Determinants of pregnancy outcomes in Ghana: Does quality of antenatal care matter?

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PRELIMNARY DRAFT

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Abstract

Over two million stillbirths occur each year globally. Like maternal deaths, over 98% of stillbirths occur in developing countries. The emphases on skilled birth attendants to prevent maternal deaths may have undermined efforts to provide good quality antenatal care (ANC). This study examines the factors associated with stillbirths in Ghana, focusing on the role of ANC quality. Data are from the Ghana Maternal Health Survey (N=4,868). Multilevel logistic regressions with moderation analysis are employed. Higher quality ANC decreases the odds of having a stillbirth by almost half after accounting for other confounding covariates including type of delivery provider and facility. Completing the recommended four antenatal visits also decreases the odds of having a stillbirth. Having a pregnancy complication, a multiple gestation, or a past stillbirth, increases the odds of having a stillbirth. Targeted efforts to increase ANC quality will help improve maternal and fetal outcomes in Ghana.

Background

Over two million stillbirths occur each year, with an estimated stillbirth rate of 18.9 per 1000 births (Cousens et al. 2011). Like maternal deaths, over 98% of stillbirths occur in low and middle income countries with Sub-Sahara Africa (SSA) and South Asia alone accounting for about 76% of stillbirths globally – 35.4% for SSA and 40.9% for South Asia. SSA has the highest stillbirth rates globally at 28.3 per 1000 births compared to 3.1 for the high income countries (Cousens et al. 2011). Though most regions observed a decline in stillbirth rates in the last several years, (together with Oceania) the smallest decline was in SSA at less than 10% compared to the average global decline of 14.5% (Cousens et al. 2011). Globally, the decline in the stillbirth rates has been slower than that for maternal, neonatal and child health. In SSA especially there has been very little reduction in stillbirth rate since 1995 despite increasing progress in reducing the under-five mortality (Cousens et al. 2011; Lawn et al. 2009, 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 (Lawn, Yakoob, et al. 2009; Lawn et al. 2011). Recent work has however demonstrated that stillbirths pose a huge burden especially in developing countries. For example, the estimated numbers of stillbirths are said to be greater than that for many other conditions high on the global agenda, including HIV/AIDS; and intrapartum stillbirths alone exceed global child deaths due to malaria (Lawn, Lee, et al. 2009; Joy E Lawn, Yakoob, et al. 2009). Estimates from high income countries suggest for every neonatal death, there are about 1.7 stillbirths (Joy E Lawn, Yakoob, et al. 2009). Stillbirths present not just a burden to countries and health systems, but also to women and their families. While social taboos may prevent women from openly grieving, the grief experienced by women with stillbirths is known to be very high (Joy E Lawn, Yakoob, et al. 2009). Studies in developed countries suggests the grief and depression felt by mothers and families who have a stillbirth may exceed that associated with a neonatal death (Hunfeld et al. 1993; Joy E Lawn, Yakoob, et al. 2009).

Compared to studies examining utilization of maternal services, relatively few studies in SSA have explicitly examined stillbirths as an outcome; leading to low quality of evidence for the effectiveness of interventions for reducing stillbirths (Bhutta et al. 2014; Joy E Lawn, Yakoob, et al. 2009). This is despite evidence that the causes and risk factors associated with stillbirths greatly overlap with those causing maternal and neonatal deaths (Joy E Lawn, Yakoob, et al. 2009; Di Mario, Say, and Lincetto 2007; Pattinson et al. 2011). For example, hypertensive disorders, antepartum hemorrhage, and maternal infections which are common causes of maternal mortality are also common causes of antepartum stillbirths; and prolonged or obstructed labor – the other major causes of maternal mortality are the major causes of intrapartum stillbirths (Bhutta et al. 2014; Joy E Lawn, Yakoob, et al. 2009; Pattinson et al. 2011). Fetal factors like congenital malformations, fetal growth restriction, infections, prematurity, and intrapartum hypoxia are also all related to maternal risk factors. It is however acknowledged that the cause of stillbirths may unknown in up to about one third of cases (Joy E Lawn, Yakoob, et al. 2009).

The recommendations for utilization 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). Furthermore, the evidence for the effectiveness of antenatal care (ANC) is stronger for fetal and neonatal outcomes than maternal mortality (Bergsjø 2000; Carroli et al. 2001; Rooney and Maternal Health and Safe Motherhood Programme 1992). More recently there have been calls to examine the quality of maternal health services as use alone is not sufficient to prevent stillbirths as for maternal deaths (Friberg et al. 2010; Graham and Varghese 2012). 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. This has led to a shift in emphasis to examining severe maternal morbidities (Furuta, Sandall, and Bick 2012; Koblinsky et al. 2012; Say, Souza, and Pattinson 2009). But even these are difficult to examine based on survey data due to problems of measurement of severity of complications; and just comparing women who report a complication to those who did not, can be problematic for service utilization predictors. This is because

pregnancy complications can occur regardless of use and quality of care received (Bergsjø 2000; Bullough et al. 2005; Carroli, Rooney, and Villar 2001).

Though there are problems related to counting stillbirths, it is a more absolute measure and examining stillbirths provides useful approach 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, Yakoob, 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, Yakoob, et al. 2009). Studying the factors associated with stillbirths is therefore important not only for the sake of saving the close to three million stillbirths that occur each year, but also to for preventing maternal deaths and disability. In addition, stillbirths are closely related to neonatal survival and disability. Lawn et al in a recent lancet series project that "failure to improve birth outcomes by 2035 will result in an estimated 116 million deaths, 99 million survivors with disability or lost developmental potential, and millions of adults at increased risk of non-communicable diseases …" (Lawn et al. 2014:1).

Ghana which is the focus of this analysis is an example from SSA. Estimates for stillbirth rates in Ghana are varied, as they are not routinely and adequately monitored – like in many other developing countries (Cousens et al. 2011). Stillbirths are hardly mentioned in the annual health reports of the Ghana Health Service (Ghana Health Service 2012, 2013); and not reported as standalone indicators in the national health surveys (Ghana Statistical Service, Ghana Health Service, and Macro International 2009; GSS 2008). The national survey reports usually report them together with early neonatal deaths as perinatal mortality rates (Ghana Statistical Service et al. 2009; GSS 2008). While this is a useful indicator of both pregnancy and delivery care, it poses problems in distinguishing between the stillbirth and neonatal death burdens, as well as problems in identifying the underlying factors some of which differ for the two (Joy E Lawn, Yakoob, et al. 2009). Making the distinction between stillbirths and neonatal deaths is said to be a prerequisite for improved measurement and attention to the respective burdens of stillbirths

and neonatal deaths as well as in identifying effective interventions to address them (Joy E Lawn, Yakoob, et al. 2009).

Data from the 2007 Ghana Maternal survey (GMHS) gives a stillbirth rate of about 21 per 1000 births (calculated from the number of stillbirths and number of all pregnancies seven or more months duration in the five years preceding the survey provided in the survey report); while that from the 2008 Ghana Demographic health survey (GDHS) gives a stillbirth rate of about 14 per 1000 births (using the same calculation as for the GMHS) (Ghana Statistical Service et al. 2009; GSS 2008). This difference in the one year period is likely not due to a reduction in stillbirths but to differences in reporting. In addition, the estimates from surveys are thought to be underestimates due to misreporting of stillbirths in surveys (Ghana Statistical Service et al. 2009; GSS 2008). Estimates from demographic surveillance data from various parts of the country provide higher rates – at 23/1000 births for the Navrongo area in the Upper East region (Engmann et al. 2012); and 32.4/ 1000 births for a rural district in the Brong Ahafo region (Ha et al. 2012). The Brong Ahafo study however used a lower cut off, defining stillbirths as pregnancy losses after 6 months gestation.

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 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 (whether the pregnancy resulted in a live birth or stillbirth) 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. I also examine if the effect of quality of ANC on pregnancy outcomes differs for women who use a SBA during delivery and those who do not; by place of residence and SES (moderation effects).

Donabedian's described three core dimensions of quality of care – structure, process and outcome (Donabedian 1988). The expectation for every pregnancy is a healthy mother and baby. Thus the ultimate outcome of good quality maternal care is the birth of a live and healthy baby to a healthy mother. This makes the outcome of the pregnancy an outcome measure of quality. 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 (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 high 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. That is, whether the effect of quality of ANC is explained by use of a SBA during delivery; or differs for women who use a SBA during delivery and those who do not.

METHODS

Data

The data for this analysis comes from the 2007 Ghana Maternal Health survey (GMHS)(Ghana Statistical Service, Ghana Health Service, and Macro International 2009). The

GMHS was the first (and still is the only) nationally representative population-based survey to collect comprehensive information on maternal morbidity and mortality in Ghana. The survey was conducted by the Ghana Statistical Service and the Ghana Health Service, with technical assistance from Macro International.[1] Data collection was implemented in two phases. First, a short household questionnaire was administered in 227,715 households, which were randomly selected from 1600 primary sampling units in urban and rural areas, in the ten administrative regions of the country. The goal was to identify female deaths between ages 12-49. In the second phase, 400 clusters were randomly selected from the 1600 clusters included in phase I. Households with (living, resident) women age 15-49 were selected at random from these 400 clusters, stratified by region and urban-rural residence. Institutional populations and those residing in refugee camps were excluded (Ghana Statistical Service et al. 2009). Verbal autopsies were completed for maternal deaths in the selected households. A household questionnaire and women's questionnaire was also administered in the selected households, to collect information on demographic and health indicators. This yielded 10,858 completed household interviews and 10,370 individual interviews with women aged 15-49 years (Ghana Statistical Service et al. 2009). Interviews were conducted face-to-face in English, Akan, Ga or Ewe using questionnaires printed in those languages. The response rate was 99% at the household level and 98% for the individual women. The refusal rate was about 2% in both rural and urban areas. The GMHS is described in detail in the published survey report (Ghana Statistical Service et al. 2009).

The questions on antenatal care was asked to only women who had a birth (live or still birth) in the five years preceding the survey (N=5,088 =49.1% of all women interviewed); this is

[1] The agency that conducts the Demographic and Health Surveys. The main aim of the GMHS was to generate data on maternal health and mortality for policymakers and the research community involved in the Reducing Maternal Morbidity and Mortality Program.

the base sample for the analysis. The analytic sample is 5,042 women (99.1% of the base sample) because 46 observations are missing on key study variables. The analysis is further restricted to women who had at least one ANC visit (ANCV) during the last pregnancy, since quality of ANC obviously cannot be measured for women who did not have ANC during pregnancy. Among the analytic sample 97% (N=4,868) received ANC during pregnancy.

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 a computed variable provided with 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 that were reported as born dead, baby did not cry, move or breath when it was born; and of pregnancy duration seven months or above were coded as stillbirths. This is consistent with the WHO definition of stillbirth for international comparison – ≥1000g 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 still or live birth in the last pregnancy in the preceding five years, pregnancies that ended in miscarriages or induced abortions are not included in this analysis. Pregnancy outcome is therefore a binary variable coded '1' for stillbirths and '0' for live births.

Key independent variable: Quality of antenatal care

In this analysis, the quality of ANC is defined as receipt of the recommended ANC services during pregnancy. This definition is based on the definition of quality of care proposed by Donabedian: the extent to which actual care is in conformity with present criteria for good care (Donabedian 1966). I created an additive index of responses to nine questions on ANC

services women received during the last pregnancy.[2] 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 anthelminthic; and tetanus vaccination. Each question had a binary response (1=Yes; and 0=No). 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. Observations missing on one or more of the component variables were assumed to be zero; no observations were missing on all the component variables. This approach may underestimate the quality of care because women who did not know whether they received the service are counted as not receiving it. However, the number of cases included for this reason is very small. The index ranges from zero to nine with responses spanning the entire range; the mean is 7.4.[3]

Other independent/control variables

Health service utilization*:* These include *ANC services* – frequency of ANC attendance (less than four or four plus), trimester of first ANC (first, second or third trimester), type of ANC provider (doctors, nurse/midwife, or other provider) and type and level of ANC facility (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 *delivery services* – the type of delivery provider (doctors, nurse/midwife, and other providers), whether delivery was assisted a SBA (includes a health worker (doctor, nurse/midwife, and auxiliary nurse/midwife); or not a health worker), where delivery took place (a government

[2] An exploratory principal components analysis (PCA) of these variables yielded one dominant factor. However, I decided to use the additive index both because PCA is not appropriate for use with binary variables (Kolenikov and Angeles 2009) and because the sum is easier to interpret.
[3] 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.

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 outcome*s**: 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, Yakoob, 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 also 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, Yakoob, 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. These included: 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 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. All these are strongly associated with higher odds of having a stillbirth and also correlated as most women who had one of these are also likely to have had some other intervention. These 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. 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. There is information on pregnancy duration, but this is only available for stillbirths, and information on the sex of the child is only available for live births, so these are also not used as predictors of the birth outcome.

Sociodemographic factors: I also examined for associations with other 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 (rural/urban residence and region of residence), SES (education and wealth), religion, ethnicity, marital status, age at first union, sex of the household head (female headed household or not), 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.

Statistical analysis

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. Chi-squared tests were used to examine significant differences in pregnancy outcome (Crosby and Salazar 2006; Davis 1971; Treiman 2009). I then used

Multilevel analysis in bivariate and multivariate regression analysis to account for clustering which is inherent in the hierarchical nature of the data (Hox 2010; Rabe-Hesketh and Skrondal 2012). Initial tests 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: chi2(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: chibar2(01) = 4.35, p = 0.0185). A two level model with district was also not significant (LR test vs. logistic regression: chibar2(01)=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). The descriptive statistics are all weighted. However no weights are used for the multilevel analysis because the weights are not appropriate for multilevel analyses. 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 also still included in the model because of their associations with the key predictors and to allow comparisons with prior studies. Some 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 excludes all the delivery variables and the second includes them. Interaction terms for quality of ANC and delivery

provider and delivery facility were also examined, but these were not significant hence not shown in the final models.

RESULTS

Weighted Descriptive statistics:

The distribution of the sample for the GMHS is presented in table 1. Table 7G1 presents the distribution of the variables for birth outcomes, delivery care and risk factors for adverse outcomes that are particularly relevant to this chapter; for the sample restricted to women who attended ANC at least once and the full analytic sample. Of the 5042 women in the analytic sample, 85 reported delivering a stillbirth for their last pregnancy. Seventy-seven (77) of the stillbirths occurred among women who attended ANC at least once (out of 4,868 women) and 8 among the 174 women who did not attend any ANC. The proportion of women who experienced a stillbirth in their last birth is 1.7% for the full sample; and 1.5% for the sample restricted to women who attended ANC at least once. A crude stillbirth rate for this sample is thus about 17 per 1000 pregnancies. The distribution of stillbirths for the full sample and the restricted sample are not significantly different for most of the predictors as shown by the overlap of the confidence intervals. The rest of the description is thus 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 4.5% 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 which included about 9% of deliveries by doctors, 45% by nurses or midwifes and 1% by auxiliary nurses or midwifes. 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 only 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%, 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 applies to most of the other bivariate distributions. Thus unless specified, the differences from the cross tabulations are not statistically significant. Differences of greater than 0.5% are however considered important, hence described.

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 went for ANC less than four times – 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 did so from a nurse (2.3% and 1.3% respectively).

The rest of the bivariate discussion is also based on the restricted sample, though these are not very different from that for the full sample. 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 ($p<0.5$). 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 were 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. This difference is significant. Also women who reported some complication had a higher percentage of still births –3.9% percent compared to 0.9% percent; and this difference is significant. In addition, those 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 maternal death had a significantly higher proportion of stillbirths – 7.7% compared to 1.4% of those without this. 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, 3.8% among those with any intervention; compared to about 1.4% or less for their reference group. But for that for blood transfusion, all the differences are significant. The stillbirth rate is also higher for those 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. But there is no major difference by number of children, except that all those who reported no child born alive and about 27% of those with no children currently alive had a stillbirth in the last pregnancy. No major differences are present by use of contraception and knowledge of family planning source.

Surprisingly, stillbirths are higher in urban 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, though these are not significant. There are no significant differences by religion and ethnicity though the lowest rate is among those in the traditional religion groups and among the Grussi/Gruma ethnicity. Those 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 outcome 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 attended ANC at least once, 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 for the sample restricted to women who attended ANC at least once and the full sample. This shows 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 attendance at ANC and attending ANC four or more times are negatively associated with delivering a stillbirth, but frequency of ANC attendance is not significantly associated with the pregnancy outcome in the unadjusted model for the sample restricted to women who attended ANC at least once.

Deliveries in a health facility and deliveries assisted by a SBA are both associated with over two times higher odds of having a stillbirth. Also delivering in a government hospital or polyclinic and deliveries assisted by a doctor are associated with higher odds of delivering a stillbirth when 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 having a stillbirth compared to those who are 25 to 29years old. There is no significant association by number of pregnancies, but women who have never married have over two times higher odds of having a stillbirth compared to those currently married.

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 association between education and wealth with pregnancy outcome is also not significant, though it is 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 model 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 a SBA 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 final multivariate models, but the difference by type of 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. These are presented here for ease of comparison, but are the same as those for the sample restricted to women who attended some ANC in

table 7G3. The first set of multivariate results exclude the delivery provider and place as well as whether the woman had any intervention during delivery. These are included in the second set of multivariate results. 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 were accounted for. However, the difference by type of delivery facility is still present; with 64% and 75% lower odds of stillbirth for deliveries in a government health center/health posts and that in private facilities, respectively –compared to deliveries in a government hospital and polyclinic. 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, attending ANC four or more is associated with 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 of experiencing a stillbirth respectively compared to women in the Greater Accra region.

Moderation analysis: This analysis sought to answer a number of questions. The first is whether quality of ANC will be associated pregnancy outcomes net of other factors. This is addressed by the results above. The second is second is whether the effect of quality of care on pregnancy outcomes differs for women who use and those who do not use a SBA. To examine this, quality of ANC was interacted with delivery by a SBA and also type of delivery facility but both interactions were not significant. This suggests does the effect of quality of ANC on pregnancy outcomes does not differ substantially by use of SBAs or the type of delivery facility.

A related question is whether the effect of quality of care differs by place of residence and SES. The interactions between quality of ANC and 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.

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 full sample to test if the findings for women who attended ANC can be generalized to the whole population. Here women who did not attend ANC are given a quality score of zero and the variable on whether or not ANC was attended is included as an indicator variable. 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. 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. The analysis also examined if quality of ANC had an effect on women's pregnancy outcome net of other factors among women who attended ANC at least once during their last pregnancy. The results show that higher quality of 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 ANC at least four times. As expected a complication in the index pregnancy, 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; Carroli et al. 2001). This is based on evidence that complications of pregnancy tend to be unpredictable and so risk assessment used on ANC leads to too many false positive and negatives (Bergsjø 2000; Rooney and Maternal Health and Safe Motherhood Programme 1992). 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 (Bergsjo and Villar 1997; Campbell and Graham 2006; Villar and Bergsjo 1997; World Health Organization 2003) Recent reviews also propose that certain content of ANC has the potential for reducing stillbirths (Bhutta et al. 2009, 2014, 2014; Lawn et al. 2014). This analysis provides additional evidence for the role of not just attending ANC, but good quality ANC in reducing stillbirths. This implies every woman who comes into contact with the health systems during pregnancy is provided with the basic components of ANC. It is projected that a basic package of interventions including periconceptional folic acid supplementation or fortification, prevention of malaria, and improved detection and management of syphilis during pregnancy, basic and comprehensive emergency obstetric care could avert up to 45% of stillbirths; and these are cost-effective interventions (Bhutta et al. 2011).

To my knowledge 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 attempted to examine some of the components of ANC. One study based on surveillance data in the Brong Ahafo region had receipt of two tetanus doses during ANC as the only measure of quality of ANC and found that women in lower wealth quintiles who were more likely to have a stillbirth were also more likely to receive lower quality care. They suggested the higher risk of stillbirths among the poor may be due to lower quality care, but did not directly model quality of care 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 these 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). Including several ANC content variables individually in the multivariate model may have led to problems of collinearity in their analysis if the ANC content variables were correlated.

Some of the studies have also found lower odds of having a stillbirth among women who attended ANC four or more times (Asundep et al. 2013), while some found no effect of frequency of ANC net of other factors (Yatich et al. 2010). Ha et al found that higher frequency of ANC was associated with lower risk of antepartum but not intrapartum stillbirth, though they did not account for the quality of the ANC. The similar findings from this analysis may therefore be because the sample includes a higher proportion of antepartum stillbirth, though we are unable to make this distinction. Like this analysis, the few studies in Ghana that examined trimester of first ANC as a predictor found no significant effect of trimester when other factors were accounted (Asundep et al. 2013; Yatich et al. 2010).

In unadjusted models in this analysis, delivery by a SBA or delivery in a health facility is associated with higher odds of having a stillbirth compared to deliveries by non-SBAs and deliveries outside a health facility, but when other factors are accounted for this association is no longer significant. Compared to deliveries in private facilities and lower tiered health facilities, delivery in a government

hospital or polyclinic is associated with higher odds of having a stillbirth controlling for other factors. This is consistent with other studies that find a higher odds of stillbirths among women who deliver in district and regional hospitals compared to those who deliver 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, where women at risk of stillbirths are more likely to use SBAs or deliver in health facilities. This also applies to the findings regarding ANC and deliveries by doctors. 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 raises a number of questions. These include: 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 experience working in Ghana, discussions with colleagues, and review of health reports in Ghana, I can say it is a bit of both.

The first 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 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 of mother and baby may be available. Some of these explain the higher stillbirths in government hospitals and polyclinics which tend to be 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, 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 babies. These suggests, a 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 these situations 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 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 deaths that occur in facilities are 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 is about 10,032-to-1 nationally, but ranges from 3,712-to-1 in the Accra, national capital to 38,267-to-1 in the Upper West region. The population-to-midwife ratio is also 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). 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 NHIS – without a corresponding increase in health workers and capacity of health facilities (Ghana Health Service 2008, 2012; Witter, Kusi, and Aikins 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 deaths in the country, which also tend to be major risk factors for stillbirths 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; with 60% using 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 either because the only midwife on duty was inundated with too many cases and so 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. Even 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. Some

stillbirths are also caused by negligence and incompetence of health providers. While 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, Yakoob, et al. 2009; Di Mario et al. 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, Yakoob, 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 ensure the survival of the fetus in the index pregnancy but reduces the chances of future stillbirths (Joy E Lawn, Yakoob, et al. 2009). A past miscarriage was not associated with having a stillbirth, likely because the etiologies of early pregnancy losses are different from that of late pregnancy losses. A facility based study in Ghana also found higher odds of having stillbirth among women had a prior induced abortion –net of other factors (Yatich et al. 2010). This was thought to be due to the fact that dilation and curettage which is the common abortion method used including by unqualified personnel may lead to cervical incompetence. In this analysis prior abortion is only positively associated with having a stillbirth in the unadjusted model – the association is not significant when other factors are controlled for.

Other identified risk factors for still birth are age and gravidity (Joy E Lawn, Yakoob, et al. 2009; Di Mario et al. 2007; McClure et al. 2009). Maternal age younger than18 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, Yakoob, 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, Yakoob, 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 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 find no effect of age (Asundep et al. 2013; Engmann et al. 2012; Yatich et al. 2010). Like this study, other studies also do not find an effect of gravidity or parity on pregnancy outcomes (Asundep et al. 2013; Yatich et al. 2010); though some find 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 also associated with higher odds of having a stillbirth compared to those currently married. One other study had similar findings (Yatich et al. 2010), though others did not find a significant effect of marital status. 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 which may include lower access and quality of care. Yatich et al (2010) found that women who were single were had fewer ANC visits, less likely to receive malaria prophylaxis, and had low folate and hemoglobin levels.

The strong significant association between reporting a sibling who experienced stillbirth 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 to some risk factors for both maternal deaths and still births like hypertension. It may also be a factor of poor access to good quality health care by women of siblings who may be affected by similar contextual factors. In addition, since a woman has to have a female sibling for her to experience a maternal death, over represents women

from large families who may be more likely to have large families themselves. 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 not likely spurious, though we cannot rule out problems of endogeneity. 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, however 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, Yakoob, 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 cited above 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 stillbirth 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 stillbirths (Bhutta et al. 2011, 2014). There are also 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 they may also be 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 potential reason is that the effect of SES depends on health service availability. In this analysis, I tried to examine this by including interactions between education and wealth with place of residence. None of these interactions were however significant. While this decreases support for this hypothesis, better measures are access are needed to fully test it.

The association between place of residence and birth outcomes is another interesting finding worth noting. Rural areas are said to account for a larger proportion of stillbirths especially for SSA (Cousens et al. 2011). The findings from the GMHS are however contrary to this. This shows that while rural areas have a larger absolute number of stillbirths, the proportion of all births that result in s 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 may 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 if deliveries in health facilities and 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, with a little over 25% of stillbirths. The difference from the other regions is however not significant even 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 are controlled for. These factors include quality of ANC and delivery provider as the regional differences are seen even when only these are added to the model with region. However, 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. For quality of ANC, Eastern region does not differ significantly from the Greater Accra region when other factors are accounted for, but Brong Ahafo region has higher quality of ANC. Thus, it does not appear the differences are due to differential use of services. Differential quality is however a potential factor, though this will require better measures of quality for both ANC and delivery care to examine this. This is an area for further research in future studies.

Limitations, strengths and conclusions

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 a short interpregnancy interval 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 this analysis is not to provide the stillbirth rate in but to examine associations. Furthermore controlling for past stillbirths helps to account for this.

The second limitation relates to the measure of quality of ANC. As discussed in previous chapters, this measure is limited in discriminating between different levels of quality of care and does not adequately capture all the dimensions of quality. Moreover all the variables are subject to recall and social desirability bias are all the information is based on self-report.

The other limitations relates to the lack of data on some variables that are related to the focal independent and 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 are about 40 to 60% and 15 to 40% respectively in different settings (Joy E Lawn, Yakoob, 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 is important because some of the determinants are different (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 (Edmond et al. 2008; Engmann et al. 2012), it is an intervening factor and 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 may be more important. Others find a higher rate of stillbirths for male infants (Ha et al. 2012) while others find but no effect in others (Engmann et al. 2012). Sex of the infant is not controlled for in this analysis because it is missing for all the stillbirths. 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.

The omission of variables related to the focal independent and dependent variables from the analysis increases omitted variable bias hence problems of endogeneity and unobserved heterogeneity (Aneshensel 2013; Treiman 2009). The other source of endogeneity – simultaneity or reverse causation may be less of a problem for the focal relationship as it is highly unlikely that the birth outcomes will cause the quality of ANC for the index pregnancy. The reverse is more plausible – which increases confidence in causal inference based on the temporal ordering of the events. However, simultaneity is a real problem for the place and type of delivery attendant as women may seek care only after they realize they have a problem. This is related to the problem of selection for place and type of delivery assistant which could not be adequately addressed in this analysis. Selection is also a potential problem for receipt of good quality care; though 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. The study is based on cross- sectional data hence has the limitations on causal inference inherent in any cross-sectional analysis. It however has several strengths.

First, it uses a nationally representative sample of women from Ghana, which increases the generalizability. Second, unlike the usual demographic health surveys which only asks the questions on maternal health to women with a live birth in the preceding five years (or other period), the GMHS includes all women with a birth (live or otherwise) in the preceding five years. This made this analysis possible, and to my knowledge, this is the first study in Ghana that has examined the predictors of stillbirths based on national data. 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. The analysis also uses multilevel modeling to account for the hierarchical nature of the data. In addition it uses other analytical approaches as sensitivity to the main analysis. Though the multilevel analysis is unweighted, the results are generally consistent with the weighted single level regression results. The findings therefore apply well to at least the over 9 in 10 women in Ghana who attend ANC at least once during pregnancy. Finally, this study addresses a gap in the maternal health literature, which is the dearth of quantitative studies that examines the relationships between process and outcome measures of quality of maternal care.

There has been a big emphasis on improving coverage for maternal health services, with relatively less emphasis on the quality of care women receive. This study seeks to extend the evidence needed to advocate for and develop targeted interventions to improve quality of maternal health services as a means of reducing disparities and improving pregnancy outcomes. The study finds that quality of ANC is important for pregnancy outcomes in Ghana; and similar or more efforts are needed to improve quality of care as for improving coverage for use of maternal health services. Improving access to maternal health services is obviously very important but use of services will not result in the desired outcomes if it is not associated with receipt of good quality services. 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. Furthermore, women may be willing to travel longer distances to health facilities if they perceive the quality of care to be high (Thaddeus and Maine 1994). Prior analysis showed women who receive ANC from the health centers are more likely to receive low quality of ANC. A first step towards improving quality of ANC is providing the basic equipment needed to provide the essential services in the health centers which tend to be located in rural areas. A second step is refresher trainings of providers at these facilities to remind them of the essential components of ANC and to enable them understand why and how they can provide these services efficiently. This should be followed by effective monitoring and supervision to ensure the right things are being done. This will ensure women do not

present in labor with unsalvageable conditions that could have been managed. 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 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 in Ghana is therefore not out of place.

In 2011, 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). The recent lancet stillbirth series also 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 they identify 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.

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 stillbirths. For ANC there is a very small coverage gap as many women in Ghana attend ANC at some point during pregnancy. But there also is a gap in quality of ANC, which may be easier to address and could potentially decrease the coverage and equity gap for skilled attendance at delivery. Reducing the quality gap for both antenatal care and delivery care is essential to preventing the large number of stillbirths and maternal deaths in Ghana. If Ghana is to achieve the goals of reducing both stillbirths and maternal deaths by half,

improving quality of both antenatal and delivery care needs to be given greater priority on the country's agenda.

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Table 1: Sample Distribution, Ghana Maternal Health Survey (GMHS), 2007

	Full analytic sample, N=5,042					Women with at least one ANC, N=4,868				
	Unweighted		*Weighted*			*Unweighted*		*Weighted*		
Variables	N	%	Proportion	[95% C.I]		N	%	Proportion	[95% C.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
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
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
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

Table 1 continued

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
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
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
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

Table 1continued										
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
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
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
ANC variables										
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			
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

Table 1continued										
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
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
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

Notes: [a] This is for only women who have been in a union so does not add up to the full sample
[b] refers to people who had some ANC from a government facility but 98% were exclusively in a government facility.

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

	Attended ANC at least once, N=4,868					Full analytic sample, N=5,042				
	Unweighted		*Weighted*			*Unweighted*		*Weighted*		
Variables	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
For deliveries in health facilities (N)	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/11missing	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

	Attended ANC at least once (N=4,868)				*Full sample (N=5,042)*			
Variable	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/9missing	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
Risk factors for adverse outcome								
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
Intervention/Procedure during delivery								
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/11missing	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
Reproductive Health variables								
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
Cohabitating	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,

	Attended ANC at least once			*Full sample*		
Independent variables	Odds of having a Stillbirth: OR [95% CI]					
Fixed effects						
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)						
Cohabitating	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]
Random effects for Null models						
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

	Bivariate			Multivariate: No delivery variables			Multivariate: Includes delivery variables		
Independent variables	*Odds of having a Stillbirth: OR [95% CI]*								
Fixed effects									
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)									
Cohabitating	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]
Random effects	*Null model*								
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