

The impact of health insurance on maternal health care utilization: evidence from Ghana, Indonesia and Rwanda

Wenjuan Wang,^{1,*} Gheda Temsah,¹ and Lindsay Mallick²

¹International Health and Development Division, ICF International, Rockville, MD, USA and ²Avenir Health, Glastonbury, CT, USA

*Corresponding author. International Health and Development Division, ICF, 530 Gaither Road, Suite 500, Rockville, MA, USA. E-mail: wenjuan.wang@icf.com

Accepted on 22 August 2016

Abstract

While research has assessed the impact of health insurance on health care utilization, few studies have focused on the effects of health insurance on use of maternal health care. Analyzing nationally representative data from the Demographic and Health Surveys (DHS), this study estimates the impact of health insurance status on the use of maternal health services in three countries with relatively high levels of health insurance coverage—Ghana, Indonesia and Rwanda. The analysis uses propensity score matching to adjust for selection bias in health insurance uptake and to assess the effect of health insurance on four measurements of maternal health care utilization: making at least one antenatal care visit; making four or more antenatal care visits; initiating antenatal care within the first trimester and giving birth in a health facility. Although health insurance schemes in these three countries are mostly designed to focus on the poor, coverage has been highly skewed toward the rich, especially in Ghana and Rwanda. Indonesia shows less variation in coverage by wealth status. The analysis found significant positive effects of health insurance coverage on at least two of the four measures of maternal health care utilization in each of the three countries. Indonesia stands out for the most systematic effect of health insurance across all four measures. The positive impact of health insurance appears more consistent on use of facility-based delivery than use of antenatal care. The analysis suggests that broadening health insurance to include income-sensitive premiums or exemptions for the poor and low or no copayments can increase use of maternal health care.

Key words: Ghana, health insurance, impact evaluation, Indonesia, maternal health care, Rwanda

Key Messages

- Estimate the impact of health insurance on the use of maternal health services using propensity score matching technique based on nationally representative data.
- Health insurance enrollment was pro-rich.
- Positive effects of health insurance coverage were found on maternal health care utilization.
- The positive impact of health insurance appears more consistent on use of facility-based delivery than use of antenatal care.

Introduction

With health insurance on the rise in low- and middle-income countries (LMICs), a growing body of literature documents the impact of health insurance on access to and use of health care, financial protection, and health status in these countries (El-Shazly *et al.* 2000; Chen *et al.* 2003; Jütting 2005; Smith and Sulzbach 2008; Wang *et al.* 2009; Kozhimannil *et al.* 2009; Mensah *et al.* 2010; Escobar *et al.* 2010; Hong *et al.* 2011; Dong 2012). While a number of rigorous studies have evaluated the impact of health insurance on the use of general health care—namely, outpatient and inpatient care (Giedion *et al.* 2013)—there is limited empirical evidence of the impact of health insurance on use of maternal health care. Existing studies do not always address the issue of endogeneity or selection bias, often focus on only one or two study areas within a given country, and thus are not generalizable (Comfort *et al.* 2013).

In the context of global maternal and child health priorities (AbouZahr 2003), there is a growing need to evaluate whether health insurance has contributed to greater use of maternal health care. Using nationally representative data from the Demographic and Health Surveys (DHS), this paper assesses the impact of health insurance on use of antenatal care and facility-based delivery care in Ghana, Indonesia, and Rwanda, while adjusting for selection bias with propensity score matching analysis. A previous study reported on the impact of health insurance on use of maternal care services across eight countries including Ghana, Indonesia and Rwanda (Wang *et al.* 2014). This paper provides a more in-depth look at these countries as they have a high level of health insurance coverage and more mature schemes.

Impact of health insurance on maternal health care utilization

The impact of health insurance is often assessed in terms of improvements in health care utilization, financial protection, and health status. Research has largely focused on the impact of health insurance on the use of healthcare services, especially general health care (Giedion *et al.* 2007; Wagstaff 2007; Wang *et al.* 2009; King *et al.* 2009; Thornton *et al.* 2010; Wagner *et al.* 2011; Nguyen *et al.* 2012; Giedion *et al.* 2013). Enrollment in health insurance has been found to increase the probability of using general health care in various settings (Wagstaff 2007; Wang *et al.* 2009; Aggarwal 2010; Wagner *et al.* 2011).

Maternal and child health services are typically covered in health insurance benefit packages. However, few studies have used rigorous methodology, such as random control trial experiment, propensity score matching, difference-in-differences and instrumental variables (Comfort *et al.* 2013) to assess the impact of health insurance on the use of maternal and child health care. Using propensity score matching estimation, Mensah *et al.* (2010) found that in Ghana women insured through the National Health Insurance Scheme (NHIS), compared with women without insurance, were more likely to have three or more prenatal check-ups, to deliver at a hospital, to receive professional assistance during birth, and to receive postnatal check-ups and vaccinations for their children, and were less likely to develop birth complications. In assessing a pilot voucher program in Bangladesh, Nguyen *et al.* (2012) used a difference-in-differences method and found that women in intervention areas had significantly higher probability of antenatal care utilization, institutional delivery, and postnatal care. In their study of the effect of subsidized health insurance in Colombia, Giedion *et al.* (2007) used both propensity score matching and difference-in-differences methods and found that program participation increased

the use of professionally attended delivery care, as well as complete immunization coverage among children, even though immunization was provided free in the public sector. Several other studies have also demonstrated a positive association between use of maternal health care and health insurance coverage, but with less rigorous methodology (Smith and Sulzbach 2008; Kozhimannil *et al.* 2009).

Some research, however, has reported mixed findings regarding the impact of health insurance on the use of maternal health care. An evaluation of community-based health insurance (CBHI) in one province of India employed a propensity score matching technique and did not find differences in the use of prenatal services or delivery in private facilities by health insurance status (Aggarwal 2010). The author suggests that this was most likely because at the time of the study coverage of normal deliveries in private settings had been only recently added to the insurance scheme, so there was not enough time to measure meaningful change. Additionally, in this province of India maternal health fees were already negligible in government facilities.

Overview of health insurance schemes in Ghana, Indonesia and Rwanda

The impact of health insurance on health care utilization is closely associated with its characteristics, such as premiums, benefits, location of healthcare services, and for whom the services are intended (Escobar *et al.* 2010; Frimpong *et al.* 2014; Robyn *et al.* 2013). Two types of insurance schemes are commonly implemented in LMICs—namely, Social Health Insurance (SHI) and Community-Based Health Insurance (CBHI). These schemes differ on enrollment requirements, funding, size of the risk pool, associated fees and reimbursement mechanisms.

Ghana

The main form of insurance in Ghana is the National Health Insurance Scheme (NHIS), which was rolled out in 2003 (Witter and Garshong 2009). It is funded by premiums, the National Health Insurance tax, Social Security and National Insurance Trust (SSNIT), government funding, and returns from investment. The NHIS is administered on a district level, although the funding is centralized and nationally standardized (Nguyen *et al.* 2011). All members must pay a small registration fee to enroll and obtain insurance cards (Blanchet *et al.* 2012). Annual payments range from about 7 to 48 Ghana Cedis annually (approximately 2 to 15 US dollars (USD)), and premiums are determined on a sliding scale based on income and geographic location, with exemptions offered for groups who cannot pay, such as the elderly, children, and indigents—defined as persons who are unemployed, without a fixed income and fixed residence, or not living with someone with a fixed income and residence (Mensah *et al.* 2009). However, indigents have little access and membership is pro-rich and pro-urban, with some ‘squeezing out’ of non-members from healthcare services (Witter and Garshong 2009).

The NHIS covers 95% of healthcare services including maternal health services, and all health providers with certification are covered (Witter and Garshong 2009; Nguyen *et al.* 2011). There are no copayments, deductibles, or coinsurance payments or any additional payments at the point of service (Nguyen *et al.* 2011). Maternal health services are free for all pregnant women; pregnant women have been included in the exemption policy since 2008 (Mensah *et al.* 2009). Under this scheme, maternal care benefits include four prenatal visits, delivery care and one postnatal visit. Care for the

child for up to three months post-delivery is included (Escobar *et al.* 2010; Dixon *et al.* 2014).

Rwanda

CBHI in Rwanda, known as *Mutuelle de Santé*, was initiated in 2004 and has been heavily promoted and subsidized by the government (Ministry of Health of Rwanda 2010). The reach of *Mutuelle* has steadily increased, bringing more Rwandans under the umbrella of health insurance due to effective promotion campaigns and low premiums, including a zero premium for the poorest 16th percentile, as well as the broad range of coverage of preventive and curative care services provided at various levels of health facilities in Rwanda (Saksena *et al.* 2011; Lu *et al.* 2012). Enrollment in *Mutuelle* has risen further after passage of the mutual health insurance law in 2007 (Ministry of Health of Rwanda 2010). There are also other types of insurance in Rwanda, including Rwandaise d'Assurance Maladie (RAMA) for the formal sector, Military Medical Insurance (MMI) for the Military, as well as other, privately purchased schemes; however, the majority of insured are enrolled in *Mutuelle* (Ministry of Health of Rwanda 2010).

Rwanda's CBHI program, although overseen at the national level with standardization of coverage throughout the country, is coordinated locally, within each of the country's 30 districts. Mobilization committees at the village level promote enrollment. Donor and development partners, the government, and contributions from individuals fund the CBHI. There are three contribution levels for individuals, based on income. The lowest contribution level, RWF 2000 annually (~.50 USD), is intended for the poorest, where premiums are subsidized by the national government or donor funds; the second tier costs RWF 3000 (~4 USD), the third tier, RWF 7000 (~9 USD) and more comprehensive plan is also available for those who can afford 10 000 RWF (~10.00 USD) per year (Ministry of Health of Rwanda 2010). Services included in the top tier, all-inclusive benefits package include outpatient and inpatient services, essential drugs, medical imagery, and laboratory tests. Prenatal and postnatal care are covered in the minimum package (Lu *et al.* 2012). Individuals must first obtain a referral from their primary care facility before seeking specialist care, except in emergency situations (Ministry of Health of Rwanda 2010).

While the country's health insurance premiums are income-sensitive, copayments, which are determined by the service provider, remain unaffordable for the poor. Copayments are about 200 RWF (~0.25 USD) and 10% of hospital fees (Lu *et al.* 2012). In 2005, a flat fee schedule was developed to encourage ease of administrative process and insurance uptake, however the fee remains unaffordable for the poorest. Sometimes, some services and commodities at partnering institutes are unavailable, leaving participants to pay for services out of pocket at private establishments (Ministry of Health of Rwanda 2010).

Indonesia

Compared with Ghana and Rwanda, which have one dominating insurance scheme, Indonesia offers more health insurance options, depending on beneficiaries' occupational status and income level: *Askes*, for civil servants and the military and *Jamsostek*, for private and formal sector workers (Achadi *et al.* 2014). Formal sector employees are required to enroll in their respective social health insurance programs, with the exception of private sector employees, who can opt for private insurance instead (Sparrow *et al.* 2013). *Jamkesmas* social health insurance (formerly called *Askeskin*) caters to the informal sector, the poor and near poor and has the largest

share of beneficiaries (Sparrow *et al.* 2013; Achadi *et al.* 2014). Eligible candidates are determined through a combination of geographic, census and household consumption-based indicators, at a district level, although participation is voluntary (Sparrow *et al.* 2013). *Jamkesda* is a local health insurance scheme intended for the poor and near poor who are not covered under *Jamkesmas* (Achadi *et al.* 2014). Comprehensive coverage of health services is provided by *Askes*, *Jamkesmas*, and *Jamsostek* (Achadi *et al.* 2014).

In 2007, Indonesia launched a conditional cash transfer program, called Program Keluarga Harapan (PKH), intended for low-income pregnant women and children. This program provides a total amount of 800.000 IDR (~66 USD) to pregnant women, under the condition that they complete the minimum recommended maternal health services—namely, four antenatal care appointments, childbirth attended by skilled professional, and two postnatal appointments if they are breastfeeding. Women who do not obtain this minimum care are penalized with a reduced amount on the subsequent payments unless they meet the requirements (Kharisma 2008). In an effort to achieve universal coverage of maternal and neonatal health services, Indonesia enacted the *Jampersal* in 2011 to cover pregnant women not enrolled in any other form of health insurance (Achadi *et al.* 2014). *Jampersal* expanded delivery services offered under *Jamkesmas* and includes both public providers and enlisted private facilities (Achadi *et al.* 2014).

Premiums vary by scheme. Under *Jamkesmas*, premiums are fully subsidized by a government health fund, although district level governments manage the funds, with the final decision on how the funding is spent (Harimurti *et al.* 2013). Among the formal sector social health insurance schemes, premiums range from 2% of salary for civil servants to 3–6% for private sector employees, depending on marital status (Harimurti *et al.* 2013). In the private sector, employers can fund 100% of the cost of the insurance; however, for private sector workers fees at the point of service are negotiated, whereas for civil servants fees are scheduled—civil service employers pay one-third of the cost of the premium, while employees pay the remaining two-thirds (Harimurti *et al.* 2013). There are no premiums under the *Jampersal* scheme (Achadi *et al.* 2014).

While health insurance programs in Indonesia are designed to meet the specific needs and circumstances of particular sub-populations, they have their shortcomings. Regardless of health insurance for the poor, access remains an issue for Indonesians in rural areas, isolated by the country's archipelago geography. Secondly, household selection under the *Jamkesmas* system is not standardized across the country, and is often left to the discretion of local health staff, leading to mismatching of health insurance to the non-poor. Finally, some members choose not to use the *Jamkesmas* card for fear of stigma, or enroll in the insurance scheme only when in need of health care, resulting in adverse selection (Harimurti *et al.* 2013).

Methods

Data and key variables

Data in this study come from the most recent DHS in the three study countries—2008 Ghana DHS, 2012 Indonesia DHS, and 2010 Rwanda DHS. Data on women's health behavior and health outcomes are obtained through interviews with women of reproductive age (15–49). Information on socioeconomic characteristics of the women and their households is also collected. Our study population for assessing the effects of health insurance is women who reported a live birth in the 5 years preceding the survey.

The study explores four outcomes of maternal health care utilization for the most recent birth: whether a woman made at least

one antenatal care visit (ANC1); whether a woman made at least four antenatal care visits (ANC4); whether the first antenatal care visit occurred within the first three months (ANCMONTH); and whether the woman gave birth in a healthcare facility (FACBIRTH). The selection of these outcomes is based on standards of prenatal and delivery care recommended by the World Health Organization (WHO 2004). All of the measures are dichotomous, coded as 0 or 1. ANC1 and FACBIRTH include all women age 15–49 who had a live birth in the 5 years preceding the survey. However, ANC4 and ANCMONTH are specific to women who reported at least one antenatal care visit.

The main independent variable of interest is health insurance coverage. The DHS asked respondents whether they were covered by health insurance and what type of health insurance they had. We constructed a dichotomous variable of whether a woman was covered by any health insurance.

Statistical methods

We applied a propensity scoring matching (PSM) approach to evaluate the effect of health insurance coverage on women's use of antenatal and delivery care. Ordinary regression can be used for causal inference of effects when confounding variables are directly measured or time invariant (Nichols 2007; Shadish *et al.* 2002). In ordinary regression, selection bias arises when a covariate is correlated with the residual (i.e. endogenous), because variables are poorly measured, or relevant variables are omitted—including observable and unobservable characteristics (Berk 1983; Nichols 2007). In our study, women who seek antenatal and delivery care may be more likely to enroll in health insurance (endogeneity). The sample of women who are enrolled in health insurance is not a random selection of women. For example, they may be more educated, belong to wealthier households and live in urban areas. The positive effects of health insurance may be overstated using ordinary regression even if these factors are controlled for in the model because selection bias can result when the distribution of the characteristics of women with health insurance and those without health insurance differ (Heckman *et al.* 1996). In addition, women who are enrolled in health insurance and those who do not have health insurance coverage may differ in their aversion to risk; women who are risk-averse are both more likely to seek health insurance coverage and seek maternal care services. This unobserved heterogeneity in women's characteristics results with unobserved self-selection bias.

Developed by Rosenbaum and Rubin (1983), PSM methods match on the propensity to receive treatment referred to as the 'propensity score'. The propensity score is defined as a function of a vector of covariates X such the covariates are independent of the assignment to treatment (D) (Rosenbaum and Rubin 1983). In this study, the propensity score is the likelihood of seeking health insurance so women with the same propensity score share a similar distribution of the characteristics (Mocan and Tekin 2006). The average treatment effect on the treated (ATT) estimates the difference in the expected outcome with and without treatment for cases that received treatment (Caliendo and Kopeinig 2008):

$$\tau_{ATT} = E(\tau | D = 1) = E[Y(1) | D = 1] - E[Y(0) | D = 1]$$

Since the counterfactual for cases that received treatment without treatment is not observed, it is estimated based on the assumption that after adjusting for observed characteristics it is the same for $D = 1$ (women with health insurance) and $D = 0$ (women without health insurance) (Aggarwal 2010). In this study, a counterfactual is created by matching women with health insurance to women

without health insurance. Even if the women in the two groups are not identical in every way, they are similar in their likelihood to seek health insurance coverage, so the health care utilization outcome of women without health insurance serves as a counterfactual outcome for women with health insurance were they not covered by health insurance. Women in either group who cannot be matched are excluded from the analysis, unlike ordinary regression where all women in both groups would be included. Additionally, PSM assigns higher weights to better matches. Assuming that selection bias is only due to observed characteristics and that the model includes all observed confounders that would influence women's decision to seek health insurance coverage and their likelihood of using health care services, this matching approach theoretically removes selection bias (on observable characteristics) and allows us to attribute differences in the outcomes of the matched cases as the effect of health insurance. The ATT is the increase in the likelihood of seeking antenatal or delivery care that can be attributed to health insurance coverage after the characteristics of the group of women with health insurance and those without health insurance are 'balanced out' (on observed characteristics) so that their odds of seeking health insurance coverage are the same.

The analysis was done with the Stata Statistical Software Release 13. We assessed the effects of health insurance status on maternal health care use in four steps. First, we ran logit models to estimate the propensity score, which is the predicted probability of being insured given a set of covariates. Second, we used the estimated propensity scores to match women who were not insured but had a similar likelihood of being insured to women who were insured. Third, we compared the outcomes of the insured and the uninsured to obtain the effects of health insurance on the insured (ATT). Depending on the quality of matching, selection bias may still impact the estimate of the average improvement in the likelihood of seeking health care due to health insurance for women with health insurance (Heckman *et al.* 1996). As a final step we tested the robustness of the results to selection bias on unobservable confounders. PSM estimates are sensitive to the conditional independence or confoundedness assumption—that is, that the model has conditioned on all relevant observable variables that simultaneously influence treatment and the outcome (i.e. confounders), and that there is no bias due to unobservable characteristics (Becker and Caliendo 2007; Nichols 2007).

Estimating the propensity score

The propensity score was estimated using a logit regression with the following confounders: maternal age at the most recent birth, current marital status, mother's level of education, mother's employment status, education of the household head, mother's exposure to mass media, child's birth order, household wealth, and place of residence (i.e. region) and whether the woman resides in an urban or rural area. Older women may be more likely to have health insurance coverage and seek antenatal and delivery care based on experience from previous pregnancies. Women with higher levels of education are expected to be more knowledgeable of the benefits of health insurance and the importance of seeking antenatal and delivery care. Similarly, the level of education of the head of the household may be positively correlated with mothers' decision to seek health insurance coverage and ability to pay for antenatal and delivery care. Employment, particularly paid formal sector work, is expected to provide women with the resources to seek health insurance coverage and cover costs associated with antenatal and delivery care. Depending on the nature of women's employment,

health insurance coverage may be a direct benefit of employment. Daily exposure to media is expected to expose women to information that may lead them to seek health insurance and antenatal and delivery care. Living in an urban area facilitates access to maternal health care services. Regional differences in the level of development (e.g. road systems, health care facilities) can influence access to both health insurance and maternal health care services.

Our selection of variables was guided by theory and consensus in the literature, and also empirically tested using the data to ensure correlations with health insurance coverage and the use of maternal health care services (Rubin and Thomas 1996; Jütting 2004; Caliendo and Kopeinig 2008; Hong *et al.* 2011; Dixon *et al.* 2014). A variable was dropped only if it was not simultaneously correlated with both the treatment (being covered by health insurance) and the outcome (use of health care). Because the analytical sample differed by outcome, for every country the propensity score was estimated for two samples: all women who had a live birth in the last 5 years (ANC1 and FACBIRTH), and women who had at least one antenatal care visit (ANC4 and ANCMONTH). Propensity scores were generated using STATA's *pscore* command.

Balancing test

Several iterations of the estimation of the propensity score were conducted in which variables were recoded to satisfy the balancing property. The recoded variables are reflected in the tables showing results. We imposed the common support to improve the quality of matching (Heckman *et al.* 1997).

Algorithm for matching and estimation of the effects of health insurance

We used STATA's *teffects psmatch* command to estimate ATT using several different algorithms and selected the one that yielded the best match. The following matching algorithms were tested: nearest neighbor with and without replacement and radius matching within various calipers.¹ The estimation of the variance of treatment effects includes variation due to the estimation of the propensity score and imputation of the common support (Aggarwal 2010). The *teffects psmatch* program accounts for additional variance due to the estimation of the propensity score (Garrido *et al.* 2014; Abadie and Imbens 2016).

Quality of matching

The distribution of the covariates between the treatment group and control group before and after matching were tested using STATA's *ptest*, which provides the standardized bias, pseudo- R^2 , likelihood ratio test for joint insignificance, and two-sample *t*-test results. Standardized bias ranging between 3 and 5% post-matching is deemed sufficient (Caliendo and Kopeinig 2008). We selected the matching method that produced the best quality matching and reported its outcomes, as well as the standardized bias, pseudo- R^2 , likelihood ratio test for joint insignificance and two-sample *t*-test.

Sensitivity analysis

To test the extent to which the results from PSM estimation are robust to violations of the conditional independence assumption or hidden bias, we conducted a sensitivity analysis. Because our outcome variables are binary, we use the Mantel and Haenszel (MH) test statistic (Aakvik 2001). In this analysis, the level of bias is increased incrementally to test: (a) whether the treatment effect has been overestimated or underestimated and (b) the effect of the hidden bias on the *P* value. We conducted sensitivity analysis using the

STATA command *mbounds* which was developed by Becker and Caliendo (2007).

Results

Health insurance coverage, health care utilization and differentials by background characteristics

Figure 1 presents the percentage of women who had a live birth in the 5 years preceding the survey and were covered by specific types of health insurance. In Ghana and Indonesia respondents could report more than one type of health insurance; but in Rwanda only the primary insurance was reported. Among the three countries, overall health insurance coverage was highest in Rwanda, at 73% of women in 2010, the vast majority of whom were covered by *Mutuelle*. Social health insurance was the primary type of coverage among women in Ghana and Indonesia.

Table 1 reports the percentage of women with health insurance coverage at the time of the interview by background characteristics. Generally, health insurance coverage was positively associated with educational attainment. In Ghana and Indonesia employed women had higher coverage rates than unemployed women. By contrast, in Rwanda, a slightly higher percentage of unemployed women reported health insurance coverage compared with employed women. Health insurance coverage was positively associated with household wealth in Ghana and Rwanda with the coverage highest among women in the richest households and lowest among women in the poorest households. In Indonesia, the relationship between household wealth and insurance coverage was somewhat non-linear; coverage rates were highest among the poorest and the richest groups. In all three countries women in urban areas were more likely to report health insurance than their rural counterparts. The urban-rural difference in Rwanda is not as pronounced as in other two countries.

Utilization of health care services varied by country as shown in Supplementary Tables S1–S3. Most women in all three countries made at least one antenatal care visit. Among women who reported at least one antenatal care, over 80% in Ghana and Indonesia but only 36% in Rwanda had four or more visits. Women in Ghana (58%) and Indonesia (83%) were also more likely to start antenatal care in the first trimester than women in Rwanda (39%). Facility delivery however was more common in Rwanda than in Ghana and Indonesia. Use of health care services was also correlated with a number of background characteristics as shown in Supplementary Tables S1–S3, especially women's level of education, household wealth status, and urban/rural residence.

Propensity score estimation and quality of matching

Because the four outcomes of interest were based on two different samples, for each country, we estimated two models of the propensity score—the full-sample model (ANC 1 and FACBIRTH) and the sub-sample model (ANC4 and ANCMONTH). The coefficients and standard errors of covariates from the propensity score estimation are available in Supplementary Tables S4–S6.

In general, household wealth status and women's education were important predictors of women's enrollment in health insurance. Net of the effects of other background characteristics, both household wealth and women's education were positively associated with women's participation in health insurance in all three countries. In addition, a positive association was observed between the education of the household head and women's health insurance status in Ghana and Indonesia, but not in Rwanda.

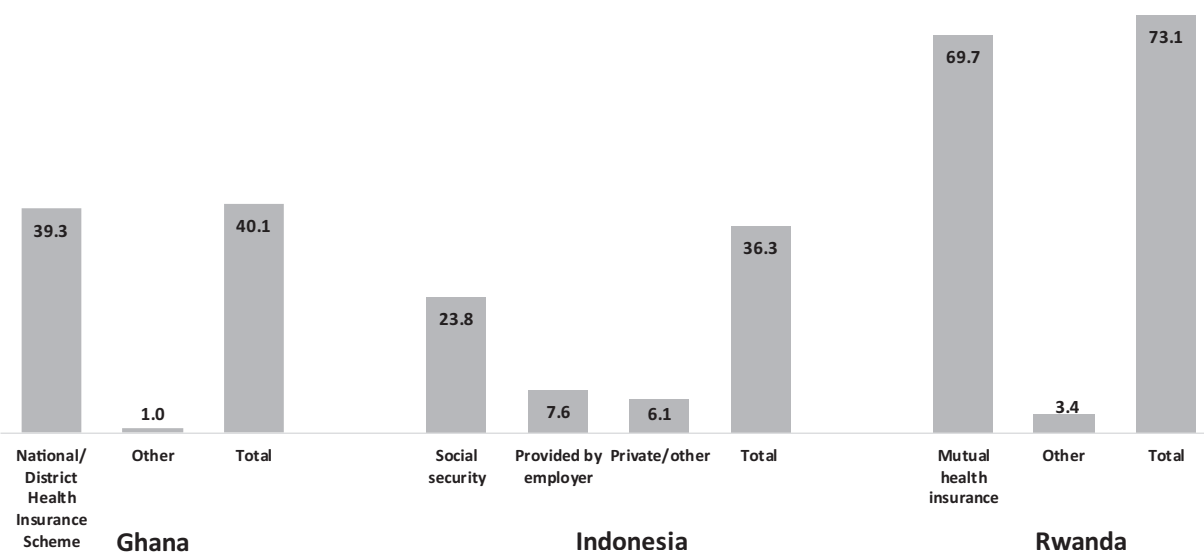


Figure 1. Percentage of women covered by specific types of health insurance in Ghana, Indonesia, and Rwanda

Table 1. Health insurance coverage among women who had a live birth in the 5 years prior to the survey, by background characteristics in Ghana, Indonesia and Rwanda

Background characteristics	Ghana		Indonesia		Rwanda	
	%	N	%	N	%	N
Woman's education						
None	33.3	612	23.5	252	65.7	1144
Primary education	30.4	495	32.1	4672	73.5	4470
Secondary or higher	50.6	912	38.7	9644	83.4	607
Marital status						
Never married	27.7	121	9.7	5	68.4	477
Currently married	41.6	1772	36.4	14 203	75.4	5143
Formerly married	35.3	126	35.2	359	56.3	600
Birth order						
1	46.4	451	32.5	5486	77.6	1428
2	42.0	422	38.7	4667	72.8	1207
3	37.6	335	38.3	2345	74.0	960
4 or higher	37.4	812	38.9	2070	70.3	2626
Employment status						
Not currently employed	38.5	253	32.4	7597	76.9	1262
Currently employed	40.7	1766	40.6	6967	72.0	4959
Education of head of the household						
No education	29.7	577	26.2	736	66.7	1372
Primary education	29.7	310	31.6	6265	73.8	4158
Secondary or higher	48.8	1,132	41.2	7566	80.7	691
Weekly exposure to mass media						
No	29.3	415	36.7	1804	64.6	2112
Yes	43.3	1604	36.3	12 763	77.4	4108
Wealth quintile						
First	27.7	448	36.0	2959	62.2	1438
Second	34.3	454	33.0	2839	71.1	1333
Middle	39.0	393	32.0	2904	75.7	1207
Fourth	50.0	420	33.4	3075	79.4	1144
Highest	56.9	304	47.8	2791	79.9	1098
Residence						
Rural	35.9	1211	31.3	7302	72.8	5411
Urban	47.2	808	41.5	7266	74.7	809
Total number of women	40.1	2019	36.3	14 568	73.1	6221

This table includes all women who had a birth in the 5 years prior to the survey. Percentages and Ns are weighted.

The urban-rural gap in insurance status that was observed in the bivariate analysis was largely diminished after controlling for other covariates. As expected, in all three countries regional differences in insurance coverage were statistically significant even after controlling for background characteristics. The magnitude and statistical significance of age, marital status, and mass media exposure on health insurance enrollment differed by country, with no consistent pattern.

Table 2 presents the results of the best-quality matching method as well as quality measurements before and after matching for full and sub-samples in each country. The final approach was chosen according to the quality of matching, which was assessed based on several model parameters, including the mean and median of absolute biases of covariates, pseudo-R², and standard Likelihood ratio test X². The pre- and post-matching comparisons on means and percent of absolute bias reduced for individual covariates were also taken into consideration in assessing the quality of matching. Radius matching generally resulted in the best quality of matching in most countries, with caliper width ranging from 0.01 to 0.05. It is expected that smaller calipers result in better quality of matching but also entail a greater possibility of losing treated cases that do not have a matched control (Grilli and Rampichini 2011). Therefore, to achieve a good-quality matching and maximize the use of data from treated cases, the choice of caliper was determined by two criteria: the quality of matching and the least number of unmatched treated cases.

Overall, in all three countries matching substantially reduced the mean and median biases between the insured and the uninsured with respect to the observed covariates included in the models. The mean absolute bias was <5% in all of the models—the threshold for decent quality matches (Rosenbaum and Rubin 1983). Comparisons on individual covariates are reported in Supplementary Tables 7–9. In all three countries, the post-matching standardized biases of all covariates across all models were <5%. Pseudo-R² comes from the regressions of the propensity score on all covariates used in matching on both matched and unmatched samples. It should be substantially reduced after matching if the covariates are well matched between the insured and uninsured groups (Aggarwal, 2010). Table 2 indicates fairly low Pseudo-R² in all models. In all models

Table 2. Propensity score matching performance: results of the quality measurements

Country	Matching approach		Sample	Mean	Median	Std. dev.	Pseudo-R ²	LR χ^2	$P > \chi^2$
Ghana	Full sample	Radius matching (caliper = 0.012)	Unmatched	16.4	14.6	12.0	0.158	403.83	<0.001
			Matched	1.8	1.7	1.2	0.002	4.47	1.000
	Sub-sample	Radius matching (caliper = 0.011)	Unmatched	17.0	16.4	11.9	0.158	403.64	<0.001
			Matched	2.0	1.7	1.2	0.002	4.33	1.000
Indonesia	Full sample	Radius matching (caliper = 0.02)	Unmatched	8.4	7.3	5.7	0.038	756.85	<0.001
			Matched	0.6	0.5	0.5	0.000	4.96	1.000
	Sub-sample	Radius matching (caliper = 0.01)	Unmatched	8.9	8.1	5.7	0.038	756.66	<0.001
			Matched	0.5	0.4	0.4	0.000	2.83	1.000
Rwanda	Full sample	Radius matching (caliper = 0.01)	Unmatched	11.1	9.2	8.9	0.066	472.45	<0.001
			Matched	3.1	2.3	2.4	0.006	75.87	<0.001
	Sub-sample	Radius matching (caliper = 0.01)	Unmatched	11.1	9.2	8.9	0.066	472.45	<0.001
			Matched	1.1	1.0	1.0	0.001	14.08	0.899

except the full-sample model for Rwanda, the Likelihood-ratio test of joint insignificance of all covariates was insignificant after matching, indicating similar distributions of observed covariates between the treatment and control groups after matching.

Effect of health insurance on maternal health care utilization

Effect on number of antenatal care visits

Table 3 presents the differences in four outcomes between insured and uninsured women before matching, as well as the estimated effects of health insurance based on the matched samples.

Irrespective of health insurance status, most women in all three countries made at least one antenatal care visit. Before matching, the proportion of women reporting at least one antenatal care visit was higher among insured women than uninsured women. For the sample of women in Ghana, matching eliminated the statistical significance of the positive effect of health insurance status on the probability of making one antenatal care visit. This implies that the differences observed in the unmatched sample in Ghana were due to the differences in the distribution of covariates between women with and without health insurance. For the sample of women in Indonesia and Rwanda, the positive impact of health insurance on women's likelihood of accessing at least one antenatal visit remained statistically significant even after matching, although the magnitude of the effect is smaller than in the unmatched samples.

Raw differences in the prevalence of four or more antenatal care visits between insured and uninsured women ranged between 4% points in Indonesia to 13% points in Ghana, and were statistically significant in all three countries. After matching on covariates that could potentially introduce selection bias, the positive effect of health insurance coverage remained statistically significant in Ghana and Indonesia. Health insurance coverage contributed to an 8% point increase in access to four or more antenatal care visits in Ghana, and a 3% point increase in Indonesia.

Effect on timing of the first ANC visit

Table 3 illustrates that in Ghana and Indonesia more than one-half of women started antenatal care in the first trimester, regardless of insurance status, while in Rwanda most women waited until the second or third trimester before making the first visit. Before matching, health insurance coverage was positively associated with the early start of antenatal care and the difference between insured and uninsured women was statistically significant in all three countries. After matching, however, the effect of health insurance on the

timing of the first antenatal care was no longer statistically significant in Ghana and Rwanda. In Indonesia, having health insurance coverage increased use of antenatal care within the first trimester of pregnancy by 1.7 percentage points and this effect is statistically significant.

Effect on facility delivery

In all three countries, at least one-half of women delivered their most recent birth in a healthcare facility. Raw differences between insured and uninsured women were statistically significant in all three countries and remained statistically significant after matching in all three countries. Health insurance coverage contributed to a 5–11 percentage-point increase in use of facility-based delivery care.

Sensitivity of estimates to hidden bias

If there is positive (unobserved) hidden bias, women who are more likely to have health insurance coverage are also more likely to seek antenatal and delivery care even without having health insurance compared to women with similar background characteristics who do not have health insurance, which would lead to an overestimation of the actual treatment effect. The results of the sensitivity analysis are reported in Supplementary Tables S10–S12. The gamma coefficient (Γ) refers to factor by which hidden bias or an unobserved confounder would affect assignment into treatment for a treated case compared to untreated case with identical covariates. There is no specific rule about the range of gammas to use; however, in the social sciences, a range between 1 and 2 is common and we adopt this approach (Keele 2010). For example, when $\Gamma=2$, this implies that an unobserved confounder causes the odds ratio of assignment into treatment to differ between treated and control cases by a factor of 2. In our study, this implies a woman in a matched pair may be 2 times as likely to have health insurance due to differences in an unobserved confounder. The results presented in Supplementary Tables S10–S12 indicate varying critical values of Γ at which the p -level of the estimated treatment effects are no longer statistically significant. For some outcomes, even at $\Gamma=2$, the effects remain statistically significant, and indicate an overestimation of the positive effects of insurance on health care seeking behavior.

Discussion

This analysis estimated the impact of health insurance coverage on maternal care utilization in three countries with relatively high levels of health insurance coverage (Ghana, Indonesia and Rwanda) using

Table 3. The average treatment effect on the treated (ATT) of health insurance on utilization of selected maternal health services

Country	Outcomes	Means before matching				Average treatment effect			Number of cases on support
		Insured	Uninsured	Difference	P value	ATT	SE	P-value	
Ghana	ANC1	0.986	0.946	0.039	<0.001	-0.0036	0.0085	0.672	1837
	ANC4	0.895	0.770	0.126	<0.001	0.0771	0.0257	0.003	1753
	First ANC visit in first 3 months	0.619	0.545	0.074	<0.001	0.0184	0.0365	0.614	1753
	Facility delivery	0.740	0.471	0.269	<0.001	0.1058	0.0319	0.001	1837
Indonesia	ANC1	0.975	0.945	0.030	<0.001	0.016	0.004	<0.001	14 954
	ANC4	0.911	0.870	0.041	<0.001	0.026	0.006	<0.001	14 318
	First ANC visit in first 3 months	0.810	0.775	0.036	<0.001	0.017	0.008	0.033	14 318
	Facility delivery	0.625	0.529	0.096	<0.001	0.049	0.009	<0.001	14 954
Rwanda	ANC1	0.990	0.965	0.025	<0.001	0.0154	0.0056	0.006	6122
	ANC4	0.379	0.318	0.061	<0.001	0.0195	0.0203	0.337	6016
	First ANC visit in first 3 months	0.411	0.332	0.080	<0.001	0.017	0.0206	0.410	6016
	Facility delivery	0.765	0.613	0.152	<0.001	0.0745	0.0186	<0.001	6122

propensity score matching analysis of nationally representative data. Our results illustrate a positive and statistically significant effect of health insurance on maternal health care utilization after adjusting for systematic differences in the observed characteristics of insured and uninsured women. Results of sensitivity analysis do not imply that unobserved heterogeneity exists and that health insurance does not have a positive effect on women's utilization of antenatal and delivery care. Rather, they imply that the confidence interval for the effect of health insurance on women's use of antenatal and delivery care would include zero if an unobserved confounder caused the odds of having health insurance to differ between treatment and control groups by the critical value of Γ at which the effect is no longer statistically significant (Becker and Caliendo 2007). Some of the results are sensitive to deviations from conditional independence assumption and should be interpreted with caution (Becker and Caliendo 2007).

In the study countries health insurance schemes primarily focus on the poor and heavily subsidize or even remove premiums for them. In Rwanda, the extremely poor are not required to pay a premium for the *Mutuelle* program (Saksena *et al.* 2011). In Indonesia, full subsidization is provided to low-income households (Sparrow *et al.* 2013), and in Ghana, premiums are based on income and geographic location with exemptions for certain sub-groups. Nonetheless, our results suggest that efforts to reach the poor with health insurance have had limited success. In all three countries, women from wealthy households are more likely to participate in health insurance. Research in Ghana shows that the insurance premium system based on income is not as efficient as it was meant to be, potentially causing exclusion of a large number of poor people from the program because they cannot afford to pay the premiums (Akazili *et al.* 2012).

Premiums are just one factor influencing enrollment in health insurance; many other factors also play a role—for example, perceived need for health insurance, knowledge about its benefits, and cultural factors, as well as an individual's health condition (Thornton *et al.* 2010; Acharya *et al.* 2013; Cofie *et al.* 2013). Additionally, women in poorer households may not know about their health insurance status if coverage is household-based, thereby leading to underreporting of actual coverage among poor women. Among the three countries studied, Indonesia shows the least wealth-related variations in coverage, likely because a variety of health insurance schemes are available for the poor.

Our results indicate that, after matching on a number of background characteristics that can bias estimates of the effects of health

insurance on use of maternal health care, insurance coverage has a positive impact on women's access to at least one antenatal care visit in Indonesia and Rwanda. The timing of the DHS survey in Indonesia (2012) coincides with the introduction of the *Jampersal* program, so some women who reported having health insurance may, in a practical sense, be considered 'untreated'. In Ghana and Indonesia, insurance coverage shows a positive impact on women making at least four antenatal visits, as recommended by the World Health Organization. Although a pre- and post- intervention analysis of the impact of NHIS membership in Ghana between 2004 and 2007 did not illustrate an increase in antenatal care visits (Witter and Garshong 2009), our results are consistent with a study using the same methodology but different data sources (Mensah *et al.* 2009; Long *et al.* 2010). Overall, our results appear consistent with previous evaluations of the impact of health insurance on antenatal care (Aji *et al.* 2013; Sparrow *et al.* 2013).

The characteristics of health insurance schemes in these countries may partially explain the higher frequency of antenatal visits. For example, maternal benefits in Ghana and Indonesia's *Jampersal* program offer four antenatal visits for free. In Rwanda high copayments may inhibit women from making more than one antenatal visit, especially among the poor. In all countries the number of antenatal care visits can also be influenced by the facility and provider, if health insurance schemes increase financial incentives for clinics and doctors, as well as hospitals and medical assistants, to provide more antenatal care visits (Chen *et al.* 2003). Also, costs not covered by health insurance, such as the cost of transportation, can prevent women from seeking antenatal care (Borghi *et al.* 2006). Our reliance on secondary data did not enable us to account for these factors in our analyses.

We also assessed the effect of health insurance on the timing of the first antenatal visit. In Indonesia health insurance status shows positive effects on initiating antenatal care in the first trimester, even after matching on covariates. In a study of community-based health insurance in three West African countries, Smith and Sulzbach (2008) found that health insurance membership was associated with greater likelihood of starting antenatal care within the first trimester in Mali, but not in Senegal and Ghana. While our results indicate that in Ghana health insurance affects frequency of antenatal care, the effect is not statistically significant for the timing of antenatal care. A similar finding was observed in a regression analysis of timing of antenatal care in Ghana (Dixon *et al.* 2014). The authors reasoned that it is possible for health insurance status to have a different effect on these two outcomes of maternal health care use

because the early use of antenatal care requires that women know that they are pregnant (Dixon *et al.* 2014).

Assessing the impact of health insurance on the use of facility-based delivery care, we found strong evidence of positive effects of health insurance in all three countries. These findings are consistent with other studies (Smith and Sulzbach, 2008; Mensah *et al.* 2009; Hong *et al.* 2011). Facility-based delivery care may be more strongly influenced by removing fees (Dzakpasu *et al.* 2012); delivery care is free in Ghana, and it is covered under all health insurance schemes in Indonesia.

While our results point to a positive impact of health insurance on several dimensions on maternal health care, they do not conclusively point to a causal relationship, due to limitations inherent in quasi-experimental methods. The matching technique eliminates bias due to selection on observable characteristics, but bias can still result from variable omission and unobserved heterogeneity. Because our assessment relied on secondary data, we could not include other factors such as provider type and health insurance characteristics that could influence both health insurance enrollment and use of maternal care. The matching was carefully done but the results are not free of bias, and the estimates could be improved by including other important confounders, such as the outcome of a previous pregnancy. Another important limitation is related to the cross-sectional nature of DHS data. DHS surveys collected women's insurance status at the time of survey and women's insurance status could have been different at the time when the health care was sought.

Conclusion

Our adjusted estimates of the effects of health insurance show positive and statistically significant effects for at least two of four measures of the use of maternal health care in the three countries studied. Indonesia stands out for the most systematic effect of health insurance across all measures of use of maternal health services. Our findings suggest that free health insurance enrollment for the poor and income-sensitive premiums, as well as the provision of antenatal care with no or low copayments, can encourage higher rates of maternal care utilization. These results support the case for broadening access to health insurance offering comprehensive coverage of maternal healthcare services that at least meet the minimum recommended standards. However, some caution in interpreting the results is needed since the sensitivity analysis indicates that hidden bias may lead to overestimation of the positive effects of health insurance. Additional research is needed to study contextual factors that influence the effectiveness of health insurance policies in improving maternal health care utilization and to explore whether health insurance can improve the use of maternal healthcare services by increasing access to higher-quality services.

Supplementary Data

Supplementary data are available at *HEAPOL* online.

Note

1. Kernel matching is not available in STATA's *teffects* *psmatch* package.

Acknowledgment

The authors acknowledge the financial support from the United States Agency for International Development (USAID) through the DHS Program (#AID-OAA-C-13-00095).

Conflict of interest statement. None declared.

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