birth									
	-0.059 (0.049)	-0.089 (0.048)	-0.084 (0.048)	-0.089 (0.048)	-0.085 (0.048)	-0.088 (0.049)	-0.086 (0.049)	-0.085 (0.048)	-0.084 (0.048)
Age in years									
	-0.0013 (0.0027)	-0.0022 (0.0046)	-0.0023 (0.0046)	-0.0025 (0.0046)	-0.0031 (0.0046)	0.00066 (0.0047)	-0.0023 (0.0046)	-0.0033 (0.0046)	-0.0029 (0.0046)
Parity									
	-0.013 (0.0084)	0.0056 (0.015)	0.011 (0.015)	0.0081 (0.015)	0.016 (0.015)	-0.0029 (0.016)	0.013 (0.016)	0.016 (0.015)	0.016 (0.015)
Marital Status									
Currently married (ref)									
Cohabiting	-0.25*** (0.063)	-0.17** (0.062)	-0.16** (0.062)	-0.16** (0.062)	-0.16* (0.062)	-0.20** (0.063)	-0.18** (0.063)	-0.16* (0.062)	-0.16** (0.062)
Previously married	-0.048 (0.079)	-0.035 (0.081)	-0.024 (0.081)	-0.029 (0.081)	-0.021 (0.081)	-0.037 (0.083)	-0.035 (0.082)	-0.023 (0.081)	-0.029 (0.081)
Never married	-0.033 (0.080)	-0.020 (0.087)	-0.018 (0.087)	-0.0087 (0.087)	-0.011 (0.087)	-0.067 (0.089)	-0.024 (0.088)	-0.014 (0.087)	-0.011 (0.087)
Married before 19years									
	-0.077 (0.041)	-0.033 (0.044)	-0.026 (0.044)	-0.034 (0.044)	-0.025 (0.044)	-0.019 (0.046)	-0.023 (0.045)	-0.023 (0.044)	-0.022 (0.044)
Female household head									
	0.0071 (0.048)	0.022 (0.050)	0.024 (0.050)	0.031 (0.050)	0.028 (0.050)	0.0067 (0.052)	0.028 (0.051)	0.024 (0.050)	0.022 (0.050)
Ever contraception									
	0.33*** (0.046)	0.24*** (0.046)	0.22*** (0.046)	0.23*** (0.046)	0.21*** (0.046)	0.23*** (0.047)	0.22*** (0.047)	0.21*** (0.046)	0.21*** (0.046)
Know family planning source									
	0.14*** (0.041)	0.15*** (0.039)	0.15*** (0.039)	0.15*** (0.039)	0.15*** (0.039)	0.13** (0.040)	0.15*** (0.040)	0.14*** (0.039)	0.14*** (0.039)

Table 5G2B continued	Bivariate	PUM1	PUM2	PUM3	PUM4	PUM5	PUM6	Full unconditional	Full conditional
Religious affiliation									
Orthodox Christian(ref)									
Other Christian	-0.033 (0.051)	-0.036 (0.049)	-0.021 (0.049)	-0.032 (0.049)	-0.023 (0.049)	-0.017 (0.050)	-0.035 (0.050)	-0.026 (0.049)	-0.026 (0.049)
Moslem	0.026 (0.077)	0.18* (0.079)	0.22** (0.079)	0.18* (0.079)	0.20* (0.079)	0.23** (0.082)	0.21* (0.082)	0.20* (0.079)	0.19* (0.080)
Traditionalist/Other	-0.28*** (0.083)	-0.067 (0.080)	-0.041 (0.080)	-0.044 (0.080)	-0.020 (0.080)	-0.087 (0.082)	-0.036 (0.082)	-0.022 (0.080)	-0.013 (0.080)
Ethnicity (ref=Akan)									
Ga/Dangme/Guan	-0.21* (0.085)	-0.068 (0.081)	-0.055 (0.081)	-0.070 (0.081)	-0.046 (0.081)	-0.071 (0.084)	-0.038 (0.083)	-0.040 (0.081)	-0.045 (0.081)
Ewe	-0.29*** (0.085)	-0.12 (0.082)	-0.11 (0.082)	-0.12 (0.082)	-0.10 (0.082)	-0.11 (0.085)	-0.093 (0.084)	-0.096 (0.082)	-0.099 (0.082)
Mole-Dagbani/Hausa	-0.32*** (0.096)	-0.25* (0.10)	-0.19 (0.10)	-0.23* (0.10)	-0.18 (0.10)	-0.20 (0.11)	-0.18 (0.11)	-0.19 (0.10)	-0.19 (0.10)
Grussi/Gruma	-0.31** (0.098)	-0.21* (0.096)	-0.16 (0.097)	-0.19* (0.096)	-0.14 (0.097)	-0.18 (0.10)	-0.13 (0.10)	-0.14 (0.097)	-0.14 (0.097)
Other	-0.33*** (0.093)	-0.28** (0.098)	-0.22* (0.100)	-0.26** (0.098)	-0.21* (0.099)	-0.24* (0.10)	-0.24* (0.10)	-0.21* (0.099)	-0.21* (0.099)
Region									
Greater Accra (ref)									
Central	0.60* (0.26)	0.58** (0.20)	0.54** (0.20)	0.56** (0.19)	0.56** (0.19)	0.67** (0.22)	0.56* (0.22)	0.58** (0.19)	0.57** (0.19)
Western	1.32*** (0.27)	1.38*** (0.20)	1.34*** (0.20)	1.35*** (0.20)	1.36*** (0.20)	1.44*** (0.22)	1.38*** (0.22)	1.38*** (0.20)	1.38*** (0.20)
Volta	-0.24 (0.27)	0.046 (0.20)	-0.0069 (0.20)	0.037 (0.20)	0.029 (0.20)	0.055 (0.22)	0.066 (0.22)	0.050 (0.20)	0.050 (0.20)
Eastern	0.32 (0.25)	0.41* (0.18)	0.36 (0.18)	0.41* (0.18)	0.40* (0.18)	0.44* (0.21)	0.40* (0.20)	0.42* (0.18)	0.41* (0.18)
Ashanti	0.69** (0.25)	0.64*** (0.19)	0.59** (0.19)	0.62*** (0.18)	0.62*** (0.18)	0.72*** (0.21)	0.68** (0.21)	0.65*** (0.18)	0.65*** (0.18)
Brong Ahafo	0.70** (0.26)	0.74*** (0.20)	0.71*** (0.20)	0.76*** (0.19)	0.77*** (0.19)	0.86*** (0.22)	0.78*** (0.22)	0.79*** (0.19)	0.78*** (0.19)
Northern	-0.44 (0.27)	-0.029 (0.21)	-0.069 (0.21)	-0.025 (0.20)	-0.013 (0.20)	0.055 (0.23)	-0.042 (0.23)	0.010 (0.20)	0.0099 (0.20)
Upper East	0.59 (0.30)	0.84*** (0.23)	0.80*** (0.23)	0.89*** (0.23)	0.90*** (0.23)	1.14*** (0.26)	0.87*** (0.26)	0.93*** (0.23)	0.95*** (0.23)

Table 5G2B continued	Bivariate	PUM1	PUM2	PUM3	PUM4	PUM5	PUM6	Full unconditional	Full conditional
Upper West	0.39 (0.32)	0.75** (0.25)	0.69** (0.25)	0.78** (0.24)	0.79** (0.24)	0.94*** (0.27)	0.73** (0.27)	0.81*** (0.24)	0.83*** (0.24)
Constant		6.52*** (0.22)	6.59*** (0.22)	6.39*** (0.22)	6.40*** (0.22)	6.63*** (0.23)	6.20*** (0.23)	6.37*** (0.22)	6.45*** (0.22)
N		4868	4868	4868	4868	4868	4868	4868	4868

Notes: *p<0.05, ** p<0.01, *** p<0.001. Standard errors in parentheses

PUM 1 includes all covariates except education and wealth

PUM 2 includes all covariates except place of residence and wealth

PUM 3 includes all covariates except place of residence and education

PUM 4 includes all covariates except place of residence

PUM 5 includes all covariates except number of ANC visits and trimester of first visit

PUM 6 includes all covariates except type of ANC facility and provider

Orthodox refers to Catholic/Methodist/Presbyterian. Other Christian refers to Pentecostals/charismatics/protestants/other Christian

Several variables with no significant effects were left in the model because their exclusion increased the size of the coefficient for the other variables suggesting they may be playing a role and their exclusion will increase omitted variable bias.

Fig 5G1: Predicted quality of ANC by education and wealth

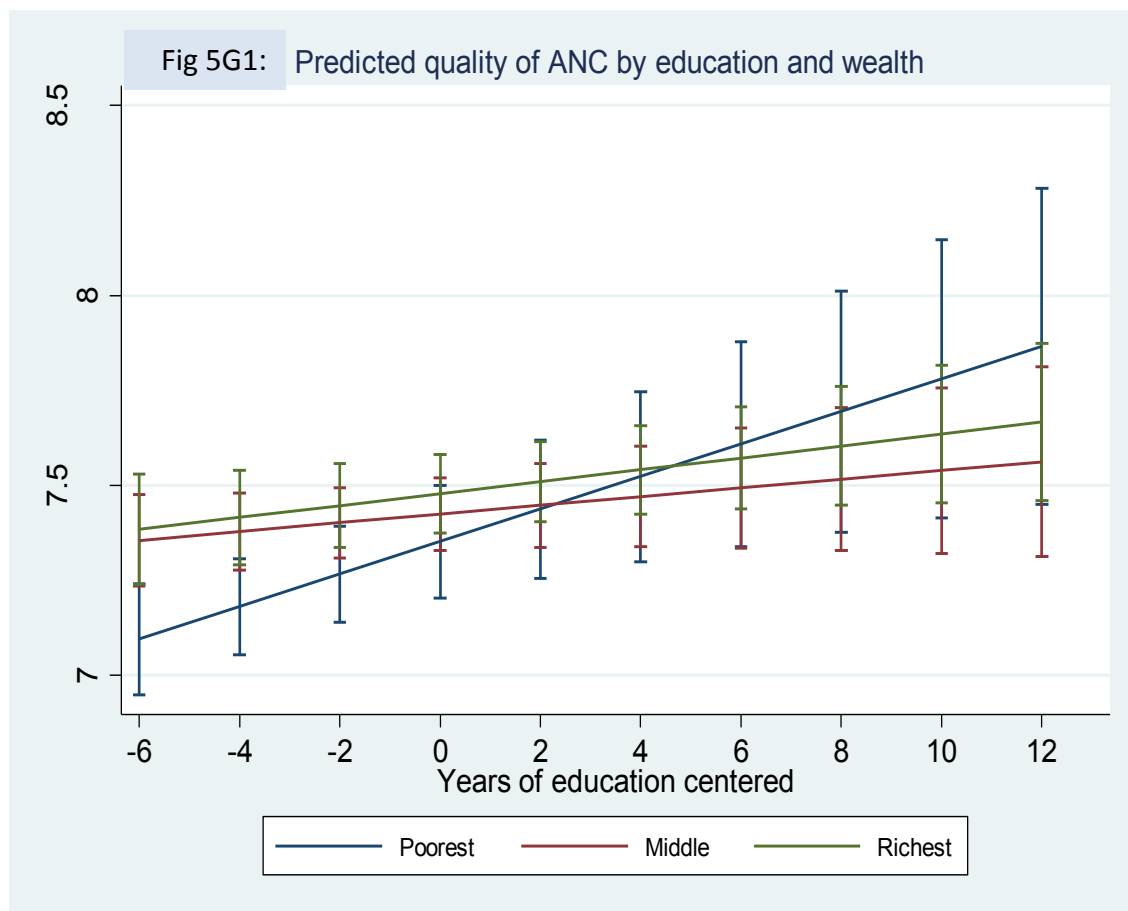


Table 5G3A: Random effect results from Multilevel Logistic Regression of Quality of Antenatal care (ANC) on Place of residence, Education and relevant confounders, GMHS, N=4,868

level	Quality of ANC : variance (se)			No. of groups	Mean observations per group
	Null model	Full unconditional	Full conditional		
district level	0.991*** (0.095)	0.538*** (0.07)	0.539*** (0.070)	110	44.3
cluster level	0.536*** (0.059)	0.397*** (0.066)	0.397*** (0.066)	400	12.2
N	4,868	4,868	4,868		

Table 5G3B: Multilevel Logistic Regression of Quality of Antenatal care (ANC) on Education, Place of residence and relevant confounders, GMHS, N=4,868

<i>Independent variables</i>	<i>Quality of ANC : OR[95% CI]</i>								
	Bivariate models			Full unconditional model			Full conditional model		
Place of residence:									
Rural (ref)									
Urban	1.78***	[1.43	2.21]	1.25	[1.00	1.58]	1.25	[1.00	1.57]
Years of sch. centered	1.07***	[1.05	1.09]	1.03**	[1.01	1.06]	1.06*	[1.01	1.11]
Household wealth Index									
Poorest (ref)									
Poorer/Middle	1.43***	[1.18	1.74]	1.25*	[1.02	1.53]	1.15	[0.90	1.48]
Rich/Richest	2.31***	[1.83	2.92]	1.43**	[1.10	1.87]	1.33	[0.99	1.79]
Interaction of wealth and Education									
Poorer/Middle*years of sch. centered							0.97	[0.93	1.02]
Rich/Richest*years of sch. centered							0.98	[0.93	1.03]
Number of ANC visits									
One to three (ref)									
Four or more	2.50***	[2.11	2.96]	1.95***	[1.62	2.35]	1.95***	[1.62	2.35]
Trimester of first ANC									
First trimester (ref)									
Second trimester	0.72***	[0.63	0.83]	0.88	[0.76	1.01]	0.87	[0.76	1.01]
Third trimester	0.33***	[0.23	0.47]	0.60**	[0.41	0.87]	0.59**	[0.40	0.87]
DK trimester	0.080*	[0.0074	0.86]	0.13	[0.013	1.32]	0.13	[0.013	1.31]
ANC provider									
Nurse (ref)									
Doctor	1.24*	[1.04	1.49]	1.04	[0.86	1.26]	1.05	[0.87	1.26]
All others	1.22	[0.80	1.87]	1.47	[0.94	2.29]	1.49	[0.95	2.32]
Type of facility									
Gov't hospital or polyclinic (ref)									
Other Gov't facility	0.62***	[0.52	0.73]	0.71***	[0.60	0.85]	0.71***	[0.60	0.85]
Only Private facility/maternity home	0.60***	[0.48	0.73]	0.55***	[0.45	0.68]	0.55***	[0.45	0.68]
Home/other/DK	0.16***	[0.075	0.33]	0.17***	[0.075	0.37]	0.17***	[0.074	0.37]
Reason for ANC									
Checkup									
Other (for problem/9DK)	1.21*	[1.01	1.44]	1.14	[0.95	1.37]	1.14	[0.95	1.37]
Pregnancy complication	1.11	[0.94	1.31]	0.81	[0.57	1.14]	0.81	[0.57	1.14]
Serious complication	1.25*	[1.05	1.49]	1.34	[0.91	1.95]	1.34	[0.92	1.96]
Ever miscarried or still birth	0.99	[0.85	1.17]	0.94	[0.80	1.12]	0.95	[0.80	1.12]
Current age in years	1	[0.99	1.01]	1	[0.98	1.01]	1	[0.98	1.01]
Parity	0.98	[0.95	1.01]	1.02	[0.97	1.07]	1.02	[0.97	1.07]
Marital Status									
Currently married (ref)									
Cohabiting	0.71**	[0.58	0.87]	0.78*	[0.63	0.96]	0.78*	[0.63	0.96]
Previously married	0.96	[0.74	1.25]	1.03	[0.78	1.37]	1.02	[0.77	1.36]
Never married	0.9	[0.69	1.17]	1.00	[0.73	1.36]	1.00	[0.74	1.36]
Married before 19years	0.98	[0.86	1.12]	1.08	[0.92	1.26]	1.08	[0.92	1.26]
Female household head	0.95	[0.81	1.12]	0.95	[0.80	1.14]	0.95	[0.80	1.14]
Ever contraception	1.70***	[1.47	1.98]	1.40***	[1.19	1.63]	1.39***	[1.19	1.63]
Know source of family planning	1.15*	[1.01	1.32]	1.16*	[1.01	1.33]	1.15*	[1.01	1.32]

Table 5G3B continued

Religious affiliation									
Orthodox Christian (ref)									
Other Christian.	1.02	[0.86	1.21]	1.03	[0.86	1.22]	1.03	[0.87	1.22]
Moslem	0.92	[0.72	1.18]	1.28	[0.98	1.68]	1.27	[0.97	1.68]
Traditionalist /other	0.67**	[0.51	0.87]	0.96	[0.73	1.27]	0.97	[0.74	1.28]
Ethnicity									
Akan									
Ga/dangme/Guan	0.61***	[0.47	0.80]	0.79	[0.60	1.04]	0.78	[0.60	1.03]
Ewe	0.63***	[0.48	0.83]	0.82	[0.62	1.09]	0.82	[0.62	1.09]
Mole-dagbani/Hausa	0.47***	[0.35	0.64]	0.57**	[0.40	0.81]	0.57**	[0.40	0.81]
Grussi/Gruma	0.51***	[0.37	0.71]	0.68*	[0.48	0.95]	0.68*	[0.48	0.96]
Other/4missing	0.54***	[0.40	0.73]	0.61**	[0.43	0.86]	0.61**	[0.43	0.86]
Region									
Greater Accra (ref)									
Central	1.64	[0.73	3.71]	1.61	[0.81	3.24]	1.60	[0.80	3.21]
Western	9.30***	[3.90	22.2]	11.0***	[5.19	23.4]	10.9***	[5.14	23.3]
Volta	0.96	[0.42	2.17]	1.56	[0.77	3.17]	1.56	[0.77	3.17]
Eastern	1.6	[0.74	3.48]	1.81	[0.94	3.46]	1.80	[0.94	3.45]
Ashanti	3.15**	[1.45	6.84]	3.13***	[1.62	6.07]	3.13***	[1.61	6.06]
Brong Ahafo	3.63**	[1.59	8.28]	4.60***	[2.27	9.30]	4.59***	[2.26	9.29]
Northern	0.6	[0.26	1.35]	1.43	[0.69	2.94]	1.43	[0.69	2.95]
Upper east	2.14	[0.84	5.46]	4.14***	[1.81	9.47]	4.22***	[1.84	9.69]
Upper west	1.36	[0.51	3.59]	2.97*	[1.25	7.02]	3.00*	[1.27	7.12]
Constant				0.39*	[0.18	0.84]	0.41*	[0.19	0.92]
N	4868			4868			4868		

Notes: *p<0.05, ** p<0.01, *** p<0.001.

Table 5W1: Number and proportion in each group who received all 3 recommended services for women who had at least one ANC, WHS, N=1,621

<i>Variables</i>	Ghana			Burkina Faso			Total		
	N	Percent	p-v	N	Percent	p-v	N	Percent	p-v^a
Total	343	52.9		129	12.6		472	28.3	***
Setting									
Rural	203	49.6	*	29	5.1	***	232	23.6	***
Urban	140	58.6		100	22.3		240	34.9	
<i>Socioeconomic variables</i>									
Education									
No formal schooling	111	50.7		73	9.0	***	184	17.9	***
Some formal schooling	232	54.1		56	26.4		288	44.9	
Less than primary sch.	61	59.2		22	25.6		83	43.9	
Primary sch. completed	155	53.1		18	27.7		173	48.5	
At least Secondary sch.	16	47.1		16	26.2		32	33.7	
Wealth Tertile									
Lower	97	50.8		38	8.6	***	135	21.3	***
Middle	76	48.7		49	13.5		125	24.1	
Upper	170	56.5		42	19.3		212	40.9	
Type of occupation⁵									
Not working for pay	47	58.8		96	14.9	***	143	19.8	***
Professional ⁶	22	57.9		5	20.8		27	43.6	
Service/sales ⁷	129	55.6		26	14.2		155	37.4	
Agricultural worker ⁸	145	48.7		2	1.2		147	31.3	
No. of ANC visits									
1-3 visits	61	39.1	***	58	9.4	***	119	15.4	***
Four or more	282	57.3		71	17.5		353	39.4	
Mean (SD)									
Most frequent ANC provider									
Doctor	62	60.2	*	40	20.4	***	102	34.1	***
Nurse	277	52.4		86	11.7		363	28.7	
All others	4	25.0		3	3.4		7	6.7	
Age in years									
18-19	4	44.4		8	11.3		12	15.0	**
20-29	135	51.3		72	13.2		207	25.6	
30-39	148	55.0		40	12.6		188	32.1	
40-49yrs	56	52.3		9	10.0		65	33.0	
Mean (SD)									
Marital status									
Currently married	276	52.2		117	12.3		393	26.5	***
Never married/Cohabiting	35	58.3		9	21.4		44	43.1	
Separated/widowed/divorced	32	54.2		3	11.1		35	40.7	
Number of children									***
None	80	54.8		1	2.8	*	81	44.5	
1-2	81	45.8		63	14.4		144	23.4	
3-4	90	60.0		40	14.6		130	30.7	
5 or more	92	52.6		25	9.1		117	26.1	
Mean (SD)									
Diagnosed with a chronic condition									
No	287	52.6		92	12.1		379	29.1	
Yes	56	54.9		37	14.0		93	25.3	

Table 5W1 continued

Self-Rated Health Status³							
Very good(1)	138	55.7	27	11.3	165	33.9	**
Good	135	51.7	69	12.8	204	25.5	
Moderate to bad	70	50.4	33	13.4	103	26.8	
Moderate	55	47.8	26	12.6	81	25.2	
Bad	13	61.9	7	18.4	20	33.9	
Very bad(5)	2	66.7	0	0.0	2	50.0	
Satisfaction with Health system⁴							
Dissatisfied	69	46.6	27	16.0	96	30.3	**
Very dissatisfied (1)	7	77.8	3	15.0	10	34.5	
Fairly dissatisfied	19	48.7	10	19.2	29	31.9	
Neither satisfied	43	43.0	14	14.4	57	28.9	
Fairly satisfied	156	55.5	78	11.7	234	24.7	
Very satisfied (5)	118	53.9	24	12.9	142	35.1	
Rating of travel time to Inpatient health facility							
Bad	55	58.5	13	10.3	68	30.9	***
Good	75	56.0	44	18.5	119	32.0	
Missing	213	50.7	72	10.9	**	285	26.4

p-v = p-value: * p<0.05, ** p<0.01 *** p<0.001

^aThe p-value for the within country comparisons are for the differences by the predictor categories. For the combined sample it is the differences between the two countries

Table 5W2A: Random effect results from Multilevel Binary Logistic Regression of Quality of Antenatal care (ANC) on Place of residence, Education and relevant confounders, WHS, N=1,671

<i>level</i>	<i>Quality of ANC : variance (se)</i>			No. of groups	Mean observations per group
	Null model	Full unconditional	Full conditional		
Strata	1.083 (0.19)	0.568* (0.139)	0.451* (0.140)	22	76
cluster	0.873 (0.133)	0.812 (0.136)	0.811 (0.136)	390	4.3
N	1,671	1,671	1,671		

Table 5W2B: Multilevel binary logistic regression of Quality of Antenatal care (ANC) on Place of residence, Education and relevant confounders, WHS, N=1,671

<i>Independent variables</i>	Quality of ANC : OR [95% CI]								
	Bivariate			Full unconditional			Full Conditional		
Place of Residence									
Rural (ref)									
Urban	1.30	[0.49	3.45]	1.56	[0.81	2.99]	4.61*	[1.40	15.2]
Education									
None (ref)									
Some	1.53*	[1.10	2.13]	1.42*	[1.01	1.99]	2.05**	[1.23	3.40]
Ghana	7.80***	[3.40	17.9]	9.13***	[4.09	20.3]	32.6***	[10.2	103.8]
Country Interactions									
Ghana*Some education							0.50*	[0.26	0.98]
Ghana*Urban							0.26*	[0.067	1.00]
Household wealth Index									
Lower tertile (ref)									
Middle tertile	1.15	[0.81	1.64]	1.03	[0.72	1.47]	1.01	[0.70	1.46]
Upper tertile	1.15	[0.81	1.64]	0.89	[0.61	1.30]	0.86	[0.59	1.26]
Occupation									
Not working (ref)									
Professional	0.82	[0.39	1.69]	0.57	[0.27	1.21]	0.50	[0.24	1.07]
Service/sales/technician	0.84	[0.56	1.24]	0.72	[0.48	1.08]	0.73	[0.49	1.10]
Agricultural/fishery worker	0.57*	[0.36	0.90]	0.55*	[0.34	0.88]	0.52**	[0.32	0.84]
Number of ANC visits									
1 - 3 ANC visits (ref)									
4 or more ANC visits	1.95***	[1.43	2.65]	1.76***	[1.28	2.42]	1.75***	[1.27	2.40]
ANC provider									
Nurse (ref)									
Doctor	1.60*	[1.08	2.36]	1.62*	[1.08	2.42]	1.64*	[1.09	2.46]
Other provider	0.26**	[0.10	0.67]	0.34*	[0.13	0.86]	0.34*	[0.13	0.89]
Current age in years	1.01	[0.99	1.03]	1.00	[0.98	1.03]	1.00	[0.98	1.03]
Marital Status									
Currently Married (ref)									
Not currently married	1.01	[0.67	1.51]	0.95	[0.63	1.44]	0.95	[0.62	1.43]
Parity	1.02	[0.96	1.08]	1.05	[0.97	1.13]	1.05	[0.97	1.13]
Self-Rated Health Status	1.03	[0.86	1.22]	1.01	[0.84	1.21]	1.00	[0.83	1.19]
Any diagnosed chronic condition	1.00	[0.71	1.41]	0.94	[0.66	1.34]	0.93	[0.65	1.33]
Satisfaction with Health system	1.01	[0.86	1.18]	1.00	[0.85	1.17]	1.00	[0.85	1.17]

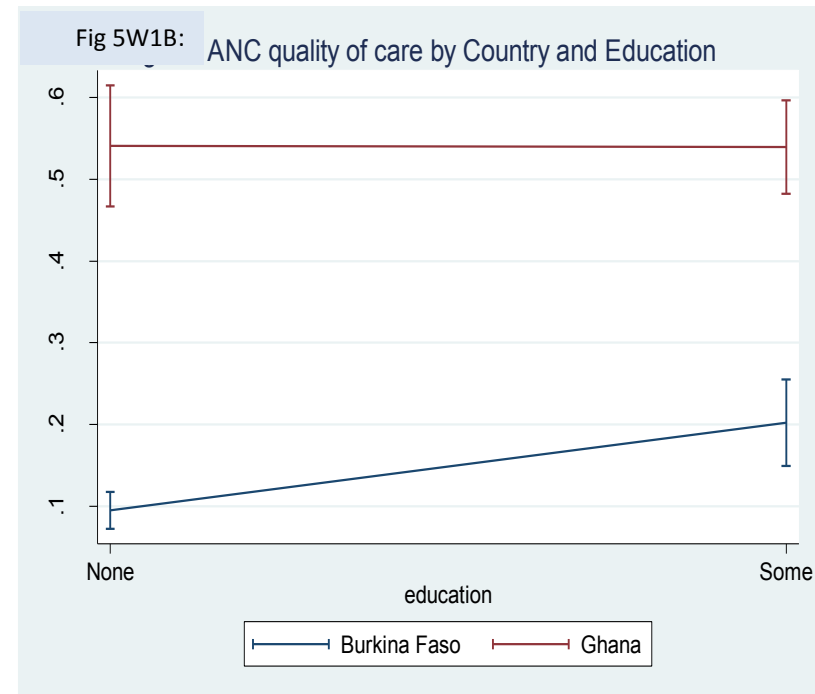
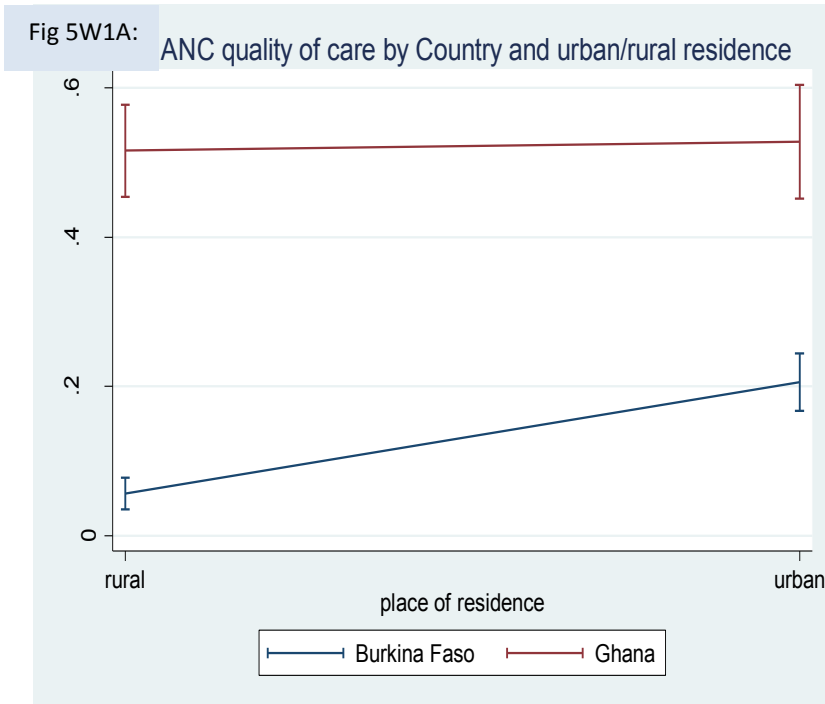
Table 5W2B continued

Perceived health service accessibility									
Bad (ref)									
Good	0.98	[0.65	1.49]	0.90	[0.59	1.37]	0.92	[0.61	1.40]
Missing(No inpatient encounter)	1.14	[0.80	1.61]	1.02	[0.71	1.45]	1.03	[0.72	1.47]
Constant				0.066***	[0.019	0.23]	0.027***	[0.0067	0.11]
N		1,671			1,671			1,671	

Notes: *p<0.05, ** p<0.01, *** p<0.001.

Fig 5W1A: ANC quality of care by country and rural/urban residence

Fig 5W1B: ANC quality of care by country and education



Chapter 6 figures and tables

Figure 6.1: Illustrating approach to mediation analysis

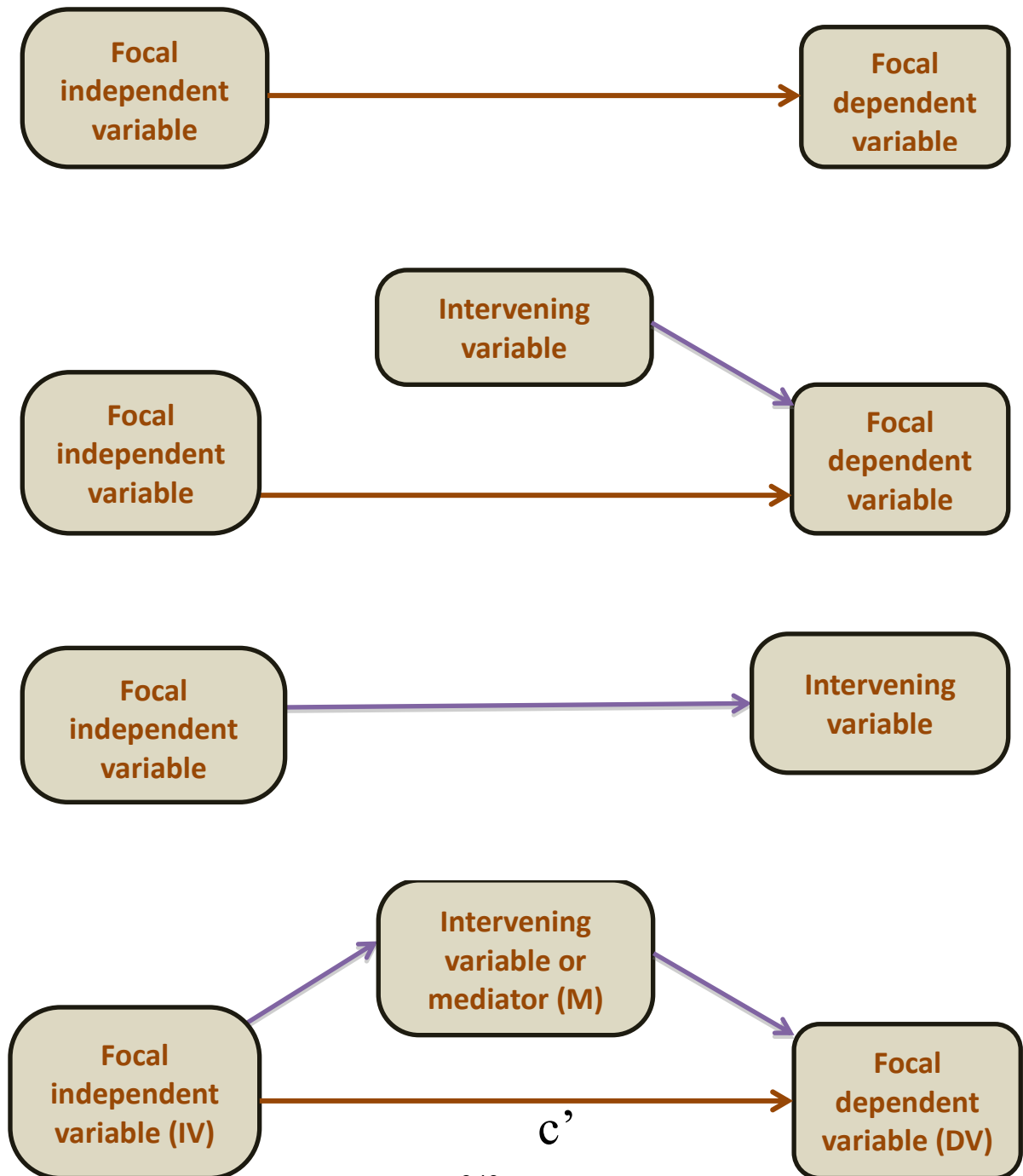


Figure 6.2: Simplified conceptual model showing mediated pathways for the association between place of residence and use of skilled birth attendants

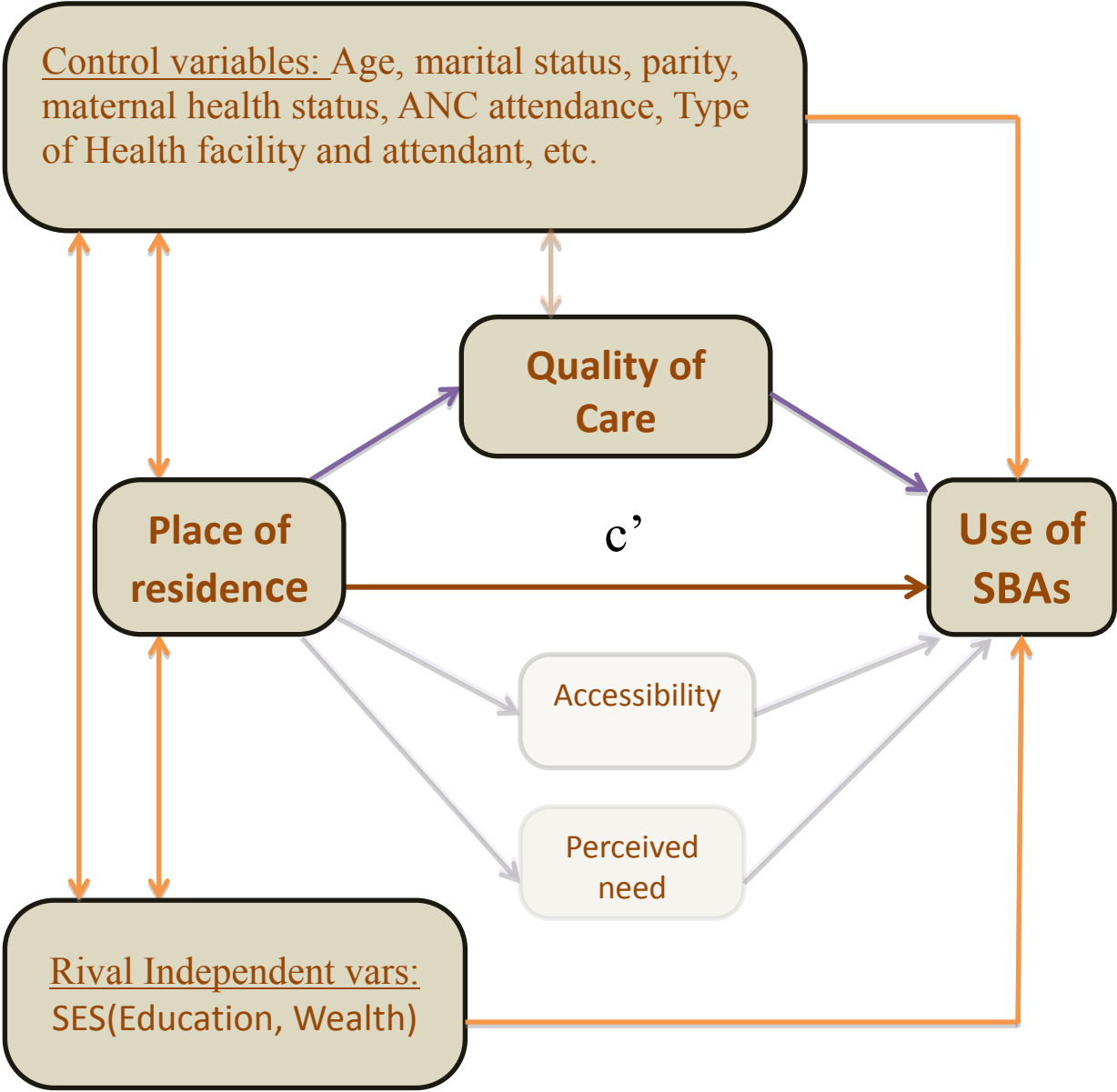


Table 6G1: Bivariate analysis: Proportion of women assisted a Skilled birth attendant, GMHS

<i>Variable</i>	Full sample (N=5,042)				At least one ANC (N=4,868)			
	N	Proportion	[95% CI]		N	Proportion	[95% CI]	
Overall	5,042	0.555	0.523	0.587	4,868	0.573	0.541	0.605
Delivery in health facility								
No	2,186	0.037	0.027	0.047	2,029	0.039	0.028	0.049
Yes	2,856	0.987	0.982	0.992	2,839	0.987	0.982	0.992
Setting								
Rural	3,115	0.394	0.357	0.431	2,967	0.412	0.374	0.449
Urban	1,927	0.864	0.834	0.893	1,901	0.870	0.842	0.898
Large city	664	0.921	0.898	0.945	654	0.928	0.907	0.950
Small city	115	0.907	0.850	0.964	113	0.914	0.857	0.972
Town	1,148	0.833	0.790	0.876	1,134	0.839	0.797	0.880
Region								
Greater Accra	636	0.796	0.748	0.844	619	0.819	0.781	0.857
Central	441	0.622	0.535	0.709	429	0.640	0.559	0.721
Western	382	0.552	0.461	0.643	371	0.568	0.479	0.656
Volta	407	0.420	0.263	0.576	389	0.437	0.278	0.596
Eastern	744	0.581	0.525	0.637	724	0.594	0.539	0.650
Ashanti	855	0.683	0.616	0.750	837	0.692	0.626	0.758
Brong Ahafo	496	0.580	0.475	0.684	486	0.591	0.487	0.695
Northern	541	0.271	0.197	0.345	491	0.294	0.215	0.373
Upper East	303	0.470	0.358	0.581	298	0.477	0.366	0.588
Upper West	237	0.436	0.259	0.614	224	0.460	0.287	0.634
R3M regions								
Other regions	2,807	0.472	0.427	0.517	2,688	0.492	0.446	0.537
R3m region	2,235	0.680	0.643	0.718	2,180	0.694	0.657	0.731
Highest Education								
None	1,697	0.331	0.292	0.371	1,588	0.352	0.310	0.394
Primary	1,109	0.524	0.482	0.566	1,072	0.537	0.495	0.579
Middle/JSS	1,830	0.715	0.681	0.750	1,804	0.725	0.691	0.758
Secondary/SSS/higher	406	0.891	0.856	0.927	404	0.896	0.860	0.931
Household wealth index								
Poorest	1,097	0.279	0.234	0.324	1,024	0.298	0.252	0.344
Poorer	994	0.371	0.323	0.420	943	0.389	0.339	0.440
Middle	951	0.534	0.486	0.582	930	0.546	0.499	0.594
Richer	995	0.761	0.722	0.800	976	0.769	0.730	0.807
Richest	1,005	0.917	0.891	0.943	995	0.921	0.896	0.946
Household head Female								
No	3,790	0.525	0.489	0.561	3,650	0.543	0.507	0.579
Yes	1,252	0.646	0.608	0.683	1,218	0.662	0.624	0.700
Religious affiliation								
Catholic	686	0.552	0.480	0.623	661	0.567	0.494	0.639
Methodist/Presbyterian	662	0.620	0.559	0.681	652	0.626	0.567	0.685
Pentecostal/charismatic	1,476	0.650	0.612	0.688	1,444	0.664	0.627	0.701
Other Christian	832	0.608	0.555	0.661	810	0.624	0.573	0.676
Moslem	886	0.474	0.400	0.549	863	0.490	0.415	0.566
Traditional/other	500	0.241	0.186	0.295	438	0.266	0.206	0.326

Table 6G1 continued

Ethnicity									
Akan	2,238	0.677	0.640	0.714	2,197	0.687	0.650	0.723	
Ga/Dangme/Guan	521	0.557	0.472	0.643	504	0.578	0.491	0.664	
Ewe	641	0.508	0.421	0.594	615	0.527	0.440	0.614	
Mole-Dagbani/Hausa	604	0.397	0.308	0.485	583	0.409	0.319	0.500	
Grussi/Gruma	580	0.319	0.234	0.404	534	0.347	0.257	0.436	
Other/4missing	458	0.500	0.397	0.603	435	0.526	0.422	0.630	
Watches television									
At least once a week	2,116	0.742	0.707	0.776	2,074	0.753	0.719	0.788	
Less than once a week	552	0.561	0.505	0.616	536	0.571	0.515	0.627	
Not at all/DK	2,374	0.396	0.357	0.436	2,258	0.416	0.375	0.457	
Reproductive Health variables									
Current age in years									
15-19yrs	247	0.526	0.446	0.605	236	0.540	0.459	0.621	
20-24	915	0.569	0.523	0.615	891	0.580	0.535	0.626	
25-29	1,176	0.579	0.537	0.620	1,138	0.597	0.555	0.639	
30-34	1,115	0.555	0.508	0.602	1,082	0.569	0.522	0.616	
35-39	913	0.589	0.549	0.629	881	0.607	0.567	0.648	
40-49yrs	676	0.459	0.407	0.512	640	0.488	0.435	0.541	
Marital status									
Currently married	3,633	0.550	0.514	0.586	3,510	0.567	0.530	0.604	
Cohabiting	687	0.479	0.416	0.542	666	0.494	0.430	0.558	
Previously married	364	0.635	0.585	0.686	347	0.670	0.619	0.721	
Never married	358	0.678	0.618	0.738	345	0.695	0.635	0.755	
Age at first union									
Less than 19years	2,445	0.480	0.443	0.517	2,337	0.500	0.463	0.538	
19 or more years	2,239	0.620	0.586	0.654	2,186	0.634	0.600	0.668	
Never in a union	358	0.678	0.618	0.738	345	0.695	0.635	0.755	
No. of Pregnancies ever had (Gravidity)									
1-2	1,669	0.620	0.583	0.657	1,629	0.633	0.596	0.669	
3-4	1,549	0.571	0.528	0.613	1,506	0.583	0.540	0.625	
5plus	1,824	0.485	0.448	0.521	1,733	0.509	0.472	0.547	
No. of children ever born (Parity)									
No children born alive	22	0.623	0.406	0.840	19	0.663	0.436	0.890	
1-2	2,072	0.641	0.605	0.676	2,028	0.654	0.619	0.688	
3-4	1,513	0.557	0.517	0.596	1,471	0.569	0.529	0.609	
5plus	1,435	0.433	0.393	0.473	1,350	0.458	0.417	0.499	
No. of children alive									
No children alive	78	0.633	0.517	0.749	71	0.666	0.547	0.786	
1-2	2,246	0.626	0.590	0.662	2,200	0.638	0.603	0.674	
3-4	1,573	0.546	0.508	0.584	1,526	0.561	0.522	0.599	
5plus	1,145	0.426	0.383	0.469	1,071	0.452	0.408	0.496	
Ever used contraception									
No	1,899	0.389	0.348	0.430	1,780	0.411	0.368	0.455	
Yes	3,143	0.659	0.629	0.689	3,088	0.669	0.640	0.699	
Currently using contraception									
No	3,792	0.512	0.476	0.548	3,638	0.532	0.496	0.568	
Yes	1,250	0.688	0.655	0.721	1,230	0.696	0.663	0.730	

Table 6G1 continued

Know family planning source								
No	2,376	0.534	0.493	0.575	2,270	0.556	0.515	0.598
Yes	2,666	0.574	0.539	0.609	2,598	0.587	0.552	0.622
Prior pregnancies								
Ever had a miscarriage								
No	4,233	0.552	0.518	0.587	4,077	0.571	0.536	0.605
Yes	809	0.570	0.525	0.614	791	0.584	0.540	0.629
Ever induced abortion								
No	4,265	0.522	0.488	0.556	4,101	0.540	0.507	0.574
Yes	777	0.746	0.705	0.786	767	0.754	0.714	0.794
Ever had a stillbirth								
No	4,748	0.548	0.515	0.581	4,585	0.565	0.532	0.598
Yes	294	0.672	0.617	0.728	283	0.701	0.645	0.757
Prior stillbirth/miscarriage								
No	4,000	0.545	0.511	0.580	3,853	0.563	0.529	0.598
Yes	1,042	0.594	0.554	0.634	1,015	0.611	0.571	0.650
Sibling had a maternal death								
No	4,956	0.555	0.522	0.587	4,783	0.572	0.540	0.605
Yes	86	0.578	0.452	0.704	85	0.594	0.475	0.713
Pregnancy complication								
No	3,956	0.527	0.491	0.562	3,818	0.544	0.509	0.579
Yes	1,086	0.667	0.627	0.707	1,050	0.686	0.646	0.725
Serious pregnancy complication								
No	4,149	0.521	0.486	0.555	3,996	0.539	0.504	0.574
Yes	893	0.728	0.689	0.767	872	0.742	0.705	0.779
Caesarian delivery								
No	4,694	0.524	0.491	0.557	4,522	0.542	0.509	0.575
Yes	348	0.998	0.995	1.002	346	0.998	0.995	1.002
Pregnancy outcome								
Born alive	4,957	0.552	0.520	0.585	4,791	0.569	0.537	0.602
Born dead(Stillbirth)	85	0.717	0.620	0.814	77	0.810	0.721	0.898
Pregnancy duration								
Born Alive	4,957	0.552	0.520	0.585	4,791	0.569	0.537	0.602
7 months	13	0.881	0.701	1.060	13	0.881	0.701	1.060
8 months	10	0.611	0.294	0.929	7	0.791	0.515	1.068
9 months	58	0.694	0.576	0.812	53	0.794	0.681	0.907
10 months	4	0.842	0.535	1.148	4	0.842	0.535	1.148
<i>ANC variables</i>								
ANC attendance								
No	174	0.073	0.036	0.110	0			
Yes	4,868	0.573	0.541	0.605	4,868	0.573	0.541	0.605
ANC quality of care score								
7 or less					1,901	0.449	0.408	0.490
8 or 9					2,967	0.652	0.620	0.685
No. of ANC visits								
1-3 visits					990	0.265	0.229	0.301
Four or more					3,878	0.651	0.618	0.684

Table 6G1 continued

Trimester of first ANC visit				
First trimester	2,688	0.637	0.601	0.672
Second trimester	1,992	0.511	0.476	0.547
Third trimester	181	0.319	0.241	0.397
Don't know	7	0.411	-0.022	0.845
Where ANC took place				
Gov't Health facility only or combine	4,119	0.558	0.523	0.593
Gov't hospital or polyclinic	2,200	0.686	0.648	0.724
Other Gov't facility ^a	1,919	0.413	0.366	0.459
Only Private facility/maternity home ^b	703	0.679	0.607	0.751
Home/other/DK	46	0.299	0.154	0.445
Highest trained ANC provider				
Doctor	1,006	0.765	0.727	0.802
Nurse/midwife	3,743	0.532	0.497	0.568
All others	119	0.306	0.202	0.411
Reason for seeking ANC				
For checkup	4,044	0.570	0.535	0.605
For a problem/missing	824	0.588	0.538	0.638

Notes: ^a refers mainly to health centers, health posts and other lower tiered government health facilities.

Table 6G2: Multilevel Logistic Regression of use of SBAs on quality of ANC, Place of residence, SES and relevant confounders, GMHS, N=4,868

<i>Independent variables</i>	<i>Use of SBA : OR[95% CI]</i>								
	<i>Bivariate</i>			<i>Multivariate</i>					
				<i>Model without region</i>			<i>model with region</i>		
<i>Fixed effects</i>									
Quality of ANC score									
0-7 (ref)									
8 or 9	1.68***	[1.43	1.98]	1.21*	[1.02	1.43]	1.18	[0.99	1.40]
Place of residence:									
Rural (ref)									
Urban	11.0***	[8.19	14.9]	4.41***	[3.34	5.83]	4.24***	[3.22	5.57]
Years of sch. centered	1.13***	[1.11	1.16]	1.08***	[1.05	1.10]	1.08***	[1.05	1.10]
Household wealth Index									
Poorest (ref)									
Poorer/Middle	1.75***	[1.41	2.17]	1.22	[0.98	1.52]	1.28*	[1.03	1.60]
Rich/Richest	6.56***	[4.95	8.70]	2.07***	[1.53	2.80]	2.17***	[1.60	2.93]
Number of ANC visits									
One to three	0.26***	[0.21	0.31]	0.36***	[0.29	0.45]	0.36***	[0.29	0.45]
Four or more(ref)									
Trimester of first ANC									
First trimester (ref)									
Second trimester	0.62***	[0.53	0.73]	0.85	[0.72	1.00]	0.87	[0.74	1.02]
Third trimester	0.35***	[0.23	0.52]	0.94	[0.61	1.45]	0.96	[0.62	1.47]
DK trimester	0.35	[0.035	3.49]	0.78	[0.076	8.05]	0.87	[0.081	9.37]
ANC provider									
Nurse/midwife (ref)									
Doctor	1.80***	[1.45	2.23]	1.31*	[1.05	1.64]	1.30*	[1.04	1.63]
All others	0.38***	[0.23	0.62]	0.42**	[0.25	0.71]	0.38***	[0.23	0.64]
Type of facility									
Gov't hosp./polyclinic(ref) ^a									
Other Gov't facility ^b	0.51***	[0.42	0.62]	0.78*	[0.65	0.95]	0.80*	[0.66	0.96]
Private /maternity home ^c	1.16	[0.89	1.50]	1.15	[0.89	1.50]	1.16	[0.90	1.51]
Home/other/DK	0.23***	[0.10	0.51]	0.49	[0.21	1.14]	0.51	[0.22	1.19]
Reason for ANC									
Checkup									
Other (for problem)	1.01	[0.83	1.22]	0.89	[0.73	1.10]	0.89	[0.73	1.10]
Pregnancy complication	1.63***	[1.35	1.97]	0.80	[0.53	1.23]	0.81	[0.53	1.24]
Serious complication	2.07***	[1.68	2.56]	2.38***	[1.50	3.77]	2.36***	[1.49	3.74]
Prior miscarriage/still birth	1.16	[0.97	1.40]	1.08	[0.88	1.31]	1.08	[0.89	1.31]
Current age in years	1	[0.99	1.01]	1.03**	[1.01	1.05]	1.03**	[1.01	1.05]
Parity	0.92***	[0.89	0.95]	0.92**	[0.86	0.98]	0.92**	[0.86	0.98]
Marital Status									
Currently married (ref)									
Cohabiting	0.59***	[0.48	0.74]	0.66***	[0.53	0.84]	0.67**	[0.53	0.85]
Previously married	0.92	[0.69	1.24]	1.05	[0.76	1.45]	1.06	[0.77	1.45]
Never married	1.31	[0.96	1.79]	1.24	[0.86	1.78]	1.24	[0.87	1.78]
Married before 19years	0.68***	[0.58	0.79]	0.94	[0.78	1.12]	0.93	[0.78	1.10]
Female household head	1.05	[0.88	1.26]	1.06	[0.87	1.30]	1.05	[0.86	1.28]

Table 6G2 continued

Ever contraception	1.65***	[1.40	1.96]	1.22*	[1.02	1.46]	1.21*	[1.01	1.45]
Know family planning source	1	[0.86	1.16]	0.98	[0.84	1.15]	0.96	[0.82	1.12]
Religious affiliation									
Orthodox Christian (ref)									
Other Christian	1.03	[0.86	1.25]	1.05	[0.86	1.27]	1.05	[0.86	1.28]
Moslem	0.89	[0.66	1.20]	1.01	[0.74	1.39]	1.07	[0.78	1.46]
Traditionalist /other	0.44***	[0.32	0.59]	0.69*	[0.50	0.94]	0.68*	[0.50	0.93]
Ethnicity									
Akan									
Ga/Dangme/Guan	0.60**	[0.43	0.84]	0.83	[0.60	1.15]	0.88	[0.63	1.22]
Ewe	0.67*	[0.48	0.93]	0.80	[0.59	1.09]	0.88	[0.63	1.23]
Mole-Dagbani/Hausa	0.40***	[0.28	0.59]	0.67*	[0.46	0.99]	0.77	[0.51	1.17]
Grussi/Gruma	0.43***	[0.29	0.62]	0.80	[0.56	1.16]	0.78	[0.53	1.16]
Other/4missing	0.49***	[0.34	0.69]	0.94	[0.63	1.39]	0.92	[0.61	1.37]
Watches television									
At least once a week (ref)									
Less than once a week	0.52***	[0.41	0.67]	0.77	[0.59	1.00]	0.77*	[0.59	1.00]
Not at all/DK	0.44***	[0.36	0.53]	0.88	[0.72	1.08]	0.88	[0.71	1.08]
Region									
Greater Accra (ref)									
Central	0.39	[0.14	1.08]				1.00	[0.52	1.90]
Western	0.26**	[0.094	0.72]				0.78	[0.40	1.51]
Volta	0.13***	[0.046	0.36]				0.66	[0.34	1.29]
Eastern	0.29**	[0.11	0.73]				0.84	[0.47	1.51]
Ashanti	0.48	[0.19	1.23]				1.06	[0.58	1.95]
Brong Ahafo	0.29*	[0.11	0.81]				0.89	[0.47	1.69]
Northern	0.048***	[0.017	0.14]				0.36**	[0.18	0.73]
Upper east	0.14***	[0.043	0.44]				1.44	[0.66	3.14]
Upper west	0.15**	[0.044	0.53]				1.80	[0.79	4.13]
Constant	1.52**	[1.18	1.95]	0.60	[0.32	1.13]	0.66	[0.29	1.47]
<i>Random effects</i>									
		<i>For Null model</i>							
District variance	0.94	[0.74	1.18]	0.47***	[0.32	0.67]	0.36***	[0.23	0.58]
Cluster variance	1.32***	[1.16	1.49]	0.60***	[0.47	0.76]	0.56***	[0.44	0.73]
N	4868			4868			4868		

Notes: *p<0.05, ** p<0.01, *** p<0.001. ^a Refers to receiving ANC at least once in a government hospital or polyclinic ^b Refers to receiving ANC at least once in a lower tiered government facility but never in a hospital or polyclinic ^c Refers to receiving all ANC only in a private facility or maternity home. This applies to all the models

Table 6G3: Multilevel Logistic Regression of Quality of Antenatal care (ANC) on Education, Place of residence and relevant confounders, GMHS, N=4,868

<i>Independent variables</i>	<i>Quality of ANC : OR[95% CI]</i>								
	Bivariate			Multivariate					
				<i>Model without region</i>			<i>model with region</i>		
<i>Fixed effects</i>									
Place of residence:									
Rural (ref)									
Urban	1.78***	[1.43	2.21]	1.18	[0.94	1.50]	1.24	[0.99	1.56]
Years of sch. centered	1.07***	[1.05	1.09]	1.03**	[1.01	1.05]	1.03**	[1.01	1.05]
Household wealth Index									
Poorest (ref)									
Poorer/Middle	1.43***	[1.18	1.74]	1.21	[0.99	1.48]	1.24*	[1.01	1.52]
Rich/Richest	2.31***	[1.83	2.92]	1.35*	[1.03	1.78]	1.40*	[1.06	1.84]
Number of ANC visits									
One to three	0.40***	[0.34	0.47]	0.52***	[0.43	0.62]	0.51***	[0.43	0.62]
Four or more (ref)									
Trimester of first ANC									
First trimester (ref)									
Second trimester	0.72***	[0.63	0.83]	0.87	[0.75	1.00]	0.88	[0.76	1.01]
Third trimester	0.33***	[0.23	0.47]	0.58**	[0.40	0.86]	0.60**	[0.41	0.87]
DK trimester	0.080*	[0.0074	0.86]	0.13	[0.014	1.31]	0.13	[0.013	1.33]
ANC provider									
Nurse (ref)									
Doctor	1.24*	[1.04	1.49]	1.05	[0.87	1.26]	1.04	[0.86	1.26]
All others	1.22	[0.80	1.87]	1.55	[0.99	2.41]	1.47	[0.94	2.29]
Type of facility									
Gov't hosp./polyclinic(ref)									
Other Gov't facility	0.62***	[0.52	0.73]	0.72***	[0.61	0.86]	0.71***	[0.60	0.85]
Private /maternity home	0.60***	[0.48	0.73]	0.56***	[0.45	0.69]	0.55***	[0.45	0.68]
Home/other/DK	0.16***	[0.075	0.33]	0.17***	[0.074	0.37]	0.17***	[0.075	0.37]
Reason for ANC									
Checkup									
Other (for problem/9DK)	1.21*	[1.01	1.44]	1.16	[0.96	1.39]	1.15	[0.95	1.38]
Pregnancy complication	1.11	[0.94	1.31]	0.82	[0.57	1.16]	0.80	[0.57	1.14]
Serious complication	1.25*	[1.05	1.49]	1.34	[0.91	1.95]	1.33	[0.91	1.95]
Prior miscarriage/still birth									
0.99	[0.85	1.17]	0.95	[0.80	1.12]	0.94	[0.80	1.11]	
Current age in years									
1	[0.99	1.01]	1.00	[0.98	1.01]	1.00	[0.98	1.01]	
Parity									
0.98	[0.95	1.01]	1.02	[0.97	1.07]	1.02	[0.96	1.07]	
Marital Status									
Currently married (ref)									
Cohabiting	0.71**	[0.58	0.87]	0.78*	[0.63	0.97]	0.78*	[0.63	0.97]
Previously married	0.96	[0.74	1.25]	1.04	[0.78	1.38]	1.03	[0.77	1.36]
Never married	0.9	[0.69	1.17]	1.01	[0.74	1.38]	1.00	[0.74	1.36]
Married before 19years	0.98	[0.86	1.12]	1.09	[0.93	1.28]	1.08	[0.92	1.26]
Female household head	0.95	[0.81	1.12]	0.95	[0.80	1.13]	0.95	[0.80	1.13]

Table 6G3 continued

Ever contraception	1.70***	[1.47	1.98]	1.42***	[1.22	1.66]	1.39***	[1.19	1.63]
Know family planning source	1.15*	[1.01	1.32]	1.17*	[1.02	1.34]	1.16*	[1.01	1.33]
Religious affiliation									
Orthodox Christian (ref)									
Other Christian	1.02	[0.86	1.21]	1.01	[0.85	1.20]	1.03	[0.87	1.22]
Moslem	0.92	[0.72	1.18]	1.23	[0.93	1.62]	1.28	[0.98	1.68]
Traditionalist /other	0.67**	[0.51	0.87]	0.94	[0.72	1.24]	0.97	[0.73	1.27]
Ethnicity									
Akan									
Ga/dangme/Guan	0.61***	[0.47	0.80]	0.70*	[0.53	0.92]	0.79	[0.60	1.04]
Ewe	0.63***	[0.48	0.83]	0.71*	[0.54	0.94]	0.83	[0.62	1.09]
Mole-dagbani/Hausa	0.47***	[0.35	0.64]	0.54***	[0.38	0.76]	0.57**	[0.40	0.82]
Grussi/Gruma	0.51***	[0.37	0.71]	0.67*	[0.48	0.94]	0.68*	[0.48	0.96]
Other/4missing	0.54***	[0.40	0.73]	0.65*	[0.46	0.91]	0.61**	[0.44	0.86]
Watches television									
At least once a week (ref)	0.882	[0.702	1.109]						
Less than once a week	0.658***	[0.558	0.775]	1.07	[0.84	1.36]	1.07	[0.84	1.36]
Not at all/DK	2.195***	[1.754	2.748]	0.93	[0.78	1.13]	0.93	[0.77	1.12]
Region									
Greater Accra (ref)									
Central	1.64	[0.73	3.71]				1.60	[0.80	3.21]
Western	9.30***	[3.90	22.2]				10.9***	[5.16	23.2]
Volta	0.96	[0.42	2.17]				1.56	[0.77	3.14]
Eastern	1.6	[0.74	3.48]				1.81	[0.95	3.46]
Ashanti	3.15**	[1.45	6.84]				3.13***	[1.62	6.04]
Brong Ahafo	3.63**	[1.59	8.28]				4.63***	[2.30	9.34]
Northern	0.6	[0.26	1.35]				1.44	[0.70	2.96]
Upper east	2.14	[0.84	5.46]				4.21***	[1.84	9.62]
Upper west	1.36	[0.51	3.59]				3.03*	[1.28	7.14]
Constant				2.13**	[1.23	3.67]	0.77	[0.35	1.68]
<i>Random effects</i>									
		<i>For Null model</i>							
District variance	0.99	[0.82	1.20]	0.80*	[0.65	0.98]	0.52***	[0.40	0.67]
Cluster variance	0.54***	[0.43	0.67]	0.38***	[0.27	0.54]	0.38***	[0.27	0.54]
N	4868			4868			4868		

Notes: *p<0.05, ** p<0.01, *** p<0.001.

Table 6G4.1: Multilevel Logistic Regression of use of SBAs and quality of ANC on Place of residence, SES and relevant confounders, GMHS

<i>Independent variables</i>	Use of SBAs				Quality of ANC			
	<i>Model without region</i>		<i>model with region</i>		<i>Model without region</i>		<i>model with region</i>	
	Unstandardized coefficient (SE)							
Quality of ANC score								
0-7 (ref)								
8 or 9	0.19*	(0.086)	0.16	(0.087)				
Place of residence:								
Rural (ref)								
Urban	1.48***	(0.14)	1.44***	(0.14)	0.17	(0.12)	0.21	(0.12)
Years of sch. centered	0.074***	(0.012)	0.074***	(0.012)	0.032**	(0.011)	0.032**	(0.011)
Household wealth Index								
Poorest (ref)								
Poorer/Middle	0.20	(0.11)	0.25*	(0.11)	0.19	(0.10)	0.22*	(0.10)
Rich/Richest	0.73***	(0.15)	0.77***	(0.15)	0.30*	(0.14)	0.33*	(0.14)
Type of facility								
Gov't hospital or polyclinic (ref)								
Other Gov't facility	-0.24*	(0.099)	-0.23*	(0.098)	-0.32***	(0.090)	-0.34***	(0.090)
Only Private /maternity home	0.14	(0.13)	0.15	(0.13)	-0.58***	(0.11)	-0.60***	(0.11)
Home/other/DK	-0.71	(0.43)	-0.67	(0.43)	-1.80***	(0.41)	-1.79***	(0.41)
Region								
Greater Accra (ref)								
Central			-0.0047	(0.33)			0.47	(0.35)
Western			-0.25	(0.34)			2.39***	(0.38)
Volta			-0.41	(0.34)			0.44	(0.36)
Eastern			-0.18	(0.30)			0.60	(0.33)
Ashanti			0.061	(0.31)			1.14***	(0.34)
Brong Ahafo			-0.12	(0.33)			1.53***	(0.36)
Northern			-1.02**	(0.36)			0.36	(0.37)
Upper east			0.37	(0.40)			1.44***	(0.42)
Upper west			0.59	(0.42)			1.11*	(0.44)
Constant	-0.50	(0.32)	-0.42	(0.41)	0.76**	(0.28)	-0.26	(0.40)
N	4868		4868		4868		4868	

Notes: *p<0.05, ** p<0.01, *** p<0.001. These are the same models from table 6G2&3, thus contain the same set of predictors.

Table 6G4.2: Mediation analysis

Does quality of ANC Mediate the effect of education on use of SBAs				
		coefficient	se	p-value:
Direct effect of education on use of SBA ^a	c'	0.074	0.012	<0.001
Direct effect of quality of care on use of SBAs ^b	b	0.190	0.086	<0.05
Direct effect of education on quality of ANC ^c	a	0.032	0.011	<0.01
Effect of education on use of SBAs quality of care (indirect effect of education)	ab	0.006		
Ratio of the indirect to direct effect	ab/c'	0.082		
Proportion of total effect mediated	ab/(ab+c')	0.076		
Significance of mediated effect		Test statistic	se	p-value:
<i>Sobel Test</i>		1.759	0.003	0.079
<i>Goodman test:</i>		1.829	0.003	0.067
Does quality of ANC Mediate the effect of wealth on use of SBAs				
		coefficient	se	p-value:
Direct effect of wealth on use of SBA ^d	c'	0.730	0.150	<0.001
Direct effect of quality of care on use of SBAs ^b	b	0.190	0.086	<0.05
Direct effect of wealth on quality of ANC ^e	a	0.300	0.140	<0.05
Effect of wealth on use of SBAs quality of care (indirect effect of wealth)	ab	0.057		
Ratio of the indirect to direct effect	ab/c'	0.078		
Proportion of total effect mediated	ab/(ab+c')	0.072		
Significance of mediated effect		Test statistic	se	p-value:
<i>Sobel Test:</i>		1.538	0.037	0.124
<i>Good man test</i>		1.626	0.035	0.104
Does quality of ANC Mediate the effect of living in the Western region on use of SBAs				
		coefficient	se	p-value:
Direct effect of Western region on use of SBA ^e	c'	-0.250	0.340	>0.05
Direct effect of quality of care on use of SBAs ^f	b	0.160	0.087	>0.05
Direct effect of Western region on quality of ANC ^g	a	2.390	0.380	<0.001
Effect of Western region on use of SBAs quality of care (indirect effect of living in western region)	ab	0.382		
Ratio of the indirect to direct effect	ab/c'	-1.530		
Proportion of total effect mediated	ab/(ab+c')	0.604		
Significance of mediated effect		Test statistic	se	p-value:
<i>Sobel Test:</i>		1.765	0.217	0.078
<i>Good man test</i>		1.786	0.214	0.074

Notes: ^a this is the coefficient for education on use of SBAs from table 6G4.1 in the model without region

^b this is the coefficient for quality of ANC on use of SBAs from table 6G4.1 in the model without region

^c this is the coefficient for education on quality of ANC from table 6G4.1 in the model without region

^d this is the coefficient for richer/richest on use of SBAs from table 6G4.1 in the model without region

^e this is the coefficient for richer/richest on quality of ANC from table 6G4.1 in the model without region

^e this is the coefficient for Western on use of SBAs from table 6G4.1 in the model with region

^f this is the coefficient for quality of ANC on use of SBAs from table 6G4.1 in the model with region

^g this is the coefficient for Western on quality of ANC from table 6G4.1 in the model with region

Sobel and Goodman tests results are from the interactive mediation test website: <http://quantpsy.org/sobel/sobel.htm>.

Table 6G5: Weighted Single Level Logistic Regression of use of SBAs and quality of ANC on relevant predictors, GMHS, N=4,868

<i>Independent variables</i>	Quality of ANC : OR[95% CI]					Use of SBA : OR[95% CI]						
	<i>Model without region</i>			<i>model with region</i>		<i>Model without region</i>			<i>model with region</i>			
Quality of ANC score												
0-7 (ref)												
8 or 9						1.22*	[1.03	1.45]	1.19*	[1.00	1.42]	
Place of residence:												
Rural (ref)												
Urban	1.15	[0.89	1.49]	1.37*	[1.04	1.78]	3.94***	[2.89	5.38]	3.84***	[2.81	5.26]
Years of sch. centered	1.02	[1.00	1.04]	1.02*	[1.00	1.05]	1.10***	[1.07	1.13]	1.10***	[1.07	1.12]
Household wealth Index												
Poorest (ref)												
Poorer/Middle	1.24*	[1.01	1.53]	1.31**	[1.07	1.61]	1.08	[0.85	1.37]	1.18	[0.91	1.51]
Rich/Richest	1.29	[0.95	1.74]	1.41*	[1.03	1.92]	2.04***	[1.46	2.86]	2.13***	[1.51	2.99]
Number of ANC visits												
One to three												
Four or more(ref)	0.54***	[0.45	0.66]	0.53***	[0.43	0.65]	0.35***	[0.28	0.43]	0.34***	[0.27	0.42]
Trimester of first ANC	0.86*	[0.74	1.00]	0.9	[0.77	1.06]	0.84*	[0.71	0.99]	0.87	[0.74	1.04]
First trimester (ref)												
Second trimester												
Third trimester	0.50***	[0.34	0.74]	0.55**	[0.36	0.82]	0.86	[0.53	1.38]	0.9	[0.55	1.47]
DK trimester	0.13*	[0.020	0.87]	0.16	[0.017	1.44]	0.77	[0.17	3.46]	0.98	[0.21	4.61]
ANC provider												
Nurse/midwife (ref)												
Doctor	1.06	[0.86	1.30]	1.08	[0.87	1.34]	1.26	[0.97	1.65]	1.26	[0.96	1.64]
All others	1.4	[0.84	2.33]	1.17	[0.71	1.92]	0.49*	[0.25	0.96]	0.35**	[0.19	0.67]
Type of facility												
Gov't hosp./polyclinic(ref)												
Other Gov't facility	0.60***	[0.49	0.75]	0.59***	[0.47	0.74]	0.78*	[0.63	0.96]	0.80*	[0.65	0.99]
Only Private/maternity home	0.49***	[0.38	0.64]	0.50***	[0.38	0.65]	1.02	[0.78	1.33]	1.09	[0.84	1.41]
Home/other/DK	0.15***	[0.060	0.37]	0.17***	[0.063	0.44]	0.43	[0.15	1.23]	0.48	[0.18	1.28]
Reason for ANC												
Checkup												
Other (for problem)	1.24*	[1.03	1.49]	1.2	[1.00	1.45]	0.92	[0.73	1.17]	0.93	[0.73	1.17]
Pregnancy complication	0.58**	[0.40	0.84]	0.58**	[0.39	0.86]	0.81	[0.53	1.25]	0.82	[0.53	1.27]
Serious complication	1.86**	[1.23	2.81]	1.81**	[1.15	2.82]	2.55***	[1.63	3.98]	2.57***	[1.64	4.01]

Table 6G5 continued

Prior miscarriage/still birth	0.98	[0.82	1.17]	0.97	[0.81	1.16]	1.11	[0.91	1.35]	1.11	[0.90	1.35]
Current age in years	0.99	[0.97	1.01]	0.99	[0.98	1.01]	1.02	[1.00	1.04]	1.02	[1.00	1.04]
Parity	1.03	[0.97	1.09]	1.03	[0.97	1.09]	0.92**	[0.86	0.98]	0.92**	[0.86	0.98]
Marital Status												
Currently married (ref)												
Cohabiting	0.83	[0.65	1.07]	0.78	[0.60	1.01]	0.71*	[0.53	0.94]	0.74*	[0.55	0.99]
Previously married	1.09	[0.79	1.51]	1.11	[0.80	1.55]	1.22	[0.86	1.72]	1.25	[0.88	1.78]
Never married	1.17	[0.83	1.65]	1.06	[0.76	1.49]	1.07	[0.76	1.50]	1.12	[0.80	1.59]
Married before 19years	1.07	[0.91	1.25]	1.06	[0.90	1.24]	0.9	[0.77	1.05]	0.89	[0.76	1.04]
Female household head	0.95	[0.78	1.15]	0.92	[0.76	1.12]	1.13	[0.90	1.41]	1.07	[0.86	1.34]
Ever contraception	1.60***	[1.34	1.91]	1.46***	[1.23	1.75]	1.29**	[1.07	1.56]	1.24*	[1.03	1.51]
Know family planning source	1.32***	[1.13	1.54]	1.25**	[1.07	1.46]	0.97	[0.83	1.15]	0.91	[0.77	1.07]
Religious affiliation												
Orthodox Christian (ref)												
Other Christian	1.01	[0.84	1.22]	1.08	[0.90	1.30]	1.09	[0.87	1.35]	1.08	[0.87	1.34]
Moslem	1.44*	[1.05	1.97]	1.56*	[1.10	2.20]	0.97	[0.63	1.49]	1.03	[0.71	1.50]
Traditionalist /other	1.13	[0.85	1.50]	1.2	[0.90	1.61]	0.60**	[0.41	0.88]	0.59**	[0.40	0.86]
Ethnicity												
Akan												
Ga/Dangme/Guan	0.43***	[0.32	0.58]	0.74	[0.53	1.02]	0.78	[0.56	1.09]	0.8	[0.56	1.13]
Ewe	0.50***	[0.38	0.67]	0.78	[0.58	1.05]	0.67*	[0.49	0.92]	0.72	[0.51	1.02]
Mole-Dagbani/Hausa	0.38***	[0.27	0.54]	0.47***	[0.32	0.68]	0.68	[0.42	1.08]	0.89	[0.55	1.42]
Grussi/Gruma	0.68*	[0.46	0.99]	0.67*	[0.45	0.98]	0.79	[0.52	1.18]	0.73	[0.45	1.18]
Other/4missing	0.54**	[0.38	0.78]	0.44***	[0.28	0.69]	1.11	[0.62	2.00]	0.99	[0.57	1.72]
Watches television												
At least once a week (ref)												
Less than once a week	0.97	[0.77	1.22]	1	[0.78	1.27]	0.84	[0.64	1.10]	0.82	[0.63	1.08]
Not at all/DK	0.88	[0.72	1.07]	0.89	[0.73	1.08]	1.04	[0.80	1.34]	0.99	[0.77	1.27]

Table 6G5 continued

Region												
Greater Accra (ref)												
Central				1.5	[0.95	2.38]			0.79	[0.48	1.30]	
Western				7.84***	[4.59	13.4]			0.61*	[0.37	1.00]	
Volta				1.57*	[1.05	2.36]			0.68	[0.43	1.07]	
Eastern				1.71**	[1.21	2.42]			0.76	[0.53	1.08]	
Ashanti				2.67***	[1.84	3.87]			0.87	[0.55	1.37]	
Brong Ahafo				4.18***	[2.55	6.86]			0.87	[0.52	1.44]	
Northern				1.54	[0.98	2.43]			0.38***	[0.22	0.64]	
Upper east				4.31***	[2.58	7.19]			1.33	[0.74	2.41]	
Upper west				2.88***	[1.59	5.22]			1.56	[0.71	3.43]	
Constant	2.22**	[1.27	3.90]	0.82	[0.44	1.54]	0.77	[0.40	1.48]	0.97	[0.47	2.01]
N	4,868			4,868			4,868		4,868			

Notes: *p<0.05, ** p<0.01, *** p<0.001.

Table 6G6: Multilevel Logistic Regression of Health facility delivery on quality of ANC, Place of residence, SES and relevant confounders, GMHS

<i>Independent variables</i>	<i>Delivery in a Health facility : OR[95% CI]</i>											
	Attended ANC at least once						Full sample					
	Model without region			Model with region			Model without region			Model with region		
<i>Fixed effects</i>												
Quality of ANC score												
0-7 (ref)												
8 or 9	1.13	[0.95	1.33]	1.09	[0.92	1.30]	1.12	[0.94	1.32]	1.08	[0.91	1.29]
Place of residence:												
Rural (ref)												
Urban	4.16***	[3.15	5.49]	3.98***	[3.03	5.22]	4.22***	[3.20	5.58]	4.05***	[3.09	5.32]
Years of sch. centered	1.08***	[1.05	1.10]	1.08***	[1.05	1.10]	1.07***	[1.05	1.10]	1.07***	[1.05	1.10]
Household wealth Index												
Poorest (ref)												
Poorer/Middle	1.29*	[1.03	1.61]	1.36**	[1.09	1.71]	1.29*	[1.03	1.61]	1.37**	[1.09	1.71]
Rich/Richest	2.24***	[1.66	3.03]	2.35***	[1.74	3.18]	2.26***	[1.68	3.06]	2.37***	[1.75	3.21]
Number of ANC visits												
One to three												
Four or more(ref)	2.88***	[2.32	3.56]	2.90***	[2.34	3.59]	2.88***	[2.32	3.56]	2.90***	[2.34	3.59]
Trimester of first ANC												
First trimester (ref)												
Second trimester	0.85	[0.72	1.00]	0.87	[0.74	1.03]	0.85	[0.72	1.00]	0.87	[0.74	1.03]
Third trimester	0.87	[0.56	1.35]	0.89	[0.58	1.38]	0.87	[0.56	1.35]	0.89	[0.58	1.38]
DK trimester	0.80	[0.079	8.08]	0.88	[0.083	9.38]	0.83	[0.081	8.43]	0.92	[0.086	9.75]
ANC provider												
Nurse (ref)												
Doctor	1.18	[0.94	1.47]	1.16	[0.93	1.45]	1.17	[0.94	1.46]	1.16	[0.93	1.44]
All others	0.46**	[0.27	0.77]	0.41***	[0.24	0.69]	0.45**	[0.27	0.77]	0.41***	[0.24	0.69]
Type of facility												
Gov't hospital/polyclinic(ref)												
Other Gov't facility	0.81*	[0.67	0.98]	0.82*	[0.68	1.00]	0.81*	[0.67	0.98]	0.83	[0.68	1.00]
Only Private/maternity home	1.14	[0.88	1.48]	1.16	[0.89	1.50]	1.12	[0.87	1.46]	1.14	[0.88	1.48]
Home/other/DK	0.23**	[0.091	0.57]	0.24**	[0.097	0.60]	0.23**	[0.091	0.58]	0.24**	[0.097	0.61]
Reason for ANC												
Checkup												
Other (for problem)	0.84	[0.68	1.03]	0.84	[0.68	1.03]	0.84	[0.68	1.03]	0.83	[0.68	1.02]

Table 6G6 continued

Pregnancy complication	0.75	[0.49	1.15]	0.76	[0.50	1.17]	0.76	[0.50	1.16]	0.77	[0.51	1.17]
Serious complication	2.56***	[1.62	4.07]	2.55***	[1.61	4.04]	2.56***	[1.63	4.04]	2.55***	[1.62	4.01]
Prior miscarriage/still birth	1.23*	[1.01	1.49]	1.23*	[1.01	1.50]	1.22*	[1.00	1.49]	1.23*	[1.01	1.49]
Current age in years	1.03**	[1.01	1.05]	1.03**	[1.01	1.05]	1.03**	[1.01	1.05]	1.03**	[1.01	1.05]
Parity	0.92**	[0.86	0.98]	0.92**	[0.86	0.98]	0.92**	[0.87	0.98]	0.92**	[0.87	0.98]
Marital Status												
Currently married (ref)												
Cohabiting	0.73**	[0.58	0.92]	0.73**	[0.57	0.92]	0.70**	[0.56	0.89]	0.70**	[0.56	0.89]
Previously married	1.12	[0.82	1.55]	1.13	[0.82	1.56]	1.05	[0.77	1.44]	1.06	[0.77	1.45]
Never married	1.39	[0.97	1.99]	1.39	[0.97	2.00]	1.38	[0.97	1.98]	1.38	[0.97	1.98]
Married before 19years	0.94	[0.79	1.13]	0.94	[0.79	1.12]	0.95	[0.79	1.13]	0.94	[0.79	1.12]
Female household head	1.08	[0.89	1.33]	1.06	[0.87	1.30]	1.08	[0.88	1.32]	1.06	[0.87	1.29]
Ever contraception	1.21*	[1.02	1.45]	1.19	[1.00	1.43]	1.22*	[1.02	1.45]	1.20*	[1.00	1.43]
Know family planning source	1.02	[0.87	1.20]	0.99	[0.85	1.16]	1.04	[0.89	1.21]	1.01	[0.86	1.18]
Religious affiliation												
Orthodox Christian (ref)												
Other Christian	1.02	[0.84	1.23]	1.02	[0.84	1.23]	1.01	[0.83	1.22]	1.01	[0.83	1.22]
Moslem	0.97	[0.71	1.34]	1.04	[0.76	1.43]	0.97	[0.71	1.33]	1.04	[0.76	1.42]
Traditionalist /other	0.62**	[0.45	0.85]	0.62**	[0.45	0.85]	0.61**	[0.44	0.83]	0.61**	[0.44	0.83]
Ethnicity												
Akan												
Ga/Dangme/Guan	0.88	[0.64	1.21]	0.88	[0.63	1.22]	0.86	[0.62	1.18]	0.86	[0.62	1.21]
Ewe	0.72*	[0.53	0.97]	0.73	[0.52	1.02]	0.72*	[0.53	0.97]	0.74	[0.53	1.04]
Mole-Dagbani/Hausa	0.67*	[0.45	0.98]	0.75	[0.49	1.13]	0.65*	[0.44	0.96]	0.73	[0.48	1.11]
Grussi/Gruma	0.82	[0.57	1.19]	0.78	[0.53	1.15]	0.79	[0.55	1.14]	0.75	[0.51	1.11]
Other/4missing	1.00	[0.67	1.48]	0.94	[0.63	1.41]	0.98	[0.66	1.45]	0.93	[0.62	1.38]
Watches television												
At least once a week (ref)												
Less than once a week	0.76*	[0.59	1.00]	0.76*	[0.58	0.99]	0.78	[0.60	1.02]	0.78	[0.60	1.01]
Not at all/DK	0.90	[0.73	1.10]	0.89	[0.72	1.09]	0.90	[0.74	1.11]	0.89	[0.73	1.09]

Table 6G6 continued

Region												
Greater Accra (ref)												
Central				0.68	[0.37	1.26]				0.68	[0.36	1.27]
Western				0.73	[0.39	1.39]				0.75	[0.40	1.43]
Volta				0.70	[0.37	1.33]				0.70	[0.37	1.33]
Eastern				0.84	[0.48	1.48]				0.86	[0.49	1.51]
Ashanti				0.95	[0.53	1.70]				1.01	[0.57	1.82]
Brong Ahafo				0.83	[0.45	1.55]				0.84	[0.45	1.57]
Northern				0.32**	[0.16	0.64]				0.32**	[0.16	0.64]
Upper east				1.27	[0.60	2.70]				1.30	[0.61	2.77]
Upper west				1.64	[0.73	3.67]				1.67	[0.74	3.75]
Constant	0.19***	[0.10	0.37]	0.24***	[0.11	0.53]	0.20***	[0.10	0.38]	0.24***	[0.11	0.53]
<i>Random effects</i>												
District variance	0.43***	[0.29	0.65]	0.32***	[0.18	0.57]	0.45***	[0.30	0.66]	0.33***	[0.19	0.57]
Cluster variance	0.62***	[0.49	0.78]	0.59***	[0.46	0.75]	0.63***	[0.50	0.79]	0.60***	[0.47	0.76]
N	4868			4868			5042			5042		

Notes: *p<0.05, ** p<0.01, *** p<0.001.

Table 6W1: Bivariate analysis: proportion of women assisted by a SBA for each, WHS, (2003), N=1,671

<i>Variables</i>	Ghana			Burkina Faso			Total		
	<i>N</i>	<i>Percent</i>	<i>p-v</i>	<i>N</i>	<i>Percent</i>	<i>p-v</i>	<i>N</i>	<i>Percent</i>	<i>p-v</i>
Total	648	57.3		1,023	67.5		1,671	63.5	
ANC quality score			***			***			**
0 to 2 services	305	49.2		894	65.1		1,199	61.1	
All 3 services	343	64.4		129	83.7		472	69.7	
Setting			***			***			***
Rural	409	43.5		574	50.0		983	47.3	
Urban	239	80.8		449	89.8		688	86.6	
Education			***			***			***
No formal schooling	219	46.6		811	61.3		1,030	58.2	
Some formal schooling	429	62.7		212	91.0		641	72.1	
Less than primary sch.	103	68.9		86	84.9		189	76.2	
Primary school completed	292	57.9		65	90.8		357	63.9	
At least Secondary sch.	34	85.3		61	100.0		95	94.7	
Wealth Tertiles			***			***			***
Lower	191	41.9		443	60.1		634	54.6	
Middle	156	50.6		362	65.8		518	61.2	
Upper	301	70.4		218	85.3		519	76.7	
Type of occupation⁵			***			***			***
Not working for pay	80	67.5		644	68.2		724	68.1	
Professional ⁶	38	97.4		24	100.0		62	98.4	
Service/sales ⁷	232	69.0		183	77.1		415	72.5	
Agricultural worker ⁸	298	40.3		172	50.0		470	43.8	
No. of ANC visits			***			***			***
1-3 visits	156	31.4		618	62.0		774	55.8	
Four or more	492	65.5		405	75.8		897	70.1	
Most frequent ANC provider			***			***			***
Doctor	103	81.6		196	66.8		299	71.9	
Nurse	529	54.3		738	71.0		1,267	64.0	
All others	16	0.0		89	39.3		105	33.3	
Age in years						**			**
18-19	9	44.4		71	60.6		80	58.8	
20-29	263	60.5		545	70.1		808	67.0	
30-39	269	56.1		317	69.1		586	63.1	
40-49yrs	107	53.3		90	51.1		197	52.3	
Marital status						*			**
Currently married	529	55.8		954	66.8		1,483	62.9	
Never married/Cohabiting	60	71.7		42	85.7		102	77.5	
Separated/widowed/divorced	59	55.9		27	63.0		86	58.1	
Number of children			**			**			***
None	146	67.1		36.0	61.1		182	65.9	
1-2	177	63.3		439.0	72.2		616	69.6	
3-4	150	52.7		274.0	67.9		424	62.5	
5 or more	175	46.9		274.0	60.2		449	55.0	
Diagnosed with a chronic condn.									
No	546	55.9		758	68.5		1,304	63.2	
Yes	102	64.7		265	64.5		367	64.6	

Table 6W1 continued

Self-Rated Health Status³			**				61.8
Very good(1)	248	65.3		239	66.1	487	65.7
Good	261	52.1		538	68.2	799	63.0
Moderate to bad	139	52.5		246	67.1	385	
Moderate	115	51.3		207	67.6	322	61.8
Bad	21	61.9		38	65.8	59	64.4
Very bad(5)	3	33.3		1	0.0	4	25.0
Satisfaction with Health system⁴							
Dissatisfied	148	54.1		169	65.7	317	60.3
Very dissatisfied (1)	9	88.9		20.0	70.0	29	75.9
Fairly dissatisfied	39	53.9		52.0	69.2	91	62.6
Neither satisfied	100	51.0		97.0	62.9	197	56.9
Fairly satisfied	281	58.4		668	68.7	949	65.7
Very satisfied (5)	219	58.0		186	64.5	405	61.0
Inpatient encounter in last 5 years			***			***	***
No	411	51.6		638	56.0	1,049	54.2
Yes	237	67.1		385	86.5	622	79.1
Reason for seeking inpatient care			***			***	***
High fever, severe diarrhea	78	56.4		76	63.2	154	59.7
Childbirth	65	93.9		237	97.1	302	96.4
Other	85	56.5		53	67.9	138	60.9
No inpatient/Missing	420	51.9		657	57.2	1,077	55.2
Rating travel time to health facility			***			***	***
Bad	94	63.8		126	77.8	220	71.8
Good	134	70.9		238	90.3	372	83.3
No inpatient/Missing	420	51.4		659	57.2	1,079	55.0
Rating interpersonal quality of care			***			***	***
Bad	86	67.4		175	88.0	261	81.2
Good	113	71.7		165	86.7	278	80.6
No inpatient/Missing	449	51.7		683	57.5	1,132	55.2
Rating technical quality of care			***			***	***
Inadequate	195	65.1		297	87.2	492	78.5
Adequate	46	76.1		100	84.0	146	81.5
No inpatient/Missing	407	51.4		626	55.4	1,033	53.8

Notes: pv = p-value; refers to within group differences using ANOVA: * p<0.05, ** p<0.01 *** p<0.001

Table 6W2 Multilevel binary logistic regression of use of SBAs on Quality of ANC, Place of residence, Education and relevant confounders, WHS, N=1,671

<i>Independent variables</i>	<i>Use of SBA : OR[95% CI]</i>					
	Bivariate			Multivariate		
<i>Fixed effects</i>						
Quality of ANC score						
Bad (score=0-2) (ref)						
Good (score=3)	1.49	[1.00	2.22]	1.41	[0.92	2.16]
Place of Residence						
Rural (ref)						
Urban	14.0***	[4.75	41.2]	7.02***	[2.62	18.8]
Education						
None (ref)						
Some	1.72*	[1.11	2.66]	1.30	[0.81	2.08]
Wealth Index						
Lower tertile (ref)						
Middle tertile	1.33	[0.95	1.86]	1.24	[0.87	1.77]
Upper tertile	1.79**	[1.18	2.71]	1.38	[0.88	2.16]
Occupation						
Not working (ref)						
Professional	35.6**	[3.19	397.0]	33.3**	[2.81	395.8]
Service/sales/technician	0.98	[0.63	1.52]	0.94	[0.59	1.51]
Agricultural/fishery worker	0.58*	[0.37	0.91]	0.68	[0.42	1.10]
Number of ANC visits						
1 - 3 ANC visits (ref)						
4 or more ANC visits	2.47***	[1.76	3.46]	2.01***	[1.41	2.86]
ANC provider						
Nurse (ref)						
Doctor	1.73*	[1.07	2.82]	1.28	[0.77	2.14]
Other provider	0.32***	[0.18	0.59]	0.39**	[0.20	0.73]
Current age in years	0.98*	[0.96	1.00]	1.00	[0.97	1.03]
Marital Status						
Currently Married (ref)						
Not currently married	0.92	[0.55	1.54]	1.04	[0.60	1.82]
Parity	0.91**	[0.86	0.97]	0.90*	[0.83	0.98]
Any diagnosed chronic condition	1.01	[0.70	1.44]	0.91	[0.62	1.33]
Self-Rated Health Status						
Very good(ref)						
Good	1.24	[0.86	1.78]	1.11	[0.76	1.63]
Moderate to bad	1.14	[0.75	1.74]	1.08	[0.69	1.71]
Satisfaction with Health system						
Dissatisfied (ref)						
Fairly satisfied	1.45	[0.97	2.17]	1.47	[0.96	2.26]
Very satisfied	1.54	[0.97	2.43]	1.70*	[1.05	2.76]
Perceived health service accessibility						
Bad (ref)						
Good	2.20***	[1.38	3.50]	2.09**	[1.30	3.37]
Missing(No inpatient encounter)	3.79***	[2.47	5.81]	3.38***	[2.17	5.27]
Ghana	0.23	[0.039	1.36]	0.22*	[0.067	0.75]

Table 6W2 continued

Constant	2.77**	[1.29	5.97]	0.81	[0.20	3.32]
<hr/> <i>Random effects</i> <hr/>						
	<i>For null model</i>					
Strata variance	1.66**	[1.17	2.36]	0.86	[0.52	1.41]
Cluster variance	1.58***	[1.31	1.91]	1.53***	[1.25	1.86]
N	1671				1671	

Notes: *p<0.05, ** p<0.01, *** p<0.001.

Table 6W3: Multilevel binary logistic regression of Quality of Antenatal care (ANC) on Place of residence, Education and relevant confounders, WHS, N=1,671

<i>Independent variables</i>	Quality of ANC : OR [95% CI]								
	Bivariate			Multivariate					
				<i>Full unconditional</i>			<i>Full Conditional</i>		
<i>Fixed effects</i>									
Place of Residence									
Rural (ref)									
Urban	1.30	[0.49	3.45]	1.57	[0.82	3.01]	4.62*	[1.41	15.2]
Education									
None (ref)									
Some	1.53*	[1.10	2.13]	1.43*	[1.01	2.01]	2.07**	[1.25	3.45]
Wealth Index									
Lower tertile (ref)									
Middle tertile	1.15	[0.81	1.64]	1.02	[0.71	1.47]	1.01	[0.70	1.45]
Upper tertile	1.15	[0.81	1.64]	0.89	[0.61	1.29]	0.86	[0.59	1.25]
Occupation									
Not working (ref)									
Professional	0.82	[0.39	1.69]	0.57	[0.27	1.22]	0.51	[0.24	1.08]
Service/sales/technician	0.84	[0.56	1.24]	0.71	[0.47	1.07]	0.72	[0.48	1.09]
Agricultural/fisheries	0.57*	[0.36	0.90]	0.54*	[0.34	0.87]	0.52**	[0.32	0.83]
Number of ANC visits									
1 - 3 ANC visits (ref)									
4 or more ANC visits	1.95***	[1.43	2.65]	1.76***	[1.28	2.41]	1.75***	[1.27	2.40]
ANC provider									
Nurse (ref)									
Doctor	1.60*	[1.08	2.36]	1.61*	[1.08	2.42]	1.64*	[1.09	2.45]
Other provider	0.26**	[0.10	0.67]	0.33*	[0.13	0.85]	0.34*	[0.13	0.88]
Current age in years	1.01	[0.99	1.03]	1.00	[0.98	1.03]	1.00	[0.98	1.03]
Marital Status									
Currently Married (ref)									
Not currently married	1.01	[0.67	1.51]	0.97	[0.64	1.47]	0.96	[0.63	1.46]
Parity	1.02	[0.96	1.08]	1.05	[0.97	1.13]	1.05	[0.97	1.13]
Any diagnosed chronic condition									
	1.00	[0.71	1.41]	0.95	[0.67	1.35]	0.94	[0.66	1.34]
Self-Rated Health Status									
Very good(ref)									
Good	1.005	[0.723,1.397]		1.04	[0.74	1.46]	1.02	[0.73	1.43]
Moderate to bad	0.991	[0.671,1.463]		0.96	[0.64	1.44]	0.93	[0.62	1.40]
Satisfaction with Health system									
Dissatisfied (ref)									
Fairly satisfied	1.067	[0.738,1.544]		1.10	[0.75	1.60]	1.11	[0.76	1.61]
Very satisfied	1.081	[0.717,1.629]		1.06	[0.70	1.61]	1.05	[0.69	1.60]
Perceived health service accessibility									
Bad (ref)									
Good	0.98	[0.65	1.49]	0.90	[0.59	1.38]	0.93	[0.61	1.41]
No inpatient/missing	1.14	[0.80	1.61]	1.01	[0.71	1.45]	1.03	[0.72	1.47]

Table 6W3 continued

Ghana	7.80***	[3.40	17.9]	9.25***	[4.14	20.6]	33.1***	[10.4	105.1]
Country Interactions									
Ghana*Some education							0.50*	[0.26	0.97]
Ghana*Urban							0.26*	[0.068	0.99]
Constant				0.060***	[0.020	0.18]	0.024***	[0.0069	0.083]
<i>Random effects</i>									
	<i>For null model</i>								
Strata variance	1.08	[0.77	1.53]	0.57*	[0.35	0.91]	0.45*	[0.24	0.83]
Cluster variance	0.87	[0.65	1.18]	0.81	[0.58	1.13]	0.81	[0.58	1.13]
N				1671					

Notes: *p<0.05, ** p<0.01, *** p<0.001.

Table6W4.1: Binary logistic regression of Use of skilled birth attendants and quality of ANC on Place of residence, Education and relevant confounders, WHS, N=1,671

<i>Independent variables</i>	Use of SBA		Quality of ANC			
	<i>Unconditional model</i>		<i>Unconditional</i>		<i>Conditional model</i>	
	<i>Unstandardized coefficients (robust SE)</i>					
Quality of ANC score						
Bad (score=0-2) (ref)						
Good (score=3)	0.36*	(0.16)				
Place of Residence						
Rural (ref)						
Urban	1.40***	(0.15)	0.65***	(0.15)	1.38***	(0.26)
Education						
None (ref)						
Some	0.38*	(0.17)	0.37*	(0.15)	0.60*	(0.24)
Household wealth Index						
Lower tertile (ref)						
Middle tertile	0.14	(0.14)	0.086	(0.16)	0.044	(0.17)
Upper tertile	0.45**	(0.17)	0.021	(0.17)	-0.052	(0.17)
Occupation						
Not working (ref)						
Professional	3.21**	(1.10)	-0.47	(0.35)	-0.62	(0.33)
Service/sales/technician	0.058	(0.17)	-0.41*	(0.19)	-0.40*	(0.19)
Agricultural/fishery worker	-0.36*	(0.16)	-0.46*	(0.19)	-0.65***	(0.20)
Number of ANC visits						
1 - 3 ANC visits (ref)						
4 or more ANC visits	0.50***	(0.13)	0.50***	(0.14)	0.51***	(0.14)
ANC provider						
Nurse (ref)						
Doctor	0.014	(0.17)	0.43*	(0.17)	0.51**	(0.17)
Other provider	-1.08***	(0.25)	-0.99*	(0.44)	-0.86	(0.45)
Current age in years	0.0079	(0.011)	0.0027	(0.011)	0.0038	(0.011)
Marital Status						
Currently Married (ref)						
Not currently married	0.097	(0.21)	0.085	(0.19)	0.029	(0.18)
Parity	-0.084**	(0.032)	0.037	(0.033)	0.039	(0.033)
Any diagnosed chronic condition	-0.032	(0.15)	0.046	(0.16)	0.035	(0.16)
Self-Rated Health Status						
Very good(ref)						
Good	-0.15	(0.14)	0.049	(0.15)	-0.0030	(0.15)
Moderate to bad	-0.15	(0.18)	-0.042	(0.18)	-0.11	(0.18)
Satisfaction with Health system						
Dissatisfied (ref)						
Fairly satisfied	0.35*	(0.16)	0.16	(0.18)	0.13	(0.17)
Very satisfied	0.27	(0.19)	0.18	(0.19)	0.14	(0.19)
Perceived health service accessibility						
Bad (ref)						
Good	0.70***	(0.19)	0.0053	(0.18)	-0.025	(0.18)
No inpatient/missing	1.00***	(0.17)	0.088	(0.17)	0.060	(0.16)
Ghana	-1.19***	(0.21)	2.12***	(0.18)	3.17***	(0.26)

Table 6W4.1 continued

Country Interactions				
Ghana*Some education				-0.54 (0.30)
Ghana*Urban				-1.29*** (0.30)
Constant	-0.36	(0.32)	-2.93***	(0.35) -3.42*** (0.37)
N	1671		1671	1671

Notes: *p<0.05, ** p<0.01, *** p<0.001.

The unconditional model for the ANC quality of care regression is used for the mediation analysis since the dependent variable and the potential mediator should have the same set of predictors

Table 6W4.2: Mediation analysis

Does quality of ANC Mediate the effect of urban residence on use of SBAs				
		coef.	se	p-value:
Direct effect of urban on use of SBA ^a	c'	1.400	0.150	<0.001
Direct effect of quality of care on use of SBAs ^b	b	0.360	0.160	<0.05
Direct effect of urban on quality of ANC ^c	a	0.650	0.150	<0.001
Effect of urban on use of SBAs that is through quality of care (indirect effect of education)	ab	0.234		
Ratio of the indirect to direct effect	ab/c'	0.167		
Proportion of total effect mediated	ab/(ab+c')	0.143		
Significance of mediated effect		Test statistic	se	p-value:
<i>Sobel Test</i>		1.997	0.117	0.046
<i>Goodman</i>		2.040	0.115	0.041

Does quality of ANC Mediate the effect of education on use of SBAs				
		coef.	se	p-value:
Direct effect of education on use of SBA ^d	c'	0.380	0.170	<0.05
Direct effect of quality of care on use of SBAs ^b	b	0.360	0.160	<0.05
Direct effect of education on quality of ANC ^e	a	0.370	0.150	<0.05
Effect of education on use of SBAs that is through quality of care (indirect effect of education)	ab	0.133		
Ratio of the indirect to direct effect	ab/c'	0.351		
Proportion of total effect mediated	ab/(ab+c')	0.259		
Significance of mediated effect		Test statistic	se	p-value:
<i>Sobel Test</i>		1.662	0.080	0.096
<i>Goodman</i>		1.742	0.076	0.081

Note: ^a this is the coefficient for urban on use of SBAs from table 6W4.1

^b this is the coefficient for quality of ANC on use of SBAs from table 6W4.1

^c this is the coefficient for urban on quality of ANC from table 6W4.1

^d this is the coefficient for education on use of SBAs from table 6W4.1

^e this is the coefficient for education on quality of ANC from table 6W4.1

The coefficient for quality of care are from the unconditional models

Table 6W5: Logistic regression of health facility delivery on quality of ANC, Place of residence, Education and relevant confounders, WHS,

<i>Independent variables</i>	Delivery in a health facility : OR[95% CI]											
	Attended ANC at least once						Full Sample					
	<i>Multilevel</i>		<i>Single level/robust std. errors</i>				<i>Multilevel</i>		<i>Single level/robust std. errors</i>			
<i>Fixed effects</i>												
Quality of ANC score												
Bad (score=0-2) (ref)												
Good (score=3)	1.43	[0.95	2.16]	1.36	[1.00	1.85]	1.28	[0.85	1.92]	1.27	[0.93	1.75]
Place of Residence												
Rural (ref)												
Urban	7.63***	[3.43	17.0]	4.37***	[3.30	5.79]	7.75***	[3.32	18.1]	4.70***	[3.56	6.19]
Education												
None (ref)												
Some	1.32	[0.84	2.07]	1.41*	[1.02	1.95]	1.38	[0.89	2.14]	1.45*	[1.06	1.98]
Household wealth Index												
Lower tertile (ref)												
Middle tertile	1.23	[0.87	1.75]	1.14	[0.87	1.49]	1.25	[0.90	1.75]	1.18	[0.91	1.53]
Upper tertile	1.38	[0.89	2.13]	1.45*	[1.05	2.01]	1.37	[0.90	2.08]	1.51*	[1.09	2.10]
Occupation												
Not working (ref)												
Professional	7.51**	[1.64	34.3]	5.37**	[1.75	16.5]	6.98**	[1.75	27.9]	4.51**	[1.66	12.2]
Service/sales/technician	0.88	[0.56	1.39]	0.94	[0.68	1.31]	0.94	[0.61	1.47]	0.98	[0.70	1.37]
Agricultural/fishery worker	0.67	[0.42	1.07]	0.61**	[0.44	0.83]	0.79	[0.50	1.24]	0.67*	[0.49	0.92]
Attended some ANC												
Number of ANC visits												
1 - 3 ANC visits (ref)												
4 or more ANC visits	2.25***	[1.59	3.18]	1.83***	[1.41	2.37]	2.20***	[1.56	3.11]	1.79***	[1.37	2.33]
ANC provider												
Nurse (ref)												
Doctor	1.24	[0.76	2.02]	1.07	[0.78	1.48]	1.24	[0.76	2.02]	1.1	[0.79	1.52]
Other provider	0.44*	[0.23	0.85]	0.37***	[0.22	0.60]	0.40**	[0.21	0.75]	0.32***	[0.20	0.53]
Current age in years	1.01	[0.98	1.04]	1.01	[0.99	1.03]	1	[0.98	1.03]	1.01	[0.99	1.03]

Table 6W5 continued

Marital Status												
Currently Married (ref)												
Not currently married	0.94	[0.55	1.61]	0.96	[0.64	1.45]	1	[0.60	1.67]	1.05	[0.70	1.58]
Parity	0.92*	[0.85	1.00]	0.94	[0.89	1.00]	0.93	[0.86	1.00]	0.94*	[0.89	1.00]
Any diagnosed chronic condition	0.81	[0.56	1.18]	0.89	[0.67	1.19]	0.96	[0.67	1.38]	1.02	[0.77	1.36]
Self-Rated Health Status												
Very good(ref)												
Good	0.92	[0.63	1.33]	0.77	[0.58	1.02]	0.85	[0.60	1.22]	0.73*	[0.56	0.96]
Moderate to bad	0.91	[0.59	1.43]	0.75	[0.53	1.05]	0.88	[0.57	1.35]	0.72	[0.52	1.00]
Satisfaction with Health system												
Dissatisfied (ref)												
Fairly satisfied	1.60*	[1.06	2.43]	1.53**	[1.11	2.11]	1.63*	[1.09	2.44]	1.50*	[1.10	2.04]
Very satisfied	1.82*	[1.13	2.91]	1.47*	[1.02	2.11]	1.75*	[1.11	2.76]	1.43*	[1.00	2.05]
Perceived health service accessibility												
Bad (ref)												
Good	2.08**	[1.30	3.31]	1.92***	[1.34	2.74]	2.00**	[1.26	3.16]	1.91***	[1.33	2.75]
Missing(No inpatient encounter)	3.33***	[2.17	5.13]	2.60***	[1.87	3.62]	3.39***	[2.23	5.15]	2.62***	[1.90	3.63]
Ghana	0.19***	[0.074	0.51]	0.31***	[0.21	0.46]	0.20**	[0.073	0.57]	0.34***	[0.23	0.50]
Constant	0.56	[0.17	1.86]	0.62	[0.33	1.16]	0.15**	[0.035	0.62]	0.18***	[0.078	0.43]
<i>Random effects</i>												
Strata variance	0.6	[0.31	1.15]				0.68	[0.38	1.19]			
Cluster variance	1.46***	[1.20	1.78]				1.49***	[1.23	1.80]			
N	1671			1671			2005			2005		

Notes: *p<0.05, ** p<0.01, *** p<0.001.

Chapter 7 figures and tables

Table 7G1: Distribution of variables related to delivery, Ghana Maternal Health Survey, 2007

<i>Variables</i>	Attended ANC at least once, N=4,868					Full analytic sample, N=5,042				
	<i>Unweighted</i>		<i>Weighted</i>			<i>Unweighted</i>		<i>Weighted</i>		
	N	%	proportion	[95% C.I.]		N	%	proportion	[95% C.I.]	
Last Pregnancy outcome										
Live birth	4,791	98.4	0.985	0.981	0.989	4,957	98.3	0.983	0.979	0.988
Stillbirth	77	1.6	0.015	0.011	0.019	85	1.7	0.017	0.012	0.021
Pregnancy duration for still births										
7 months	13	16.9	0.147	.	.	13	15.3	0.130	.	.
8 months	7	9.1	0.091	.	.	10	11.8	0.112	.	.
9 months	53	68.8	0.700	.	.	58	68.2	0.705	.	.
10 months	4	5.2	0.061	.	.	4	4.7	0.054	.	.
Total	77	100.0				85	100.0			
Past Stillbirth										
No	4,648	95.5	0.956	0.950	0.962	4,819	95.6	0.957	0.951	0.963
Yes	220	4.5	0.044	0.038	0.050	223	4.4	0.043	0.037	0.049
Ever had a miscarriage										
No	4,077	83.8	0.844	0.831	0.856	4,233	84.0	0.845	0.833	0.858
Yes	791	16.3	0.156	0.144	0.169	809	16.1	0.155	0.142	0.167
Past miscarriage or stillbirth										
No	3,853	79.2	0.799	0.785	0.813	4,000	79.3	0.800	0.787	0.814
Yes	1,015	20.9	0.201	0.187	0.215	1,042	20.7	0.200	0.186	0.213
Delivery by SBA										
No	1,992	40.9	0.427	0.395	0.459	2,147	42.6	0.445	0.413	0.477
Yes	2,876	59.1	0.573	0.541	0.605	2,895	57.4	0.555	0.523	0.587
Delivery assisted by										
Doctor	493	10.1	0.096	0.084	0.107	500	9.9	0.093	0.082	0.104
Nurse/Midwife	2,331	47.9	0.467	0.437	0.497	2,342	46.5	0.452	0.422	0.482
Other	2,044	42.0	0.437	0.406	0.469	2,200	43.6	0.455	0.423	0.487
Auxiliary nurse/midwife	52	1.1	0.010	0.006	0.014	53	1.1	0.010	0.006	0.014
Trained TBA	943	19.4	0.201	0.179	0.223	981	19.5	0.202	0.180	0.224
Untrained TBA	421	8.7	0.090	0.075	0.104	462	9.2	0.094	0.079	0.110
Relative/friend	473	9.7	0.105	0.086	0.124	520	10.3	0.111	0.092	0.130
Other/DK	1	0.0	0.000	0.000	0.001	2	0.0	0.001	0.000	0.002
No one	154	3.2	0.031	0.025	0.037	182	3.6	0.037	0.030	0.043

Table 7G1 continued

Delivery in health facility										
No	2,029	41.7	0.437	0.404	0.469	2,186	43.4	0.455	0.422	0.487
Yes	2,839	58.3	0.563	0.531	0.596	2,856	56.6	0.545	0.513	0.578
<i>For deliveries in health facilities (N)</i>	2,839					2,856				
Type of Delivery facility										
Gov't hospital or polyclinic	1,530	53.9	0.538	0.501	0.576	1,539	53.9	0.538	0.501	0.575
Other Gov't facility	689	24.3	0.262	0.227	0.296	691	24.2	0.262	0.227	0.296
Private clinic/maternity home	620	21.8	0.200	0.172	0.228	626	21.9	0.200	0.172	0.228
Delivery assisted by										
Doctor	491	17.3	0.169	0.150	0.188	498	17.4	0.170	0.150	0.189
Nurse/Midwife	2,265	79.8	0.804	0.783	0.825	2,274	79.6	0.804	0.783	0.825
Auxiliary nurse/midwife	41	1.4	0.014	0.008	0.020	42	1.5	0.014	0.008	0.020
Trained TBA	34	1.2	0.011	0.006	0.015	34	1.2	0.011	0.006	0.015
Untrained TBA	1	0.0	0.000	0.000	0.001	1	0.0	0.000	0.000	0.001
Relative/friend	2	0.1	0.001	-0.001	0.002	2	0.1	0.001	-0.001	0.002
No one	5	0.2	0.001	0.000	0.003	5	0.2	0.001	0.000	0.003
Days at health facility post delivery										
One or less days	993	35.0	0.351	0.330	0.372	997	34.9	0.351	0.330	0.372
Two to three days	821	28.9	0.291	0.270	0.312	826	28.9	0.290	0.269	0.312
Four to six days	387	13.6	0.133	0.118	0.148	391	13.7	0.133	0.118	0.148
A week or more/11 missing	638	22.5	0.225	0.205	0.246	642	22.5	0.226	0.205	0.247
Intervention during delivery										
No	1,702	60.0	0.604	0.580	0.628	1,711	59.9	0.604	0.580	0.627
Yes	1,137	40.1	0.396	0.372	0.420	1,145	40.1	0.396	0.373	0.420
Caesarian delivery	346	12.2	0.121	0.106	0.136	348	12.2	0.121	0.106	0.136
Forceps	94	3.3	0.033	0.025	0.041	94	3.3	0.033	0.025	0.041
Blood transfusion	92	3.2	0.029	0.022	0.035	92	3.2	0.029	0.022	0.035
IV Infusion	1,016	35.8	0.351	0.329	0.374	1,023	35.8	0.352	0.329	0.374
CS/Forceps/Blood	422	14.9	0.147	0.130	0.163	424	14.9	0.147	0.130	0.163

Table 7G2 : Proportion with a stillbirth for each predictor, GMHS

Variable	Attended ANC at least once (N=4,868)			Full sample (N=5,042)				
	Total N	Proportion	[95% CI]		Total N	Proportion	[95% CI]	
Overall	4,868	0.015	0.011	0.019	5,042	0.017	0.012	0.021
ANC attendance								
No	0				174	0.056	0.012	0.100
Yes	4,868	0.015	0.011	0.019	4,868	0.015	0.011	0.019
ANC quality of care score								
7 or less	1,901	0.018	0.012	0.025				
8 or 9	2,967	0.013	0.009	0.018				
No. of ANC visits								
1-3 visits	990	0.021	0.011	0.032				
Four or more	3,878	0.014	0.009	0.018				
Trimester of first ANC visit								
First trimester	2,688	0.014	0.009	0.019				
Second trimester	1,992	0.017	0.011	0.024				
Third trimester	181	0.008	-0.001	0.018				
Don't know	7	.						
Where ANC took place								
Gov't Health facility	4,119	0.017	0.012	0.021				
Gov't hospital or polyclinic	2,200	0.019	0.013	0.025				
Other Gov't facility	1,919	0.014	0.008	0.020				
Private facility/maternity home	703	0.007	0.000	0.013				
Home/other/DK	46	.						
Highest trained ANC provider								
Doctor	1,006	0.023	0.012	0.033				
Nurse	3,743	0.013	0.009	0.018				
All others	119	0.008	-0.008	0.023				
Reason for seeking ANC								
For checkup	4,044	0.015	0.011	0.019				
For a problem/missing	824	0.015	0.006	0.025				
Delivery by SBA								
No	1,992	0.007	0.003	0.010	2,147	0.011	0.006	0.015
Yes	2,876	0.021	0.015	0.028	2,895	0.021	0.015	0.028

Table 7G2 continued

Delivery assisted by								
Doctor	493	0.051	0.029	0.072	500	0.051	0.030	0.072
Nurse/Midwife	2,331	0.016	0.009	0.023	2,342	0.016	0.009	0.022
Other nurses	2,044	0.007	0.003	0.010	2,200	0.010	0.006	0.015
Delivery in health facility								
No	2,029	0.007	0.004	0.011	2,186	0.011	0.006	0.015
Yes	2,839	0.021	0.015	0.028	2,856	0.021	0.015	0.028
Type of Delivery facility								
Gov't hospital or polyclinic	1,530	0.031	0.022	0.041	1,539	0.032	0.022	0.041
Other Gov't facility	689	0.010	0.002	0.018	691	0.010	0.002	0.018
Private clinic/maternity home	620	0.009	0.000	0.018	626	0.009	0.000	0.018
Home/other/DK	2,029	0.007	0.004	0.011	2,186	0.011	0.006	0.015
<i>Risk factors for adverse outcome</i>								
Ever had a miscarriage								
No	4,077	0.015	0.011	0.019	4,233	0.016	0.011	0.020
Yes	791	0.017	0.007	0.028	809	0.022	0.008	0.036
Ever induced abortion								
No	4,101	0.013	0.009	0.017	4,265	0.015	0.010	0.019
Yes	767	0.025	0.013	0.037	777	0.026	0.014	0.038
Past Stillbirth								
No	4,648	0.013	0.010	0.017	4,819	0.015	0.011	0.019
Yes	220	0.054	0.025	0.084	223	0.054	0.025	0.082
Past miscarriage or stillbirth								
No	3,853	0.012	0.009	0.016	4,000	0.013	0.009	0.017
Yes	1,015	0.027	0.015	0.038	1,042	0.030	0.017	0.044
Pregnancy complication								
No	3,818	0.009	0.006	0.012	3,956	0.011	0.007	0.014
Yes	1,050	0.039	0.024	0.053	1,086	0.040	0.026	0.054
Serious pregnancy complication								
No	3,996	0.010	0.007	0.013	4,149	0.011	0.008	0.015
Yes	872	0.041	0.026	0.057	893	0.042	0.027	0.057
Type of Gestation								
Single pregnancy	4,742	0.013	0.010	0.017	4,914	0.015	0.011	0.019
Multiple pregnancy	126	0.085	0.034	0.136	128	0.094	0.042	0.147

Table 7G2 continued

Sibling had a maternal death								
No	4,783	0.014	0.010	0.018	4,956	0.015	0.011	0.020
Yes	85	0.077	0.015	0.139	86	0.075	0.014	0.135
<i>Intervention/Procedure during delivery</i>								
Caesarian delivery								
No	4,522	0.013	0.009	0.017	4,694	0.014	0.010	0.019
Yes	346	0.047	0.021	0.073	348	0.047	0.021	0.073
Forceps delivery								
No	4,774	0.014	0.010	0.018	4,948	0.015	0.011	0.020
Yes	94	0.080	0.023	0.138	94	0.080	0.023	0.138
Blood transfusion								
No	4,776	0.014	0.010	0.018	4,950	0.016	0.012	0.020
Yes	92	0.063	0.011	0.114	92	0.063	0.011	0.114
IV Infusion								
No	3,852	0.010	0.007	0.014	4,019	0.012	0.009	0.016
Yes	1,016	0.034	0.020	0.047	1,023	0.034	0.020	0.047
Any intervention								
No	3,731	0.009	0.006	0.012	3,897	0.011	0.007	0.014
Yes	1,137	0.038	0.025	0.051	1,145	0.038	0.025	0.051
Days at health facility post delivery								
One or less days	993	0.032	0.019	0.045	997	0.032	0.019	0.045
Two to three days	821	0.021	0.009	0.032	826	0.021	0.009	0.032
Four to six days	388	0.017	0.005	0.029	392	0.017	0.005	0.029
A week or more/11 missing	638	0.008	0.000	0.017	642	0.009	0.000	0.017
No HF Del	2,028	0.007	0.004	0.011	2,185	0.011	0.006	0.015
<i>Reproductive Health variables</i>								
Current age in years								
15-19yrs	236	0.020	-0.001	0.040	247	0.022	0.002	0.042
20-24	891	0.011	0.004	0.019	915	0.015	0.006	0.024
25-29	1,138	0.014	0.007	0.021	1,176	0.015	0.008	0.021
30-34	1,082	0.010	0.004	0.015	1,115	0.009	0.004	0.015
35-39	881	0.017	0.006	0.027	913	0.016	0.006	0.026
40-49yrs	640	0.028	0.014	0.043	676	0.033	0.015	0.051

Table 7G2 continued

Marital status								
Currently married	3,510	0.014	0.010	0.019	3,633	0.015	0.010	0.021
Cohabiting	666	0.008	0.001	0.014	687	0.012	0.004	0.021
Previously married	347	0.013	0.001	0.024	364	0.012	0.001	0.023
Never married	345	0.039	0.017	0.061	358	0.044	0.021	0.067
Age at first union								
Less than 19years	2,337	0.010	0.006	0.014	2,445	0.012	0.007	0.016
19 or more years	2,186	0.017	0.010	0.024	2,239	0.018	0.010	0.025
Never in a union	345	0.039	0.017	0.061	358	0.044	0.021	0.067
No. of Pregnancies (Gravidity)								
1-2	1,629	0.013	0.007	0.019	1,669	0.014	0.008	0.019
3-4	1,506	0.011	0.005	0.017	1,549	0.013	0.007	0.020
5plus	1,733	0.021	0.013	0.029	1,824	0.022	0.013	0.031
No. of children born (Parity)								
No children born alive	19	1.000			22	1.000		
1-2	2,028	0.011	0.006	0.015	2,072	0.012	0.007	0.017
3-4	1,471	0.012	0.005	0.019	1,513	0.013	0.006	0.020
5plus	1,350	0.012	0.006	0.019	1,435	0.013	0.005	0.021
No. of children alive								
No children alive	71	0.268	0.158	0.377	78	0.272	0.167	0.377
1-2	2,200	0.011	0.006	0.016	2,246	0.012	0.007	0.018
3-4	1,526	0.012	0.005	0.018	1,573	0.013	0.006	0.020
5plus	1,071	0.012	0.005	0.019	1,145	0.013	0.006	0.020
Ever used contraception								
No	1,780	0.014	0.008	0.021	1,899	0.017	0.009	0.025
Yes	3,088	0.016	0.011	0.020	3,143	0.016	0.011	0.021
Currently using contraception								
No	3,638	0.016	0.011	0.021	3,792	0.018	0.013	0.024
Yes	1,230	0.012	0.005	0.018	1,250	0.011	0.005	0.018
Know family planning source								
No	2,270	0.015	0.009	0.020	2,376	0.016	0.010	0.023
Yes	2,598	0.016	0.010	0.021	2,666	0.017	0.011	0.022

Table 7G2 continued*Sociodemographic factors***Setting**

Rural	2,967	0.011	0.007	0.015	3,115	0.013	0.008	0.018
Urban	1,901	0.023	0.015	0.031	1,927	0.023	0.015	0.031
Large city	654	0.020	0.006	0.035	664	0.020	0.005	0.035
Small city	113	0.024	-0.002	0.051	115	0.024	-0.002	0.050
Town	1,134	0.023	0.013	0.034	1,148	0.025	0.014	0.035

Region

Greater Accra	619	0.010	0.003	0.018	636	0.011	0.003	0.019
Central	429	0.013	0.003	0.023	441	0.015	0.004	0.026
Western	371	0.004	-0.003	0.011	382	0.007	-0.002	0.016
Volta	389	0.008	-0.001	0.018	407	0.008	-0.001	0.017
Eastern	724	0.026	0.010	0.042	744	0.027	0.011	0.043
Ashanti	837	0.017	0.007	0.028	855	0.021	0.008	0.033
Brong Ahafo	486	0.028	0.012	0.045	496	0.028	0.011	0.044
Northern	491	0.013	0.002	0.024	541	0.015	0.001	0.030
Upper East	298	0.007	-0.002	0.016	303	0.007	-0.002	0.016
Upper West	224	0.004	-0.004	0.013	237	0.007	-0.003	0.016

R3M regions

Other regions	2,688	0.013	0.008	0.018	2,807	0.014	0.009	0.020
R3m region	2,180	0.018	0.011	0.025	2,235	0.020	0.012	0.028

Highest Education

None	1,588	0.010	0.004	0.015	1,697	0.013	0.006	0.019
Primary	1,072	0.014	0.006	0.022	1,109	0.016	0.008	0.025
Middle/JSS	1,804	0.019	0.012	0.027	1,830	0.019	0.012	0.027
Secondary/SSS/higher	404	0.022	0.004	0.040	406	0.022	0.004	0.040

Household wealth index

Poorest	1,024	0.016	0.007	0.025	1,097	0.015	0.007	0.023
Poorer	943	0.012	0.005	0.019	994	0.018	0.008	0.027
Middle	930	0.011	0.004	0.017	951	0.010	0.004	0.017
Richer	976	0.014	0.007	0.021	995	0.017	0.009	0.025
Richest	995	0.024	0.013	0.036	1,005	0.024	0.013	0.036

Household head Female

No	3,650	0.014	0.010	0.019	3,790	0.015	0.011	0.020
Yes	1,218	0.017	0.009	0.025	1,252	0.020	0.012	0.029

Table 7G2 continued

Religious affiliation								
Catholic	661	0.015	0.005	0.025	686	0.017	0.007	0.027
Methodist/Presbyterian	652	0.016	0.006	0.026	662	0.016	0.006	0.026
Pentecostal/charismatic	1,444	0.017	0.009	0.024	1,476	0.018	0.010	0.026
Other Christian	810	0.016	0.007	0.024	832	0.017	0.008	0.026
Moslem	863	0.015	0.006	0.023	886	0.018	0.006	0.029
Traditional/other	438	0.009	0.000	0.018	500	0.010	0.001	0.019
Ethnicity								
Akan	2,197	0.016	0.010	0.022	2,238	0.018	0.012	0.025
Ga/Dangme/Guan	504	0.021	0.003	0.039	521	0.020	0.003	0.038
Ewe	615	0.014	0.004	0.024	641	0.013	0.004	0.023
Mole-Dagbani/Hausa	583	0.014	0.004	0.025	604	0.018	0.003	0.032
Grussi/Gruma	534	0.007	0.000	0.014	580	0.007	0.000	0.013
Other/4missing	435	0.018	0.003	0.032	458	0.020	0.005	0.035
Watches television								
At least once a week	2,074	0.021	0.014	0.028	2,116	0.022	0.015	0.029
Less than once a week	536	0.010	0.002	0.018	552	0.012	0.003	0.020
Not at all/DK	2,258	0.011	0.006	0.017	2,374	0.013	0.007	0.019

Table 7G3: Multilevel Bivariate regression of Pregnancy outcome on quality of Antenatal Care and relevant confounders, GMHS,

<i>Independent variables</i>	<i>Attended ANC at least once</i>			<i>Full sample</i>		
	Odds of having a Stillbirth: OR [95% CI]					
<i>Fixed effects</i>						
ANC attendance				0.30**	[0.13	0.66]
Higher ANC Quality (score =8/9)	0.62*	[0.39	0.98]	0.55**	[0.35	0.85]
Quality of ANC score (cont.)	0.85*	[0.74	0.97]	0.84***	[0.77	0.92]
Delivery by a SBA	2.59***	[1.47	4.57]	1.93**	[1.18	3.18]
Type of Delivery assistant						
Doctor	4.15***	[2.43	7.11]	4.27***	[2.51	7.26]
Nurse (nurse)	.			.		
Other provider	0.56	[0.31	1.03]	0.76	[0.44	1.32]
Delivery in a health facility	2.48**	[1.43	4.33]	1.89*	[1.16	3.08]
Type of delivery facility						
Gov't hospital or polyclinic (ref)	.			.		
Other Gov't facility	0.27**	[0.11	0.64]	0.26**	[0.11	0.63]
Only Private facility/maternity home	0.25**	[0.097	0.63]	0.24**	[0.096	0.62]
Home/other/DK	0.26***	[0.15	0.46]	0.34***	[0.21	0.57]
ANC Four or more times	0.66	[0.39	1.11]	0.54*	[0.34	0.87]
Trimester of first ANC						
First trimester (ref)						
Second trimester	1.14	[0.71	1.82]	1.13	[0.71	1.81]
Third trimester	1.10	[0.33	3.65]	1.10	[0.33	3.66]
DK trimester/No ANC				3.38**	[1.49	7.68]
ANC provider						
Nurse (ref)						
Doctor	1.74*	[1.05	2.89]	1.73*	[1.04	2.87]
All others	0.67	[0.090	5.07]	2.55*	[1.19	5.44]
Type of facility						
Gov't hospital or polyclinic (ref)						
Other Gov't facility	0.59*	[0.35	0.98]	0.54*	[0.33	0.89]
Private /maternity home	0.33*	[0.13	0.83]	0.30*	[0.12	0.77]
Home/other/DK (dropped)						
ANC for problem	0.90	[0.48	1.69]	0.90	[0.48	1.69]
Pregnancy complication	3.70***	[2.33	5.88]	3.54***	[2.28	5.50]
Serious complication	3.56***	[2.23	5.69]	3.36***	[2.15	5.27]
Prior Miscarriage	1.13	[0.63	2.05]	1.21	[0.69	2.11]
Past Stillbirth	4.93***	[2.66	9.16]	4.48***	[2.43	8.25]
Past abortion	1.93*	[1.16	3.21]	1.93*	[1.16	3.21]
Multiple gestation	7.45***	[3.64	15.3]	7.55***	[3.80	15.0]
Sibling had a maternal death	6.51***	[2.76	15.3]	6.01***	[2.57	14.1]

Table 7G3 continued

Any intervention during delivery	3.70***	[2.32	5.90]	3.13***	[2.01	4.88]
Caesarian delivery	3.34***	[1.84	6.07]	3.02***	[1.67	5.43]
Forceps delivery	7.11***	[3.30	15.3]	6.64***	[3.09	14.2]
Blood transfusion	4.68***	[1.90	11.5]	4.32**	[1.77	10.6]
IV Infusion	2.75***	[1.71	4.42]	2.40***	[1.52	3.80]
Current age in year groups						
15-19	1.61	[0.62	4.18]	1.13	[0.37	3.46]
20-24	0.91	[0.44	1.89]	0.73	[0.33	1.63]
25-29 (ref)						
30-34	0.82	[0.40	1.66]	0.86	[0.42	1.77]
35-39	0.92	[0.44	1.90]	0.98	[0.47	2.05]
40-49	2.16*	[1.12	4.15]	2.11*	[1.07	4.17]
No. of Pregnancies (Gravidity)						
1 (ref)	.			.		
2	1.22	[0.52	2.88]	0.93	[0.42	2.07]
3	1.05	[0.43	2.55]	1.04	[0.47	2.28]
4	0.96	[0.37	2.46]	0.72	[0.30	1.78]
5plus	1.82	[0.89	3.73]	1.43	[0.75	2.71]
Marital Status						
Currently married (ref)						
Cohabiting	0.58	[0.24	1.37]	0.85	[0.41	1.75]
Previously married	0.95	[0.37	2.42]	0.91	[0.36	2.32]
Never married	2.25*	[1.17	4.34]	2.78***	[1.53	5.06]
Married before 19years	0.78	[0.49	1.24]	0.79	[0.51	1.23]
Female household head	1.21	[0.73	2.02]	1.35	[0.84	2.18]
Ever contraception	1.03	[0.63	1.69]	0.97	[0.61	1.54]
Know family planning source	1.01	[0.64	1.60]	1.02	[0.65	1.58]
Urban residence:	2.05**	[1.25	3.36]	1.98**	[1.23	3.17]
Region						
Greater Accra (ref)						
Central	1.14	[0.39	3.31]	1.18	[0.43	3.24]
Western	0.19	[0.023	1.53]	0.33	[0.069	1.60]
Volta	0.54	[0.14	2.13]	0.47	[0.12	1.83]
Eastern	1.68	[0.70	4.03]	1.60	[0.69	3.72]
Ashanti	1.30	[0.53	3.18]	1.34	[0.57	3.12]
Brong Ahafo	2.16	[0.85	5.47]	1.94	[0.79	4.78]
Northern	1.15	[0.40	3.27]	1.08	[0.40	2.92]
Upper east	0.47	[0.094	2.33]	0.42	[0.086	2.07]
Upper west	0.30	[0.035	2.55]	0.54	[0.11	2.69]
Highest Education						
None	.			.		
Primary	0.99	[0.48	2.04]	1.04	[0.54	1.99]
Middle/JSS	1.56	[0.88	2.80]	1.39	[0.81	2.41]
Secondary/SSS/or higher	1.81	[0.79	4.13]	1.58	[0.71	3.53]
Years of sch. centered	1.05	[1.00	1.11]	1.04	[0.98	1.09]

Table 7G3 continued

Household wealth Index						
Poorest (ref)						
Poorer/Middle	0.76	[0.39	1.48]	0.92	[0.48	1.76]
Rich/Richest	1.29	[0.69	2.43]	1.52	[0.82	2.82]
Religious affiliation						
Orthodox Christian (ref)						
Other Christian	0.78	[0.45	1.32]	0.78	[0.47	1.31]
Moslem	0.85	[0.42	1.72]	0.89	[0.46	1.74]
Traditionalist /other	0.47	[0.16	1.40]	0.50	[0.19	1.33]
Ethnicity						
Akan						
Ga/Dangme/Guan	1.30	[0.63	2.70]	1.13	[0.55	2.30]
Ewe	1.01	[0.48	2.13]	0.86	[0.42	1.79]
Mole-Dagbani/Hausa	0.89	[0.40	2.00]	0.94	[0.45	1.97]
Grussi/Gruma	0.45	[0.15	1.32]	0.37	[0.13	1.07]
Other/4missing	1.03	[0.44	2.44]	1.00	[0.45	2.24]
Watches television						
At least once a week (ref)						
Less than once a week	0.64	[0.28	1.45]	0.66	[0.31	1.43]
Not at all/DK	0.60*	[0.36	0.99]	0.59*	[0.36	0.95]
Constant	0.011***	[0.0073	0.018]	0.012***	[0.0082	0.019]
<i>Random effects for Null models</i>						
Cluster variance	0.86	[0.49	1.51]	0.84	[0.48	1.45]
N	4868			5042		

Notes: *p<0.05, ** p<0.01, *** p<0.001.

Table 7G4: Multilevel regression of Pregnancy outcome on quality of Antenatal Care and relevant confounders, GMHS, N=4868

<i>Independent variables</i>	Bivariate		Multivariate						
			No delivery variables			Includes delivery variables			
	<i>Odds of having a Stillbirth: OR [95% CI]</i>								
<i>Fixed effects</i>									
Higher ANC Quality (score =8/9)	0.62*	[0.39	0.98]	0.55*	[0.33	0.92]	0.50**	[0.30	0.85]
Delivery by a SBA	2.59***	[1.47	4.57]				2.18	[0.32	14.7]
Type of delivery facility									
Gov't hospital or polyclinic (ref)									
Other Gov't facility	0.27**	[0.11	0.64]				0.36*	[0.14	0.93]
Private facility/maternity home	0.25**	[0.097	0.63]				0.25**	[0.096	0.67]
Home/other/DK	0.26***	[0.15	0.46]				0.81	[0.12	5.44]
Any intervention during delivery	3.70***	[2.32	5.90]				1.93*	[1.05	3.55]
ANC Four or more times	0.66	[0.39	1.11]	0.49*	[0.27	0.88]	0.41**	[0.22	0.76]
ANC provider									
Nurse (ref)									
Doctor	1.74*	[1.05	2.89]	1.65	[0.91	2.97]	1.44	[0.79	2.60]
All others	0.67	[0.090	5.07]	1.02	[0.12	8.59]	1.37	[0.15	12.2]
Attended ANC because of a problem	0.90	[0.48	1.69]	0.82	[0.42	1.58]	0.79	[0.40	1.55]
Pregnancy complication	3.70***	[2.33	5.88]	3.16***	[1.93	5.17]	2.71***	[1.63	4.50]
Past Stillbirth	4.93***	[2.66	9.16]	3.66***	[1.81	7.41]	3.36**	[1.63	6.95]
Multiple gestation	7.45***	[3.64	15.3]	6.12***	[2.78	13.5]	4.82***	[2.16	10.8]
Sibling had a maternal death	6.51***	[2.76	15.3]	5.45***	[2.09	14.2]	5.42***	[2.04	14.4]
Current age in years	1.03*	[1.00	1.07]	1.05	[0.99	1.10]	1.04	[0.98	1.09]
Number of pregnancies	1.069	[0.982,	1.163]	0.96	[0.83	1.12]	0.99	[0.85	1.16]
Marital Status									
Currently married (ref)									
Cohabiting	0.58	[0.24	1.37]	0.79	[0.31	1.99]	0.92	[0.37	2.32]
Previously married	0.95	[0.37	2.42]	0.9	[0.34	2.39]	0.94	[0.35	2.52]
Never married	2.25*	[1.17	4.34]	3.53**	[1.58	7.87]	3.13**	[1.38	7.08]
Urban residence:	2.05**	[1.25	3.36]	2.16*	[1.06	4.40]	1.84	[0.89	3.83]
Years of sch. centered	1.05	[1.00	1.11]	1.05	[0.98	1.12]	1.04	[0.97	1.11]

Table 7G4 continued

Household wealth Index										
Poorest (ref)										
Poorer/Middle	0.76	[0.39	1.48]		0.62	[0.30	1.31]	0.58	[0.27	1.23]
Rich/Richest	1.29	[0.69	2.43]		0.75	[0.30	1.90]	0.57	[0.22	1.50]
Region										
Greater Accra (ref)										
Central	1.14	[0.39	3.31]		2.22	[0.71	6.89]	2.39	[0.75	7.60]
Western	0.19	[0.023	1.53]		0.35	[0.042	3.02]	0.39	[0.045	3.38]
Volta	0.54	[0.14	2.13]		1.29	[0.30	5.55]	1.35	[0.31	5.91]
Eastern	1.68	[0.70	4.03]		2.64*	[1.02	6.84]	2.72*	[1.04	7.07]
Ashanti	1.30	[0.53	3.18]		1.74	[0.69	4.42]	1.61	[0.63	4.13]
Brong Ahafo	2.16	[0.85	5.47]		4.07**	[1.44	11.5]	4.62**	[1.62	13.2]
Northern	1.15	[0.40	3.27]		2.63	[0.82	8.47]	3.11	[0.95	10.2]
Upper east	0.47	[0.094	2.33]		1.74	[0.30	10.2]	1.77	[0.29	10.7]
Upper west	0.30	[0.035	2.55]		0.91	[0.099	8.30]	0.89	[0.096	8.30]
Constant					0.0018***	[0.00030	0.010]	0.0022***	[0.00016	0.032]
<i>Random effects</i>	<i>Null model</i>									
Cluster variance	0.86	[0.49	1.51]		0.6	[0.21	1.66]	0.57	[0.18	1.83]
N	4868				4868					

Notes: *p<0.05, ** p<0.01, *** p<0.001. This sample is restricted to women who attended ANC at least once during pregnancy

Table 7G5: Average treatment effects (ATE) of quality of ANC (8/9 vs ≤ 7 services) on pregnancy outcome (stillbirth vs. life birth) for women attended ANC at least once during their last pregnancy, GMHS, N=4868

<i>Model</i>	<i>Coef.</i>	<i>SE</i>	<i>p-value</i>
Multivariate model without delivery variables	-0.013	0.006	0.016
Multivariate model with delivery variables	-0.014	0.006	0.009

Notes: SE refers to AI robust standard errors.

APPENDICES

Appendix 1A: Definitions related to maternal death (ICD-10)

Maternal death: The death of a woman while pregnant or within 42 days of termination of pregnancy, irrespective of the duration and site of the pregnancy, from any cause related to or aggravated by the pregnancy or its management but not from accidental or incidental causes.

Direct maternal deaths: maternal deaths resulting from obstetric complications of the pregnant state (pregnancy, delivery and postpartum), interventions, omissions, incorrect treatment, or a chain of events resulting from any of the above. E.g. deaths due to, obstetric haemorrhage or hypertensive disorders in pregnancy, or those due to complications of anaesthesia or caesarean section

Indirect maternal deaths: those resulting from previously existing diseases, or from diseases that developed during pregnancy and that were not due to direct obstetric causes but aggravated by physiological effects of pregnancy. For example, deaths due to aggravation of an existing cardiac or renal disease are considered indirect maternal deaths.

Pregnancy-related death: The death of a woman while pregnant or within 42 days of termination of pregnancy, irrespective of the cause of death.

Late maternal death: The death of a woman from direct or indirect obstetric causes, more than 42 days, but less than 1 year after termination of pregnancy.

Statistical measures of maternal mortality

Maternal mortality ratio (MMR): Number of maternal deaths during a given time period per 100 000 live births during the same time period. MMR depicts the risk of maternal death relative to the number of live births.

Maternal mortality rate (MMRate): Number of maternal deaths in a given period per 100 000 women of reproductive age during the same time period. The MMRate captures both the risk of maternal death per pregnancy or per birth (live birth or stillbirth) and the level of fertility in the population

Adult lifetime risk of maternal death: The probability that a 15-year-old women will die eventually from a maternal cause.

The **proportion of maternal deaths among deaths of women of reproductive age (PM):**The number of maternal deaths in a given time period divided by the total deaths among women aged 15–49 years

Classification of MMR: MMR is considered to be extremely high if it is ≥ 1000 ; high if ≥ 300 ; moderate if from 100 to 299; and low if from 20 to 99 per 100, 000 live births. Most countries in SSA have high MMR; with extremely high in Chad (1100) and Somalia (1000). A few countries in SSA like Mauritius, Sao Tome and Principe and Cape Verde have low MMR and Botswana, Djibouti, Namibia, Gabon, Equatorial Guinea, Eritrea and Madagascar have moderate MMR. Only four countries (the Lao People’s Democratic Republic, Afghanistan, Haiti and Timor-Leste) outside the sub-Saharan African region have high MMR. (WHO et al. 2012)

Measuring progress towards MDG 5: Countries with $MMR \geq 100$ in 1990 have been categorized as “on track” (average annual percentage decline of 5.5% or more), “making progress” (decline if 2 -5.5%), “insufficient progress” (decline of less than 2%) or “no progress” (rising MMR) in improving maternal health.

(WHO et al. 2012)

Appendix 1B: Definitions related to skilled attendance

Skilled birth attendant: “refers exclusively to people with midwifery skills (for example, doctors, midwives, nurses) who have been trained to proficiency in the skills necessary to manage normal deliveries and diagnose, manage or refer complications. Ideally, the skilled attendants live in, and are part of, the community they serve. They must be able to manage normal labour and delivery, recognize the onset of complications, perform essential interventions, start treatment, and supervise the referral of mother and baby for interventions that are beyond their competence or not possible in the particular setting.”

Midwifery skills: a defined set of cognitive and practical skills that enable the individual to provide basic health care services throughout the period of the perinatal continuum and also to provide first aid for obstetric complications and emergencies, including life-saving measures when needed.

Skilled attendance “the process by which a woman is provided with adequate care during labour, delivery and the early postpartum period.” This emphasizes that the process requires a skilled attendant AND an enabling environment which includes adequate supplies, equipment and infrastructure as well as efficient and effective systems of communication and referral.

(Graham et al. 2001)

Appendix 1C: Definitions for emergency obstetric care facilities

Signal functions: These are key medical interventions that are used to treat the direct obstetric complications that cause the vast majority of maternal deaths around the globe. Signal functions used to identify basic and comprehensive emergency obstetric care services.

There nine signal functions:

1. Administer parenteral¹ antibiotics
2. Administer uterotonic drugs² (i.e. parenteral oxytocin)
3. Administer parenteral anticonvulsants for preeclampsia and eclampsia (i.e. magnesium sulfate)
4. Manually remove the placenta
5. Remove retained products (e.g. manual vacuum extraction, dilation and curettage)
6. Perform assisted vaginal delivery (e.g. vacuum extraction, forceps delivery)
7. Perform basic neonatal resuscitation (e.g. with bag and mask)
8. Perform surgery (e.g. caesarean section)
9. Perform blood transfusion

A **basic emergency obstetric care facility** is one in which all functions 1–7 are performed.

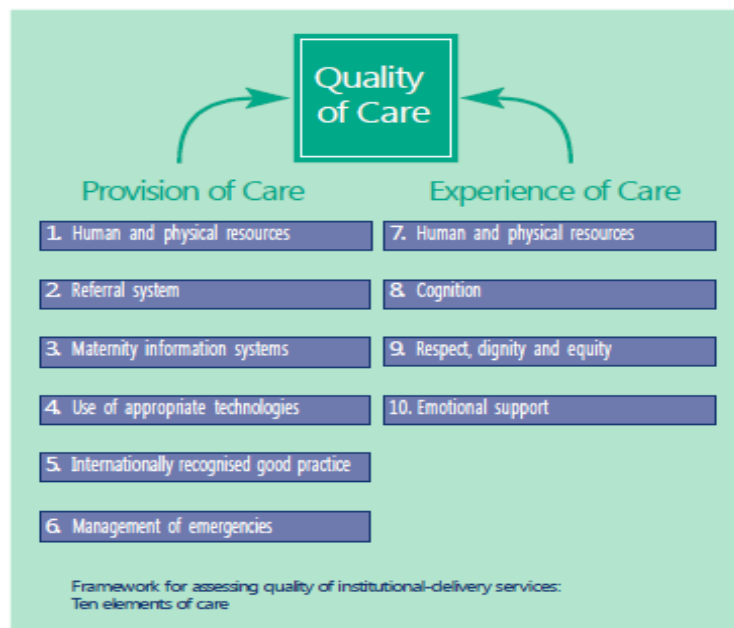
A **comprehensive emergency obstetric care facility** is one in which all functions 1–9 are performed.

(World Health Organisation et al. 2009)

Appendix 2A: Maxwell's quality dimensions

- **Effectiveness:** delivering health care that is adherent to an evidence base and results in improved health outcomes for individuals and communities, based on need
- **Efficiency:** delivering health care in a manner which maximizes resource use and avoids waste
- **Accessibility:** delivering health care that is timely, geographically reasonable, and provided in a setting where skills and resources are appropriate to medical need)
- **acceptability/patient-centered:** delivering health care which takes into account the preferences and aspirations of individual service users and the cultures of their communities:
- **equitable:** delivering health care which does not vary in quality because of personal characteristics such as gender, race, ethnicity, geographical location, or socioeconomic status
- **safety:** delivering health care which minimizes risks and harm to service

Appendix 2B: Hulton's framework for assessing quality of maternal health care



- **Human and physical resources:** the quantity and quality of health and non-health personnel employed to provide services including supportive functions. It also includes the configuration of staff, levels of supervision, management styles, population-based staffing ratios, and nature and frequency of staff training. Physical resources are the grounds, buildings equipment, vehicles, furniture, supplies,

pharmaceuticals, water, electricity, sanitation facilities and all physical assets required to adequately manage a facility

- **Referral:** procedures, equipment and staff required to facilitate rapid access to emergency obstetric care including an efficient and reliable communication and transportation and system
- **Maternity Information management systems:** the system in place to ensure adequate documentation and use of information for monitoring and auditing.
- **Use of appropriate technologies:** the use of technologies and interventions known to be effective within limits; and the non-use of routine interventions not supported by the evidence. E.g appropriate use of caesarian section, episiotomy, blood transfusion, pain medication, etc.
- **Internationally recognized good practice:** appropriate use of procedures in maternity care that have shown to be of benefit to mother and baby such as active management of the third stage of labor, use of Magnesium Sulphate for eclampsia, prophylactic antibiotics for caesarian sections
- **Management of Emergencies;** availability of essential drugs and equipment as well as trained personnel needed to recognize and manage or refer specific emergency conditions
- **Experience of care as regards human and physical resources:** women's impressions of the state of the infrastructure (the bed, sheets, food, toilets and so on); their perception of the quality and appropriateness of the care they receives, as well as experience of actual contact time with qualified staff. For example, whether or not women are being left alone for extended periods, or whether unqualified personnel are undertaking inappropriate duties.
- **Cognition:** The extent to which a woman feels she understands what is happening and feels that her questions have been answered adequately; and whether she receives information in a form that she and her family understand and that she has the right to know
- **Respect, dignity, and equity:** dimensions of interpersonal care and issues such as privacy, confidentiality, informed choice, concern, empathy, honesty, tact and sensitivity'.
- **Emotional support:** responsiveness to a woman's need for support during labor by a person of their choice including relatives and members of the health staff.

Appendix 3A: Thaddeus and Maine's three delays model

General model

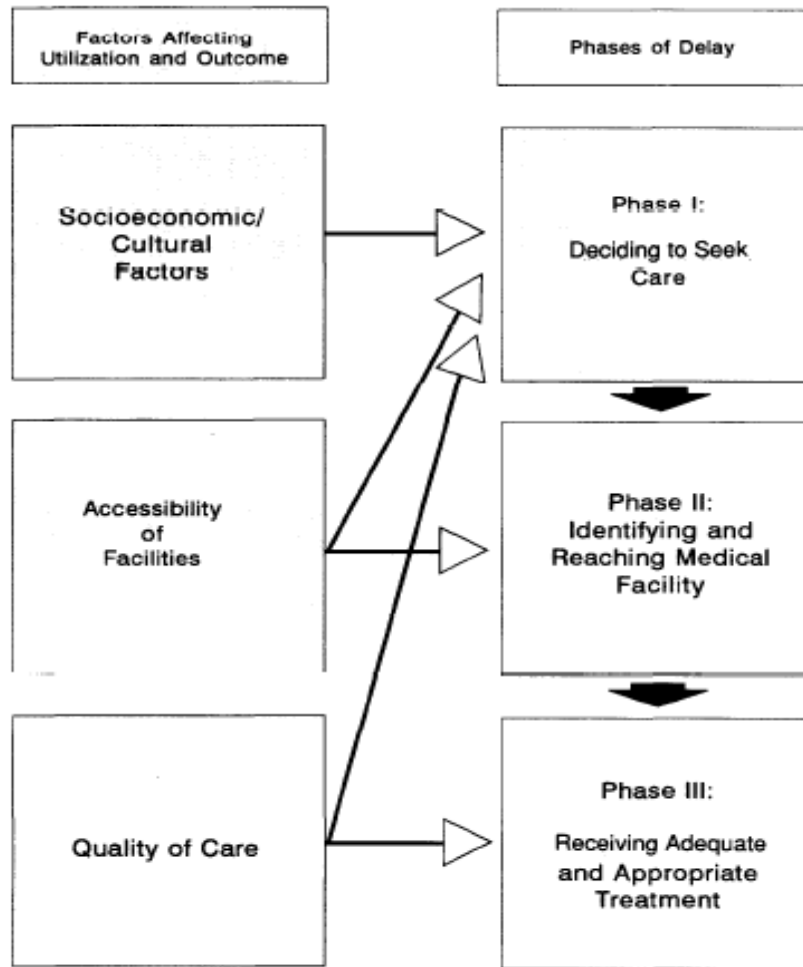


Fig. 1. The three delays model.

Appendix 3A1: Thaddeus and Maine's three delays model
Phase 1 detail

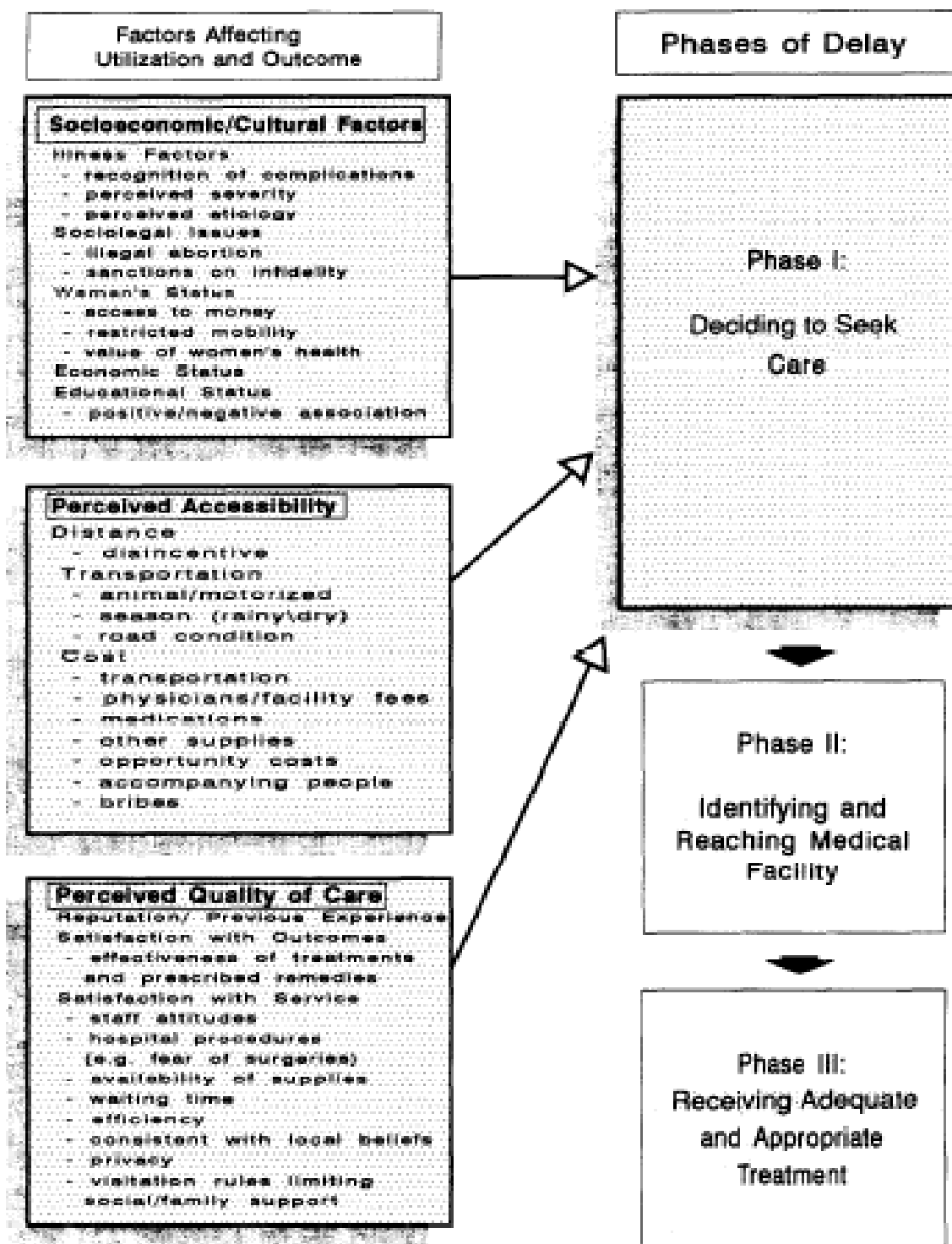


Fig. 2. Phase I delay, detail.

Appendix 3A2: Thaddeus and Maine's three delays model
Phase 2 detail

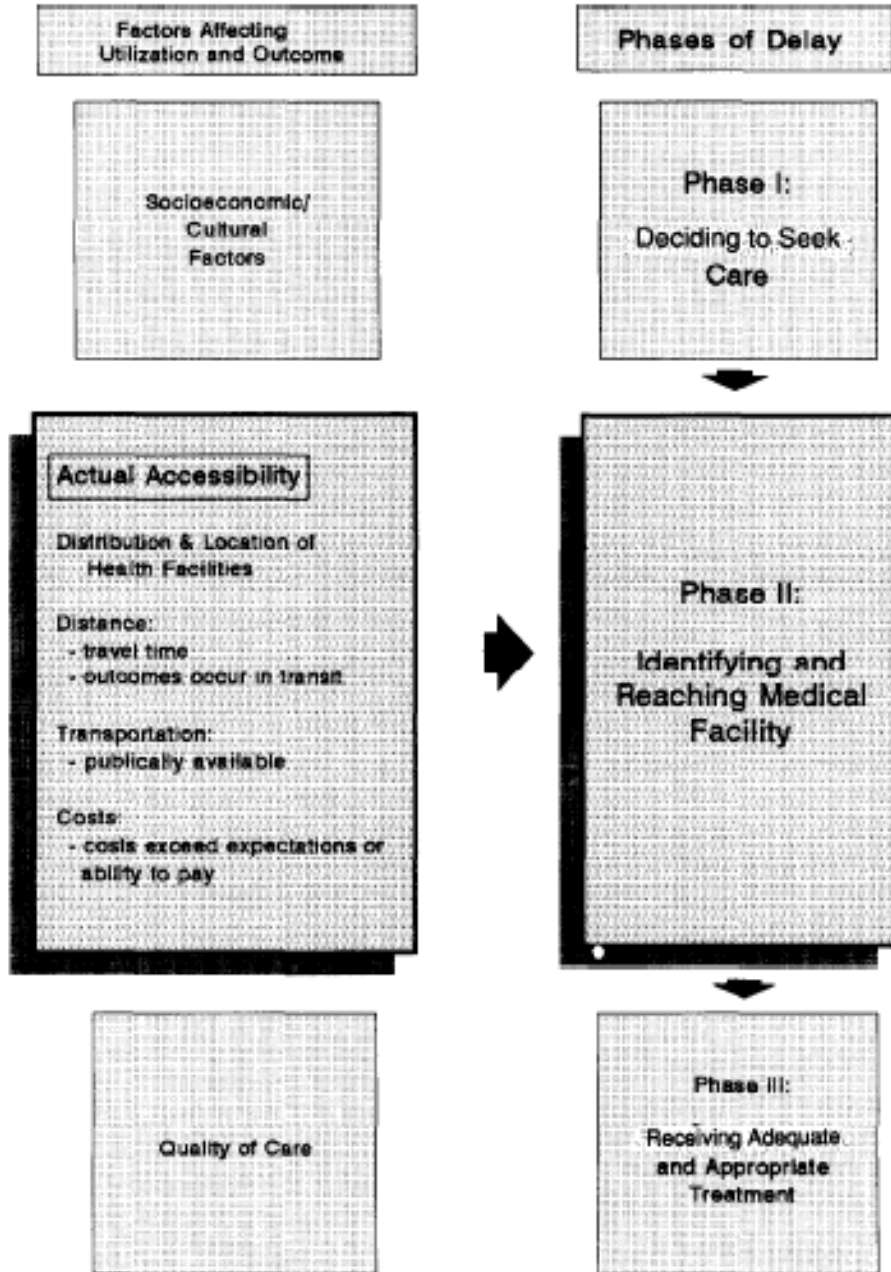


Fig. 3. Phase II delay, detail.

Appendix 3A3: Thaddeus and Maine's three delays model
Phase 3 detail

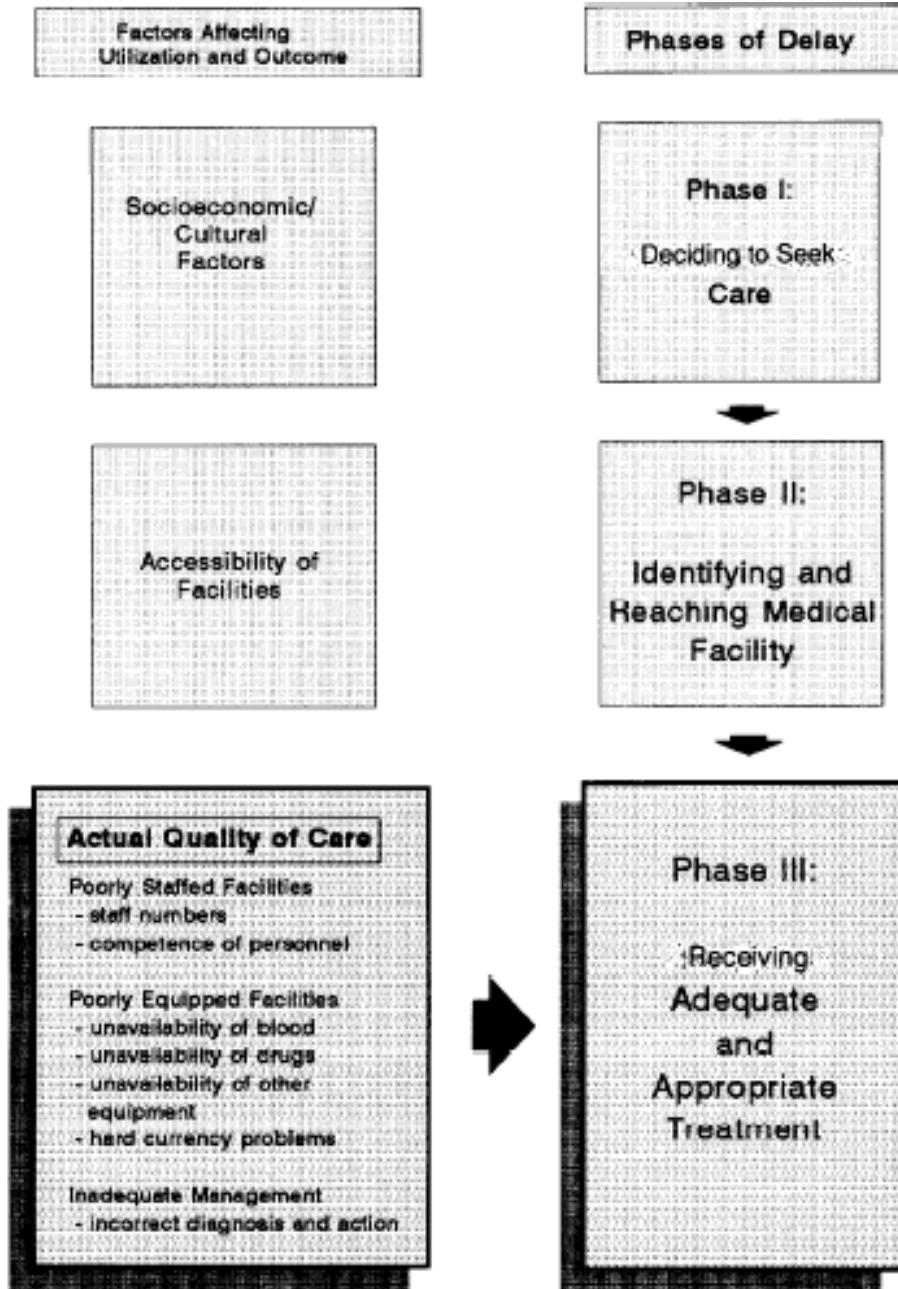


Fig. 4. Phase III delay, detail.

Appendix 3B: Gabrysch and Campbell's expansion of the three delays models

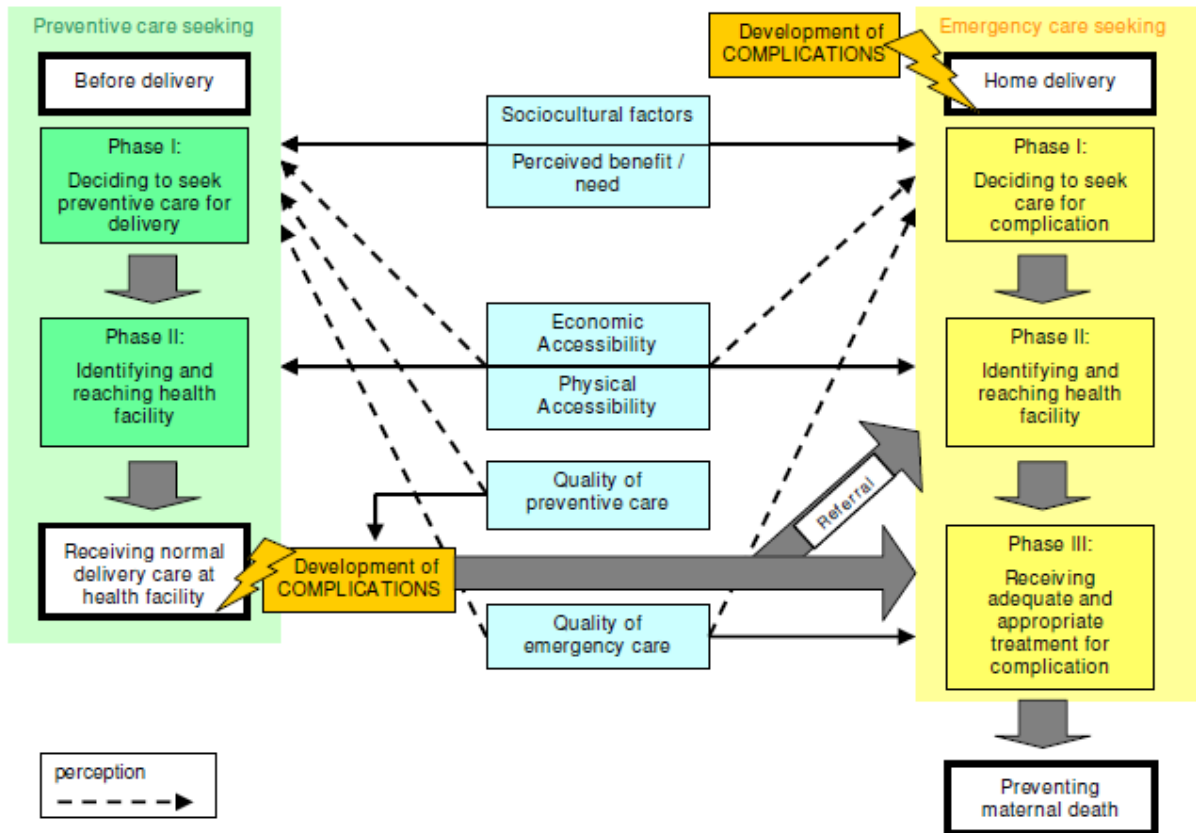
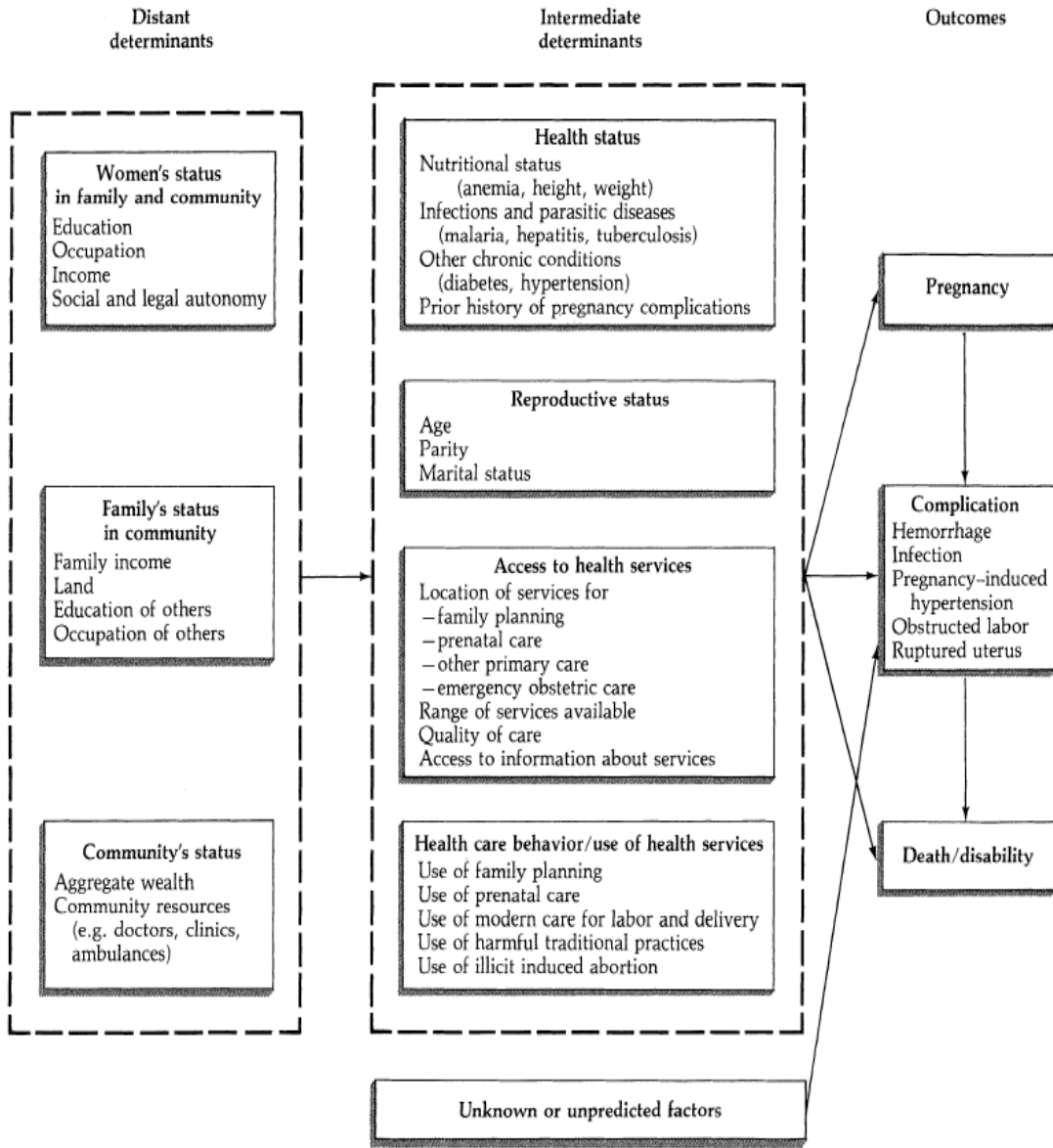


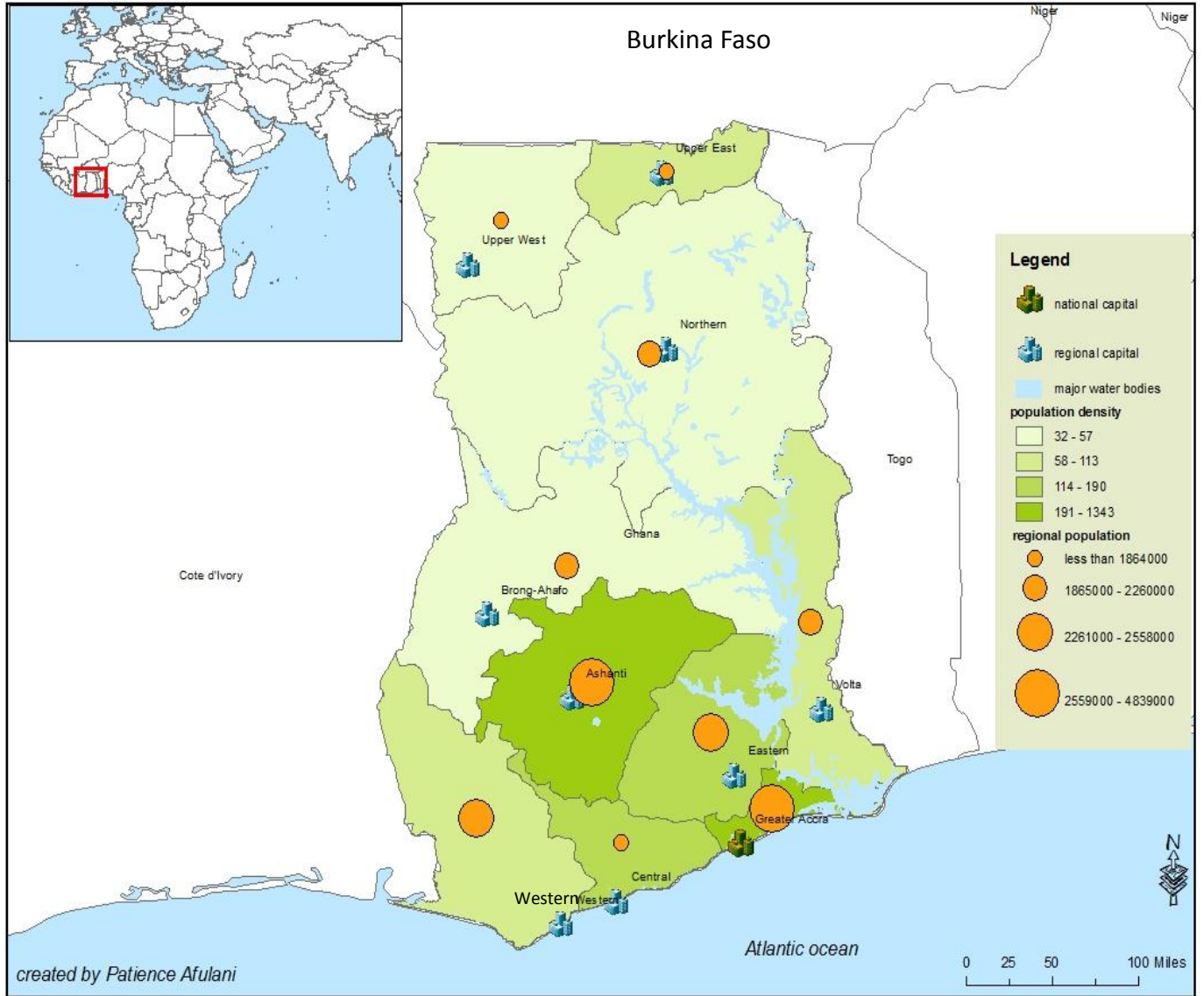
Figure 1
Delay phases and factors affecting use of delivery care and maternal mortality (adapted from Thaddeus & Maine). The three delays for emergency care-seeking are unchanged from the framework presented by Thaddeus and Maine. We conceptually separated preventive care-seeking. Only a first and second phase are relevant for receiving normal preventive delivery care. If a woman who is receiving such preventive care at a health facility then develops a complication, her survival will depend on whether she receives adequate and appropriate treatment in time (third delay of emergency care-seeking). Since she is already in a facility, skilled providers should be able to discover this quickly (no first emergency delay) and she does not need to travel far if it can be handled there (no second emergency delay). For those complications that cannot be handled at that facility and that require referral to a higher-level facility, she will need to travel to a referral facility, possibly with help from the first facility (second emergency delay).

Appendix 3C: McCarthy and Maine's framework

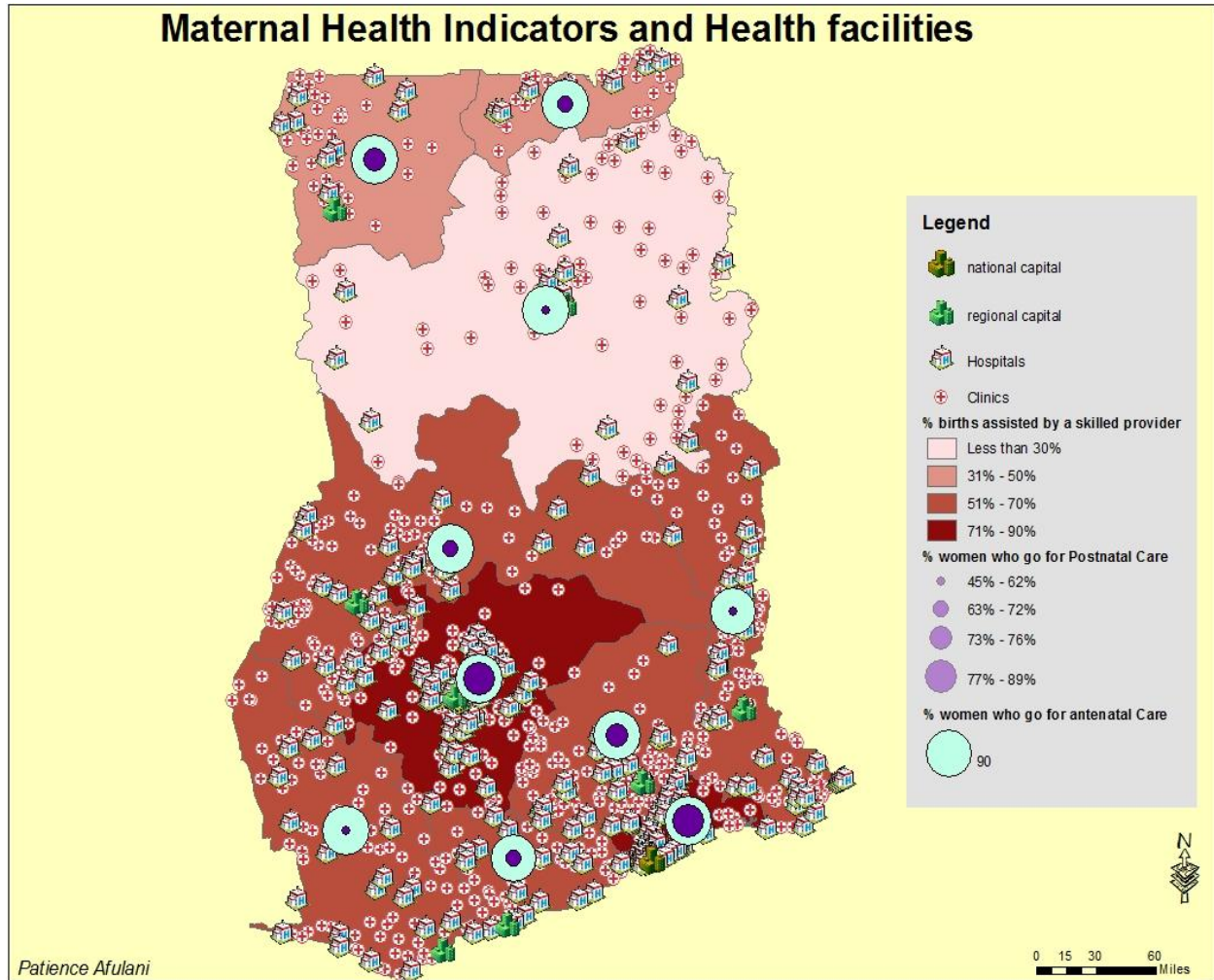
Figure 2 A detailed framework for analyzing the determinants of maternal mortality and morbidity



Appendix 4A: Overview of Ghana



Appendix 4B: Maternal Health Indicators and distribution of Health facilities in Ghana



Supplemental Results

Chapter 4

Appendix 4G1: Bivariate associations: Independent variables by Antenatal attendance, GMHS, N = 5,042

Variable	proportion with one at least ANC visit			
	N	proportion	[95% Conf. Interval]	
<i>Geographic location</i>				
Setting				
Rural	3,115	0.951	0.937	0.966
Urban	1,927	0.989	0.984	0.994
Large city	664	0.987	0.977	0.997
Small city	115	0.986	0.966	1.006
Town	1,148	0.990	0.984	0.996
Region				
Greater Accra	636	0.965	0.942	0.989
Central	441	0.969	0.948	0.989
Western	382	0.971	0.947	0.995
Volta	407	0.960	0.939	0.982
Eastern	744	0.972	0.960	0.984
Ashanti	855	0.979	0.968	0.990
Brong Ahafo	496	0.981	0.966	0.997
Northern	541	0.917	0.860	0.973
Upper east	303	0.985	0.970	1.000
Upper west	237	0.943	0.894	0.992
R3M regions				
Other regions	2,807	0.958	0.943	0.973
R3m region	2,235	0.974	0.965	0.982
Socioeconomic variables				
Highest Education				
None	1,697	0.934	0.912	0.956
Primary	1,109	0.965	0.953	0.978
Middle/JSS	1,830	0.986	0.979	0.992
Secondary/SSS/or higher	406	0.995	0.988	1.002
Mean years education (SD)	5,042			
Household wealth index				
Poorest	1,097	0.931	0.897	0.965
Poorer	994	0.945	0.926	0.965
Middle	951	0.976	0.966	0.986
Richer	995	0.984	0.976	0.993
Richest	1,005	0.992	0.986	0.998
Household head Female				
No	3,790	0.962	0.950	0.974
Yes	1,252	0.972	0.961	0.982
Religious affiliation				
Catholic	686	0.968	0.950	0.985
Methodist/Presbyterian	662	0.989	0.981	0.997
Pentacostal/charismatic/protestant	1,476	0.975	0.965	0.984
Other christian	832	0.968	0.955	0.982
Moslem	886	0.967	0.953	0.981
Traditional/spiritualist/No religion/other	500	0.879	0.816	0.943

Ethnicity				
Akan	2,238	0.981	0.973	0.988
Ga/dangme/Guan	521	0.964	0.948	0.981
Ewe	641	0.956	0.933	0.979
Mole-dagbani/Hausa	604	0.968	0.950	0.985
Grussi/Gruma	580	0.913	0.853	0.974
Other/4missing	458	0.947	0.916	0.977
Reproductive Health variables				
Current age in years				
15-19yrs	247	0.966	0.945	0.987
20-24	915	0.975	0.964	0.986
25-29	1,176	0.967	0.952	0.982
30-34	1,115	0.968	0.956	0.981
35-39	913	0.963	0.948	0.978
40-49yrs	676	0.939	0.914	0.964
Mean (SD)	5,042			
Marital status				
Currently married	3,633	0.965	0.953	0.977
Living with a man(Cohabiting)	687	0.969	0.955	0.983
Previously married	364	0.949	0.923	0.974
Never married	358	0.967	0.946	0.989
Age at first union				
Less than 19years	2,445	0.954	0.938	0.969
19 or more years	2,239	0.976	0.968	0.984
Never in a union	358	0.967	0.946	0.989
Mean (SD)	4,684			
No. Pregnancies ever had (Gravidity)				
1-2	1,669	0.976	0.966	0.986
3-4	1,549	0.976	0.967	0.985
5plus	1,824	0.944	0.927	0.961
Mean (SD)	5,042			
No. children ever born (Parity)				
0 (None)	22	0.910	0.801	1.019
1-2	2,072	0.978	0.969	0.986
3-4	1,513	0.975	0.966	0.984
3.5plus	1,435	0.935	0.914	0.955
Mean (SD)	5,042			
No. children alive				
0 (None)	78	0.933	0.877	0.989
1-2	2,246	0.979	0.971	0.987
3-4	1,573	0.971	0.960	0.981
3.5plus	1,145	0.929	0.906	0.952
Mean (SD)	5,042			
Ever used Contraception				
No	1,899	0.937	0.916	0.958
Yes	3,143	0.981	0.976	0.987
Currently using Contraception				
No	3,792	0.958	0.945	0.970
Yes	1,250	0.985	0.978	0.992

Know source for FP				
No	2,376	0.954	0.939	0.969
Yes	2,666	0.973	0.965	0.982
Prior pregnancies				
Ever had a Miscarriage				
No	4,233	0.963	0.952	0.973
Yes	809	0.974	0.960	0.987
Ever Induced abortion				
No	4,265	0.960	0.950	0.971
Yes	777	0.986	0.977	0.996
Ever had a stillbirth				
No	4,748	0.965	0.955	0.975
Yes	294	0.954	0.925	0.982
Ever had a SB or Miscarriage				
No	4,000	0.963	0.952	0.973
Yes	1,042	0.970	0.958	0.982
Sibling had a maternal death				
No	4,956	0.964	0.955	0.974
Yes	86	0.974	0.926	1.023
<i>Index Pregnancy</i>				
pregnancy complication				
No	3,956	0.963	0.953	0.973
Yes	1,086	0.968	0.954	0.982
Serious pregnancy complication				
No	4,149	0.962	0.952	0.972
Yes	893	0.976	0.963	0.989
Caesarian delivery for last pregnancy				
No	4,694	0.962	0.952	0.972
Yes	348	0.997	0.992	1.001
Pregnancy duration in months for SBs				
Born Alive	4,957	0.966	0.956	0.975
7 months	13	1.000	.	.
8 months	10	0.721	0.428	1.014
9 months	58	0.874	0.774	0.974
10 months	4	1.000	.	.

Appendix 4G2: Crosstabs by place of residence, education and wealth, GMHS, N = 5,042

<i>Variable</i>	<i>Total</i> N	<i>Proportion in a rural area</i>			<i>Mean years of schooling</i>			<i>Proportion in richer/richest wealth tertile</i>		
		<i>Proportn.</i>	<i>[95% CI]</i>		<i>Mean</i>	<i>[95% CI]</i>		<i>Proportn.</i>	<i>[95% CI]</i>	
Setting										
Rural	3,115				4.019	3.657	4.381	0.157	0.124	0.189
Urban	1,927				6.938	6.535	7.341	0.776	0.726	0.827
Large city	664				7.817	7.190	8.443	0.946	0.919	0.972
Small city	115				7.018	5.268	8.768	0.951	0.894	1.008
Town	1,148				6.528	5.990	7.067	0.681	0.611	0.750
Highest Education										
None	1,697	0.822	0.787	0.857	0.000			0.159	0.125	0.193
Primary	1,109	0.689	0.648	0.731	4.187	4.077	4.297	0.347	0.304	0.390
Middle/JSS	1,830	0.559	0.509	0.608	8.726	8.673	8.780	0.491	0.445	0.537
Secondary/SSS/higher	406	0.276	0.214	0.339	12.458	12.214	12.702	0.814	0.758	0.869
Household wealth index										
Poorest	1,097	0.969	0.946	0.992	2.358	1.982	2.735			
Poorer	994	0.914	0.879	0.948	3.747	3.271	4.222			
Middle	951	0.744	0.694	0.795	5.136	4.703	5.570			
Richer	995	0.406	0.344	0.467	6.278	5.909	6.648			
Richest	1,005	0.132	0.093	0.171	8.355	7.988	8.722			
Household head Female										
No	3,790	0.681	0.648	0.715	4.577	4.230	4.923	0.364	0.325	0.403
Yes	1,252	0.584	0.539	0.629	6.359	6.055	6.663	0.386	0.345	0.427
Religious affiliation										
Catholic	686	0.737	0.676	0.798	5.409	4.816	6.002	0.307	0.249	0.364
Methodist/Presbyterian	662	0.656	0.597	0.715	6.810	6.271	7.349	0.453	0.385	0.520
Pentecostal/charismatic	1,476	0.565	0.521	0.608	6.349	6.005	6.693	0.472	0.429	0.516
Other Christian	832	0.641	0.583	0.700	5.575	5.113	6.037	0.379	0.318	0.439
Moslem	886	0.650	0.569	0.731	2.286	1.682	2.890	0.319	0.237	0.400
Traditional/other	500	0.859	0.813	0.905	2.137	1.649	2.626	0.110	0.070	0.150

Region										
Greater Accra	636	0.226	0.156	0.296	6.850	6.121	7.579	0.801	0.724	0.878
Central	441	0.637	0.557	0.717	5.837	5.122	6.552	0.380	0.268	0.492
Western	382	0.716	0.625	0.807	5.777	4.884	6.671	0.458	0.337	0.580
Volta	407	0.722	0.557	0.886	5.107	3.748	6.466	0.318	0.158	0.477
Eastern	744	0.661	0.604	0.719	6.238	5.757	6.720	0.358	0.286	0.431
Ashanti	855	0.620	0.552	0.688	6.451	5.873	7.028	0.473	0.405	0.541
Brong Ahafo	496	0.700	0.632	0.767	4.832	3.966	5.699	0.222	0.151	0.293
Northern	541	0.803	0.733	0.873	1.661	0.934	2.389	0.152	0.063	0.241
Upper East	303	0.790	0.716	0.865	1.648	0.803	2.494	0.189	0.099	0.280
Upper West	237	0.897	0.843	0.950	1.943	0.825	3.061	0.119	0.057	0.181
R3M regions										
Other regions	2,807	0.735	0.696	0.775	4.053	3.629	4.478	0.271	0.225	0.317
R3m region	2,235	0.538	0.496	0.580	6.484	6.133	6.835	0.518	0.472	0.564
Ethnicity										
Akan	2,238	0.595	0.550	0.640	6.882	6.599	7.165	0.452	0.407	0.497
Ga/Dangme/Guan	521	0.608	0.504	0.712	4.978	4.257	5.698	0.440	0.340	0.540
Ewe	641	0.681	0.584	0.778	5.941	5.270	6.613	0.380	0.295	0.466
Mole-Dagbani/Hausa	604	0.717	0.623	0.811	2.054	1.334	2.774	0.256	0.163	0.349
Grussi/Gruma	580	0.857	0.792	0.921	1.894	1.362	2.426	0.144	0.085	0.202
Other/4missing	458	0.662	0.538	0.785	2.184	1.702	2.667	0.292	0.193	0.391
Reproductive Health variables										
Current age in years										
15-19yrs	247	0.722	0.659	0.785	5.819	5.323	6.316	0.289	0.225	0.353
20-24	915	0.671	0.627	0.714	5.902	5.525	6.279	0.386	0.340	0.432
25-29	1,176	0.650	0.611	0.690	5.300	4.914	5.685	0.395	0.350	0.440
30-34	1,115	0.632	0.587	0.677	4.820	4.380	5.260	0.397	0.352	0.442
35-39	913	0.623	0.581	0.666	4.814	4.369	5.260	0.368	0.322	0.414
40-49yrs	676	0.713	0.667	0.758	3.644	3.151	4.137	0.289	0.239	0.339
Marital status										
Currently married	3,633	0.663	0.630	0.695	4.676	4.322	5.030	0.371	0.334	0.409
Cohabiting	687	0.705	0.648	0.762	5.500	5.010	5.990	0.346	0.286	0.406
Previously married	364	0.610	0.546	0.673	5.852	5.322	6.382	0.344	0.284	0.405
Never married	358	0.548	0.485	0.610	6.733	6.302	7.164	0.424	0.357	0.491

Age at first union										
Less than 19years	2,445	0.742	0.709	0.774	4.190	3.855	4.525	0.294	0.257	0.331
19 or more years	2,239	0.579	0.542	0.615	5.683	5.323	6.044	0.446	0.406	0.487
Never in a union	358	0.548	0.485	0.610	6.733	6.302	7.164	0.424	0.357	0.491
No. of Pregnancies ever had (Gravidity)										
1-2	1,669	0.612	0.574	0.649	6.119	5.750	6.488	0.427	0.386	0.469
3-4	1,549	0.633	0.589	0.676	5.198	4.806	5.589	0.408	0.363	0.453
5plus	1,824	0.717	0.684	0.750	3.897	3.558	4.235	0.285	0.250	0.320
No. of children ever born (Parity)										
No children born alive	22	0.319	0.107	0.532	7.430	5.517	9.343	0.586	0.361	0.811
1-2	2,072	0.584	0.547	0.621	6.330	5.993	6.667	0.466	0.426	0.506
3-4	1,513	0.642	0.601	0.683	4.859	4.474	5.245	0.386	0.341	0.430
5plus	1,435	0.778	0.747	0.810	3.324	2.980	3.667	0.215	0.181	0.248
No. of children alive										
No children alive	78	0.597	0.486	0.708	5.678	4.536	6.820	0.380	0.261	0.499
1-2	2,246	0.597	0.560	0.634	6.133	5.785	6.482	0.455	0.414	0.495
3-4	1,573	0.652	0.613	0.691	4.751	4.383	5.118	0.367	0.327	0.408
5plus	1,145	0.782	0.749	0.814	3.218	2.855	3.581	0.209	0.172	0.246
Ever used contraception										
No	1,899	0.781	0.745	0.817	2.912	2.583	3.242	0.208	0.173	0.244
Yes	3,143	0.579	0.543	0.615	6.339	6.068	6.610	0.470	0.433	0.508
Currently using contraception										
No	3,792	0.686	0.653	0.718	4.548	4.211	4.885	0.329	0.293	0.365
Yes	1,250	0.566	0.525	0.608	6.492	6.179	6.804	0.496	0.453	0.538
Know family planning source										
No	2,376	0.669	0.633	0.704	4.547	4.148	4.946	0.350	0.310	0.390
Yes	2,666	0.646	0.610	0.682	5.441	5.133	5.750	0.387	0.348	0.425
<i>Prior pregnancies</i>										
Ever had a miscarriage										
No	4,233	0.662	0.630	0.694	5.004	4.675	5.333	0.363	0.327	0.400
Yes	809	0.630	0.588	0.672	5.113	4.706	5.520	0.404	0.361	0.446
Ever induced abortion										
No	4,265	0.693	0.663	0.722	4.641	4.321	4.962	0.327	0.293	0.361
Yes	777	0.450	0.395	0.504	7.199	6.838	7.560	0.612	0.560	0.664
Ever had a stillbirth										

No	4,748	0.661	0.630	0.692	5.020	4.703	5.336	0.369	0.333	0.404
Yes	294	0.587	0.521	0.654	5.040	4.395	5.684	0.383	0.316	0.450
Ever had a stillbirth/miscarriage										
No	4,000	0.666	0.634	0.699	5.004	4.667	5.340	0.362	0.325	0.399
Yes	1,042	0.619	0.583	0.656	5.089	4.713	5.466	0.399	0.360	0.439
Sibling had a maternal death										
No	4,956	0.656	0.626	0.687	5.016	4.704	5.328	0.371	0.336	0.406
Yes	86	0.689	0.590	0.787	5.267	4.208	6.325	0.295	0.189	0.401
Pregnancy complication										
No	3,956	0.673	0.640	0.706	4.909	4.572	5.247	0.355	0.319	0.391
Yes	1,086	0.594	0.556	0.632	5.458	5.095	5.822	0.427	0.383	0.471
Serious pregnancy complication										
No	4,149	0.675	0.643	0.707	4.867	4.535	5.198	0.351	0.315	0.387
Yes	893	0.563	0.522	0.604	5.794	5.411	6.177	0.462	0.414	0.510
Caesarian delivery										
No	4,694	0.674	0.644	0.704	4.866	4.557	5.176	0.348	0.314	0.382
Yes	348	0.410	0.341	0.478	7.215	6.635	7.794	0.670	0.607	0.732
Pregnancy outcome										
Born alive	4,957	0.659	0.629	0.690	5.008	4.697	5.319	0.368	0.333	0.403
Born dead(Stillbirth)	85	0.516	0.383	0.649	5.782	4.511	7.052	0.453	0.324	0.581
Pregnancy duration										
Born Alive	4,957	0.659	0.629	0.690	5.008	4.697	5.319	0.368	0.333	0.403
7 months	13	0.472	0.166	0.777	6.992	2.763	11.222	0.769	0.536	1.002
8 months	10	0.612	0.295	0.928	5.502	2.909	8.096	0.528	0.203	0.852
9 months	58	0.521	0.360	0.681	5.628	4.179	7.077	0.353	0.210	0.496
10 months	4	0.365	-0.172	0.901	5.461	2.383	8.540	0.842	0.535	1.148
Delivery by a SBA										
No	2,147	0.895	0.871	0.918	3.155	2.814	3.497	0.138	0.112	0.165
Yes	2,895	0.466	0.427	0.505	6.516	6.234	6.797	0.555	0.514	0.595
Delivery in health facility										
No	2,186	0.891	0.867	0.915	3.194	2.849	3.539	0.141	0.114	0.167
Yes	2,856	0.461	0.422	0.501	6.544	6.262	6.825	0.560	0.519	0.601
<i>ANC variables</i>										
ANC quality of care score										
7 or less	1,901	0.737	0.699	0.775	4.074	3.709	4.439	0.278	0.236	0.320
8 or 9	2,967	0.591	0.554	0.627	5.808	5.490	6.127	0.443	0.405	0.481

No. of ANC visits										
1-3 visits	990	0.842	0.812	0.871	3.622	3.249	3.994	0.157	0.124	0.191
Four or more	3,878	0.599	0.564	0.634	5.512	5.181	5.843	0.435	0.396	0.473
Trimester of first ANC visit										
First trimester	2,688	0.615	0.576	0.653	5.452	5.107	5.797	0.439	0.396	0.481
Second trimester	1,992	0.683	0.650	0.716	4.854	4.513	5.196	0.313	0.279	0.346
Third trimester	181	0.759	0.689	0.829	3.554	2.867	4.241	0.228	0.161	0.296
Don't know	7	0.647	0.227	1.067	1.434	-0.346	3.214	0.285	-0.129	0.699
Where ANC took place										
Gov't Health facility only or combine	4,119	0.666	0.632	0.701	4.992	4.659	5.326	0.358	0.321	0.395
Gov't hospital or polyclinic	2,200	0.517	0.466	0.568	6.089	5.697	6.482	0.519	0.470	0.567
Other Gov't facility	1,919	0.835	0.789	0.880	3.750	3.327	4.174	0.177	0.142	0.212
Only Private facility/maternity home	703	0.535	0.448	0.623	6.058	5.328	6.788	0.507	0.424	0.589
Home/other/DK	46	0.699	0.533	0.865	3.357	2.125	4.590	0.279	0.121	0.436
Highest trained ANC provider										
Doctor	1,006	0.427	0.374	0.479	6.798	6.355	7.241	0.629	0.580	0.677
Nurse	3,743	0.697	0.664	0.730	4.764	4.437	5.091	0.321	0.284	0.357
All others	119	0.870	0.793	0.947	3.307	2.168	4.446	0.226	0.103	0.349
Reason for seeking ANC										
For checkup	4,044	0.640	0.607	0.674	5.072	4.742	5.401	0.380	0.343	0.418
For a problem/missing	824	0.685	0.644	0.726	5.415	4.977	5.853	0.370	0.321	0.419

Appendix 4G3: Multilevel Logistic Regression of Antenatal attendance on relevant predictors ,
Ghana Maternal Health Survey, N=5,042

<i>Independent variables</i>	At least one ANC attendance		
	OR	[95% CI]	
Place of residence:			
Rural (ref)			
Urban	2.06*	[1.12	3.79]
Years of sch. centered	1.10**	[1.04	1.17]
Household wealth Index			
Poorest (ref)			
Poorer/Middle	1.27	[0.83	1.94]
Rich/Richest	1.13	[0.59	2.16]
Pregnancy complication	0.52*	[0.28	0.96]
Serious complication	2.33*	[1.09	5.01]
Ever miscarried or had a still birth	1.47	[0.93	2.34]
Ever contraception	2.10***	[1.41	3.13]
Know source of family planning	1.51*	[1.06	2.14]
Current age in years	1.05*	[1.01	1.10]
Parity	0.78***	[0.70	0.88]
Marital Status			
Currently married (ref)			
Cohabiting	0.93	[0.52	1.65]
Previously married	0.38**	[0.21	0.69]
Never married	0.49*	[0.24	0.98]
Married at 19plus years	1.31	[0.88	1.95]
Religious affiliation			
Catholic/Methodist/Presby(ref)			
Pent/charis/protest/otherchr.	1.04	[0.64	1.67]
Moslem	2.21*	[1.13	4.33]
Trad./Spiritualist/Other/None	0.49**	[0.29	0.82]
Ethnicity			
Akan(ref)			
Ga/Dangme/Guan	0.72	[0.35	1.51]
Ewe	0.58	[0.29	1.18]
Mole-Dgbani/Hausa	0.79	[0.33	1.88]
Grussi/Gruma	0.5	[0.23	1.05]
Other/4missing	0.42*	[0.19	0.91]
Region			
Greater Accra (ref)			
Central	1.8	[0.49	6.57]
Western	2.02	[0.53	7.75]
Volta	2.35	[0.68	8.19]
Eastern	1.66	[0.53	5.23]
Ashanti	2.04	[0.61	6.82]
Brong Ahafo	3.66	[0.95	14.1]
Northern	1.5	[0.43	5.30]
Upper east	12.5**	[2.39	65.2]
Upper west	2.46	[0.54	11.3]
Constant	7.72**	[1.72	34.6]

Notes: *p<0.05, ** p<0.01, *** p<0.001

Chapter 5

Appendix 5G1A: Questions for variables used to create ANC quality of care index, GMHS,

As part of your antenatal care during this pregnancy, were any of the following done at least once:

1. Were you weighed?
2. Was your blood pressure measured?
3. Did you give a urine sample?
4. Did you give a blood sample?
5. During (any of) your antenatal care visit (s), were you told about the signs of pregnancy complications?
6. Were you told where to go if you had any of these complications? (asked only if yes to the preceding question).
7. During this pregnancy, were you given or did you buy any iron tablets or iron syrup?
8. During this pregnancy, did you take any drug for intestinal worms?
9. During this pregnancy, were you given an injection in the arm to prevent the baby from getting tetanus, that is, convulsions after birth?
 - At any time before this pregnancy, did you receive any tetanus injections, either to protect yourself or another baby?
 - Before this pregnancy, how many other times did you receive a tetanus injection?).

Appendix 5G1B: Distribution of individual variables used to create ANC quality of care index, GMHS, N=4,868^a

Variable	Unweighted		Weighted ^b		
	N	%	Proportion	[95% Conf. Interval]	
Weight taken^c					
No	113	2.32	0.022	0.016	0.027
Yes	4,755	97.68	0.978	0.973	0.984
Total	4,868	100.00			
Blood Pressure^d					
No	74	1.52	0.015	0.011	0.020
Yes	4,794	98.48	0.985	0.980	0.989
Total	4,868	100.00			
Urine sample^e					
No	535	10.99	0.109	0.094	0.124
Yes	4,332	88.99	0.891	0.876	0.906
Missing	1	0.02			
Total	4868	100.00			
Blood sample^f					
No	540	11.09	0.110	0.096	0.125
Yes	4,326	88.87	0.890	0.875	0.904
Missing	2	0.04			
Total	4868				
Told about signs of Pregnancy complications^g					
No	1,407	28.90	0.294	0.268	0.319
Yes	3,448	70.83	0.706	0.681	0.732
Missing	13	0.27			
Total	4,868	100.00			
Told about sources of care for pregnancy complication^h					
No	110	2.26	0.034	0.027	0.042
Yes	3,335	68.51	0.966	0.958	0.973
Missing	1,423	29.23			
Total	4,868				
Iron tablets during pregnancyⁱ					
No	133	2.73	0.026	0.021	0.032
Yes	4,714	96.84	0.974	0.968	0.979
Missing	21	0.43			
Total	4,868				
Anthelmintic during pregnancy^j					
No	2,636	54.15	0.586	0.564	0.608
Yes	1,857	38.15	0.414	0.392	0.436
Missing	375	7.70			
Total	4,868				
Tetanus Injection during pregnancy^k					
No	384	7.89	0.079	0.070	0.088
Yes	4,469	91.80	0.921	0.912	0.930
Missing	15	0.31			
Total	4,868	100.00			

Appendix 5G1B continued

Four plus tetanus injections before pregnancy ^l						
No	4,669	95.91		0.960	0.953	0.966
Yes	199	4.09		0.040	0.034	0.047
Total	4,868					
Tetanus injection during pregnancy or completed before pregnancy ^m						
No	332	6.82		0.068	0.059	0.076
Yes	4,521	92.87		0.932	0.924	0.941
Missing	15	0.31				
Total	4,868					
Quality of ANC score ⁿ						
	0	10	0.21	0.003	0.001	0.004
	1	14	0.29	0.003	0.001	0.005
	2	20	0.41	0.004	0.001	0.006
	3	50	1.03	0.010	0.007	0.013
	4	153	3.14	0.033	0.024	0.042
	5	220	4.52	0.047	0.039	0.054
	6	849	17.44	0.175	0.158	0.192
	7	585	12.02	0.118	0.107	0.130
	8	1,726	35.46	0.354	0.333	0.374
	9	1,241	25.49	0.255	0.236	0.274
Mean (SD)	4,868	7.41 (1.52)		7.406	7.322	7.490

^aThis is for women who had at least one ANC

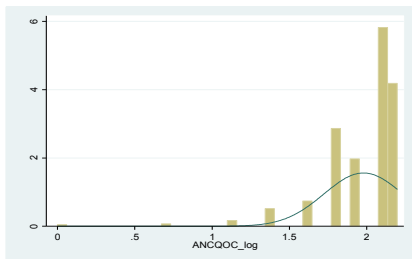
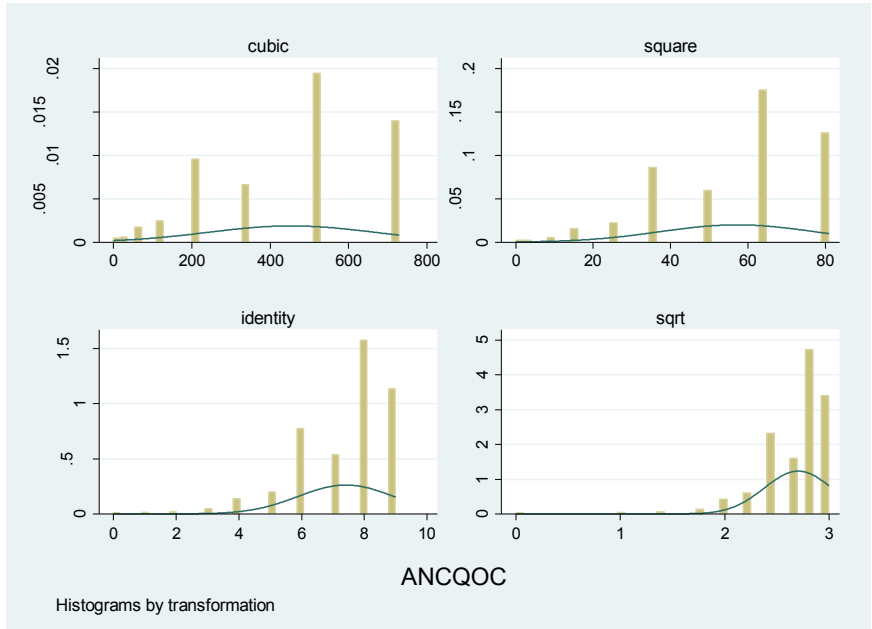
^bexcludes missing for the particular variable

^hasked of only those who responded yes to g, so missing here include those who responded no to

^mNo in ^k is recoded to yes here if they received more than 4 tetanus injections ^l

ⁿCreated from a sum of ^c to ^j and ^m

Appendix 5G2: Distribution of Quality of ANC variable



Appendix 5G3: Weighted Linear Regression of Quality of Antenatal care (ANC) on Education, Place of residence and relevant confounders, GMHS, N=4,868

<i>Independent variables</i>	<i>Quality of ANC : b(se)</i>	
	Model 1	Model 2
Mean ANCQOC in cluster		0.60*** (0.028)
Place of residence:		
Rural (ref)		
Urban	0.13 (0.070)	-0.11** (0.043)
Years of sch. centered	0.042* (0.018)	0.028 (0.015)
Household wealth Index		
Poorest (ref)		
Poorer/Middle	0.15 (0.094)	0.014 (0.086)
Rich/Richest	0.17 (0.11)	0.0075 (0.093)
Interaction of wealth and Education		
Poorer/Middle*years of sch. centered	-0.039* (0.018)	-0.034* (0.016)
Rich/Richest*years of sch. centered	-0.026 (0.019)	-0.020 (0.016)
Number of ANC visits		
One to three (ref)		
Four or more	0.67*** (0.083)	0.55*** (0.077)
Trimester of first ANC		
First trimester (ref)		
Second trimester	-0.093* (0.045)	-0.087* (0.042)
Third trimester	-0.47** (0.16)	-0.51*** (0.15)
DK trimester	-0.88 (0.53)	-0.62 (0.57)
ANC provider		
Nurse (ref)		
Doctor	0.069 (0.054)	0.040 (0.050)
All others	-0.48** (0.18)	-0.31 (0.17)
Type of facility		
Gov't hospital or polyclinic (ref)		
Other Gov't facility	-0.32*** (0.067)	-0.20*** (0.058)
Only Private facility/maternity home	-0.39*** (0.073)	-0.29*** (0.066)
Home/other/DK	-2.19*** (0.44)	-1.94*** (0.44)

Appendix 5G3 continued

Reason for ANC		
Checkup (ref)		
Other (for problem/9DK)	0.071 (0.062)	0.076 (0.058)
Pregnancy complication	-0.29* (0.13)	-0.25* (0.12)
Serious complication	0.35* (0.14)	0.31* (0.13)
Ever miscarried or had a still birth	-0.058 (0.056)	-0.057 (0.053)
Current age in years	-0.0041 (0.0057)	-0.0050 (0.0054)
Parity	0.019 (0.018)	0.019 (0.017)
Marital Status		
Currently married (ref)		
Cohabiting	-0.17* (0.084)	-0.18* (0.081)
Previously married	-0.028 (0.12)	-0.097 (0.11)
Never married	-0.021 (0.096)	-0.027 (0.090)
Married before 19years	-0.011 (0.046)	-0.019 (0.044)
Female household head	0.015 (0.056)	0.0071 (0.052)
Ever contraception	0.24*** (0.053)	0.18*** (0.050)
Know family planning source	0.17*** (0.050)	0.13** (0.047)
Religious affiliation		
Orthodox Christian (ref)		
Other Christian	-0.021 (0.053)	-0.014 (0.051)
Moslem	0.28*** (0.084)	0.20** (0.068)
Traditionalist/other	0.021 (0.096)	0.12 (0.086)
Ethnicity		
Akan (ref)		
Ga/Dangme/Guan	-0.12 (0.10)	-0.051 (0.070)
Ewe	-0.069 (0.096)	-0.014 (0.071)
Mole-Dagbani/Hausa	-0.33** (0.11)	-0.27** (0.090)
Grussi/Gruma	-0.18 (0.12)	0.069 (0.093)
Other/4missing	-0.40*** (0.11)	-0.23* (0.098)

Appendix 5G3 continued

Region		
Greater Accra (ref)		
Central	0.53*** (0.14)	0.13 (0.091)
Western	1.23*** (0.14)	0.42*** (0.095)
Volta	0.020 (0.15)	-0.019 (0.089)
Eastern	0.39** (0.13)	0.099 (0.075)
Ashanti	0.55*** (0.12)	0.093 (0.074)
Brong Ahafo	0.75*** (0.14)	0.15 (0.086)
Northern	0.057 (0.17)	0.11 (0.11)
Upper East	0.95*** (0.16)	0.18 (0.11)
Upper West	0.80*** (0.18)	0.34* (0.16)
Constant	6.44*** (0.24)	2.68*** (0.28)
Total N	10370	10370
Subpop N	4868	4868
Design df	380	380
F(45, 336)	19.14	
F(46, 335)		61.98
Prob > F	0.0001	0.0001
R-squared	0.227	0.299

Notes: *p<0.05, ** p<0.01, *** p<0.001. Standard errors in parentheses
 Model 1 is the has the same set of predictors as the multilevel model and model 2 has in addition the ANC quality in one's cluster

Appendix 5G4: Comparing fixed effects from the multilevel linear regression of Antenatal care (ANC) measure obtained from the summative index and from principal component analysis (PCA), Ghana Maternal Health Survey, N=4,868

<i>Independent variables</i>	<i>Quality of ANC : b(se)</i>			
	<i>Unconditional models</i>		<i>Conditional models</i>	
	<i>Additive</i>	<i>PCA</i>	<i>Additive</i>	<i>PCA</i>
Urban residence	0.084 (0.066)	0.064 (0.040)	0.084 (0.066)	0.066 (0.043)
Years of sch. centered	0.018** (0.0059)	0.0029 (0.0037)	0.043** (0.013)	0.021* (0.0091)
Wealth (ref=poorest)				
Poorer/Middle	0.17** (0.060)	0.17*** (0.037)	0.073 (0.074)	0.11* (0.050)
Rich/Richest	0.21** (0.077)	0.16*** (0.048)	0.13 (0.086)	0.12* (0.058)
Wealth & Education interaction				
Poorer/Middle*education			-0.031* (0.015)	-0.021* (0.010)
Rich/Richest*education			-0.027 (0.015)	-0.018 (0.010)
Four or more ANC visits	0.60*** (0.055)	0.38*** (0.035)	0.60*** (0.055)	0.43*** (0.038)
First ANC (ref= first trimester)				
Second trimester	-0.086* (0.042)	-0.021 (0.027)	-0.088* (0.042)	-0.028 (0.029)
Third trimester	-0.50*** (0.11)	-0.34*** (0.069)	-0.50*** (0.11)	-0.42*** (0.075)
DK trimester	-1.76*** (0.50)	-1.39*** (0.31)	-1.76*** (0.50)	-1.62*** (0.33)
ANC provider (ref=Nurse)				
Doctor"	0.049 (0.053)	0.090** (0.034)	0.051 (0.053)	0.094** (0.036)
All others	-0.37** (0.13)	0.077 (0.083)	-0.36** (0.13)	-0.014 (0.089)
ANC facility (ref=Gov't hosp/polyclinic)				
Other Gov't facility	-0.23*** (0.051)	-0.18*** (0.032)	-0.22*** (0.051)	-0.18*** (0.034)
Only Private facility/maternity home	-0.31*** (0.061)	-0.18*** (0.038)	-0.31*** (0.061)	-0.20*** (0.041)
Home/other/DK	-1.84*** (0.21)	-1.70*** (0.14)	-1.85*** (0.21)	-1.81*** (0.15)
ANC for problem	0.061 (0.052)	-0.059 (0.033)	0.058 (0.052)	-0.057 (0.036)
Pregnancy complication	-0.16 (0.10)	-0.14* (0.067)	-0.16 (0.10)	-0.14* (0.072)

Serious complication	0.21 (0.11)	0.14 (0.072)	0.22 (0.11)	0.16* (0.077)
Ever miscarried or had a still birth	-0.085 (0.048)	-0.032 (0.031)	-0.084 (0.048)	-0.045 (0.033)
Current age in years	-0.0033 (0.0046)	0.0019 (0.0029)	-0.0029 (0.0046)	0.0026 (0.0031)
Parity	0.016 (0.015)	-0.0045 (0.0098)	0.016 (0.015)	-0.0050 (0.011)
Marital Status (ref= Currently married)				
Cohabiting	-0.16* (0.062)	-0.071 (0.039)	-0.16** (0.062)	-0.071 (0.042)
Previously married	-0.023 (0.081)	-0.065 (0.052)	-0.029 (0.081)	-0.060 (0.056)
Never married	-0.014 (0.087)	-0.062 (0.056)	-0.011 (0.087)	-0.062 (0.060)
Married before 19years	-0.023 (0.044)	-0.037 (0.028)	-0.022 (0.044)	-0.032 (0.031)
Female household head	0.024 (0.050)	0.046 (0.032)	0.022 (0.050)	0.046 (0.035)
Ever contraception	0.21*** (0.046)	0.085** (0.030)	0.21*** (0.046)	0.092** (0.032)
Know family planning source	0.14*** (0.039)	0.033 (0.025)	0.14*** (0.039)	0.044 (0.027)
Religion (ref=Orthodox Christian)				
Other Christian.	-0.026 (0.049)	-0.0064 (0.031)	-0.026 (0.049)	-0.0086 (0.033)
Moslem	0.20* (0.079)	0.14** (0.049)	0.19* (0.080)	0.15** (0.053)
Traditionalist /other	-0.022 (0.080)	-0.096 (0.050)	-0.013 (0.080)	-0.084 (0.054)
Ethnicity (ref=Akan)				
Ga/Dangme/Guan	-0.040 (0.081)	0.0026 (0.050)	-0.045 (0.081)	-0.023 (0.054)
Ewe	-0.096 (0.082)	0.029 (0.050)	-0.099 (0.082)	-0.0085 (0.054)
Mole-Dagbani/Hausa	-0.19 (0.10)	0.073 (0.064)	-0.19 (0.10)	0.034 (0.069)
Grussi/Gruma	-0.14 (0.097)	-0.011 (0.060)	-0.14 (0.097)	-0.021 (0.064)
Other/4missing	-0.21* (0.099)	-0.11 (0.063)	-0.21* (0.099)	-0.13* (0.067)
Region (ref=Greater Accra)				
Central	0.58**	0.21**	0.57**	0.24**

	(0.19)	(0.075)	(0.19)	(0.086)
Western	1.38***	0.24**	1.38***	0.33***
	(0.20)	(0.076)	(0.20)	(0.087)
Volta	0.050	-0.11	0.050	-0.064
	(0.20)	(0.078)	(0.20)	(0.089)
Eastern	0.42*	0.039	0.41*	0.063
	(0.18)	(0.063)	(0.18)	(0.074)
Ashanti	0.65***	0.12	0.65***	0.18*
	(0.18)	(0.065)	(0.18)	(0.076)
Brong Ahafo	0.79***	0.23**	0.78***	0.29***
	(0.19)	(0.074)	(0.19)	(0.085)
Northern	0.010	-0.13	0.0099	-0.096
	(0.20)	(0.084)	(0.20)	(0.095)
Upper East	0.93***	0.0075	0.95***	0.17
	(0.23)	(0.093)	(0.23)	(0.11)
Upper West	0.81***	-0.17	0.83***	-0.017
	(0.24)	(0.10)	(0.24)	(0.11)
Constant	6.37***	-0.47***	6.45***	-0.52***
	(0.22)	(0.11)	(0.22)	(0.13)
N	4868	4455	4868	4455

Notes: This table compares the results using the ANC quality measures obtained from the summative index and that extracted from the principal component analysis. *p<0.05, ** p<0.01, *** p<0.001. Standard errors in parentheses

Appendix5W1: Distribution of individual variables used to create ANC quality of care index, World Health survey (N=1,671)^a

Variable	Ghana		Burkina Faso		Total		
	N	%	N	%	N	%	
Blood Pressure							
No	22	3.4	76	7.43	98	5.86	
Yes	625	96.45	942	92.08	1,567	93.78	
Missing	1	0.15	5	0.49	6	0.36	
Total	648	100	1,023	100	1,671	100	
Blood sample							
No	117	18.06	617	60.31	734	43.93	
Yes	525	81.02	393	38.42	918	54.94	
Missing	6	0.93	13	1.27	19	1.14	
Total	648	100	1,023	100	1,671	100	
Told about signs of Pregnancy complications							
No	233	35.96	735	71.85	968	57.93	
Yes	400	61.73	274	26.78	674	40.34	
Missing	15	2.31	14	1.37	29	1.74	
Total	648	100	1,023	100	1,671	100	
ANC quality of care score							
	0	10	1.54	63	6.16	73	4.37
	1	69	10.65	440	43.01	509	30.46
	2	226	34.88	391	38.22	617	36.92
	3	343	52.93	129	12.61	472	28.25
Mean (SD)	648	2.39 (0.74)	1,023	1.57 (0.79)	1,671	1.89 (0.87)	

Appendix 5W2: Multilevel binary logistic regression of Quality of Antenatal care (ANC) on Place of residence, Education and relevant confounders, Stratified by country, WHS

<i>Independent variables</i>	Quality of ANC : OR [95% CI]					
	Ghana			Burkina Faso		
Place of Residence						
Rural (ref)						
Urban	1.31	[0.62	2.75]	4.49***	[2.40	8.42]
Education						
None (ref)						
Some	1.06	[0.67	1.69]	2.01*	[1.17	3.47]
Household wealth Index						
Lower tertile (ref)						
Middle tertile	0.7	[0.41	1.19]	1.45	[0.87	2.44]
Upper tertile	0.83	[0.51	1.37]	0.83	[0.45	1.55]
Occupation						
Not working (ref)						
Professional	0.71	[0.25	2.00]	0.59	[0.17	2.02]
Service/sales/technician	0.82	[0.44	1.55]	0.82	[0.47	1.43]
Agricultural/fishery worker	0.73	[0.37	1.42]	0.088**	[0.020	0.39]
Number of ANC visits						
1 - 3 ANC visits (ref)						
4 or more ANC visits	1.94**	[1.21	3.12]	1.78*	[1.14	2.79]
ANC provider						
Nurse (ref)						
Doctor	1.19	[0.67	2.11]	2.62**	[1.47	4.65]
Other provider	0.23*	[0.055	0.92]	0.52	[0.15	1.84]
Current age in years	1.02	[0.98	1.05]	0.97	[0.92	1.02]
Marital Status						
Currently Married (ref)						
Not currently married	1.08	[0.65	1.81]	0.75	[0.34	1.65]
Parity	1.02	[0.94	1.12]	1.16	[0.99	1.37]
Self-Rated Health Status	0.97	[0.77	1.23]	1.07	[0.80	1.42]
Any diagnosed chronic condition	0.93	[0.55	1.57]	0.9	[0.55	1.49]
Satisfaction with Health system	1.08	[0.87	1.32]	0.87	[0.67	1.13]
Perceived health service accessibility						
Bad (ref)						
Good	1.12	[0.64	1.97]	0.66	[0.32	1.36]
Missing(No inpatient encounter)	0.84	[0.51	1.38]	1.35	[0.81	2.25]
Constant	0.42	[0.095	1.90]	0.072**	[0.013	0.39]
<i>Random effects</i>						
Strata	0.58	[0.33	1.01]	3.10E-13	[0	.]
cluster	0.85	[0.55	1.33]	0.75	[0.44	1.26]
N	648			1023		

Notes: *p<0.05, ** p<0.01, *** p<0.001.

Appendix 6G1: Multilevel Logistic Regression of use of SBAs on quality of ANC, Place of residence, SES and relevant confounders for full sample, GMHS, N=5,042

<i>Independent variables</i>	<i>Use of SBA : OR[95% CI]</i>					
	<i>Model without region</i>			<i>Model with region</i>		
Quality of ANC score						
0-7 (ref)						
8 or 9	1.20*	[1.01	1.42]	1.17	[0.99	1.39]
Place of residence:						
Rural (ref)						
Urban	4.47***	[3.38	5.91]	4.30***	[3.27	5.66]
Years of sch. centered	1.07***	[1.05	1.10]	1.07***	[1.05	1.10]
Household wealth Index						
Poorest (ref)						
Poorer/Middle	1.23	[0.98	1.53]	1.28*	[1.03	1.60]
Rich/Richest	2.10***	[1.56	2.84]	2.19***	[1.62	2.96]
Number of ANC visits						
One to three	0.36***	[0.29	0.45]	0.36***	[0.29	0.45]
Four or more(ref)						
Trimester of first ANC						
First trimester (ref)						
Second trimester	0.85	[0.72	1.00]	0.87	[0.74	1.03]
Third trimester	0.94	[0.61	1.45]	0.96	[0.62	1.47]
DK trimester	0.81	[0.079	8.39]	0.9	[0.084	9.71]
ANC provider						
Nurse (ref)						
Doctor	1.31*	[1.04	1.63]	1.30*	[1.04	1.62]
All others	0.42**	[0.25	0.71]	0.38***	[0.23	0.64]
Type of facility						
Gov't hosp./polyclinic(ref)						
Other Gov't facility	0.78*	[0.65	0.95]	0.80*	[0.66	0.97]
Only Private facility/maternity home	1.13	[0.87	1.47]	1.15	[0.88	1.49]
Home/other/DK	0.49	[0.21	1.16]	0.52	[0.22	1.20]
Reason for ANC						
Checkup						
Other (for problem)	0.9	[0.73	1.10]	0.89	[0.73	1.10]
No ANC	0.29	[0.024	3.36]	0.29	[0.024	3.56]
Pregnancy complication	0.8	[0.53	1.22]	0.81	[0.54	1.23]
Serious complication	2.40***	[1.53	3.77]	2.39***	[1.52	3.74]
Prior miscarriage/still birth	1.07	[0.88	1.30]	1.07	[0.88	1.30]
Current age in years	1.03**	[1.01	1.04]	1.03**	[1.01	1.05]
Parity	0.92**	[0.87	0.98]	0.92**	[0.87	0.98]
Marital Status						
Currently married (ref)						
Cohabiting	0.64***	[0.51	0.81]	0.65***	[0.51	0.82]
Previously married	0.98	[0.71	1.34]	0.98	[0.72	1.34]
Never married	1.23	[0.86	1.76]	1.23	[0.86	1.76]
Married before 19years	0.94	[0.79	1.12]	0.93	[0.78	1.11]
Female household head	1.06	[0.87	1.29]	1.04	[0.85	1.27]
Ever contraception	1.22*	[1.02	1.46]	1.21*	[1.01	1.44]

Know family planning source	0.99	[0.85	1.16]	0.97	[0.83	1.13]
Appendix 6G1 continued						
Religious affiliation						
Orthodox Christian (ref)						
Other Christian	1.04	[0.85	1.26]	1.04	[0.86	1.26]
Moslem	1	[0.73	1.38]	1.06	[0.77	1.45]
Traditionalist /other	0.69*	[0.51	0.94]	0.69*	[0.50	0.94]
Ethnicity						
Akan						
Ga/Dangme/Guan	0.82	[0.59	1.12]	0.86	[0.62	1.20]
Ewe	0.8	[0.59	1.09]	0.89	[0.63	1.24]
Mole-Dagbani/Hausa	0.66*	[0.45	0.96]	0.75	[0.49	1.13]
Grussi/Gruma	0.77	[0.54	1.11]	0.76	[0.51	1.12]
Other/4missing	0.91	[0.62	1.35]	0.9	[0.60	1.33]
Watches television						
At least once a week (ref)						
Less than once a week	0.79	[0.61	1.03]	0.79	[0.61	1.03]
Not at all/DK	0.88	[0.72	1.08]	0.88	[0.72	1.08]
Region						
Greater Accra (ref)						
Central				1.01	[0.53	1.93]
Western				0.8	[0.41	1.55]
Volta				0.66	[0.34	1.29]
Eastern				0.85	[0.47	1.54]
Ashanti				1.13	[0.61	2.08]
Brong Ahafo				0.9	[0.47	1.72]
Northern				0.37**	[0.18	0.76]
Upper east				1.47	[0.67	3.22]
Upper west				1.83	[0.79	4.20]
Constant	0.63	[0.34	1.17]	0.67	[0.30	1.50]
District variance	0.48***	[0.33	0.68]	0.37***	[0.24	0.59]
Cluster variance	0.60***	[0.47	0.77]	0.57***	[0.45	0.74]
N	5042			5042		

Notes: *p<0.05, ** p<0.01, *** p<0.001.

This analysis involves the full sample including those who did not attend ANC

Appendix 6G2: Weighted logistic regression of health facility delivery on quality of ANC, Place of residence, SES and relevant confounders, GMHS

<i>Independent variables</i>	<i>Delivery in a Health facility : OR[95% CI]</i>											
	<i>Attended ANC at least once</i>						<i>Full sample</i>					
	<i>Model without region</i>			<i>Model with region</i>			<i>Model without region</i>			<i>Model with region</i>		
Quality of ANC score												
0-7 (ref)												
8 or 9	1.17	[0.98	1.39]	1.12	[0.95	1.33]	1.16	[0.98	1.38]	1.12	[0.94	1.33]
Place of residence:												
Rural (ref)												
Urban	3.81***	[2.83	5.12]	3.70***	[2.75	4.99]	3.83***	[2.85	5.14]	3.72***	[2.76	5.02]
Years of sch. centered	1.09***	[1.07	1.12]	1.09***	[1.06	1.12]	1.09***	[1.07	1.12]	1.09***	[1.06	1.12]
Household wealth Index												
Poorest (ref)												
Poorer/Middle	1.15	[0.92	1.44]	1.27*	[1.01	1.61]	1.15	[0.92	1.44]	1.27*	[1.01	1.61]
Rich/Richest	2.23***	[1.61	3.10]	2.35***	[1.69	3.27]	2.26***	[1.63	3.14]	2.38***	[1.71	3.31]
ANC attendance												
One to three												
Four or more(ref)	2.91***	[2.31	3.66]	3.03***	[2.41	3.81]	2.90***	[2.30	3.65]	3.02***	[2.40	3.80]
Trimester of first ANC												
First trimester (ref)												
Second trimester	0.84*	[0.71	0.99]	0.87	[0.74	1.03]	0.84*	[0.71	0.99]	0.87	[0.74	1.03]
Third trimester	0.85	[0.53	1.35]	0.89	[0.55	1.43]	0.84	[0.53	1.34]	0.88	[0.55	1.42]
DK trimester	0.79	[0.16	3.91]	1	[0.20	4.93]	0.8	[0.16	3.97]	1.01	[0.20	5.03]
ANC provider												
Nurse (ref)												
Doctor	1.15	[0.89	1.48]	1.13	[0.88	1.45]	1.15	[0.89	1.48]	1.13	[0.88	1.45]
All others	0.52	[0.26	1.05]	0.37**	[0.19	0.72]	0.52	[0.26	1.05]	0.37**	[0.19	0.71]
Type of facility												
Gov't hospital/polyclinic (ref)												
Other Gov't facility	0.78*	[0.63	0.96]	0.80*	[0.66	0.99]	0.78*	[0.64	0.96]	0.81*	[0.66	1.00]
Only Private/maternity home	0.99	[0.76	1.29]	1.06	[0.82	1.38]	0.99	[0.76	1.29]	1.07	[0.82	1.39]
Home/other/DK	0.22**	[0.078	0.62]	0.24**	[0.090	0.67]	0.22**	[0.077	0.62]	0.25**	[0.090	0.67]
Reason for ANC												
Checkup												
Other (for problem)	0.89	[0.71	1.12]	0.89	[0.71	1.12]	0.89	[0.71	1.12]	0.89	[0.71	1.11]

Appendix 6G2 continued

Pregnancy complication	0.73	[0.48	1.10]	0.73	[0.48	1.12]	0.72	[0.48	1.09]	0.73	[0.48	1.10]
Serious complication	2.85***	[1.86	4.35]	2.87***	[1.87	4.41]	2.88***	[1.89	4.39]	2.91***	[1.90	4.45]
Prior miscarriage/still birth	1.23*	[1.00	1.51]	1.23*	[1.00	1.52]	1.22	[1.00	1.50]	1.22	[1.00	1.50]
Current age in years	1.02	[1.00	1.04]	1.02	[1.00	1.04]	1.02	[1.00	1.04]	1.02	[1.00	1.04]
Parity	0.92*	[0.86	0.98]	0.93*	[0.87	0.99]	0.92*	[0.86	0.98]	0.93*	[0.87	0.99]
Marital Status												
Currently married (ref)												
Cohabiting	0.79	[0.60	1.03]	0.8	[0.61	1.06]	0.77	[0.59	1.01]	0.78	[0.59	1.03]
Previously married	1.36	[0.96	1.93]	1.4	[0.99	1.99]	1.3	[0.93	1.84]	1.34	[0.95	1.90]
Never married	1.18	[0.84	1.67]	1.25	[0.88	1.77]	1.19	[0.84	1.68]	1.25	[0.88	1.78]
Married before 19years	0.88	[0.74	1.05]	0.88	[0.74	1.05]	0.88	[0.75	1.04]	0.88	[0.74	1.04]
Female household head	1.13	[0.90	1.42]	1.07	[0.85	1.34]	1.12	[0.90	1.40]	1.06	[0.85	1.33]
Ever contraception	1.28**	[1.06	1.54]	1.22*	[1.00	1.47]	1.29**	[1.07	1.55]	1.22*	[1.01	1.48]
Know family planning source	1.01	[0.86	1.18]	0.95	[0.80	1.12]	1.01	[0.86	1.19]	0.95	[0.81	1.12]
Religious affiliation												
Orthodox Christian (ref)												
Other Christian	1.06	[0.86	1.33]	1.05	[0.85	1.30]	1.06	[0.85	1.32]	1.05	[0.85	1.29]
Moslem	0.92	[0.59	1.43]	0.99	[0.67	1.46]	0.91	[0.59	1.41]	0.98	[0.67	1.44]
Traditionalist /other	0.54**	[0.36	0.79]	0.53***	[0.36	0.76]	0.53**	[0.36	0.77]	0.52***	[0.36	0.75]
Ethnicity												
Akan												
Ga/Dangme/Guan	0.87	[0.62	1.22]	0.81	[0.57	1.15]	0.86	[0.62	1.19]	0.79	[0.56	1.13]
Ewe	0.67*	[0.49	0.93]	0.66*	[0.47	0.93]	0.68*	[0.49	0.93]	0.67*	[0.48	0.94]
Mole-Dagbani/Hausa	0.7	[0.44	1.13]	0.85	[0.53	1.37]	0.7	[0.44	1.12]	0.84	[0.53	1.35]
Grussi/Gruma	0.85	[0.56	1.27]	0.73	[0.45	1.18]	0.83	[0.55	1.24]	0.72	[0.45	1.15]
Other/4missing	1.26	[0.69	2.29]	1.04	[0.59	1.84]	1.24	[0.68	2.25]	1.03	[0.58	1.81]
Watches television												
At least once a week (ref)												
Less than once a week	0.85	[0.65	1.11]	0.83	[0.63	1.10]	0.86	[0.66	1.14]	0.85	[0.64	1.12]
Not at all/DK	1.03	[0.80	1.34]	0.98	[0.76	1.26]	1.03	[0.80	1.34]	0.97	[0.76	1.25]

Appendix 6G2 continued

Region												
Greater Accra (ref)												
Central				0.57*	[0.35	0.91]				0.56*	[0.35	0.90]
Western				0.57*	[0.36	0.92]				0.57*	[0.35	0.91]
Volta				0.67	[0.41	1.09]				0.66	[0.41	1.07]
Eastern				0.77	[0.53	1.10]				0.77	[0.53	1.11]
Ashanti				0.78	[0.50	1.23]				0.8	[0.51	1.27]
Brong Ahafo				0.83	[0.50	1.36]				0.82	[0.50	1.35]
Northern				0.35***	[0.21	0.61]				0.35***	[0.21	0.61]
Upper east				1.24	[0.68	2.26]				1.25	[0.68	2.28]
Upper west				1.47	[0.65	3.35]				1.46	[0.65	3.31]
Constant	0.24***	[0.12	0.48]	0.34**	[0.16	0.73]	0.098*	[0.014	0.67]	0.16	[0.024	1.06]
N	10370			10370			10370			10370		

Notes: *p<0.05, ** p<0.01, *** p<0.001.

Appendix 6W1: Logistic regression of use of SBAs on quality of ANC, Place of residence, Education and relevant confounders for full sample, WHS, N=2,005

<i>Independent variables</i>	Multilevel			Single level/robust std. errors		
	Use of SBA : OR[95% CI]			Use of SBA : OR[95% CI]		
<i>Fixed effects</i>						
Quality of ANC score						
Bad (score=0-2) (ref)						
Good (score=3)	1.25	[0.82	1.91]	1.33	[0.97	1.82]
Place of Residence						
Rural (ref)						
Urban	7.28***	[2.53	20.9]	4.32***	[3.27	5.70]
Education						
None (ref)						
Some	1.31	[0.83	2.07]	1.48*	[1.08	2.03]
Household wealth Index						
Lower tertile (ref)						
Middle tertile	1.37	[0.98	1.91]	1.26	[0.97	1.63]
Upper tertile	1.47	[0.96	2.27]	1.69**	[1.22	2.34]
Occupation						
Not working (ref)						
Professional	18.0**	[2.97	109.6]	10.7***	[3.27	35.3]
Service/sales/technician	0.93	[0.59	1.46]	1.07	[0.77	1.48]
Agricultural/fishery worker	0.7	[0.45	1.12]	0.77	[0.56	1.05]
Attended some ANC	3.55**	[1.66	7.57]	2.63**	[1.40	4.94]
Number of ANC visits						
1 - 3 ANC visits (ref)						
4 or more ANC visits	1.96***	[1.38	2.78]	1.63***	[1.26	2.12]
ANC provider						
Nurse (ref)						
Doctor	1.15	[0.69	1.91]	1.04	[0.75	1.44]
Other provider	0.35***	[0.18	0.65]	0.29***	[0.17	0.48]
Current age in years	0.99	[0.97	1.02]	1	[0.98	1.02]
Marital Status						
Currently Married (ref)						
Not currently married	0.94	[0.56	1.59]	1.13	[0.76	1.68]
Parity	0.92*	[0.85	1.00]	0.93*	[0.87	0.98]
Any diagnosed chronic condition	0.96	[0.67	1.39]	1.02	[0.77	1.35]
Self-Rated Health Status						
Very good(ref)						
Good	1.11	[0.77	1.60]	0.87	[0.67	1.14]
Moderate to bad	1.2	[0.77	1.86]	0.91	[0.66	1.27]
Satisfaction with Health system						
Dissatisfied (ref)						
Fairly satisfied	1.44	[0.96	2.16]	1.37*	[1.01	1.86]
Very satisfied	1.69*	[1.06	2.70]	1.33	[0.93	1.90]
Perceived health service accessibility						
Bad (ref)						
Good	2.08**	[1.30	3.33]	1.97***	[1.37	2.84]
No inpatient/missing	3.47***	[2.25	5.34]	2.76***	[1.98	3.84]

Appendix 6W1 continued

Ghana	0.25*	[0.069	0.93]	0.34***	[0.23	0.51]
Constant	0.27	[0.052	1.42]	0.26**	[0.11	0.60]
<i>Random effects</i>						
Strata variance	0.96	[0.61	1.51]			
Cluster variance	1.57***	[1.29	1.90]			
N	2005			2005		

Notes: *p<0.05, ** p<0.01, *** p<0.001.

Appendix 7G1: Final models from multivariate regression of Pregnancy outcome on quality of Antenatal Care and relevant confounders, GMHS,

<i>Independent variables</i>	Multilevel						Weighted single level					
	Attended at least one ANC			Full sample			Attended at least one ANC			Full sample		
	<i>Odds of having a Stillbirth: OR [95% CI]</i>											
ANC attendance				0.45	[0.044	4.68]				0.28	[0.022	3.48]
Higher ANC Quality	0.50**	[0.30	0.85]	0.49**	[0.29	0.82]	0.55*	[0.33	0.90]	0.53*	[0.32	0.86]
Delivery by a SBA	2.18	[0.32	14.7]	1.78	[0.27	11.5]	2.79	[0.43	18.1]	2.14	[0.39	11.8]
Type of delivery facility												
Gov't hosp./polyclinic (ref)												
Other Gov't facility	0.36*	[0.14	0.93]	0.36*	[0.14	0.94]	0.41*	[0.17	0.97]	0.41*	[0.18	0.94]
Private /maternity home	0.25**	[0.096	0.67]	0.24**	[0.092	0.65]	0.30*	[0.11	0.81]	0.30*	[0.11	0.79]
Home/other/DK	0.81	[0.12	5.44]	0.78	[0.12	5.17]	0.93	[0.13	6.45]	0.87	[0.14	5.56]
Attended ANC ≥ 4times	0.41**	[0.22	0.76]	0.42**	[0.23	0.77]	0.37**	[0.19	0.70]	0.37**	[0.19	0.70]
ANC provider												
Nurse (ref)												
Doctor	1.44	[0.79	2.60]	1.45	[0.80	2.61]	1.38	[0.67	2.81]	1.36	[0.67	2.72]
All others	1.37	[0.15	12.2]	1.28	[0.14	11.6]	1.23	[0.11	13.4]	1.05	[0.092	12.0]
Attended ANC for problem	0.79	[0.40	1.55]	0.79	[0.40	1.56]	0.88	[0.44	1.77]	0.87	[0.44	1.75]
Pregnancy complication	2.71***	[1.63	4.50]	2.74***	[1.68	4.45]	3.03***	[1.74	5.25]	2.78***	[1.69	4.56]
Past Stillbirth	3.36**	[1.63	6.95]	3.55***	[1.72	7.32]	2.74*	[1.19	6.31]	2.88**	[1.30	6.38]
Multiple gestation	4.82***	[2.16	10.8]	5.67***	[2.58	12.4]	4.63***	[2.04	10.5]	5.45***	[2.56	11.6]
Intervention during delivery	1.93*	[1.05	3.55]	1.82	[1.00	3.34]	2.22*	[1.19	4.15]	2.15*	[1.16	3.97]
Sibling maternal death	5.42***	[2.04	14.4]	5.44***	[2.05	14.4]	5.46**	[1.77	16.8]	4.67**	[1.55	14.1]
Current age in years	1.04	[0.98	1.09]	1.03	[0.98	1.08]	1.05	[0.99	1.10]	1.05*	[1.00	1.10]
Number of pregnancies	0.99	[0.85	1.16]	0.99	[0.85	1.15]	1	[0.85	1.18]	0.97	[0.85	1.09]
Marital Status												
Currently married (ref)												
Cohabiting	0.92	[0.37	2.32]	1.31	[0.59	2.91]	0.9	[0.33	2.46]	1.37	[0.59	3.19]
Previously married	0.94	[0.35	2.52]	0.86	[0.32	2.31]	0.96	[0.35	2.66]	0.8	[0.29	2.20]
Never married	3.13**	[1.38	7.08]	3.30**	[1.54	7.07]	4.08**	[1.69	9.83]	3.81**	[1.72	8.46]

Appendix 7G1 cont.

Urban residence:	1.84	[0.89	3.83]	1.69	[0.82	3.49]	1.8	[0.77	4.20]	1.57	[0.72	3.43]
Years of sch. centered	1.04	[0.97	1.11]	1.02	[0.96	1.09]	1.05	[0.97	1.15]	1.03	[0.95	1.12]
Household wealth Index												
Poorest (ref)	.											
Poorer/Middle	0.58	[0.27	1.23]	0.86	[0.41	1.80]	0.5	[0.24	1.06]	0.9	[0.49	1.65]
Rich/Richest	0.57	[0.22	1.50]	0.99	[0.38	2.56]	0.48	[0.19	1.26]	0.92	[0.37	2.25]
Region												
Greater Accra (ref)												
Central	2.39	[0.75	7.60]	2.43	[0.79	7.52]	2.44	[0.74	8.02]	2.56	[0.83	7.86]
Western	0.39	[0.045	3.38]	0.68	[0.13	3.55]	0.76	[0.11	5.46]	1.3	[0.31	5.48]
Volta	1.35	[0.31	5.91]	1.05	[0.24	4.55]	2.15	[0.49	9.45]	1.53	[0.36	6.44]
Eastern	2.72*	[1.04	7.07]	2.61*	[1.02	6.68]	4.12*	[1.22	13.9]	3.85*	[1.25	11.9]
Ashanti	1.61	[0.63	4.13]	1.74	[0.69	4.38]	2.13	[0.70	6.45]	2.54	[0.87	7.39]
Brong Ahafo	4.62**	[1.62	13.2]	4.71**	[1.66	13.4]	5.82**	[1.94	17.4]	5.97***	[2.12	16.9]
Northern	3.11	[0.95	10.2]	2.66	[0.83	8.57]	3.87*	[1.13	13.3]	3.3	[0.84	13.0]
Upper east	1.77	[0.29	10.7]	1.82	[0.30	11.0]	2.68	[0.55	13.0]	2.66	[0.58	12.2]
Upper west	0.89	[0.096	8.30]	1.46	[0.25	8.60]	1.46	[0.14	15.1]	1.71	[0.26	11.1]
Constant	0.0022***	[0.00016	0.032]	0.0046**	[0.00015	0.14]	0.0011***	[0.00011	0.011]	0.0037***	[0.00017	0.080]
<i>Random effects</i>												
Cluster variance	0.57	[0.18	1.83]	0.73	[0.35	1.54]						
N	4868			5042			4868			5042		

Notes: *p<0.05, ** p<0.01, *** p<0.001. These models include only significant predictors from full model and those with strong rational for inclusion

Appendix 7G2: Full models from multivariate regression of Pregnancy outcome on quality of Antenatal Care and relevant confounders, GMHS,

<i>Independent variables</i>	Multilevel						Weighted single level					
	<i>At least one ANC visit</i>			<i>Full sample</i>			<i>At least one ANC visit</i>			<i>Full sample</i>		
	Odds of having a Stillbirth: OR [95% CI]											
Attend ANC at least once				0.24	[0.016	3.41]				0.07	[0.0031	1.58]
Higher ANC Quality	0.51*	[0.30	0.87]	0.49**	[0.29	0.84]	0.56*	[0.34	0.94]	0.54*	[0.32	0.90]
Delivery by a SBA	2.38	[0.34	16.5]	1.93	[0.29	12.8]	3.08	[0.47	20.2]	2.53	[0.46	13.9]
Type of delivery facility												
Gov't hosp./polyclinic (ref)	.	.	.	.	.	.	.	.	.	.	.	.
Other Gov't facility	0.35*	[0.13	0.94]	0.36*	[0.13	0.96]	0.39*	[0.17	0.89]	0.40*	[0.17	0.90]
Private /maternity home	0.24**	[0.089	0.64]	0.23**	[0.086	0.62]	0.29*	[0.11	0.79]	0.29*	[0.11	0.77]
Home/other/DK	0.86	[0.12	5.98]	0.87	[0.13	5.84]	0.98	[0.14	6.91]	1.03	[0.17	6.35]
Attended ANC ≥ 4times	0.35**	[0.18	0.68]	0.35**	[0.18	0.67]	0.32**	[0.16	0.63]	0.32***	[0.16	0.62]
Trimester of first ANC												
First trimester (ref)												
Second trimester	0.97	[0.56	1.66]	0.93	[0.54	1.60]	1.16	[0.66	2.05]	1.15	[0.64	2.05]
Third trimester	0.52	[0.13	2.03]	0.48	[0.12	1.95]	0.31	[0.077	1.29]	0.31	[0.073	1.30]
ANC provider												
Nurse (ref)												
Doctor	1.41	[0.77	2.58]	1.41	[0.77	2.56]	1.36	[0.68	2.75]	1.28	[0.64	2.54]
All others	1.27	[0.13	12.8]	1.26	[0.13	12.3]	1.19	[0.075	18.8]	0.96	[0.061	15.0]
ANC for problem	0.83	[0.42	1.64]	0.84	[0.42	1.67]	0.91	[0.45	1.85]	0.95	[0.47	1.91]
Pregnancy complication	2.73	[0.97	7.68]	2.63*	[1.00	6.90]	3.34	[0.99	11.2]	2.93	[0.95	9.08]
Serious complication	0.98	[0.34	2.87]	1.01	[0.37	2.77]	0.95	[0.29	3.06]	0.96	[0.31	2.97]
Past miscarriage	0.95	[0.48	1.90]	1.16	[0.60	2.24]	0.77	[0.37	1.59]	1.28	[0.62	2.62]
Past stillbirth	3.53***	[1.68	7.42]	3.82***	[1.82	7.99]	2.96*	[1.28	6.85]	3.17**	[1.44	6.98]
Ever Induced abortion	1.6	[0.83	3.06]	1.74	[0.92	3.29]	1.27	[0.61	2.67]	1.55	[0.79	3.05]
Multiple gestation	5.49***	[2.40	12.6]	6.56***	[2.90	14.9]	4.67***	[2.03	10.7]	5.63***	[2.57	12.3]
Sibling maternal death	5.97***	[2.22	16.1]	6.12***	[2.28	16.4]	5.71***	[2.05	15.9]	5.26**	[1.93	14.3]
Intervention at delivery	1.96*	[1.05	3.65]	1.85	[1.00	3.43]	2.21*	[1.13	4.30]	2.16*	[1.14	4.12]
Current age in years	1.05	[1.00	1.11]	1.05	[0.99	1.11]	1.05	[0.98	1.12]	1.06*	[1.00	1.12]
Number of pregnancies	0.95	[0.79	1.14]	0.91	[0.76	1.09]	1.02	[0.81	1.29]	0.93	[0.79	1.10]

Appendix 7G2 cont.

Marital Status												
Currently married (ref)												
Cohabiting	0.9	[0.35	2.30]	1.26	[0.56	2.84]	0.88	[0.31	2.50]	1.32	[0.56	3.10]
Previously married	1.05	[0.37	3.02]	0.88	[0.31	2.52]	1.13	[0.39	3.26]	0.84	[0.30	2.35]
Never married	3.78**	[1.52	9.41]	3.87**	[1.63	9.20]	3.92*	[1.33	11.5]	3.65*	[1.28	10.4]
Married before 19years	1.33	[0.74	2.39]	1.36	[0.77	2.41]	0.78	[0.35	1.73]	0.88	[0.41	1.90]
Female household head	0.8	[0.43	1.49]	0.9	[0.50	1.62]	0.74	[0.38	1.45]	0.89	[0.48	1.66]
Ever contraception	0.59	[0.32	1.08]	0.67	[0.38	1.20]	0.56	[0.27	1.17]	0.62	[0.32	1.19]
Know family planning source	0.93	[0.56	1.54]	0.99	[0.61	1.62]	0.97	[0.60	1.57]	1	[0.63	1.59]
Urban residence:	1.83	[0.87	3.84]	1.6	[0.77	3.35]	1.65	[0.71	3.86]	1.4	[0.65	3.02]
Years of sch. centered	1.04	[0.96	1.12]	1.02	[0.95	1.09]	1.05	[0.97	1.14]	1.02	[0.94	1.11]
Household wealth Index												
Poorest (ref)	.		.									
Poorer/Middle	0.54	[0.25	1.17]	0.8	[0.37	1.70]	0.48	[0.22	1.04]	0.81	[0.45	1.49]
Rich/Richest	0.46	[0.17	1.29]	0.79	[0.29	2.17]	0.39	[0.13	1.17]	0.71	[0.27	1.81]
Religious affiliation												
Orthodox Christian (ref)												
Other Christian	0.68	[0.38	1.22]	0.7	[0.39	1.23]	0.96	[0.51	1.81]	0.96	[0.53	1.73]
Moslem	0.99	[0.40	2.44]	1.14	[0.47	2.78]	0.93	[0.41	2.08]	1.1	[0.50	2.42]
Traditionalist /other	0.74	[0.22	2.44]	0.68	[0.22	2.08]	0.93	[0.21	4.11]	0.79	[0.18	3.34]
Ethnicity												
Akan												
Ga/Dangme/Guan	1.64	[0.69	3.90]	1.24	[0.53	2.94]	2.07	[0.65	6.60]	1.46	[0.46	4.69]
Ewe	1.34	[0.55	3.26]	1.05	[0.43	2.57]	1.31	[0.49	3.50]	0.89	[0.33	2.42]
Mole-Dagbani/Hausa	0.8	[0.24	2.68]	0.85	[0.26	2.72]	1.05	[0.38	2.90]	1.24	[0.51	3.01]
Grussi/Gruma	0.49	[0.13	1.80]	0.36	[0.100	1.32]	0.47	[0.13	1.72]	0.35	[0.10	1.19]
Other/4missing	1.21	[0.39	3.76]	1.01	[0.34	2.99]	1.62	[0.52	5.05]	1.2	[0.41	3.48]
Watches television												
At least once a week (ref)												
Less than once a week	0.64	[0.25	1.61]	0.7	[0.29	1.67]	0.37	[0.12	1.10]	0.41	[0.15	1.12]
Not at all/DK	0.67	[0.34	1.34]	0.7	[0.36	1.35]	0.52	[0.23	1.18]	0.58	[0.28	1.22]

Appendix 7G2 cont.

Region												
Greater Accra (ref)												
Central	2.96	[0.85	10.3]	2.51	[0.75	8.41]	3.88	[0.86	17.5]	3.1	[0.77	12.4]
Western	0.5	[0.055	4.55]	0.72	[0.13	4.01]	1.17	[0.13	10.8]	1.6	[0.31	8.24]
Volta	1.38	[0.29	6.51]	1.09	[0.23	5.09]	2.82	[0.55	14.4]	2.07	[0.44	9.65]
Eastern	3.15*	[1.17	8.52]	2.69*	[1.02	7.10]	5.53*	[1.39	22.0]	4.43*	[1.23	16.0]
Ashanti	1.98	[0.69	5.67]	1.78	[0.64	4.92]	3.4	[0.88	13.1]	3.12	[0.91	10.7]
Brong Ahafo	6.50**	[2.06	20.6]	5.74**	[1.83	18.0]	10.5**	[2.58	42.9]	8.36**	[2.25	31.0]
Northern	3.26	[0.81	13.2]	2.47	[0.62	9.78]	4.47*	[1.08	18.6]	2.95	[0.72	12.2]
Upper east	1.96	[0.28	13.8]	1.98	[0.28	13.9]	3.43	[0.53	22.1]	3.26	[0.56	19.0]
Upper west	1.11	[0.10	12.2]	1.52	[0.21	11.1]	2.28	[0.18	28.9]	1.83	[0.23	14.8]
Constant	0.0029***	[0.00015	0.058]	0.012*	[0.00025	0.56]	0.0017***	[0.000060	0.049]	0.02	[0.00035	1.13]
<i>Random effects</i>												
Cluster variance	0.54	[0.14	2.04]	0.72	[0.31	1.64]						
N	4868			5042			4868			5042		

Notes: *p<0.05, ** p<0.01, *** p<0.001. This has all the predictors in the model (including those that do not improve the model)

REFERENCES

- Abasiékong, Edet M. 1981. "Familism and Hospital Admission in Rural Nigeria—a Case Study." *Social Science & Medicine. Part B: Medical Anthropology* 15(1):45–50.
- Abdullah, Fizan et al. 2011. "Assessment of Surgical and Obstetrical Care at 10 District Hospitals in Ghana Using on-Site Interviews." *The Journal of surgical research* 171(2):461–66.
- AbouZahr, Carla. 2003. "Safe Motherhood: A Brief History of the Global Movement 1947–2002." *British Medical Bulletin* 67(1):13–25.
- Adanu, Richard M. K. 2010. "Utilization of Obstetric Services in Ghana between 1999 and 2003." *African journal of reproductive health* 14(3):153–58.
- Addai, I. 1998. "Demographic and Sociocultural Factors Influencing Use of Maternal Health Services in Ghana." *African journal of reproductive health* 2(1):73–80.
- Addai, I. 2000. "Determinants of Use of Maternal-Child Health Services in Rural Ghana." *Journal of biosocial science* 32(1):1–15.
- Addo, V. N. 2010. "Body Mass Index, Weight Gain during Pregnancy and Obstetric Outcomes." *Ghana medical journal* 44(2):64–69.
- Adjiwanou, Vissého, and Thomas LeGrand. 2013. "Does Antenatal Care Matter in the Use of Skilled Birth Attendance in Rural Africa: A Multi-Country Analysis." *Social Science & Medicine* 86:26–34.
- Adler, Nancy E. et al. 1994. "Socioeconomic Status and Health: The Challenge of the Gradient." *American Psychologist* 49(1):15–24.
- Afulani, Patience A. 2012. "Distribution of Health Facilities and Disparities in Maternal Health in Ghana: A GIS Approach; Poster Presentation at the 140th Annual APHA Conference, San Francisco, Ca October 2012." Retrieved August 28, 2013 (<https://apha.confex.com/apha/140am/webprogram/Paper254440.html>).
- Afulani, Patience A., John K. Awoonor-Williams, Ernest C. Opoku, and Joseph Asunka. 2012. "Using Community Health Workers in Community-Based Growth Promotion: What Stakeholders Think." *Health Education Research*. Retrieved August 2, 2012 (<http://her.oxfordjournals.org/content/early/2012/07/11/her.cys083>).
- Ameh, Charles et al. 2012. "Status of Emergency Obstetric Care in Six Developing Countries Five Years before the MDG Targets for Maternal and Newborn Health" edited by Martin Gerbert Frasch. *PLoS ONE* 7(12):e49938.
- Amooti-Kaguna, B., and F. Nuwaha. 2000. "Factors Influencing Choice of Delivery Sites in Rakai District of Uganda." *Soc Sci Med* 50(2):203–13.

- Andersen, H. M. 2004. “‘Villagers’: Differential Treatment in a Ghanaian Hospital.” *Social Science & Medicine* 59:2003–12.
- Andersen, Ronald M. 1995. “Revisiting the Behavioral Model and Access to Medical Care: Does It Matter?” *Journal of Health and Social Behavior* 36(1):1.
- Aneshensel, Carol S. 2013. *Theory-Based Data Analysis for the Social Sciences*. 2nd ed. Thousand Oaks, Calif.: SAGE Publications, Inc.
- Appiah-Denkyira, Ebenezer, Christopher H. Herbst, Agnes Soucat, Christophe Lemiere, and Karima Saleh. 2013. *Towards Interventions in Human Resources for Health in Ghana* □: *Evidence for Health Workforce Planning and Results*. The World Bank. Retrieved August 1, 2014 (<http://ideas.repec.org/b/wbk/wbps/13116.html>).
- Aremu, O., S. Lawoko, and K. Dalal. 2011. “Neighborhood Socioeconomic Disadvantage, Individual Wealth Status and Patterns of Delivery Care Utilization in Nigeria: A Multilevel Discrete Choice Analysis.” *Int J Womens Health* 3:167–74.
- Asundep, Ntui N. et al. 2013. “Antenatal Care Attendance, a Surrogate for Pregnancy Outcome? The Case of Kumasi, Ghana.” *Maternal and child health journal*.
- Atinga, Roger A., and Anita A. Baku. 2013. “Determinants of Antenatal Care Quality in Ghana.” *International Journal of Social Economics* 40(10):852–65.
- Austin, Peter C. 2011. “An Introduction to Propensity Score Methods for Reducing the Effects of Confounding in Observational Studies.” *Multivariate Behavioral Research* 46(3):399–424.
- Babalola, Stella, and Adesegun Fatusi. 2009. “Determinants of Use of Maternal Health Services in Nigeria - Looking beyond Individual and Household Factors.” *BMC Pregnancy and Childbirth* 9(1):43.
- Bandura, Albert. 2004. “Health Promotion by Social Cognitive Means.” *Health Education & Behavior: The Official Publication of the Society for Public Health Education* 31(2):143–64.
- Basu, Sanjay, Jason Andrews, Sandeep Kishore, Rajesh Panjabi, and David Stuckler. 2012. “Comparative Performance of Private and Public Healthcare Systems in Low- and Middle-Income Countries: A Systematic Review.” *PLoS Med* 9(6):e1001244.
- Bazzano, Alessandra Nina, Betty Kirkwood, Charlotte Tawiah-Agyemang, Seth Owusu-Agyei, and Philip Adongo. 2008. “Social Costs of Skilled Attendance at Birth in Rural Ghana.” *International Journal of Gynecology & Obstetrics* 102(1):91–94.
- Bell, J., S. L. Curtis, and S. Alayon. 2003. “Trends in Delivery Care in Six Countries.” *DHS Analytical Studies No 7*. Retrieved (http://www.measuredhs.com/pubs/pub_details.cfm?ID=482&srchTp=advanced).

- Bergsjø, Per. 2000. "What Is the Evidence for the Role of Antenatal Care Strategies in the Reduction of Maternal Mortality and Morbidity?" *Safe motherhood strategies: a review of the evidence*. Retrieved July 1, 2013 (<http://givebetter.net/files/DWDA%202009/Interventions/Maternal%20Mortality/SafeMotherhoodStrategies.pdf#page=43>).
- Bergsjø, P., and J. Villar. 1997. "Scientific Basis for the Content of Routine Antenatal Care. II. Power to Eliminate or Alleviate Adverse Newborn Outcomes; Some Special Conditions and Examinations." *Acta Obstet Gynecol Scand* 76:15–25.
- Bhutta, Zulfiqar A. et al. 2011. "Stillbirths: What Difference Can We Make and at What Cost?" *The Lancet* 377(9776):1523–38.
- Bhutta, Zulfiqar A. et al. 2014. "Can Available Interventions End Preventable Deaths in Mothers, Newborn Babies, and Stillbirths, and at What Cost?" *The Lancet*. Retrieved July 3, 2014 (<http://www.sciencedirect.com/science/article/pii/S0140673614607923>).
- Bhutta, Zulfiqar A., Gary L. Darmstadt, Rachel A. Haws, Mohammad Yawar Yakoob, and Joy E. Lawn. 2009. "Delivering Interventions to Reduce the Global Burden of Stillbirths: Improving Service Supply and Community Demand." *BMC pregnancy and childbirth* 9 Suppl 1:S7.
- Blanchet, N. J., G. Fink, and I. Osei-Akoto. 2012. "The Effect of Ghana's National Health Insurance Scheme on Health Care Utilisation." *Ghana Medical Journal* 46(2):76–84.
- Bolam, A. et al. 1998. "Factors Affecting Home Delivery in the Kathmandu Valley, Nepal." *Health Policy Plan* 13(2):152–58.
- Boller, C., K. Wyss, D. Mtasiwa, and M. Tanner. 2003. "Quality and Comparison of Antenatal Care in Public and Private Providers in the United Republic of Tanzania." *Bull World Health Organ* 81(2):116–22.
- Bongaarts, John. 1978. "A Framework for Analyzing the Proximate Determinants of Fertility." *Population and Development Review* 4(1):105.
- Boulkedid, Rym et al. 2013. "Quality Indicators for Continuous Monitoring to Improve Maternal and Infant Health in Maternity Departments: A Modified Delphi Survey of an International Multidisciplinary Panel" edited by Hamid Reza Baradaran. *PLoS ONE* 8(4):e60663.
- Braveman PA, Cubbin C, Egerter S, and et al. 2005. "Socioeconomic Status in Health Research: One Size Does Not Fit All." *JAMA* 294(22):2879–88.
- Van den Broek, N. R., and W. J. Graham. 2009. "Quality of Care for Maternal and Newborn Health: The Neglected Agenda." *BJOG* 116(Suppl 1):18–21.
- De Brouwere, Vincent, Vincent De Brouwere, René Tonglet, and Wim Van Lerberghe. 1998. "Strategies for Reducing Maternal Mortality in Developing Countries: What Can We

- Learn from the History of the Industrialized West?" *Tropical Medicine & International Health* 3(10):771–82.
- Bullough, C. et al. 2005. "Current Strategies for the Reduction of Maternal Mortality." *BJOG* 112:1180–88.
- Burgard, S. 2004. "Race and Pregnancy-Related Care in Brazil and South Africa." *Soc Sci Med* 59(6):1127–46.
- Caldwell, J. C. 1979. "Education as a Factor in Mortality Decline An Examination of Nigerian Data." *Population Studies* 33(3):395.
- Caldwell, Jc, and P. Caldwell. 1985. "Education and Literacy as Factors in Health." Retrieved August 13, 2013 (<http://www.popline.org/node/425408>).
- Campbell, Oona MR, and Wendy J. Graham. 2006. "Strategies for Reducing Maternal Mortality: Getting on with What Works." *The lancet* 368(9543):1284–99.
- Campbell, S. ..., M. ... Roland, and S. ... Buetow. 2000. "Defining Quality of Care." *Social Science & Medicine* 51(11):1611–25.
- Carroli, G. et al. 2001. "WHO Systematic Review of Randomised Controlled Trials of Routine Antenatal Care." *Lancet* 357:1565–70.
- Carroli, Guillermo, Cleone Rooney, and Jose Villar. 2001. "How Effective Is Antenatal Care in Preventing Maternal Mortality and Serious Morbidity? An Overview of the Evidence." *Paediatric and perinatal Epidemiology* 15(s1):1–42.
- Chowdhury, R. I., M. A. Islam, J. Gulshan, and N. Chakraborty. 2007. "Delivery Complications and Healthcare-Seeking Behaviour: The Bangladesh Demographic Health Survey, 1999-2000." *Health Soc Care Community* 15(3):254–64.
- Cousens, Simon et al. 2011. "National, Regional, and Worldwide Estimates of Stillbirth Rates in 2009 with Trends since 1995: A Systematic Analysis." *Lancet* 377(9774):1319–30.
- Crosby, Richard A., DiClemente, and Laura Francisca Salazar. 2006. *Research Methods in Health Promotion*. San Francisco, CA: Jossey-Bass.
- D'Ambruoso, L., M. Abbey, and J. Hussein. 2005. "Please Understand When I Cry out in Pain: Women's Accounts of Maternity Services during Labour and Delivery in Ghana." *BMC Public Health* 5:140.
- Davis, James Allan. 1971. *Elementary Survey Analysis*. Englewood Cliffs, N.J.: Prentice-Hall.
- Doctor, Henry V., Sally E. Findley, Giorgio Cometto, and Godwin Y. Afenyadu. 2013. "Awareness of Critical Danger Signs of Pregnancy and Delivery, Preparations for Delivery, and Utilization of Skilled Birth Attendants in Nigeria." *Journal of health care for the poor and underserved* 24(1):152–70.

- Donabedian, A. 1966. "Evaluating the Quality of Medical Care." *Milbank Mem Fund Q* 44(3):166–206.
- Donabedian, A. 1988. "The Quality of Care. How Can It Be Assessed?" *JAMA* 260(12):1743–48.
- Donabedian, A. 1988. "The Quality of Care. How Can It Be Assessed?" *JAMA: the journal of the American Medical Association* 260(12):1743–48.
- Duong, Dat van, Colin W. Binns, Andy H. Lee, and David B. Hipgrave. 2004. "Measuring Client-Perceived Quality of Maternity Services in Rural Vietnam." *International Journal for Quality in Health Care* 16(6):447–52.
- Duong, D. V., C. W. Binns, and A. H. Lee. 2004. "Utilization of Delivery Services at the Primary Health Care Level in Rural Vietnam." *Soc Sci Med* 59(12):2585–95.
- Edmond, Karen M. et al. 2008. "Aetiology of Stillbirths and Neonatal Deaths in Rural Ghana: Implications for Health Programming in Developing Countries." *Paediatric and Perinatal Epidemiology* 22(5):430–37.
- Edward, Bbaale. 2011. "Factors Influencing the Utilisation of Antenatal Care Content in Uganda." *The Australasian Medical Journal* 4(9):516–26.
- Engmann, Cyril et al. 2012. "Stillbirths and Early Neonatal Mortality in Rural Northern Ghana." *Tropical medicine & international health: TM & IH* 17(3):272–82.
- Ensor, Tim et al. 2013. "Knowledgeable Antenatal Care as a Pathway to Skilled Delivery: Modelling the Interactions between Use of Services and Knowledge in Zambia." *Health policy and planning*.
- Filippi, Veronique et al. 2004. "Obstetric Audit in Resource-Poor Settings: Lessons from a Multi-Country Project Auditing 'near Miss' Obstetrical Emergencies." *Health Policy and Planning* 19(1):57–66.
- Filippi, Veronique et al. 2005. "Maternity Wards or Emergency Obstetric Rooms? Incidence of near-Miss Events in African Hospitals." *Acta obstetrica et gynecologica Scandinavica* 84(1):11–16.
- Flenady, Vicki, Laura Koopmans, et al. 2011. "Major Risk Factors for Stillbirth in High-Income Countries: A Systematic Review and Meta-Analysis." *The Lancet* 377(9774):1331–40.
- Flenady, Vicki, Philippa Middleton, et al. 2011. "Stillbirths: The Way Forward in High-Income Countries." *The Lancet* 377(9778):1703–17.
- Fortney, J. 2001. "Emergency Obstetric Care: The Keystone in the Arch of Safe Motherhood." *International Journal of Gynecology & Obstetrics* 74(2):95–97.

- Friberg, Ingrid K. et al. 2010. "Sub-Saharan Africa's Mothers, Newborns, and Children: How Many Lives Could Be Saved with Targeted Health Interventions?" *PLoS medicine* 7(6):e1000295.
- Frøen, J. Frederik et al. 2009. "Making Stillbirths Count, Making Numbers Talk - Issues in Data Collection for Stillbirths." *BMC Pregnancy and Childbirth* 9(1):58.
- Furuta, Marie, and Sarah Salway. 2006. "Women's Position within the Household as a Determinant of Maternal Health Care Use in Nepal." *International Family Planning Perspectives* 32(1):17–27.
- Gabrysch, Sabine, and Oona MR Campbell. 2009. "Still Too Far to Walk: Literature Review of the Determinants of Delivery Service Use." *BMC Pregnancy and Childbirth* 9(1):34.
- Gage, Anastasia J. 2007. "Barriers to the Utilization of Maternal Health Care in Rural Mali." *Social Science & Medicine* 65(8):1666–82.
- Gans-Lartey, Florence, Beverley A. O'Brien, Faustina Oware Gyekye, and Donald Schopflocher. 2013. "The Relationship between the Use of the Partograph and Birth Outcomes at Korle-Bu Teaching Hospital." *Midwifery* 29(5):461–67.
- De Geyndt, Willy. 1995. *Managing the Quality of Health Care in Developing Countries*. World Bank Publications.
- Ghana Health Service. 2008. "Ghana Health Service 2007 Annual Report." Retrieved (<http://www.ghanahealthservice.org/publications.php>).
- Ghana Health Service. 2012. "Ghana Health Service 2011 Annual Report." Retrieved (<http://www.ghanahealthservice.org/publications.php>).
- Ghana Health Service. 2013. "Ghana Health Service 2012 Annual Report." Retrieved (<http://www.ghanahealthservice.org/publications.php>).
- Ghana Ministry of Health et al. 2011. "National Assessment for Emergency Obstetric and Newborn Care."
- Ghana Ministry of Local Government and Rural Development website. n.d. "Ghana Districts - A Repository of All Districts in the Republic of Ghana. Ghana Districts. 2007. Available at: <Http://ghanadistricts.com/home/> [Accessed January 12, 2010]."
- Ghana Statistical Service. 2011. "Ghana Multiple Indicator Cluster Survey with an Enhanced Malaria Module and Biomarker, 2011, Final Report. Accra, Ghana."
- Ghana Statistical Service. 2012. "2010 Census Report."
- Ghana Statistical Service, Ghana Health Service, and Macro International. 2009. "Ghana Maternal Health Survey 2007."

- Glanz, Karen, and K. Barbara Rimer. 1997. *Theory at a Glance: A Guide for Health Promotion Practice*. National Cancer Institute, National Institutes of Health, U.S. Department of Health and Human Services. NIH Pub. No. 97-3896. Washington, DC: NIH.
- Glei, D. A., N. Goldman, and G. Rodriguez. 2003. "Utilization of Care during Pregnancy in Rural Guatemala: Does Obstetrical Need Matter?" *Soc Sci Med* 57(12):2447–63.
- Godlee, F. 2009. "Effective, Safe, and a Good Patient Experience." *BMJ* 339(oct22 1):b4346–b4346.
- Goldenberg, Robert L. et al. 21. "Stillbirths: The Vision for 2020." *The Lancet* 377(9779):1798–1805.
- Graham, Wendy J., Jacqueline S. Bell, Colin HW Bullough, V. De Brouwere, and Wim Van Lerberghe. 2001. "Can Skilled Attendance at Delivery Reduce Maternal Mortality in Developing Countries." *Safe motherhood strategies: a review of the evidence* 17:97–130.
- Graham, Wendy J., Affette McCaw-Binns, and Stephen Munjanja. 2013a. "Translating Coverage Gains into Health Gains for All Women and Children: The Quality Care Opportunity." *PLoS Medicine* 10(1):e1001368.
- Graham, Wendy J., Affette McCaw-Binns, and Stephen Munjanja. 2013b. "Translating Coverage Gains into Health Gains for All Women and Children: The Quality Care Opportunity." *PLoS Medicine* 10(1). Retrieved July 30, 2013 (<http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3545868/>).
- Graham, Wendy J., and Beena Varghese. 2012. "Quality, Quality, Quality: Gaps in the Continuum of Care." *The Lancet* 379(9811):e5–6.
- Graham, W. J., and B. Varghese. 2012. "Quality, Quality, Quality: Gaps in the Continuum of Care." *Lancet* 379(9811):e5–6.
- GSS. 2008. "Measure DHS Macro International. Ghana Demographic and Health Survey 2008. Accra, Ghana: Ghana Statistical Service, Ghana Health Service; 2009:41pp."
- Guildea, Z. E., D. L. Fone, F. D. Dunstan, J. R. Sibert, and P. H. Cartlidge. 2001. "Social Deprivation and the Causes of Stillbirth and Infant Mortality." *Archives of Disease in Childhood* 84(4):307–10.
- Guliani, Harminder, Ardeshir Sepehri, and John Serieux. 2012. "What Impact Does Contact with the Prenatal Care System Have on Women's Use of Facility Delivery? Evidence from Low-Income Countries." *Social Science & Medicine* 74(12):1882–90.
- Gumanga, S. K. et al. 2011. "Trends in Maternal Mortality in Tamale Teaching Hospital, Ghana." *Ghana medical journal* 45(3):105–10.

- Gyimah, Stephen Obeng, Baffour K. Takyi, and Isaac Addai. 2006. "Challenges to the Reproductive-Health Needs of African Women: On Religion and Maternal Health Utilization in Ghana." *Social science & medicine (1982)* 62(12):2930–44.
- Hamilton, Lawrence C. 2012. *Statistics with STATA: Version 12*. 8 edition. Boston, MA: Cengage Learning.
- Harrison, K. A. 1983. "Obstetric Fistula: One Social Calamity Too Many." *BJOG: An International Journal of Obstetrics & Gynaecology* 90(5):385–86.
- Harvey, Steven A. et al. 2007. "Are Skilled Birth Attendants Really Skilled? A Measurement Method, Some Disturbing Results and a Potential Way Forward." *Bulletin of the World Health Organization* 85(10):783–90.
- Ha, Yoonhee P., Lisa S. Hurt, Charlotte Tawiah-Agyemang, Betty R. Kirkwood, and Karen M. Edmond. 2012. "Effect of Socioeconomic Deprivation and Health Service Utilisation on Antepartum and Intrapartum Stillbirth: Population Cohort Study from Rural Ghana." *PloS one* 7(7):e39050.
- Heidemann, E. G. 1993. "The Contemporary Use of Standards in Health Care." Retrieved July 26, 2013 (<http://apps.who.int/iris/handle/10665/59466>).
- Hogan, Margaret C. et al. 2010. "Maternal Mortality for 181 Countries, 1980–2008: A Systematic Analysis of Progress towards Millennium Development Goal 5." *The Lancet* 375(9726):1609–23.
- Hotchkiss, D. R., K. Krasovec, MDZ-E. El-Idrissi, E. Eckert, and A. M. Karim. 2003. "The Role of User Charges and Structural Attributes of Quality on the Use of Maternal Health Services in Morocco." *Working Paper WP-03-68*. Retrieved (<http://www.popline.org/docs/1529/279072.html>).
- Hounton, S. et al. 2008. "Accessibility and Utilisation of Delivery Care within a Skilled Care Initiative in Rural Burkina Faso." *Trop Med Int Health* 13 Suppl 1:44–52.
- Hox, J. J. 2010. *Multilevel Analysis*. London: Routledge Academic.
- Hulton, L. A., Z. Matthew, and R. W. Stones. 2000. "A Framework for the Evaluation of Quality Care in Maternity Services." Retrieved August 1, 2013 (<http://r4d.dfid.gov.uk/Output/65139/Default.aspx>).
- Hulton, Louise Anne, Zoë Matthews, and Robert William Stones. 2007. "Applying a Framework for Assessing the Quality of Maternal Health Services in Urban India." *Social science & medicine* 64(10):2083–95.
- Hussein, J. et al. 2005. "How Do Women Identify Health Professionals at Birth in Ghana?" *Midwifery* 21:36–43.

- Hussein, J., E. A. Goodburn, H. Damisoni, V. Lema, and W. Graham. 2001. "Monitoring Obstetric Services: Putting the 'UN Guidelines' into Practice in Malawi: 3 Years on." *International Journal of Gynecology & Obstetrics* 75(1):63–73.
- Hutchinson, Paul L., Mai Do, and Sohail Agha. 2011. "Measuring Client Satisfaction and the Quality of Family Planning Services: A Comparative Analysis of Public and Private Health Facilities in Tanzania, Kenya and Ghana." *BMC Health Services Research* 11(1):203.
- Institute of Medicine. 2001. *Crossing the Quality Chasm: A New Health System for the 21st Century*. Retrieved July 25, 2013 (<http://www.iom.edu/Reports/2001/Crossing-the-Quality-Chasm-A-New-Health-System-for-the-21st-Century.aspx>).
- Issah, Kofi et al. 2013. "Hospital Work Shifts and Days of Occurrence of Maternal Deaths in 6 Hospitals in the Upper West Region of Ghana." *International Journal of Gynecology & Obstetrics* 120(1):89–91.
- Issah, Kofi, Alexis Nang-Beifubah, and Chris F. Opoku. 2011. "Maternal and Neonatal Survival and Mortality in the Upper West Region of Ghana." *International Journal of Gynecology & Obstetrics* 113(3):208–10.
- Jansen, I. 2006. "Decision Making in Childbirth: The Influence of Traditional Structures in a Ghanaian Village." *International nursing review* 53(1):41–46.
- Joshi, Chandni, Siranda Torvaldsen, Ray Hodgson, and Andrew Hayen. 2014. "Factors Associated with the Use and Quality of Antenatal Care in Nepal: A Population-Based Study Using the Demographic and Health Survey Data." *BMC pregnancy and childbirth* 14(1):94.
- Khan, K. S., D. Wojdyla, L. Say, A. M. Gulmezoglu, and P. F. Van Look. 2006. "WHO Analysis of Causes of Maternal Death: A Systematic Review." *Lancet* 367:1066–74.
- Kinfu, Yohannes, Mario R. Dal Poz, Hugo Mercer, and David B. Evans. 2009. "The Health Worker Shortage in Africa: Are Enough Physicians and Nurses Being Trained?" *Bulletin of the World Health Organization* 87(3):225–30.
- Kloos, Helmut et al. 1987. "Illness and Health Behaviour in Addis Ababa and Rural Central Ethiopia." *Social Science & Medicine* 25(9):1003–19.
- Knight, Hannah E., Alice Self, and Stephen H. Kennedy. 2013. "Why Are Women Dying When They Reach Hospital on Time? A Systematic Review of the 'Third Delay.'" *PloS one* 8(5):e63846.
- Kolenikov, Stanislav, and Gustavo Angeles. 2009. "Socioeconomic Status Measurement with Discrete Proxy Variables: Is Principal Component Analysis a Reliable Answer?" *Review of Income and Wealth* 55(1):128–65.
- Krull, Jennifer. 2014. "Multilevel Regression Lecture Notes."

- Krull, Jennifer L., and David P. Mackinnon. 1999. "Multilevel Mediation Modeling in Group-Based Intervention Studies." *Evaluation Review* 23(4):418–44.
- Krull, Jennifer L., and David P. Mackinnon. 2001. "Multilevel Modeling of Individual and Group Level Mediated Effects." *Multivariate Behavioral Research* 36(2):249–77.
- Kumbani, Lily, Gunnar Bjune, Ellen Chirwa, Address Malata, and Jon Øyvind Odland. 2013. "Why Some Women Fail to Give Birth at Health Facilities: A Qualitative Study of Women's Perceptions of Perinatal Care from Rural Southern Malawi." *Reproductive Health* 10(1):1–12.
- Kwast, Barbara E. 1998. "Quality of Care in Reproductive Health Programmes: Concepts, Assessments, Barriers and Improvements — an Overview." *Midwifery* 14(2):66–73.
- Kyei, Nicholas N. A., Collins Chansa, and Sabine Gabrysch. 2012. "Quality of Antenatal Care in Zambia: A National Assessment." *BMC Pregnancy and Childbirth* 12(1):151.
- Kyei, N. N. A., O. M. R. Campbell, and S. Gabrysch. 2012. "The Influence of Distance and Level of Service Provision on Antenatal Care Use in Rural Zambia." *PLoS One* 7(10):e46475.
- Kyomuhendo, G. B. 2003. "Low Use of Rural Maternity Services in Uganda: Impact of Women's Status, Traditional Beliefs and Limited Resources." *Reprod Health Matters* 11(21):16–26.
- Lawn, J. E. et al. 2009. "Two Million Intrapartum-Related Stillbirths and Neonatal Deaths: Where, Why, and What Can Be Done?" *Int J Gynaecol Obstet* 107(1):S5–18.
- Lawn, J. E., S. Cousens, and J. Zupan. 2005. "4 Million Neonatal Deaths: When? Where? Why?" *Lancet* 365(9462):891–900.
- Lawn, Joy E. et al. 2009. "3.2 Million Stillbirths: Epidemiology and Overview of the Evidence Review." *BMC Pregnancy and Childbirth* 9(Suppl 1):S2.
- Lawn, Joy E. et al. 2011. "Stillbirths: Where? When? Why? How to Make the Data Count?" *The Lancet* 377(9775):1448–63.
- Lawn, Joy E. et al. 2014. "Every Newborn: Progress, Priorities, and Potential beyond Survival." *Lancet*.
- Van Lerberghe, Wim, and Vincent De Brouwere. 2000. "Of Blind Alleys and Things That Have Worked: History's Lessons on Reducing Maternal Mortality." *Safe motherhood strategies: a review of the evidence* 7–35.
- Letamo, G., and S. D. Rakgoasi. 2003. "Factors Associated with Non-Use of Maternal Health Services in Botswana." *J Health Popul Nutr* 21(1):40–47.

- Little, R. J., and D. B. Rubin. 2000. "Causal Effects in Clinical and Epidemiological Studies via Potential Outcomes: Concepts and Analytical Approaches." *Annual Review of Public Health* 21:121–45.
- Li, X. F., J. A. Fortney, M. Kotelchuck, and L. H. Glover. 1996. "The Postpartum Period: The Key to Maternal Mortality." *International journal of gynaecology and obstetrics: the official organ of the International Federation of Gynaecology and Obstetrics* 54(1):1–10.
- MacKeith, N., O. J. Chinganya, Y. Ahmed, and S. F. Murray. 2003. "Zambian Women's Experiences of Urban Maternity Care: Results from a Community Survey in Lusaka." *Afr J Reprod Health* 7(1):92–102.
- MacKinnon, David Peter. 2008. *Introduction to Statistical Mediation Analysis*. New York: Lawrence Erlbaum Associates.
- Magadi, M., I. Diamond, and R. N. Rodrigues. 2000. "The Determinants of Delivery Care in Kenya." *Soc Biol* 47(3-4):164–88.
- Magadi, Monica Akinyi, Alfred O. Agwanda, and Francis O. Obare. 2007. "A Comparative Analysis of the Use of Maternal Health Services between Teenagers and Older Mothers in Sub-Saharan Africa: Evidence from Demographic and Health Surveys (DHS)." *Social science & medicine (1982)* 64(6):1311–25.
- Magoma, Moke, Jennifer Requejo, Oona MR Campbell, Simon Cousens, and Veronique Filippi. 2010. "High ANC Coverage and Low Skilled Attendance in a Rural Tanzanian District: A Case for Implementing a Birth Plan Intervention." *BMC Pregnancy and Childbirth* 10(1):13.
- Mahmud Khan, M., D. R. Hotchkiss, A. A. Berruti, and P. L. Hutchinson. 2006. "Geographic Aspects of Poverty and Health in Tanzania: Does Living in a Poor Area Matter?" *Health Policy Plan* 21(2):110–22.
- Maine, Deborah. 1981. *Family Planning: Its Impact on the Health of Women and Children*. Columbia Univ Center for Population.
- Di Mario, Simona, Lale Say, and Ornella Lincetto. 2007. "Risk Factors for Stillbirth in Developing Countries: A Systematic Review of the Literature." *Sexually Transmitted Diseases* 34(7 Suppl):S11–21.
- Maxwell, R. J. 1984. "Quality Assessment in Health." *Br Med J* 288(6428):1470–72.
- Maxwell, R. J. 1992. "Dimensions of Quality Revisited: From Thought to Action." *Quality in Health Care* 1(3):171–77.
- McCarthy, James, and Deborah Maine. 1992. "A Framework for Analyzing the Determinants of Maternal Mortality." *Studies in Family Planning* 23(1):23–33.

- McClure, Elizabeth M., Sarah Saleem, Omrana Pasha, and Robert L. Goldenberg. 2009. "Stillbirth in Developing Countries: A Review of Causes, Risk Factors and Prevention Strategies." *The Journal of Maternal-Fetal & Neonatal Medicine* 22(3):183–90.
- McLeroy, K. R., D. Bibeau, A. Steckler, and K. Glanz. 1988. "An Ecological Perspective on Health Promotion Programs." *Health Education & Behavior* 15(4):351–77.
- Mekonnen, Y., and A. Mekonnen. 2003. "Factors Influencing the Use of Maternal Healthcare Services in Ethiopia." *J Health Popul Nutr* 21(4):374–82.
- Mensah, Joseph, Joseph R. Oppong, and Christoph M. Schmidt. 2010. "Ghana's National Health Insurance Scheme in the Context of the Health MDGs: An Empirical Evaluation Using Propensity Score Matching." *Health economics* 19 Suppl:95–106.
- Ministry of Health, Ghana, Ghana Health service, and UNDP. 2011. "Ghana MDG Acceleration Framework and Country Action Plan."
- Mitchell, P. H., S. Ferketich, and B. M. Jennings. 1998. "Quality Health Outcomes Model. American Academy of Nursing Expert Panel on Quality Health Care." *Image--the journal of nursing scholarship* 30(1):43–46.
- Montagu, Dominic, Gavin Yamey, Adam Visconti, April Harding, and Joanne Yoong. 2011. "Where Do Poor Women in Developing Countries Give Birth? A Multi-Country Analysis of Demographic and Health Survey Data." *PLoS ONE* 6(2):e17155.
- Montgomery, M. R., and P. C. Hewett. 2005. "Urban Poverty and Health in Developing Countries: Household and Neighborhood Effects." *Demography* 42(3):397–425.
- Mood, Carina. 2010. "Logistic Regression: Why We Cannot Do What We Think We Can Do, and What We Can Do About It." *European Sociological Review* 26(1):67–82.
- Morestin, Florence, Abel Bicaba, Jean de Dieu Sermé, and Pierre Fournier. 2010. "Evaluating Quality of Obstetric Care in Low-Resource Settings: Building on the Literature to Design Tailor-Made Evaluation Instruments--an Illustration in Burkina Faso." *BMC health services research* 10:20.
- Morgan, Stephen L., and Christopher Winship. 2007. *Counterfactuals and Causal Inference: Methods and Principles for Social Research*. 1 edition. New York: Cambridge University Press.
- Moyer, Cheryl A. et al. 2013. "'It's up to the Woman's People': How Social Factors Influence Facility-Based Delivery in Rural Northern Ghana." *Maternal and child health journal*.
- Moyer, Cheryl A., Philip B. Adongo, Raymond A. Aborigo, Abraham Hodgson, and Cyril M. Engmann. 2013. "'They Treat You like You Are Not a Human Being': Maltreatment during Labour and Delivery in Rural Northern Ghana." *Midwifery*. Retrieved August 26, 2013 (<http://www.sciencedirect.com/science/article/pii/S0266613813001514>).

- Moyer, Cheryl A., and Aesha Mustafa. 2013. "Drivers and Deterrents of Facility Delivery in Sub-Saharan Africa: A Systematic Review." *Reproductive health* 10:40.
- Mpembeni, Rose Nm et al. 2007. "Use Pattern of Maternal Health Services and Determinants of Skilled Care during Delivery in Southern Tanzania: Implications for Achievement of MDG-5 Targets." *BMC pregnancy and childbirth* 7:29.
- Mrisho, M. et al. 2007. "Factors Affecting Home Delivery in Rural Tanzania." *Trop Med Int Health* 12(7):862–72.
- Naariyong, Sharon et al. 2012. "Quality of Antenatal Care Services in the Birim North District of Ghana: Contribution of the Community-Based Health Planning and Services Program." *Maternal and Child Health Journal* 16(8):1709–17.
- Navaneetham, K., and A. Dharmalingam. 2002. "Utilization of Maternal Health Care Services in Southern India." *Soc Sci Med* 55(10):1849–69.
- Nikiéma, Béatrice, Gervais Beninguisse, and Jeannie L. Haggerty. 2009. "Providing Information on Pregnancy Complications during Antenatal Visits: Unmet Educational Needs in Sub-Saharan Africa." *Health Policy and Planning* 24(5):367–76.
- Nwakoby, B. N. 1994. "Use of Obstetric Services in Rural Nigeria." *J R Soc Health* 114(3):132–36.
- Nyonator, Frank K., J. Koku Awoonor-Williams, James F. Phillips, Tanya C. Jones, and Robert A. Miller. 2005. "The Ghana Community-Based Health Planning and Services Initiative for Scaling up Service Delivery Innovation." *Health Policy and Planning* 20(1):25–34.
- Onah, H. E., L. C. Ikeako, and G. C. Iloabachie. 2006. "Factors Associated with the Use of Maternity Services in Enugu, Southeastern Nigeria." *Soc Sci Med* 63(7):1870–78.
- Onah, Hyacinth Eze, Lawrence C. Ikeako, and Gabriel C. Iloabachie. 2006. "Factors Associated with the Use of Maternity Services in Enugu, Southeastern Nigeria." *Social Science & Medicine* 63(7):1870–78.
- Ouma, Peter et al. 2010. "Antenatal and Delivery Care in Rural Western Kenya: The Effect of Training Health Care Workers to Provide 'Focused Antenatal Care.'" *Reproductive Health* 7(1):1.
- Parkhurst, Justin Oliver et al. 2005. "Health Systems Factors Influencing Maternal Health Services: A Four-Country Comparison." *Health Policy* 73(2):127–38.
- Pattinson, Robert et al. 2011. "Stillbirths: How Can Health Systems Deliver for Mothers and Babies?" *The Lancet* 377(9777):1610–23.
- Pebley, Anne R., Noreen Goldman, and German Rodriguez. 1996. "Prenatal and Delivery Care and Childhood Immunization in Guatemala: Do Family and Community Matter?" *Demography* 33(2):231–47.

- Pell, Christopher et al. 2013. "Factors Affecting Antenatal Care Attendance: Results from Qualitative Studies in Ghana, Kenya and Malawi." *PLoS ONE* 8(1):e53747.
- Peltzer, Karl. 2009. "Patient Experiences and Health System Responsiveness in South Africa." *BMC Health Services Research* 9(1):117.
- Pirkle, Catherine M., Alexandre Dumont, and Maria-Victoria Zunzunegui. 2011. "Criterion-Based Clinical Audit to Assess Quality of Obstetrical Care in Low- and Middle-Income Countries: A Systematic Review." *International journal for quality in health care: journal of the International Society for Quality in Health Care / ISQua* 23(4):456–63.
- Pittrof, Rüdiger, Oona M. R. Campbell, and Véronique G. A. Filippi. 2002. "What Is Quality in Maternity Care? An International Perspective." *Acta obstetricia et gynecologica Scandinavica* 81(4):277–83.
- Rabe-Hesketh, Sophia, and Anders Skrondal. 2012. *Multilevel and Longitudinal Modeling Using Stata, Volumes I and II, Third Edition*. 3 edition. College Station, Tex: Stata Press.
- Rahman, M. H., W. H. Mosley, S. Ahmed, and H. H. Akhter. 2008. "Does Service Accessibility Reduce Socioeconomic Differentials in Maternity Care Seeking? Evidence from Rural Bangladesh." *J Biosoc Sci* 40(1):19–33.
- Rai, Rajesh Kumar, Prashant Kumar Singh, and Lucky Singh. 2012. "Utilization of Maternal Health Care Services among Married Adolescent Women: Insights from the Nigeria Demographic and Health Survey, 2008." *Women's health issues: official publication of the Jacobs Institute of Women's Health* 22(4):e407–14.
- Rajaratnam, Julie Knoll et al. 2010. "Neonatal, Postneonatal, Childhood, and under-5 Mortality for 187 Countries, 1970-2010: A Systematic Analysis of Progress towards Millennium Development Goal 4." *Lancet* 375(9730):1988–2008.
- Rice, N., S. Robone, and P. C. Smith. 2008. *The Measurement and Comparison of Health System Responsiveness*. HEDG, c/o Department of Economics, University of York. Retrieved June 20, 2013 (<http://ideas.repec.org/p/yor/hectdg/08-05.html>).
- Robone, Silvana, Nigel Rice, and Peter C. Smith. 2011. "Health Systems' Responsiveness and Its Characteristics: A Cross-Country Comparative Analysis." *Health Services Research* 46(6pt2):2079–2100.
- Rooney, Cleone, and Maternal Health and Safe Motherhood Programme. 1992. *Antenatal Care and Maternal Health: How Effective Is It?: A Review of the Evidence*. Geneva: Maternal Health and Safe Motherhood Programme, Division of Family Health, World Health Organization.
- Rosenbaum, Paul R., and Donald B. Rubin. 1983. "The Central Role of the Propensity Score in Observational Studies for Causal Effects." *Biometrika* 70(1):41–55.
- Rosenberg, Morris. 1968. *The Logic of Survey Analysis*. New York: Basic.

- Rutstein, Shea O. 2008. "The DHS Wealth Index: Approaches for Rural and Urban Areas."
- Sargent, C. 1980. "Utilization of National Health Maternity Services in a Northern District of People's Republic of Benin." *Rural Africana* (8/9):77–89.
- Sargent, Carolyn. 1985. "Obstetrical Choice among Urban Women in Benin." *Social Science & Medicine* 20(3):287–92.
- Say, Lale, Allan Donner, A. Metin Gülmezoglu, Monica Taljaard, and Gilda Piaggio. 2006. "The Prevalence of Stillbirths: A Systematic Review." *Reproductive Health* 3(1):1.
- Say, L., and R. Raine. 2007. "A Systematic Review of Inequalities in the Use of Maternal Health Care in Developing Countries: Examining the Scale of the Problem and the Importance of Context." *Bull World Health Organ* 85(10):812–19.
- Senah, Kodjo. 2003. "Maternal Mortality in Ghana: The Other Side." *Research Review of the Institute of African Studies* 19(1):47–56.
- Sibley, L. M. et al. 2007. "Traditional Birth Attendant Training for Improving Health Behaviours and Pregnancy Outcomes." *The Cochrane database of systematic reviews* (3):CD005460.
- Sibley, Lynn, and Theresa Ann Sipe. 2004. "What Can a Meta-Analysis Tell Us about Traditional Birth Attendant Training and Pregnancy Outcomes?" *Midwifery* 20(1):51–60.
- Sobel, Michael. 1982. "Asymptotic Confidence Intervals for Indirect Effects in Structural Equation Models." *Sociological Methodology* 13:290–312.
- Souza, João Paulo et al. 2013. "Moving beyond Essential Interventions for Reduction of Maternal Mortality (the WHO Multicountry Survey on Maternal and Newborn Health): A Cross-Sectional Study." *The Lancet* 381(9879):1747–55.
- Spector, Jonathan M. et al. 2012. "Improving Quality of Care for Maternal and Newborn Health: Prospective Pilot Study of the WHO Safe Childbirth Checklist Program" edited by Philippa Middleton. *PLoS ONE* 7(5):e35151.
- Spong, Catherine Y., Uma M. Reddy, and Marian Willinger. 14. "Addressing the Complexity of Disparities in Stillbirths." *The Lancet* 377(9778):1635–36.
- Stanton, Cynthia, Joy E. Lawn, Hafiz Rahman, Katarzyna Wilczynska-Ketende, and Kenneth Hill. 2006. "Stillbirth Rates: Delivering Estimates in 190 Countries." *The Lancet* 367(9521):1487–94.
- Starrs, A. 1997. "The Safe Motherhood Action Agenda: Priorities for the next Decade. Report on the Safe Motherhood Technical Consultation, 18-23 October 1997, Colombo, Sri Lanka." Retrieved July 2, 2013 (<http://www.popline.org/node/526231>).

- Stekelenburg, J., S. Kyanamina, M. Mukelabai, I. Wolffers, and J. van Roosmalen. 2004. "Waiting Too Long: Low Use of Maternal Health Services in Kalabo, Zambia." *Trop Med Int Health* 9(3):390–98.
- Stephenson, R., A. Baschieri, S. Clements, M. Hennink, and N. Madise. 2006a. "Contextual Influences on the Use of Health Facilities for Childbirth in Africa." *Am J Public Health* 96(1):84–93.
- Stephenson, R., A. Baschieri, S. Clements, M. Hennink, and N. Madise. 2006b. "Contextual Influences on the Use of Health Facilities for Childbirth in Africa." *Am J Public Health* 96(1):84–93.
- Stock, Robert. 1983. "Distance and the Utilization of Health Facilities in Rural Nigeria." *Social Science & Medicine* 17(9):563–70.
- Stringer, Elizabeth M. et al. 2011. "Determinants of Stillbirth in Zambia." *Obstetrics and gynecology* 117(5):1151–59.
- Sutan, R., D. Campbell, G. J. Prescott, and W. C. S. Smith. 2010. "The Risk Factors for Unexplained Antepartum Stillbirths in Scotland, 1994 to 2003." *Journal of Perinatology: Official Journal of the California Perinatal Association* 30(5):311–18.
- Thaddeus, S., and D. Maine. 1994. "Too Far to Walk: Maternal Mortality in Context." *Social science & medicine (1982)* 38(8):1091–1110.
- The Partnership for Maternal, Newborn & Child Health. 2011. "Essential Interventions, Commodities and Guidelines for Reproductive, Maternal, Newborn and Child Health." WHO. Retrieved September 5, 2013 (http://www.who.int/pmnch/knowledge/publications/201112_essential_interventions/en/index.html).
- Tran, Toan K., Karin Gottvall, Hinh D. Nguyen, Henry Ascher, and Max Petzold. 2012. "Factors Associated with Antenatal Care Adequacy in Rural and Urban Contexts-Results from Two Health and Demographic Surveillance Sites in Vietnam." *BMC Health Services Research* 12(1):40.
- Treiman, Donald J. 2009. *Quantitative Data Analysis: Doing Social Research to Test Ideas*. San Francisco: Jossey-Bass.
- Tunçalp, Ozge, Michelle J. Hindin, Kwame Adu-Bonsaffoh, and Richard Adanu. 2012. "Listening to Women's Voices: The Quality of Care of Women Experiencing Severe Maternal Morbidity, in Accra, Ghana." *PloS one* 7(8):e44536.
- Tweheyo, Raymond, Joseph Konde-Lule, Nazarius M. Tumwesigye, and Juliet N. Sekandi. 2010. "Male Partner Attendance of Skilled Antenatal Care in Peri-Urban Gulu District, Northern Uganda." *BMC pregnancy and childbirth* 10:53.

- Twum-Danso, Nana A. Y. et al. 2012. "A Nationwide Quality Improvement Project to Accelerate Ghana's Progress toward Millennium Development Goal Four: Design and Implementation Progress." *International journal for quality in health care: journal of the International Society for Quality in Health Care / ISQua* 24(6):601–11.
- UNICEF. 2011. "Childinfo.org: Statistics by Area - Delivery Care - Background." Retrieved December 4, 2011 (http://www.childinfo.org/delivery_care.html).
- UNICEF. 2013. "Childinfo.org: Statistics by Area - Delivery Care - The Challenge." Retrieved September 8, 2013 (http://www.childinfo.org/delivery_care.html).
- United Nations Secretary-General. 2010. "Global Strategy for Women's and Children's Health." Retrieved July 19, 2013 (http://www.who.int/pmnch/topics/maternal/201009_globalstrategy_wch/en/).
- Villar, J. et al. 2001. "WHO Antenatal Care Randomised Trial for the Evaluation of a New Model of Routine Antenatal Care." *Lancet* 357:1551–64.
- Villar, J., and P. Bergsjö. 1997. "Scientific Basis for the Content of Routine Antenatal Care. I. Philosophy, Recent Studies, and Power to Eliminate or Alleviate Adverse Maternal Outcomes." *Acta Obstet Gynecol Scand* 76:1–14.
- Wall, Stephen N. et al. 2010. "Reducing Intrapartum-Related Neonatal Deaths in Low- and Middle-Income Countries-What Works?" *Seminars in perinatology* 34(6):395–407.
- Ward, H., T. E. Mertens, and C. Thomas. 1997. "Health Seeking Behaviour and the Control of Sexually Transmitted Disease." *Health policy and planning* 12(1):19–28.
- WHO. 1994. "Mother-Baby Package: Implementing Safe Motherhood in Countries."
- WHO. 1999. "Reduction of Maternal Mortality. A Joint WHO/UNFPA/UNICEF/World Bank Statement." *Geneva*. Retrieved (<http://www.who.int/reproductivehealth/publications/monitoring/9789241561952/en/>).
- WHO. 2000. "The World Health Report 2000 - Health Systems: Improving Performance." *WHO*. Retrieved August 21, 2013 (<http://www.who.int/whr/2000/en/>).
- WHO. 2002. "WHO Antenatal Care Randomized Trial. Manual for the Implementation of the New Model." Retrieved September 9, 2013 (http://www.who.int/reproductivehealth/publications/maternal_perinatal_health/RHR_01_30/en/).
- WHO. 2004. "Making Pregnancy Safer: The Critical Role of the Skilled Attendant." *A joint statement by WHO, ICM and FIGO. Geneva*.
- WHO. 2005a. "WHO | The Health Systems Responsiveness Analytical Guidelines for Surveys in the MCSS." *WHO*. Retrieved June 20, 2013 (<http://www.who.int/responsiveness/mcss/en/>).

- WHO. 2005b. “World Health Report 2005 - Make Every Mother and Child Count.” *Geneva*.
- WHO. 2005c. “World Health Survey.” *WHO*. Retrieved May 23, 2014 (<http://www.who.int/healthinfo/survey/en/>).
- WHO. 2005d. “World Health Survey 2003 -Burkina Faso Report.”
- WHO. 2005e. “World Health Survey 2003 -Ghana Report.”
- WHO. 2009. “WHO Recommended Interventions for Improving Maternal and Newborn Health.” Retrieved July 19, 2013 (http://www.who.int/maternal_child_adolescent/documents/who_mps_0705/en/).
- WHO. 2011. “PMNCH Fact Sheet: Maternal Mortality.” Retrieved July 17, 2013 (http://www.who.int/pmnch/media/press_materials/fs/fs_mdg5_maternalmortality/en/index.html).
- WHO. 2013a. “Facts on Maternal Health.” *WHO*. Retrieved July 17, 2013 (http://www.who.int/features/factfiles/maternal_health/en/index.html).
- WHO. 2013b. “Global Health Observatory Data Repository, MDG 5: Maternal Health:” Retrieved September 5, 2013 (<http://apps.who.int/gho/data/node.main.REPWOMEN39>).
- WHO. 2013c. “MDG 5: Improve Maternal Health.” *WHO*. Retrieved July 5, 2013 (http://www.who.int/topics/millennium_development_goals/maternal_health/en/).
- WHO. 2013d. “MDG 5: Maternal and Reproductive Health: Women - Data by Country.” Retrieved June 9, 2014 (<http://apps.who.int/gho/data/node.main.531?lang=en>).
- WHO. 2014. “WHO | Maternal Mortality Country Profiles.” *WHO*. Retrieved June 9, 2014 (http://www.who.int/gho/maternal_health/countries/en/).
- WHO Department of making pregnancy safer. 2006. “Standards for Maternal and Neonatal Care: Maternal Immunization against Tetanus.”
- WHO, UNICEF, UNFPA, and the World Bank. 2012. “Trends in Maternal Mortality: 1990 to 2010.” *WHO*. Retrieved July 5, 2013 (<http://www.who.int/reproductivehealth/publications/monitoring/9789241503631/en/index.html>).
- WHO, UNICEF, UNFPA, The World Bank, and United Nations Population Division. 2014. “Trends in Maternal Mortality: 1990 to 2013.” *WHO*. Retrieved July 17, 2014 (<http://www.who.int/reproductivehealth/publications/monitoring/9789241503631/en/index.html>).
- Wild, Kayli, Lesley Barclay, Paul Kelly, and Nelson Martins. 2010. “Birth Choices in Timor-Leste: A Framework for Understanding the Use of Maternal Health Services in Low Resource Settings.” *Social Science & Medicine* 71(11):2038–45.

- Winfred A. Avogo. 2011. "Countdown to the Millenium Development Goal Five: Maternal Health Seeking Behavior in Ghana." Retrieved June 20, 2013 (http://docsfiles.com/pdf_princeton_and_the_millennium.html).
- Winnard, K. 1995. "No Longer Giving Life through Death." *International Journal of Gynecology & Obstetrics* 48, Supplement:S7–20.
- Witter, Sophie, Sam Adjei, Margaret Armar-Klemesu, and Wendy Graham. 2009. "Providing Free Maternal Health Care: Ten Lessons from an Evaluation of the National Delivery Exemption Policy in Ghana." *Global Health Action* 2. Retrieved October 15, 2013 (<http://www.ncbi.nlm.nih.gov/pmc/articles/PMC2779941/>).
- Witter, Sophie, Daniel Kojo Arhinful, Anthony Kusi, and Sawudatu Zakariah-Akoto. 2007. "The Experience of Ghana in Implementing a User Fee Exemption Policy to Provide Free Delivery Care." *Reproductive Health Matters* 15(30):61–71.
- Witter, Sophie, Anthony Kusi, and Moses Aikins. 2007. "Working Practices and Incomes of Health Workers: Evidence from an Evaluation of a Delivery Fee Exemption Scheme in Ghana." *Human resources for health* 5:2.
- World Health Organisation, UNFPA, UNICEF, and Mailman School of Public Health. Averting Maternal Death and Disability (AMDD). 2009. *Monitoring Emergency Obstetric Care: A Handbook*. World Health Organization.
- World Health Organization. 1986. *Prevention of Maternal Mortality: Report of a WHO Interregional Meeting, Geneva, 11-15 November 1985*. World Health Organization.
- World Health Organization. 2006. *Quality of Care: A Process for Making Strategic Choices in Health Systems*. WHO Regional Office for the Western Pacific.
- World Health Organization, UNICEF. 2003. "Antenatal Care in Developing Countries. Promises, Achievements and Missed Opportunities. An Analysis of Trends, Levels and Differentials, 1990-2001."
- Yanagisawa, Satoko, Sopal Oum, and Susumu Wakai. 2006. "Determinants of Skilled Birth Attendance in Rural Cambodia." *Tropical medicine & international health: TM & IH* 11(2):238–51.
- Yanagisawa, S., S. Oum, and S. Wakai. 2006. "Determinants of Skilled Birth Attendance in Rural Cambodia." *Trop Med Int Health* 11(2):238–51.
- Yatich, Nelly J. et al. 2010. "Malaria, Intestinal Helminths and Other Risk Factors for Stillbirth in Ghana." *Infectious diseases in obstetrics and gynecology* 2010:350763.