Three Essays on the Economics of Health in Developing Countries

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Submitted in partial fulfillment of the
requirements for the degree
of Doctor of Philosophy
in the Graduate School of Arts and Sciences

COLUMBIA UNIVERSITY

2013

ABSTRACT

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This dissertation consists of three chapters that address health issues in developing countries. The first two chapters study Ghana's social health insurance program, the National Health Insurance Scheme. Many developing countries have recently instituted social health insurance schemes (SHIs) to ease financial barriers to utilization of healthcare services and help mitigate the effects of adverse health shocks. Although these SHIs offer generous terms and benefits, enrollment remains low especially among the poorest households who are the intended primary beneficiaries. The first two chapters are based on randomized field interventions implemented in the Wa West district of the Upper West Region of Ghana to (a) understand the reasons for low enrollment in SHIs; (b) estimate the effects of insurance coverage on utilization of healthcare services, financial protection and health outcomes, and c) learn about how resource-constrained households allocate health resources among its members. The interventions were increased convenience of signing for insurance, an education intervention that provided information about the insurance program, and a subsidy intervention that included varying levels of subsidies for insurance premiums.

The first chapter deals with objectives (a) and (b). The results show that inadequate information about the insurance program, and insurance premium and fees affect enrollment. The results also show that the demand for insurance is price elastic in the sense that small subsidies generate substantial enrollment effects. Insurance coverage leads to increased utilization of healthcare services, reduced out-of-pocket payments among individuals with prior positive expenses and ,moderate improvement in health outcomes. The results suggest strong complementarities between providing information and providing subsidies in utiliza-

tion and health outcomes, an indication of the importance of the combined interventions for achieving changes in health-seeking behavior and outcomes.

The second chapter focuses on objective (c): intra-household allocation of health resources among resource-constrained households. The analysis in this chapter is based on households who were assigned to receive subsidies only and the pure control group. Two types of vouchers were issued to households who did not receive full subsidies: one that allowed households to decide how to allocate subsidy among its members and one in which they had no control over the allocation. This chapter compares within household enrollment patterns across these two vouchers. The results suggest that households prioritize children in the presence of resource constraints. Among children, households who were allowed to determine allocation of subsidy amounts enroll 11.7 percentage or 18% more boys than girls. The results suggest that these patterns of allocation cannot be explained by baseline health conditions or expected health. The chater presents supporting evidence that differential labor market participation is a likely explanation for the differential allocation by gender among children: among children aged 7-17 years, labor market participation is 3.6 percentage points higher for boys than girls.

The third and final chapter is coauthored with Ayaga A. Bawah and James F. Phillips. The chapter seeks to explore how the quasi-experimental introduction of reproductive and family planning services affects the fertility behavior of different socio-economic groups in a rural African setting. We combine a quasi-experimental introduction of reproductive and family planning services in the Kassena-Nankana districts in the Upper East Region of Ghana with longitudinal data from the Navrongo Health and Demographic Surveillance System to quantify the differential fertility effects of the interventions by socio-economic status (as measured by woman's education status, her husband's education status and wealth). We track the fertility behavior and outcomes of more than 24,000 women in their reproductive

age (15-49) over a period of eighteen years. Our results show that before the interventions educated women did not have significantly fewer children, but desired lower family sizes and were more likely to use modern contraceptives. However, husband's education was associated with lower fertility especially when their wives were also educated. Wealth was associated with higher fertility, reflecting a higher child survival rate in wealthy families. Moreover, controlling for wealth does not affect the effect of education on fertility. We find that the reproductive health interventions affected both educated and uneducated women but the effect on educated women was stronger, leading to the emergence of an education-fertility differential 16 years after the introduction of the interventions. Our results suggest that in settings where men dominate reproductive decision-making, their education status may have a stronger effect on fertility than the educational attainment of women.

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Acknowledgments

I thank the Almighty God for bringing me this far in the program. I would not have made it this far without His favor, goodness and mercies.

I am ernormously indebted to my advisors Cristian Pop-Eleches (Kiki) and Eric Verhoogen for their advice, dedication, guidance, and exceptional mentorship. Kiki's relentless efforts to help me secure funding for my fieldwork is gratefully acknowledged. I also like to extend special thanks to the other members of my committee Douglas Almond, James Habyarimana and Miguel Urquiola for their advice and suggestions in the course of the program and especially in the course of writing this dissertation.

This dissertation has benefitted from helpful comments and suggestions from Wassiuw Abdul-Rahaman, Samuel Kofi Ampaabeng, Richmond Atta-Ankomah, Ayaga Bawah, Pierre-Andre Chiappori, Giacomo De Giorgi, Keith Finlay, Supreet Kaur, Wojciech Kopczuk, Leigh Linden, Corrine Low, Dekumwini Mornah, James F. Phillips, Bernard Salanie, Nicholas Wilson, and participants of the Applied Micro Colloquium and Development/Applied Micro Worskhop at Columbia, conference participants at CSAE Conference 2013 and Population Association of America 2013 Annual Meeting, and seminar participants at Washington & Lee University and The World Bank.

Generous financial support from SEND-Ghana Foundation for my fieldwork and from the William and Flora Hewlett Foundation for the third chapter of this dissertation is gratefully acknowledged. The opinions expressed in this dissertation are my own.

I also thank Hillary Babuna, Siapha Kamara, Adamu Mukaila, George Osei-Bimpeh, Titus Sorey and all staff of SEND-Ghana and Wa West District Mutual Health Insurance Scheme for various forms of assistance with the fieldwork. I am grateful to Santa Aaron, Mu-

muni Abdul-Kadir, Salifu Abdulai, Mavis Antoinette, Seidu Asonne, John Gambo, Adamu Hamidu, Paschal Kuusavih, Edward Tabiasinaa and Mudasir Yussif for their diligent fieldwork.

I would also like to thank my colleagues at Columbia especially Anukriti, Yaw Owusu Ansah, Emma Garcia, Ran Huo, Hyuncheol Kim, Todd Kumler, Ben Marx and WooRam Park for making my time at Columbia worthwhile. I am especially grateful to Ama Baafra Abeberese for her friendship which greatly enriched my life in the last six years.

Finally, I thank my parents Monica and Thompson Asuming and my brother and sisters Augustine, Lydia, Adwoa, Ama and Dora for their love, patience and sacrifices.

Dedication

This dissertation is dedicated to my parents, Monica and Thompson.

Chapter 1

Getting the Poor to Enroll in Health Insurance and Its Effects on Their Health: Evidence from a Field Experiment in Ghana

1.1 Introduction

Health shocks have non-trivial negative effects on the financial conditions of uninsured poor households and their ability to smoothen consumption (Townsend, 1994; Deaton, 1997; Gertler and Gruber, 2002; Wagstaff, 2007). Yet many poor households in developing countries lack access to mechanisms for pooling risks and suffer health-related poverty in the wake of adverse health shocks. In the absence of insurance, a high fraction of medical expenses are borne by households in the form of out-of-pocket payments, and financial constraints are significant barriers to access to healthcare in many low-income countries (Xu et al, 2003).[1]

With encouragement from international organizations and donor governments, many developing countries have recently instituted social health insurance schemes (SHIs) to remove financial barriers to healthcare and help mitigate the impact of adverse health shocks (WHO, 2005; WHO, 2010).[2] Moreover, countries with existing insurance programs for formal sector workers have recently extended them to the informal sector.[3] However, in spite of the relatively low cost of signing up and the generous benefits offered by SHIs, take-up rates are very low in many countries especially among the poorest households (Acharya, et al forthcoming). Low take-up of government programs is not peculiar to health insurance programs

[1] For instance, according to WHO (see http://www.who.int/mediacentre/factsheets/fs320.pdf) 11.3% of all medical expenses in Germany are borne by households while in the Democratic Republic of the Congo about 90% of the money spent on healthcare is paid directly by households to providers.

[2] Recent examples include Georgia, Ghana, Kenya, Nigeria, Tanzania and Vietnam. Countries in the process of instituting SHIs include Cambodia, Laos, Malaysia and South Africa.

[3] Examples include Colombia's Regimen Subsidiado, Mexico's Seguro Popular, Phillipine's National Health Insurance Program and Nicaragua's Insitituto Nicaraguense de Securidad Social (INSS)

in low-income countries; it is pervasive across programs and countries.[4] It is a concern for policy-makers because it undermines their purpose of promoting equity and redistributing income. This concern is exaggerated in the case of health insurance programs due to the potential for adverse selection and its welfare implications. Yet, in spite of the growing literature evaluating SHIs, little attention has been paid to the issue of low take-up.

An important related issue is whether enrollment in SHIs provides adequate financial protection, increases utilization of healthcare services and, ultimately, improves health outcomes. An extensive empirical literature in the US, both experimental and non-experimental, has shown that insurance coverage reduces out-of-pocket payments and increases utilization of healthcare services while evidence on the impact on health outcomes is mixed (Newhouse et al 1993; Currie and Gruber, 1996; Card et al, 2008; Finkelstein and McKnight, 2008; Card et al 2009; Michalopoulos et al, 2011; Finkelstein et al, 2012). However, the structure of the health insurance market in the US differs in important ways from those of developing countries. First, supply-side constraints, in the form of availability and quality of health facilities and personnel, are more binding in developing countries. Second, a high fraction of the population in the US obtain health insurance from private markets. By contrast, with limited or non-existent private health insurance markets, SHIs in low-income countries tend to be single-payer country-wide government-run insurance schemes. A growing empirical literature has evaluated the effects of SHIs on utilization and out-of-pocket payments (See Acharya et al, forthcoming, for a review of this literature). However, many of these studies fail to adequately address concerns about selection in the take-up of insurance and their estimates may be biased. King et al (2009) and Thornton et al (2010) are exceptions.

[4]A large empirical literature from developed countries, especially the United States, has highlighted the role of non-financial factors in low take-up of government programs for the poor (Moffitt, 1983; Currie and Grogger, 2001; Bitler et al, 2003; Remler and Glied, 2003; Hernanz et al, 2004; Bansak and Raphael, 2006; Currie, 2006; Kleven and Kopczuk, 2011). Studies from developing countries emphasize both financial and non-financial factors (Clert, 2000; Coady and Parker, 2009; Amior et al; 2012).

This chapter seeks answers to three broad questions. First, what accounts for the low enrollment in SHIs? To what extent do the levels of premiums, incomplete information and remoteness from enrollment locations contribute to low enrollment? Second, how do resource-constrained households allocate health resources among its members? Third, does enrollment in SHIs improves access to healthcare services, provides financial protection against out-of-pocket expenses and improves health outcomes?

To understand low enrollment in insurance, I introduced randomized interventions in a poor, rural and agrarian district in northern Ghana to encourage take-up of a nationwide health insurance scheme. I then used the resulting random variation in insurance coverage to estimate the effects of enrollment on utilization of healthcare services, probability of making out-of-pocket expenses and health outcomes. The interventions are a convenience intervention, an education campaign and a subsidy intervention. The convenience intervention sought to increase the convenience of enrolling in insurance by allowing individuals in randomly selected communities to sign up in their community instead of traveling over 18km (mostly by foot) to the district capital. The education intervention assesses the role of incomplete information on enrollment by providing information on registration procedures, premiums and exemptions, and benefits of the insurance scheme. For the subsidy intervention, households in randomly selected communities were randomly assigned to receive amounts equivalent to 1/3, 2/3 or the full financial cost of signing up for insurance. I use the resulting variation in the price of insurance to estimate the price elasticity of demand.

My experimental set-up was designed to test for possible complementarities among the interventions. An important ongoing debate in development policy is focused on the proper design of multiple interventions. Although it is frequently presumed that an integrated approach of multiple anti-poverty interventions has stronger effects[5], there is limited empirical

[5] PROGRESA and the Millennium Villages Project (MVP) are recent examples. Pronyk et al (2012) discusses the logic behind the approach of the MVP.

demonstration of the presumed complementarities that underlie this approach. I test for possible complementarities by stratifying my interventions and including a complete set of interactions.

Seven months after the introduction of the interventions, I find that providing additional convenience of signing up has no effect on take-up but the price of insurance (premium and fees) and information are significant determinants. My estimates suggest that the demand for insurance is price elastic. Providing a moderate amount of subsidy has strong effect on enrollment. For instance, a 33% subsidy on premiums and fees doubles enrollment. There is no evidence of complementarities among the interventions in terms of take-up. However, I find evidence of adverse selection: individuals from lower socioeconomic backgrounds and in poorer health respond more to the interventions, especially the education intervention, and are also more likely to take up the 1/3 subsidy.

Insurance coverage has strong effect on utilization of healthcare. My two-stage least square local average treatment effect (LATE) estimates suggest that insurance coverage increases utilization by 120% to 211%, which is consistent with the evidence on adverse selection on health. I also find evidence that insurance coverage improves health outcomes. For instance, insurance coverage reduces the number of days of illness by 0.339 days (or 42%) and the number of days an individual is unable to perform normal daily activities by 0.805 days (or 52%). I also find improvement in self-reported health outcomes.

More importantly, my reduced-form estimates imply strong complementarities between the education and subsidy interventions in utilization of healthcare and health outcomes. This is an important finding in the light of the absence of complementarities in the first-stage estimation. It suggests that to the extent that policy makers care about utilization of services and health outcomes but not take-up of insurance in itself, policy should com-

bine price interventions with education. It is also a significant finding because it informs the ongoing policy debate about the proper design of multiple development interventions mentioned earlier. Although previous studies have provided macro-level evidence on policy complementarities (De Macedo and Martins, 2008; Chang et al, 2009), my chapter is among the first to demonstrate complementarity in a convincing way at the micro-level.

In terms of financial protection, only a small fraction of individuals make positive out-of-pocket (OOP) health expenditure (12.6% of individuals at baseline) in my setting. Unsurprisingly, I find no effect of insurance coverage on the likelihood of a positive OOP for my full sample. However, for individuals with positive baseline expenditures, I find that insurance coverage leads to a 2.7 percentage point reduction in the probability of making such expenditures at the follow-up. These results are consistent with findings from previous studies that use nationally representative data from Ghana.

My chapter contributes to a large empirical literature on health insurance. It is one of very few studies that provide experimental evidence on health insurance in low-income countries. King et al (2009), Thornton et al (2010) and Barofsky (2011) are the closest of the existing work to my chapter. My contribution to this literature is two-fold. Firstly, to my knowledge, my chapter is the first to use multiple randomized interventions to understand enrollment decisions of vulnerable rural populations. Thorton et al (2010) also implement multiple interventions to study enrollment in Nicaragua but they focus on an urban population and they do not test for possible complementarities nor examine the effect of insurance on health outcomes. Secondly, my chapter is the first to provide experimental evidence on the effect of enrollment in a nation-wide government-run health insurance scheme. Although King et al (2009) and Barofsky (2011) also examine the effect of Mexico's nationwide Seguro Popular (SP) on utilization, health spending and health outcomes, SP was implemented along with other health interventions which makes it difficult to isolate the effect of health insurance from the other interventions.

My chapter also contributes to a growing body of work explaining low take-up of public programs. Within this strand, it is more closely related to the empirical literature on the role of pricing in take-up and use of health products and services in developing countries.[6] My results are consistent with previous studies that find that price is a strong driver od demand for insurance and other health products and services (Kremer and Miguel, 2007; Dupas, 2009; Cohen and Dupas, 2010; Karlan et al, 2012; Mobarak and Rosenzweig, 2012; Cole et al, 2013). My chapter differs from existing studies in its focus on health insurance.

The rest of the chapter is organized as follows: section 2 documents the institutional context by providing details of the NHIS; section 3 describes the research design and data collection; section 4 describes the empirical framework; section 5 presents the main results and section 6 concludes the chapter.

1.2 Institutional Background

1.2.1 Historical Context

At independence in 1957, Ghana established a tax-financed publicly provided health care system with no payment for services at point of use. Healthcare personnel were trained and paid by the government which also provided supplies for health facilities. In the early post-independence era, the Ghanaian economy, boosted by high international prices for its main exports, especially cocoa, was able to support this health financing arrangement. From the late 1960s, however, as world prices of Ghana's main exports commodities began to tumble and the economy began to deteriorate sharply, it became increasingly difficult to sustain publicly provided "free" healthcare. Health facilities began experiencing acute shortage of

[6]Holla and Kremer (2009) reviews the recent evidence of the effect of price on access to education and health services from randomized evaluations.

essential medical supplies and equipments and quality of health services deteriorated.

Major health care reforms were introduced in 1985, as part of a broader Structural Adjustment Program. These reforms led to the introduction of user fees at public health facilities in the form of co-payment for health services (Ramachandra & Hsiao, 2007). By 1992, this arrangement had evolved into a system of full cost recovery, infamously known as the "cash and carry" system. The sector was also liberalized to allow private sector participation in the provision of healthcare (Gajate-Girrado & Ahiadeke, 2012).

The cash and carry system was found to have accentuated inequities in financial access to healthcare and deprived the poor of access to basic and essential services (Waddington and Enyimayew, 1990). As widespread discontent over this financing arrangement grew, pressure mounted on political leaders to replace it with a different health financing system. In response, and with encouragement of the Ministry of Health, a number of community-initiated mutual health insurance schemes began to emerge in 1990s. These schemes clustered around major health facilities and required members to pay periodic premiums in order to enjoy the benefits offered. While these schemes partially bridged the gap in social protection between the formal sector which benefits from the national social security system, and the impoverished informal sector, most members could not afford the very low premiums (Ramachandra & Hsiao, 2007). Nevertheless, the community-based initiatives became an important foundation for the introduction of the National Health Insurance Scheme.

1.2.2 Ghana's National Health Insurance Scheme

The National Health Insurance Scheme (NHIS) was established by the National Health Insurance Act (Act 560) in 2003. The scheme became fully operational in 2005. It aims to improve access to and the quality of basic healthcare services for all citizens, especially

the poor and vulnerable, through the establishment of an affordable healthcare financing arrangement (MOH, 2004).

Act 560 provides for the establishment of three types of insurance schemes: District Mutual Health Insurance Schemes (DMHISs), Private Mutual Health Insurance Schemes (PMHISs) and Private Commercial Insurance Schemes (PCHISs). The DMHISs are publicly-run and subsidized by the government through the National Health Insurance Fund (NHIF).[7] It accounts for more than 96% of insurance coverage (GSS, GHS and ICF, 2009) and is the focus of this study. The law mandates that every citizen enroll in at least one scheme although in practice obtaining insurance is voluntary as no penalties are prescribed for those who do not enroll. Almost all of the 170 administrative districts of Ghana operate its own DMHIS. They are run as semi-independent corporate bodies under the control of the National Health Insurance Authority (NHIA), the regulator. Individuals enroll in their district of residence but membership is readily transferable from one district to another. DMHISs accept and process applications, collect premiums (and fees), provide membership identification cards and process claims from accredited facilities for reimbursement. Premiums collected by DMHISs are transferred to the NHIF from which claim reimbursements are made.[8]

Act 560 provides for means-tested premiums to be charged to informal sector workers, ranging from GH¢7.20 ($5) to GH¢48 ($32) annually. However, due to the lack of information on household incomes, this has proved difficult to enforce. In practice, poor rural districts tend to charge the lowest premiums while the urban districts charge higher premiums. Premiums can be adjusted upwards after approval by the NHIA. Indigents, children

[7]PMHIS are non-profit non-subsidized schemes run by NGOs, religious bodies and cooperative societies. Most schemes under this catergory existed before the passage of Act 560 but were previously unregulated. PCHISs are for profit schemes that do not receive government subsidies.

[8]Informal sector premiums contribute 5% of total funding for the NHIS (NHIA, 2010). The other sources of funds to the NHIF are a 2.5% VAT levy on selected goods and services (61.49%), retention of 2.5% of formal sector workers's salaries (16.87%), sectoral budgetary allocation (4.76%) and donor support.

under 18 years of age and the elderly (aged 70 years and above) are exempt from premiums.[9] Beginning from July 2008, pregnant women also enjoy premium exemption status under the Free Maternal Care program. All members (except indigents and pregnant women) are required to pay a registration fee at first registration and subsequent renewal. To put the annual premiums in context, annual per capita income estimated from latest Ghana Living Standards Survey was 400 cedis or $433 in 2006 (GSS, 2008).

There is a minimum waiting premium period of three months before new members become eligible for benefits. Existing members who do not renew their membership at the due date are liable to pay a penalty when they eventually renew their membership.

The benefits package of the NHIS, which is specified by a legislative instrument and is the same across DMHISs, is very generous. Table A8 summarizes included and excluded services. Broadly, it covers i) full outpatient and inpatient (surgery and medical) treatments and services; ii) full payment for medications on the approved list; iii) payments for referrals on the approved list and iv) all emergencies. The NHIA estimates that 95% of disease conditions that affect Ghanaians are covered by the scheme. Excluded services include aesthetic treatments, assisted reproduction, appliances and prostheses, anti-retroviral drugs for HIV/AIDS, cancer treatment other than breast and cervical cancer, cosmetic surgeries, brain and heart surgery, organ transplant and all treatments obtained outside Ghana.

In spite of the low premiums and generous benefits, enrollment in the NHIS remains low. By the end of 2010, the total active membership stood at 34% of the population of Ghana (NHIA, 2011). Enrollment is particularly low among the poorest quintile. A 2008 nationwide survey found that 29% of the individuals in the lowest wealth quintile were

[9]The law defines an indigent as "a person who has no visible or adequate means of income or who has nobody to support him or her and by the means test qualifies as an indigent". Regulation 58 of LI 1809 provides more concrete criteria. An indigent is a person who satisfy all of these criteria i) unemployed and has no visible source of income, ii) does not have a fixed place of residence according to standards determined by the scheme iii) does not live with a person who is employed and who has fixed place of residence iv) does not have any identifiably consistent support from another person

active members of the scheme compared to 64% of households in the highest quintile (NDPC, 2009). Membership is also lower among individuals with no education, those employed in the informal sector and those who reside in rural areas.

1.2.3 Setting

The study was conducted in the Wa West district in the north-western part of Ghana. Wa West is a poor and remote rural district located in the Savanna High Plains. It covers an area of approximately 5,899.3 square kilometers and had population of about 81,000 in 2010. The district is inhabited mainly by the Dagaaba, Brefo, Lobi and Wala ethnic groups. Settlements patterns are highly dispersed with majority of residents living in hamlets of about 100-200 people.[10] This, coupled with poor road network, makes traveling within the district difficult and expensive.

The economy is largely agrarian. Over 90% of the labor force are subsistence farmers who grow food crops such as maize, sorghum and vegetables. The district is classified as one of the most deprived districts in Ghana and is located in the poorest region of Ghana, the Upper Region. Latest estimates of household incomes from the Ghana Living Standard Survey (GLSS V) in 2006 indicates that per capita income for a person living in a rural savannah locality, like Wa West, was GH¢232 or \$252.80[11] (GSS, 2008). The annual per capita health expenditure was GH¢24 cedis or \$26.

Besides income poverty, the district also has a high basic infrastructure deficit. It is one of few districts yet to be connected to the national electricity grid. Only the district capital and the health centres have access to electricity powered by solar energy. The district

[10]See: http://www.ghanadistricts.com/districts/?r=9&_=115&sa=3249

[11]At 2006 exchange rate: \$1=GH¢0.92

has no tertiary health facility and only 6 public health centres. However, following recent reforms in Ghana Health System 13 Community-Based Health Planning and Services (CHPS) facilities have been placed in areas farther away from health centers, leading to a fairly even distribution of health facilities and a significant reduction in the distance to primary health care services.[12][13] All these facilities are accredited to provide care under the NHIS. As at June 2010, the district had no medical doctor but 15 professional nurses (Nang-Beifua, 2010).

The district has a high disease burden. The most common cause of out-patient (OPD) visits in the region is malaria (a third of all OPD visits), which has a reported prevalence of 16.5 (as of 2004).[14] Other common causes of OPD visits are acute respiratory-tract infections, skin diseases and snakebites. Trachoma (an infectious blindness-causing disease) and guinea worm are endemic in the district.

The Wa West Mutual Health Insurance Scheme became operational in January 2007. Although the Upper West Region has the highest active membership rate in the NHIS of 53% (NHIA, 2011), Wa West has one of the lowest enrollment rates in Ghana. The baseline enrollment rate for the study sample is 21%. At the start of the project the Wa West DMIHS charged a uniform premium of GH¢8.20 ($5.46) for adults (18-69) and processing fee was GH¢4 for first-time members and GHC1 for renewals. Late renewals attract a fee of GHC2 in addition to full premiums for all years for which membership was not renewed.[15]

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[12]CHPS (Community-Based Health and Planning Services) facilities are located within rural communities with limited access to larger hospitals and manned by regular and community health nurses to provide primary health care services. Among the services are treatment of common ailments (malaria and diarrheal diseases) and maternal and child care services.

[13]Seventy-five percent (75%) of communities in the study sample are within 6 km (3.73 miles) of a health facility.

[14]http://www.statsghana.gov.gh/Prm.html

[15]The exchange rate used here is $1=GHC1.5. This rate will be used in all subsequent conversions.

1.3 Research Design

1.3.1 Experimental Design

The study introduced three interventions: a subsidy towards the payment of NHIS premium and fees, an education campaign and a convenience intervention as well as a complete set of their interactions (see Figure 1a). All interventions were randomized at the community level. The convenience intervention sought to reduce the cost of signing up for NHIS resulting from remoteness from the district capital where the DMHIS office is located by allowing residents of selected communities to sign up in their own community.[16] For this intervention, an official from the Wa West DMHIS, accompanied by a fieldworker visited randomly selected communities to register or renew membership of community members. There were two visits seven days apart, each lasting from 9am to 5pm, and on different days of the week. Each visit was pre-arranged with community leaders who were informed that the exercise was strictly for members of that community.

The goal of the education intervention was to assess the impact of lack of or incomplete information about the NHIS on enrollment. This intervention provided basic information on the NHIS including registration information, premiums and exemptions, and benefits of the scheme as well as general education on the importance of being insured. As with the convenience intervention, trained fieldworkers visited randomly selected communities to provide information/education and answer questions about the scheme. It also involved two visits, each from 9 am to 5pm, seven days apart and on different days of the week.

The subsidy intervention gave households in randomly selected communities subsidies to

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[16] To deal with the problem of remoteness, the Wa West DMHIS has an "agent system" in place. Under this system, community leaders from strategic locations are appointed as "local informants" for the scheme to collate registration and renewal forms for onward transmission to the scheme. The convenience intervention is therefore a test of the additional convenience on top of this existing arrangement.

defray all or part of the cost of enrolling in the NHIS. The level of subsidy received was randomized at the household level. Households in subsidy communities were assigned to receive a full subsidy (GH¢12.20 or $8.13), subsidy worth 2/3 (GH¢8.10 or $5.40) or 1/3 (GH¢4 or $2.67) of insurance premiums and fees (See Figure 1b). In all cases, children (aged less than 18 years) and the elderly (aged 70 years or more) received full subsidies for registration fees so the variation in subsidy level applies to adult household members. Subsidies were given in the form of vouchers with a two-month validity period and redeemable only at the Wa West DMHIS. The voucher specified names, ages and gender of all household members, expiration date and where it should be redeemed. Figure 1.3 presents an illustrative example.

Vouchers were issued irrespective of the individual's enrollment status so that currently enrolled individuals could use the vouchers only if their membership expired within the two-month validity period. To aid the redemption of vouchers, a list of all subsidy recipients as well as amount of subsidy assigned was given to the Wa West DMHIS office. The DMHIS verified the names and amount assigned when vouchers were presented for redemption and retained the redeemed voucher. An amount equivalent to half the total value of vouchers issued was deposited with the scheme at the start of the subsidy intervention. The scheme continued to redeem vouchers in excess of this amount and was reimbursed at two weeks interval for additional vouchers redeemed until the end of the validity period.

1.3.2 Data collection

The sampling frame was limited to communities with 30-400 residents that are at least 1km from the nearest other community. The size restriction was informed by budgetary considerations because interventions were randomized at the community level. The distance restriction was to minimize spillover of education and convenience interventions to neighbor-

ing communities. All 61 communities meeting these criteria were included and all households in these communities were interviewed.

The baseline survey was conducted in September 2011. Interventions were implemented in October 2011 with the follow-up survey in April 2012. The household questionnaire used for both surveys was adapted from the Ghana Demographic and Health Survey (GDHS) 2008 and the Ghana Livings Standards Survey 2005/2006 (GLSS V). The baseline survey collected information on demographic characteristics, employment, health history, general health and utilization of healthcare services, expected future health, enrollment in the NHIS and health behaviors for all household members. Information on knowledge of health insurance was collected from household heads or an adult respondent present if the household head was not present. Information on pre-natal care, delivery and post-natal care was collected for all women aged 15 to 49 years. Additional information on household characteristics, including ownership of assets, and GIS information on all communities and health facilities in the district was collected.

Table A.1 provides information on attrition. Panel A shows that the follow-up survey successfully relocated almost 94% of individuals from the baseline sample. More importantly, there is no statistically significant difference in attrition rate between treatments and control groups. Panel B shows that among individuals who could not be relocated, 58% had traveled outside the district, 26% had relocated outside the district and 8% were deceased.

1.3.3 Descriptive Statistics

Table 1.1 presents descriptive characteristics from the baseline survey and tests of balance between treatments and control groups. The first column reports summary values for the full sample. The baseline survey collected information on 4625 individuals from 680 households

in the 61 communities. The average household has 6.8 members, including 3.9 children under 18 years of age. The average age is 23 years. Forty-eight percent (48%) of individuals are male and 80% of households are headed by males. Fifty-one percent (51%) of households own a farmland and 59% own a mosquito net. Half of the households belong to the Dagaaba ethnic group and about 43% are Christian. A third of all individuals have some formal education.

In terms of health characteristics of the sample, 7% reported having a chronic health condition lasting more than six months and 12% reported a sickness or injury in the last four weeks. Utilization of formal healthcare is low even among those with illnesses. Only 8.7% of all respondents (including 36% of those reporting illness or injury) visited a health facility in the last four weeks. About 12.6% made a positive out-of-pocket health expenditure. Among those reporting a positive expenditure, the average expenditure was GHC11.95 ($6.64) over the four-week period. The average household lives within 5.36km of a health facility and 18.43km from the district capital where registration for NHIS takes place. The subjective probability of being sick over the next 12 months is 0.447. Eleven percent (11%) of adults respondents (18 years and above) are current or past smokers and 53% had an alcoholic beverage in the two weeks before the baseline survey. About 54% of individuals reported sleeping under a mosquito net the night before the survey.

Although 96% of adult respondents had heard about the NHIS, on average, they answered less than 11 of 18 questions on knowledge of NHIS premiums levels, exemptions and benefits correctly. Enrollment rate in the NHIS is 21% but 37% of individuals had registered with the scheme once before. The re-enrollment rate is 63%.

The remaining columns of Table 1.1 present the balance test between the control and treatment groups. All tests are pairwise comparisons between each treatment and the control group and columns report mean differences. Tests adjust standard errors for intra-cluster (intra-community) correlation. The table shows a good balance between treatments and

control groups. Although there are statistically significant differences for some variables, the magnitude of differences are small and the number of such significant differences (16) is not very different from what is expected by chance for 182 comparisons at 10% level (18). Table 1.2 presents a similar balance test between the control group and subsidy treatments by level of subsidy and voucher type. This table shows that these treatments and control group are also reasonably balanced.

1.4 Empirical Framework

1.4.1 Intent-to-Treat Estimation

I estimate reduced-form effects of being assigned to each treatment on various outcomes by ordinary least squares estimation of the following equation:

$$y_{ihc} = \alpha + \beta_1 sub_c + \beta_2 edu_c + \beta_3 conv_c + \beta_4 edu\&conv_c + \beta_5 sub\&conv_c + \beta_6 sub\&edu_c + \beta_7 sub\&edu\&conv_c + X_{ihc}\theta + Z_{hc}\delta + V_c\omega + \varepsilon_{ihc} \quad (1.1)$$

where i denotes an individual, h denotes a household and c denotes a community and y_{ihc} refers to an outcome of interest. $educ_c$, sub_c and $conv_c$ indicate assignment to education and subsidy and convenience interventions respectively, β_1- β_7 are the reduced-form estimates of the effect interventions on the outcome variable. $educ\&conv_c$ denotes an indicator for assignment to education and convenience treatments. X_{ihc} denote a set of individual-level covariates that are potentially correlated with the outcome (individual's age grouping (under 18, 18-69 or 70+), gender, indicator for having some formal education, indicator for having a health condition at baseline, indicator for visiting a health facility at baseline and indicator for having ever registered with the NHIS). Z_{hc} and V_c denote household-level co-

variates (household size, religion, ethnicity, wealth) and community-level covariates (distance to nearest health facility, distance to the district capital) respectively. The measure of household wealth used here is a three-category index constructed from principal component scores of household assets. The outcomes considered here are: utilization of healthcare services, out-of-pocket expenses, health status, and self-reported health status. In all estimations, standard errors are clustered at the community level. Estimations employ linear probability models (LPM).

1.4.2 Local Average Treatment Effect

Instrumental variables (IV) estimates of the effect of insurance coverage on the outcomes are obtained from estimation of the following systems by two-stage least squares (2SLS):

$$\begin{aligned} enrolled_{ihc} = \alpha + \rho_1 sub_c + \rho_2 edu_c + \rho_3 conv_c + \rho_4 edu\&conv_c + \rho_5 sub\&conv_c + \\ \rho_6 sub\&edu_c + \rho_7 sub\&edu\&conv_c + X_{ihc}\varphi + Z_{hc}\psi + V_c\varrho + \upsilon_{ihc} \end{aligned} \tag{1.2}$$

$$y_{ihc} = \nu + \pi enrolled_{ihc} + X_{ihc}\sigma + Z_{hc}\vartheta + V_c\xi + \mu_{ihc} \tag{1.3}$$

where $enrolled_{ihc}$ is an indicator for being enrolled in the NHIS at the follow-up survey and (2) is the first-stage estimation using treatment status as the excluded instrument. The coefficient of interest, π, from the outcome equation (3) is the local average treatment effect (LATE) of insurance coverage. It measures the causal effect of insurance among the subset of intervention recipients induced to take-up insurance but who would otherwise not have obtained insurance.

1.5 Results

1.5.1 First-Stage Results

1.5.1.1 Effect of interventions on insurance take-up

Figure 1.4 presents the effect of the interventions on insurance coverage. The blue bars show the baseline enrollment rate while the green bars show the rate at the follow-up. The figure shows that enrollment rose slightly (about 7 percentage points) in the control group between the baseline and follow-up. All interventions had strong effect on enrollment. The convenience treatment had the weakest effect on enrollment: the increase in enrollment for this treatment is similar to that of the control group. Moreover, adding the convenience intervention to other interventions had little or no additional effect on enrollment. For instance, the effect of the education only treatment is almost identical to the effect of the education with convenience treatment. The subsidy with education treatment had the strongest effect on enrollment, stronger than the treatment that combined all three interventions.

Table 1.3 presents results from the first-stage estimation. Each column represents a separate regression and the outcome variable is an indicator that an individual is enrolled in the NHIS at follow-up. Column 1 reports regression without other covariates and columns 2-4 adds individual, household and community covariates. The results show that all but the convenience only treatment have statistically significant positive effect on the enrollment. Column 4, the preferred specification, shows that education only and subsidy only treatments led to 14.7 and 37 percentage points increase in the likelihood of enrollment respectively, representing 53% and 133% increase from the control group. The convenience treatment is associated with a 1.3 percentage point increase in the likelihood of insurance take-up but this is not statistically significant. Moreover, adding the convenience treatment to either education or subsidy or their combination does not change the coefficient of either

intervention alone by much and formal tests confirm that convenience produces no significant additional effects. Combining education and subsidy leads to a 52.5 percentage point increase in the probability of being enrolled. This coefficient is not statistically different from the sum of the coefficients on education only and subsidy only.[17] This suggests that there is no complementarity between the two interventions in terms of take-up of insurance. Similar tests of interaction between education and convenience, and subsidy and convenience find no evidence of complementarity. The F-statistic associated with the excluded instruments is sufficiently high at 21.22.

Columns 5 and 6 report separate regressions for adults (18 years +) and children respectively. They show that the effects are similar between the two groups with the exception of the education intervention. The effect of education campaign is concentrated in adults members, with coefficients of 0.261 (significant at 1% level) for adults and 0.05 (not statistically significant) for children.

In sum, the results from Figure 1.4 and Table 1.3 suggest that incomplete information and insurance premiums and fees are two of the factors behind the low take-up of the NHIS. The absence of an effect of the convenience intervention may seem surprising given the significant costs of traveling within the district. It might be the case that the "agent system" already in place in the district have reduced costs associated with remoteness. While my results is consistent with this reasoning, my study was not designed to test the effectiveness of this system.

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[17]More formally, a test of the null hypothesis: Subsidy & education - (subsidy only + education only) = 0 has a p-value of 0.9291

1.5.1.2 Effect of education intervention of knowledge of NHIS

Table 1.4 investigates the effect of the interventions on knowledge of the NHIS. Although 96% of household heads or adult respondents reported that they had heard about the NHIS at baseline, much of their knowledge of the NHIS were incomplete or inaccurate. In Table 1.4 knowledge of NHIS has been classified under three main headings: knowledge of premium levels, exemptions and benefits. The knowledge of premiums outcome variable is generated from questions asking respondents to quote the premiums and fees for children, adults and the elderly in the Wa West District. Correct answers are tallied and standardized scores are used as outcome variables. Outcome variables for knowledge of exemptions and benefits are generated in a similar fashion. The fourth outcome variable is an aggregated standardized score of all three knowledge variables. The regressions include controls for baseline score of each outcome variable so the coefficients are difference-in-difference estimates.

The results in columns 1-3 show that the education intervention had significant positive impact on all knowledge of all aspects of the NHIS. The coefficient on all treatments with some education intervention is positive and statistically significant in 7 out of 12 instances. The subsidy treatment also has positive impact on knowledge of NHIS although the magnitudes are smaller and fewer of these coefficients are statistically significant. This possibly reflects additional knowledge gained from interaction with NHIS officials during registration process and/or use of services covered under the NHIS. Column 4 confirms these findings using the aggregate measure of knowledge. The convenience intervention has no effect on knowledge of NHIS. The results from this subsection indicate the education intervention improved the knowledge of the NHIS of its recipients. The subsidy intervention also resulted in slight improvement in knowledge of recipients.

1.5.1.3 Effect of Subsidy level on Insurance take-up

Figure 1.5 and Table 1.5 present the effect of the subsidy level on enrollment. Figure 1.5 shows enrollment rates by levels of subsidy offered at baseline and follow-up. As expected, the enrollment rate is increasing in the amount of subsidy offered. However, the differences in enrollment rates by subsidy level is not very large, particularly between 2/3 subsidy and full subsidy. The enrollment response to the 1/3 subsidy is strong: 1/3 subsidy is associated with a 28 percentage point (or 100%) increase in enrollment. Table 1.5 presents the corresponding regression results. In these regressions, I pull all subsidy recipients and include dummy variables for receiving education and convenience interventions.[18] Column 1 reports regressions without other covariates while the columns 2-4 progressively add individual, household and community covariates. As expected enrollment is increasing in the level of subsidy offered. The preferred specification in column 4 shows that receiving 1/3, 2/3 and full are associated with 26.2, 35.6 and 37.4 percentage points higher likelihood of enrolling in insurance. The difference between 1/3 and 2/3, and between 1/3 and full subsidies are statistically significant but the difference between 2/3 and full subsidy is not. Columns 5 and 6 report separate regressions for adults and children. They show similar effects of subsidy levels on enrollment for children and adults. This suggest that although children always receive full subsidy, their enrollment is still strongly related to the enrollment of adult household members.

My elasticity estimate is much larger than the -0.2 estimated for United States by Manning et al (1987). However, it is lower than estimates from previous experimental studies of health products and services in Africa (Kremer and Miguel, 2007; Dupas, 2009; Cohen and

[18] Table A.2 in the appendix presents results from regressions that isolates subsidy levels for subsidy only recipients. The coefficients from those regressions are very similar to those presented in the main analysis here.

Dupas, 2010).[19]

The implied demand curve for health insurance is similar to those found by previous studies for other types of insurance products in settings similar to mine. Karlan et al (2012) randomize the price of rainfall index insurance in northern Ghana and find high price elasticities. Cole et al (2013) and Mobarak and Rosenzweig (2012) also randomize the price of a similar product in rural India and find similar results. All these studies randomized over a larger range of prices than those in this chapter. My findings and those of others show that price is a consistent driver of demand for insurance among the poor.

1.5.1.4 Heterogeneous impact of treatments

Tables A.3-A.6 in the appendix investigates possible heterogeneous response to the interventions. Tables A.3 and A.4 present evidence on differential response by household's socioeconomic status. Column 1 of Table A.3 reports results from interacting an indicator for being in the poorest third of household wealth distribution with treatment status. The results show that the poorer households were more responsive to the subsidy intervention, especially when combined with the education intervention. Among those receiving education and subsidy treatments, enrollment was at least 25 percentage points higher for individuals in the poorest third of the wealth distribution. Column 2 estimates response to subsidy levels by household wealth. Relatively poor households were more likely to take advantage of the lower levels of subsidies. Table A.4 presents similar evidence of heterogeneous response by education status of the household head. Column 1 shows that individuals from households where the head is

[19]In Kremer and Miguel (2007), the introduction of a $0.15 user fee on deworming drugs led to a 62% drop in take-up in Kenya. Dupas (2009) finds that an increase in the price of an insecticide-treated mosquito net (ITN) in Kenya from $0 to $1 led to a 35 percentage point drop in take-up and a further 25 percentage point drop when price increases from $1 to $2. In Cohen and Dupas (2010), take-up of ITN dropped by 60% when price increased from $0 to $0.60. By contrast, my results suggest that an increase in the price of insurance from $0 to $2.67 leads to a 2.8% fall in enrollment and a further increase in price from $2.67 to $5.67 leads to a 14.8% percent fall in enrollment.

educated were more responsive to the subsidy and education intervention, particularly the combined education/subsidy treatment. Column 2 confirms that such households were also more likely to use the 2/3 and full subsidies.

Tables A.5 and A.6 present results from interacting treatments with baseline health status.[20] Column 1 of Table A.5 shows that enrollment was higher among individuals with chronic conditions at baseline especially among those receiving the education intervention. Among recipients of the education only treatment, individuals with chronic conditions were 15.6 percentage points more likely to enroll. The coefficients for those receiving education with subsidy and all three interventions are 10.5 and 16.3 percentage points respectively. Column 2 shows that there is no interaction between subsidy level and chronic health status. This indicates that the result in column 1 may have been driven by the education campaign. Table A.6 focuses on individuals with "unmet need" for healthcare, defined as anyone with a chronic health condition but who had not been receiving treatment for it at baseline. The results are very similar to those from Table A.5. Among individuals from education only or education with subsidy communities, those with unmet need for health care are more likely to enroll in insurance. Unlike in Table A.5, there is an interaction between subsidy level and unmet need. Among one-third subsidy recipients, those with unmet need at baseline were more likely use the subsidy.

The results in this subsection shed more light on the first-stage results. They are indicative of adverse selection on health condition and socioeconomic status. These are not unexpected given baseline enrollment and utilization patterns. Baseline enrollment was strongly correlated with wealth status: enrollment was 8.4 percentage points lower among the poorest third of households. Moreover, while there was no difference in the incidence of

[20]In regressions not reported here, I also undertook similar investigations by baseline health expenditures, probability of illness/injury over the coming year and expected health expenditure and found no systematic patterns along these characteristics.

illness by wealth status, use of health facility is strongly related to enrollment status and visits to health facilities conditional on illness/injury was 3.7 percentage points lower for their poorest third of households. This suggests that poorer households had higher unmet need for healthcare services and responded more to the interventions.

1.5.2 Effect of Insurance Coverage on Care utilization, out-of-pocket expenses and Health

1.5.2.1 Utilization of healthcare services

Table 1.6 presents the effects of insurance coverage on the utilization of healthcare services in the short-run. Utilization is measured by i) an indicator for visiting a health facility in the last four weeks, ii) an indicator for visiting a health facility in the last six months, iii) number of visits to a health facility in the last six months and iv) an indicator for visiting a facility to seek treatment for malaria, the leading cause of OPD visits in the district. Panel A presents the IV results. Insurance coverage leads to an increase in utilization of healthcare services. The coefficient on insured is positive and statistically significant in all regressions. The effects are strong: utilization increases by 120% to 211% among individuals induced to take up insurance by the interventions. Table A.7 in the appendix presents results separately for adults (odd-numbered columns) and children (even-numbered columns). Although insurance coverage increases utilization for both children and adults, effects are stronger for children. Indeed, columns 7 and 8 show that insurance coverage increases the probability of visiting a facility for malaria treatment for children but not for adults.

Columns 1-4 Panel B present the reduced-form results. Both education alone and subsidy alone have positive but statistically insignificant effects on utilization. The combined education and subsidy treatment has the strongest impact on utilization of healthcare ser-

vices across all outcomes except visiting a facility for malaria treatment. The treatment combining all three interventions is positive and significant across all specifications but the magnitude is smaller than the education with subsidy treatment in all but column 4.

The magnitude of coefficients in Panel B suggest there is complementarity between the education and subsidy. This contrasts with results from the first-stage. The preferred first-stage specification is reproduced in column 5 for ease of comparison. Panel C performs a formal test of the complementarities between the education and subsidy interventions by testing the hypothesis that the sum of education only and subsidy only treatments is equal to the combined education and subsidy treatment. The F-statistic and p-values from these tests are reported. The null hypothesis (of no complementarity) is rejected in all cases for the utilization outcomes (columns 1-4) but it is not rejected in the first-stage (column 5). This implies that while education and subsidy may each have strong effects on enrollment, it is the combination of the two that induces changes in health-seeking behavior. It also suggests that besides financial cost, cost of information remains a significant barrier to utilization of healthcare services in this setting. More generally, this result also speaks to an ongoing lively policy debate about the design of multiple interventions. This debate has been rekindled by the Millennium Villages Project which simultaneously introduce multiple interventions in villages in rural Africa (Pronyk et al 2012). Although complementarities among interventions is a key underlying assumption behind this approach, this has not been demonstrated rigorously at the micro level. My results provide a convincing demonstration of the existence of such complementarities.

Table 1.7 presents reduced-form effect of subsidy levels on utilization of healthcare services. The effect of prices on utilization of health products and services has received considerable attention in recent times following the introduction of user fees on social services in developing countries. Proponents of user fees argue that cost-sharing is necessary for sustainability of public programs because positive prices screen out users with low need for services

and reduces waste of subsidy money (World Bank 1993; Easterly, 2006). Recent empirical work using randomized designs to test the existence of such screening effects of higher prices have found mixed results. While Ashraf et al (2010) find that high prices stimulate product use through screening effect, Dupas (2009) and Cohen and Dupas (2010) find no effect of higher prices on product use. The current design allows estimation of causal impact of price on use of healthcare services without disentangling selection effect from sunk cost effect.[21]

Consistent with Dupas (2009) and Cohen and Dupas (2010), Table 6 finds no evidence that the utilization of healthcare services is increasing in the price paid for insurance. For all four outcomes, there are no statistically significant differences in the use healthcare by the level of subsidy received. Indeed, the coefficient on all three subsidy levels are not statistically different from zero.

1.5.2.2 Effect on Out-Of-Pocket Expenses

Table 1.8 presents the IV estimates of the effect of insurance coverage on out-of-pocket (OOP) expenses. Columns 1 and 2 present the effects at the extensive margin using an indicator for making a positive OOP health expenditure in the last 4 weeks as the outcome variable. Column 1 shows that insurance coverage has no effect on the probability of making OOP expenses in the last 4 weeks. Indeed, the coefficient on being insured is positive but not statistically significant. Column 2 includes an indicator for making a positive OOP at the baseline. Insurance coverage reduces the probability by 2.7 percentage points for those who made positive OOP expenses at baseline. Columns 3-6 examines the effect on amount of OOP expenses made in the last 4 weeks. Columns 3 and 4 uses the raw amounts while columns 5 and 6 account for the skewed distribution of health expenditures by using

[21] An aspect of this project that employs a design similar to Ashraf et al (2010) to isolate the selection effect from sunk cost effect is currently on-going.

predicted expenditures from a Tobit estimation. The results mirror those in columns 1 and 2. Insurance coverage has no effect on the amount of OOP expenses for the general sample but reduces leads to a slight reduction for those with prior such expenses.

Table 1.9 presents the reduced-form results. As with Table 1.8, the outcome variable in columns 1 and 2 is an indicator for making a positive OOP expense and the outcome variable for columns 3-6 is the amount of OOP expense. The coefficients on most treatments are negative but are very small and not statistically significant. The only exception is education with subsidy treatment which has a negative and statistically signficant at both the extensive and intensive margins.

The finding that insurance coverage has no effect on the probability of making OOP expenses for the general sample is somewhat surprising because many previous studies, experimental and non-experimental, have found that insurance is associated with a reduction in OOP payments. However, it is consistent with Brugiavini and Pace (2010) who find weak effects of the NHIS on out-of-pocket expenses using data from a nationally representative sample in Ghana. The difference from other studies may be explained by the fact that in this setting, people without insurance hardly seek care at the health facilities and rather resort to the use of traditional/herbal medicines obtained at virtually zero price. Indeed, only 12.6% of individuals made positive out-of-pocket expenses at baseline. With insurance, there is substitution from traditional medicines to formal health facilities but this does not involve any expenses because of the absence of co-payment. But for those who had made positive OOP expenditure by paying at point of use, insurance coverage reduces this likelihood of payment at facilities.

1.5.2.3 Health Outcomes

Table 1.10 presents the effect of insurance coverage on health measures. My measures of health are: i) number of days an individual suffered an illness in the last month; ii) an indicator for not being able to perform normal daily activities in the last month; iii) the number of days in the last month that an individual was unable to perform normal daily activities,[22] and iv) number of days a person who reported an illness or injury waited before seeking care at a health facility.

Even-numbered columns report IV estimates while odd-numbered columns report reduced-form results. Column 1 shows that the insurance coverage is associated with 0.339 fewer days of illness suffered. This represents a 42% reduction from the control group. Columns 3-6 show the effect of coverage on ability to perform usual activities as a result of illness. There is no effect on ability to perform normal daily activities at the extensive margin although the coefficient has the expected sign. There is however a strong effect at the intensive margin. Column 5 shows that insurance coverage leads to 0.805 fewer days of inability to perform normal daily activities, a 51% reduction from the control group. Columns 7 shows that insurance coverage also leads to 1.57 fewer waiting days before seeking care although this is not statistically significant due to reduced sample size. As with utilization of healthcare, the reduced-form results show that the LATE effects of coverage on health are mainly driven by the combined education and subsidy treatments.

Table 1.11 presents additional results on the effects of insurance coverage on health using self-reported health outcomes. I use seven measures of self-reported health. The first is an

[22]In essence, this measure is similar to Activities of Daily Living (ADLs) commonly used in the literature although it is derived differently. In the literature ADLs are usually constructed from asking respondents questions about their ability to perform basic daily activities such as self-feeding, ambulation, dressing and undressing etc. The variables used here are derived from the following questions "During the last month did (NAME) have to stop his/her usual activities because of this (illness/injury)" and "For how many days (in the last one month) was name unable to do his/her usual activities". One advantage of my measure is that it is directly linked to illness/injury

indicator for being happy or very happy created from a question asking respondents to rank their general state of happiness (very happy, happy, so-so, unhappy, very unhappy). The second is an indicator for being healthy or very healthy generated from a question asking respondents to rank the overall state of their health (very healthy, healthy, so-so, unhealthy, very unhealthy). The other measures are an indicator for improvement in health status in the last seven months, number of days in the last month that the respondent's physical health was not good, the number of days in the last month that the respondent's mental health was not good, an indicator for feeling depressed and an indicator for being hopeful about the future.[23]

Panel A presents the IV results. All but one of the seven measures have the expected signs and four are statistically significant. Insurance coverage leads to 21.8, 13.7 and 12.5 percentage point increases in the probability of being happy or very happy, being healthy or very healthy and being hopeful about the future respectively. Individuals with insurance coverage also have 0.684 fewer days of being in poor mental health. Those with insurance coverage are however 1.1 percentage points less likely to report that their health status has improved although this is not statistically significant. Panel B reports the reduced-form estimates. Consistent with the results on utilization of healthcare services above, education with subsidy treatment is the major driver of the effect on self-reported health.

Although the results in this section indicate significant improvement as a result of insurance coverage, given the subjective nature of the outcomes considered here, there may be concerns about the extent to which they reflect actual improvements in physical health. While these concerns may be valid, they are not specific to this chapter. Moreover, the fact that the reduced-form results mimic the findings from utilization of healthcare suggests that

[23]The self-reported health variables are available only for 1335 adult household members who were available on the day of the follow-up survey. I have checked that all previous results hold for this restricted sample although the magnitudes differ slightly when compared with the full adult sample.

the findings on health may be due to interactions with the healthcare system.

1.6 Conclusion

Many developing countries have recently set up social health insurance schemes (SHIs) to ease financial barriers to utilization of healthcare services and help mitigate the effect of adverse health shocks on the poor. Although these SHIs offer generous terms and benefits, enrollment remains low especially among vulnerable populations who are the primary targets. In this chapter, I implemented randomized interventions to test the role of pricing, information and convenience of signing up in low enrollment. I then used the resulting variation in insurance coverage to estimate the effect of insurance coverage on utilization of healthcare services, out-of-pocket expenses and health outcomes.

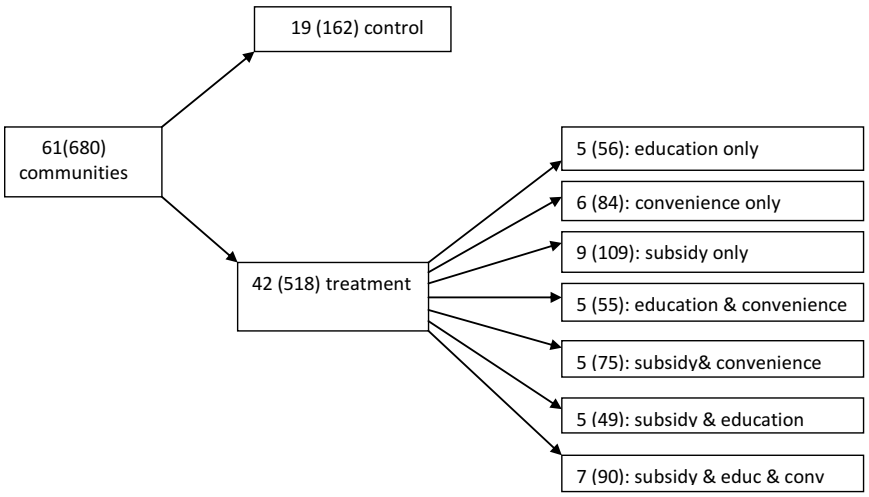
I find that the additional convenience of signing up provided by my interventions had no effect on enrollment but providing information and giving subsidies led to significant increase in enrollment. My results suggest that the demand for insurance is price elastic in the sense that a moderate subsidy for insurance premiums leads to substantial increase in enrollment.

I also find that insurance coverage leads to increased utilization of healthcare services and improvement in health outcomes, both self-reported and more objective measures of health. Unlike the first-stage, I find evidence of strong complementarity between providing information and providing subsidy in terms of utilization of healthcare services and health outcomes. This is an important finding because it indicates that while education and subsidy can each increase enrollment, it is the combination of two interventions that leads to changes in health-seeking behavior and improvement in health. I do not find any effect of insurance coverage on the probability of making out-of-pocket health expenditures in this setting where very few people make positive such expenditures. However, insurance coverage leads to a

moderate reduction in probability of paying out of pocket among individuals who made positive expenditures at the baseline.

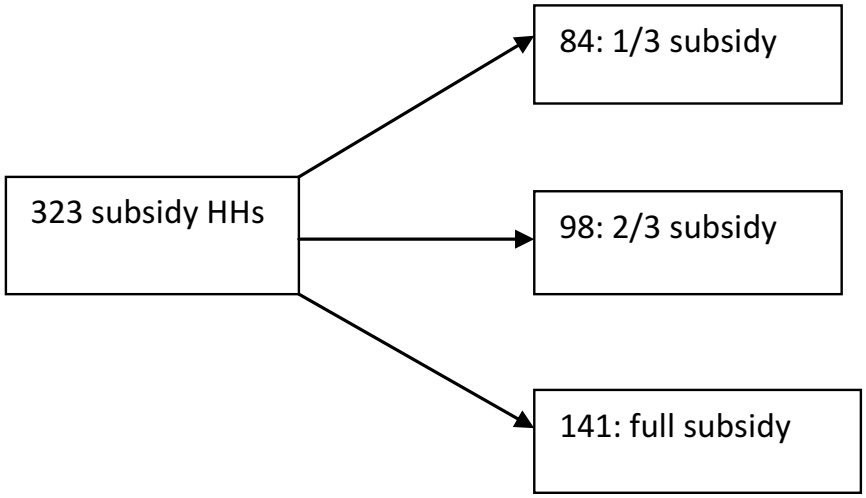
The findings of this chapter raises several questions. Given the short duration between the enrollment and follow-up survey (the average individual had been enrolled for 4.8 months at the time of the follow-up survey), my results on utilization and health outcomes represent the short-run effects of insurance coverage. To what extent will these differ from the longer-run effects? Furthermore, the strong effect of the education campaign suggests that learning about the benefits of insurance may be important. To what extent will such learning affect subsequent enrollment behavior in the absence of the interventions? Planned future work on this long-term project will seek to address these and other important questions.

Figure 1.1: Design of Interventions



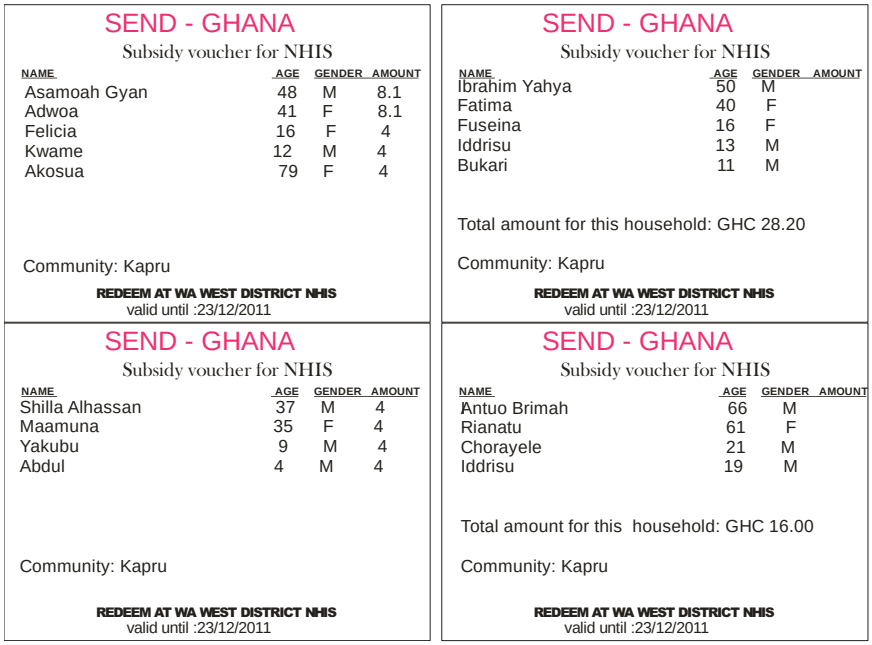
Note: Numbers refer to communities and numbers in brackets refer to affected households.

Figure 1.2: Subsidy Intervention



Notes: Based on number of affected households. Both subsidy level and voucher type are stratified by broader treatment arms in Figure 1a.

Figure 1.3: Sample Subsidy Voucher



SEND - GHANA

Subsidy voucher for NHIS

NAME	AGE	GENDER	AMOUNT
Asamoah Gyan	48	M	8.1
Adwoa	41	F	8.1
Felicia	16	F	4
Kwame	12	M	4
Akosua	79	F	4

Community: Kapru

REDEEM AT WA WEST DISTRICT NHIS
valid until :23/12/2011

SEND - GHANA

Subsidy voucher for NHIS

NAME	AGE	GENDER	AMOUNT
Ibrahim Yahya	50	M	
Fatima	40	F	
Fuseina	16	F	
Iddrisu	13	M	
Bukari	11	M	

Total amount for this household: GHC 28.20

Community: Kapru

REDEEM AT WA WEST DISTRICT NHIS
valid until :23/12/2011

SEND - GHANA

Subsidy voucher for NHIS

NAME	AGE	GENDER	AMOUNT
Shilla Alhassan	37	M	4
Maamuna	35	F	4
Yakubu	9	M	4
Abdul	4	M	4

Community: Kapru

REDEEM AT WA WEST DISTRICT NHIS
valid until :23/12/2011

SEND - GHANA

Subsidy voucher for NHIS

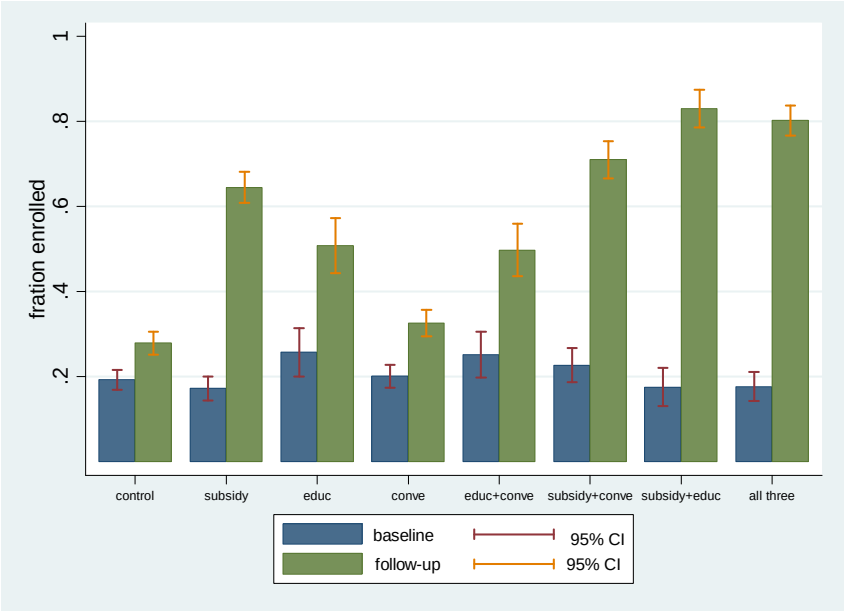
NAME	AGE	GENDER	AMOUNT
Antuo Brimah	66	M	
Rianatu	61	F	
Chorayele	21	M	
Iddrisu	19	M	

Total amount for this household: GHC 16.00

Community: Kapru

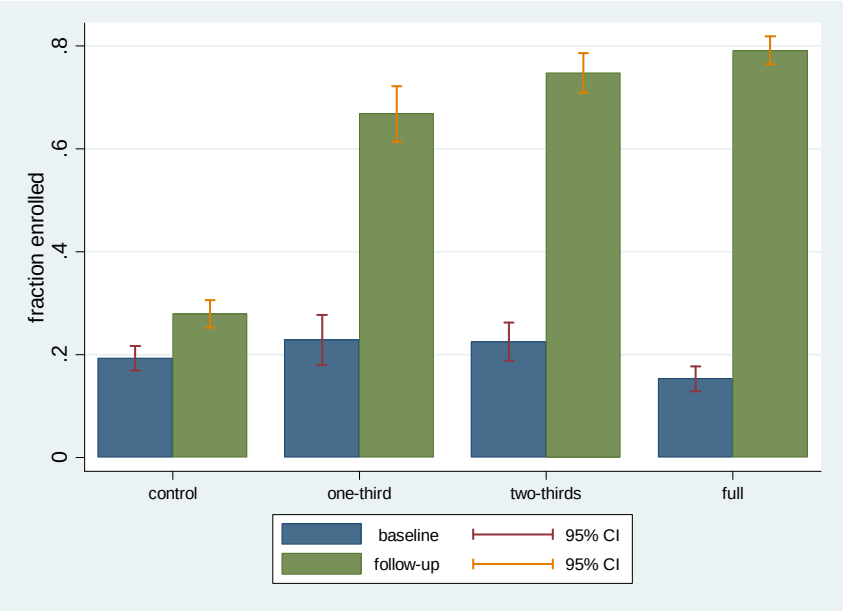
REDEEM AT WA WEST DISTRICT NHIS
valid until :23/12/2011

Figure 1.4: Enrollment in NHIS at baseline and follow-up across interventions



Notes: Figure is based on full sample of 4298 individuals. Conve, educ and subsidy refer to assisngment to convenience only, education only and subsidy only inteventions respectively. educ + conve, subsidy+conve and subsidy+educ refer to assignment to education and convenience, subsidy and convenience, and subsidy and education interventions. All three refers to assignment to subsidy, education and convenience intervention.

Figure 1.5: Enrollment in NHIS at baseline and follow-up across interventions



Notes: Figure is based on sample of subsidy only and pure control groups. One-third, two-thirds and full refer to assignment to 1/3 subsidy, 2/3 subsidy and full subsidy respectively.

Table 1.1: Balance Between Treatments and Control Groups (All Treatments)

Variable	Full	Control mean	subsidy minus control	Educ. minus control	Conve. minus control	Edu/conv minus control	sub/conve minus control	sub/educ minus control	All 3 minus control
Observations (N)	**4625**	**1313**	**709**	**327**	**604**	**328**	**481**	**300**	**561**
Age	22.956	24.313	0.842	1.661	2.129	0.856	1.930	-1.532	1.102
Male	0.483	0.476	-0.009	-0.014	0.015	-0.023	0.020	-0.022	-0.032
Has some formal education	0.335	0.337	0.025	0.030	-0.006	0.148*	0.038	0.045	-0.019
Has a health condition [≥6 months]	0.070	0.072	0.002	0.011	-0.000	0.012	-0.018	0.004	-0.002
Has been ill in the last month	0.120	0.109	-0.003	-0.030	0.040	0.031	-0.033	-0.027	-0.018
Has recently visited health facility	0.087	0.085	-0.002	-0.003	0.007	-0.005	-0.024	-0.008	0.008
Made out of pocket expense	0.126	0.133	0.001	0.007	0.020	-0.032	-0.013	-0.017	0.007
Health expend. in last month [GHC]	11.95	13.07	3.827**	-1.283	1.213	2.519	-2.666*	0.020	2.226
Probably will be sick in the next year	0.447	0.468	0.004	0.059	0.008	0.040	-0.028	0.033	0.059
Heard of the NHIS	0.960	0.958	-0.002	0.000	-0.003	0.001	-0.002	-0.001	0.002
Knowledge of NHIS (raw score)[a]	10.710	10.576	0.044	-0.409	-0.353	-0.289	-0.068	-0.055	0.008
Ever enrolled in NHIS	0.374	0.338	-0.084	-0.085**	-0.022	-0.022	-0.091*	-0.074	0.070
Currently enrolled in NHIS	0.205	0.201	0.011	-0.045	-0.006	-0.056	-0.024	0.011	-0.011
Re-enrolled in NHIS	0.629	0.700	0.023	0.102	0.013	0.123	0.108	0.136*	0.132
Ever smoked	0.110	0.117	0.013	-0.006	-0.015	-0.012	0.024	-0.028	0.040
Drank alcohol in last 2 weeks	0.528	0.524	-0.001	-0.036	0.042	-0.048	-0.015	-0.038	0.052
Slept under mosquito net last night	0.544	0.452	-0.080	-0.103*	-0.004	0.041	-0.152*	-0.089	0.080
Christian	0.432	0.422	-0.048	0.090	0.005	0.091	0.014	-0.207**	-0.067
Dagaaba	0.502	0.438	-0.046	-0.045	0.015	-0.015	0.041	-0.170*	-0.059
Household size	6.805	6.944	0.214	-1.099	0.431	0.164	-0.805	0.862	-0.956
Number of children under 18	3.874	3.697	-0.050	-1.006	-0.116	0.166	-0.787	0.536	-0.946
Head is male	0.800	0.808	-0.007	-0.076	0.095*	-0.069	-0.008	-0.081	-0.062
Owns farming land	0.509	0.480	-0.217*	-0.020	0.013	0.058	-0.067	0.105	-0.027
Owns a mosquito net	0.590	0.544	-0.084	-0.106	0.135	-0.031	0.128*	-0.125*	0.029
Distance to NHIS regist. (km)	18.436	21.286	-2.001	0.087	5.236**	2.119	-3.246	0.071	2.981
Distance to health fac. (km)	5.359	5.501	0.981	1.092	0.049	-0.119	0.563	1.290	-0.982

a: out of 18 questions about the NHIS. 1$ = 1.5 GHC. Reported differences are from pairwise t-tests of differences between each treatment and the control group. All tests of differences adjust standard errors for intra-cluster (intra-village) correlation. *, ** and *** denote statistical significance at 10%, 5% and 1% levels respectively. Dagaaba refer to an ethnic group.

Table 1.2: Balance Between Treatments and Control Groups (Subsidy Levels)

	Control Mean	1/3 subsidy minus control	2/3 subsidy minus control	full subsidy minus control
Number of individuals	**1313**	**476**	**559**	**983**
Age	24.313	-1.696	0.399	1.458
Male	0.476	-0.015	0.012	-0.021
Has some formal education	0.337	0.005	0.001	-0.015
Has a health condition	0.072	-0.015	-0.014	-0.006
Has been ill in the last month	0.109	-0.049	-0.031	-0.019
Has visited health facility	0.085	0.033	-0.019	0.004
Made out of pocket expense	0.133	-0.004	-0.049	0.015
Health expend. in last month	13.07	0.614	-0.638	0.884
Probably will be sick next year	0.468	-0.006	0.018	0.041
Heard of the NHIS	0.958	0.002	0.001	-0.002
Knowledge of NHIS	10.576	-0.089	-0.412	0.130
Ever enrolled in NHIS	0.338	0.139*	-0.056	-0.077
Currently enrolled in NHIS	0.201	-0.057	-0.040	0.042
Re-enrolled in NHIS	0.700	0.106	0.020	0.172**
Ever smoked	0.117	-0.001	0.057**	-0.001
Drank alcohol in last 2 weeks	0.524	0.028	0.027	-0.013
Slept under mosquito net	0.452	-0.108	-0.105	-0.008
Christian	0.422	-0.133	-0.110	-0.076
Dagaaba	0.438	-0.158	-0.140	0.025
Household size	6.944	0.271	-0.081	-0.567
Number of children under 18	3.697	-0.055	-0.162	-0.699
Head is male	0.808	0.037	-0.049	-0.048
Owns farming land	0.480	-0.102	-0.052	-0.107
Owns a mosquito net	0.544	-0.141	-0.209**	-0.096
Distance to NHIS regist. (km)	21.286	-3.122	-1.659	4.601
Distance to health fac. (km)	5.501	0.046	0.096	0.573

Notes: *, ** and *** refers to statistical significance at 10%, 5% and 1% levels respectively. All tests of differences adjust standard errors for intra-cluster correlation ie intra-community/village correlation. Dagaaba refers to an ethnic group.

Table 1.3: First-stage: Effect of Interventions on Enrollment in NHIS

	Outcome variable: indicator = 0 for not enrolled, 1 for enrolled					
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
Education only	0.229**	0.208**	0.156**	0.147**	0.261***	0.050
	(0.105)	(0.083)	(0.080)	(0.072)	(0.096)	(0.072)
Subsidy only	0.365***	0.372***	0.361***	0.370***	0.328****	0.408***
	(0.064)	(0.054)	(0.050)	(0.049)	(0.063)	(0.050)
Convenience	0.046	0.039	0.035	0.013	-0.012	0.016
	(0.082)	(0.062)	(0.048)	(0.048)	(0.060)	(0.070)
Educ & convenience	0.203*	0.197*	0.157*	0.186*	0.223*	0.170
	(0.113)	(0.110)	(0.095)	(0.108)	(0.127)	(0.140)
Subsidy & conve.	0.429***	0.396***	0.368***	0.354***	0.363***	0.340***
	(0.063)	(0.062)	(0.061)	(0.066)	(0.074)	(0.077)
Subsidy & educ	0.551***	0.562***	0.499***	0.525***	0.607***	0.444***
	(0.071)	(0.066)	(0.065)	(0.070)	(0.081)	(0.079)
Subsidy&educ&conve	0.523***	0.531***	0.495***	0.455***	0.470***	0.444***
	(0.054)	(0.058)	(0.057)	(0.064)	(0.072)	(0.063)
Individual covariates		X	X	X	X	X
Household covariates			X	X	X	X
Community covariates				X	X	X
Mean for control group	0.279	0.279	0.279	0.279	0.235	0.329
N	**4298**	**4298**	**4298**	**4298**	**1995**	**2303**
F-statistic	**18.54**	**20.73**	**19.07**	**21.22**	**19.41**	**20.57**
R^2	**0.1738**	**0.2527**	**0.2713**	**0.2773**	**0.2986**	**0.2817**

Notes: Robust standard errors clustered at community level are reported in brackets. *, ** and *** denote statistical significance at 10%, 5% and 1% levels respectively. F-statistic is for excluded instruments (interventions). Individual covariates are: age group (<18 years, 18-69, and 70+), gender, education status, indicator for having ever registered with the NHIS at baseline, and indicator having visited a health facility at baseline. Household covariates are: household size, religion, ethnicity and wealth index (poor third, middle third and rich third). Community covariates are: distance to nearest health facility, distance to NHIS registration center. Columns (5) and (6) restricts sample to adults aged 18 and above and children under 18 respectively.

Table 1.4: Effect of Education Intervention on Knowledge of NHIS

Dependent variable:	Knowledge of premiums **(1)**	Knowledge of benefits **(2)**	Knowledge of exemptions **(3)**	Overall knowledge of NHIS **(4)**
Education	0.237	0.182**	0.293***	0.901*
	(0.183)	(0.074)	(0.091)	(0.516)
Subsidy	0.099	-0.017	0.094	0.731*
	(0.100)	(0.083)	(0.101)	(0.406)
Conve regist	-0.035	-0.036	0.070	-0.083
	(0.074)	(0.062)	(0.113)	(0.332)
Educ. &conve reg	0.278**	0.054	0.160	0.641
	(0.140)	(0.073)	(0.150)	(0.503)
Subsidy & conve reg.	0.074	0.021	0.152	0.337
	(0.070)	(0.104)	(0.177)	(0.452)
Subsidy & educ.	0.255**	0.123**	0.270***	1.129**
	(0.116)	(0.062)	(0.076)	(0.441)
Subsidy & educ & conve	0.239	0.065	0.239*	0.683**
	(0.225)	(0.062)	(0.135)	(0.279)
Baseline knowledge of premiums	0.270**			
	(0.138)			
Baseline knowledge of benefits		0.271***		
		(0.080)		
Baseline knowledge of exemptions			0.259***	
			(0.084)	
Baseline knowledge of NHIS				0.439***
				(0.132)
N	**531**	**531**	**531**	**531**
F-statistic	**9.35**	**10.23**	**7.48**	**5.34**
R^2	**0.1381**	**0.1384**	**0.3120**	**0.4817**

Notes: Robust standard errors clustered at community level are reported in brackets. *, ** and *** denote statistical significance at 10%, 5% and 1% levels respectively. The sample for all regressions is restricted to household heads or adult household members present at the time of the follow-up survey. All regressions include a full set of covariates (individual, household, community).

Table 1.5: Effect of Subsidy Levels on Enrollment in NHIS

	Outcome variable: indicator = 0 for not enrolled, 1 for enrolled					
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
1/3 Subsidy	0.287***	0.284***	0.254***	0.262***	0.253***	0.279***
	(0.068)	(0.066)	(0.060)	(0.060)	(0.070)	(0.080)
2/3 subsidy	0.378***	0.374***	0.347***	0.356***	0.347***	0.358***
	(0.054)	(0.057)	(0.055)	(0.052)	(0.062)	(0.059)
Full subsidy	0.407***	0.390***	0.377***	0.374***	0.375***	0.375***
	(0.059)	(0.054)	(0.054)	(0.054)	(0.063)	(0.056)
Education	0.152**	0.143**	0.139**	0.130**	0.195***	0.073
	(0.066)	(0.059)	(0.059)	(0.058)	(0.061)	(0.064)
Conve regist.	0.017	0.001	0.001	0.023	-0.010	0.039
	(0.062)	(0.049)	(0.042)	(0.045)	(0.049)	(0.058)
Individual covariates		X	X	X	X	X
Household covariates			X	X	X	X
Community covariates				X	X	X
Mean for control group	0.279	0.279	0.279	0.279	0.235	0.329
N	**4298**	**4298**	**4298**	**4298**	**1995**	**2283**
F-statistic	**25.06**	**25.22**	**21.71**	**21.21**	**18.40**	**19.58**
R^2	**0.1700**	**0.2491**	**0.2760**	**0.2768**	**0.3000**	**0.2582**

Notes: Robust standard errors clustered at community level are reported in brackets. *, ** and *** denote statistical significance at 10%, 5% and 1% levels respectively. F-statistic is for excluded instruments (interventions). Individual covariates are: age group (<18 years, 18-69, and 70+), gender, education status, indicator for having ever registered with the NHIS at baseline, and indicator having visited a health facility at baseline. Household covariates are: household size, religion, ethnicity and wealth index (poor third, middle third and rich third). Community covariates are: distance to nearest health facility, distance to NHIS registration center. Columns (5) and (6) restrict sample to adults aged 18 and above and children under 18 respectively.

Table 1.6: Effect of Interventions on Utilization of Healthcare Services

Dependent variable:	Visited facility in last 4 weeks (1)	Visited facility in 6 months (2)	# of visits in last 6 months (3)	Visited facility for malaria treatment (4)	Enrolled (5)
Panel A: IV results					
Insured	0.140***	0.151***	0.324***	0.038**	
	(0.052)	(0.055)	(0.125)	(0.015)	
Control mean	0.116	0.103	0.203	0.018	
R^2	**0.0755**	**0.0672**	**0.0514**	**0.0134**	
Panel B: Reduced-form and first-stage results					
Education	0.019	0.024	0.103	0.016	0.147**
	(0.027)	(0.027)	(0.068)	(0.091)	(0.072)
Subsidy only	0.026	0.012	0.015	0.002	0.370***
	(0.020)	(0.018)	(0.051)	(0.006)	(0.049)
Conve. regist.	-0.026	-0.019	-0.008	-0.001	0.013
	(0.022)	(0.023)	(0.070)	(0.009)	(0.048)
Educ & conve	0.041	0.050	0.073	0.004	0.186*
	(0.048)	(0.049)	(0.087)	(0.015)	(0.108)
Subsidy & educ	0.106***	0.122***	0.285***	0.010	0.525***
	(0.032)	(0.040)	(0.054)	(0.009)	(0.070)
Subsidy & conve	0.005	0.014	0.023	-0.000	0.354***
	(0.040)	(0.036)	(0.090)	(0.009)	(0.066)
Subsidy&educ&conve	0.106***	0.109***	0.252***	0.033***	0.455***
	(0.031)	(0.029)	(0.062)	(0.010)	(0.064)
N	**4298**	**4298**	**4298**	**4298**	**4298**
R^2	**0.0844**	**0.0752**	**0.0526**	**0.0169**	**0.2773**
Panel C: Test of complementarity					
Hypothesis:	Subsidy & education - (subsidy only + education) = 0				
F-statistic (p-value)	7.07(0.01)	5.72(0.02)	4.58(0.04)	4.53(0.04)	0.008(0.929)

Notes: Robust standard errors clustered at community level are reported in brackets. *, ** and *** denote statistical significance at 10%, 5% and 1% levels respectively. All regressions include a full set of individual-level and household/community-level covariates. Individual-level covariates are: age-group (<18 and 70+, 18-69 is omitted), gender, indicator for having a health condition, indicator for visiting a health facility at baseline, education status. Household/community-level covariates are: household wealth (poorest third and richest third, middle third omitted), household size, religion, ethnicity, distance to nearest health facility and distance to NHIS registration point.

Table 1.7: Effect of Subsidy Level on Utilization of Healthcare Services

Dependent variable:	Visited facility in last month **(1)**	Visited facility in last 6 months **(2)**	# of visits in last 6 months **(3)**	Visit facility for malaria treatment **(4)**
1/3 subsidy	0.020	0.005	0.028	0.009
	(0.021)	(0.020)	(0.058)	(0.007)
2/3 subsidy	0.023	0.015	0.023	0.012
	(0.025)	(0.025)	(0.079)	(0.009)
Full subsidy	0.027	0.010	0.021	0.002
	(0.028)	(0.031)	(0.083)	(0.007)
N	**2022**	**2022**	**2022**	**2022**
R^2	**0.0814**	**0.0743**	**0.0580**	**0.0186**

Notes: Robust standard errors clustered at community level are reported in brackets. *, ** and *** denote statistical significance at 10%, 5% and 1% levels respectively. Sample for all regressions is restricted to subsidy only and control households. All regressions include a full set of covariates (individual, household and community).

Table 1.8: Effect of Insurance Coverage on Out-of-Pocket Expenses (IV)

Outcome variable:	Made positive out-of-pocket health expense in last the last 4 weeks		Total out-of-pocket expenses made in the last 4 weeks			
	OLS		OLS		Tobit	
	(1)	(2)	(3)	(4)	(5)	(6)
Insured	0.020	0.019	0.731	0.787	2.170	2.088
	(0.014)	(0.013)	(1.240)	(1.131)	(1.716)	(1.672)
Had positive health expend. at baseline		-0.027***		0.458*		-1.978*
		(0.010)		(0.246)		(1.066)
N	**4298**	**4298**	**4298**	**4298**	**4298**	**4298**
R^2	**0.0056**	**0.0100**	**0.0018**	**0.2166**	**0.0211**	**0.0334**

Notes: Robust standard errors clustered at community level are reported in brackets. *, *** and *** denote statistical significance at 10%, 5% and 1% levels respectively. All regressions include a full set of covariates. All regressions include individual controls [age group (<18 years, 18-69, and 70+), gender, education status, indicator for having ever registered with the NHIS at baseline, and indicator having visited a health facility at baseline], household controls (household size, religion, ethnicity and wealth index: poor third, middle third and rich third) and community controls (distance to the nearest health facility and distance to the NHIS registration point). The out-of-pocket expense outcome variable for columns 3 and 4 are raw outcome variable while those for (5) and (6) are predicted using a Tobit model.

Table 1.9: Effect of Insurance Coverage on Out-of-Pocket Expenses (Reduced-form)

Outcome variable:	Made positive out-of-pocket health expense in last the last 4 weeks		Total out-of-pocket expenses made in the last 4 weeks			
	OLS		OLS		Tobit	
	(1)	(2)	(3)	(4)	(5)	(6)
Education	-0.005	-0.005	-1.103	-1.118*	-0.858	-0.813
	(0.010)	(0.010)	(0.745)	(0.670)	(0.744)	(0.712)
Subsidy only	-0.009	-0.000	-0.837	0.829	-1.714*	-1.695*
	(0.013)	(0.007)	(0.873)	(0.666)	(1.031)	(1.012)
Conve. regist.	0.012	0.012	2.282**	2.243**	2.483*	2.380*
	(0.011)	(0.010)	(0.956)	(0.925)	(1.394)	(1.317)
Educ & conve	-0.005	-0.005	-0.863	-0.716	-0.577	-0.568
	(0.010)	(0.009)	(0.775)	(0.832)	(1.229)	(1.176)
Subsidy & educ	-0.024**	-0.024**	-1.577**	-1.759**	-2.210**	-1.974**
	(0.011)	(0.010)	(0.775)	(0.771)	(0.840)	(0.817)
Subsidy & conve	0.003	0.003	-0.860	-0.908	0.708	0.736
	(0.017)	(0.017)	(0.695)	(0.679)	(0.837)	(0.833)
Subsidy&educ&conve	-0.009	-0.009	-0.588	-0.540	-0.844	-0.866
	(0.014)	(0.009)	(0.715)	(0.655)	(0.960)	(0.861)
Had positive health expend. at baseline		-0.029*		1.843**		-1.622**
		(0.016)		(0.903)		(0.779)
N	**4298**	**4298**	**4298**	**4298**	**4298**	**4298**
R^2	**0.0184**	**0.0567**	**0.0103**	**0.0150**	**0.2859**	**0.2891**

Notes: Robust standard errors clustered at community level are reported in brackets. *, *** and *** denote statistical significance at 10%, 5% and 1% levels respectively. All regressions include a full set of covariates. All regressions include individual controls [age group (<18 years, 18-69, and 70+), gender, education status, indicator for having ever registered with the NHIS at baseline, and indicator having visited a health facility at baseline], household controls (household size, religion, ethnicity and wealth index: poor third, middle third and rich third) and community controls (distance to the nearest health facility and distance to the NHIS registration point). The out-of-pocket expense outcome variable for columns 3 and 4 are raw outcome variable while those for (5) and (6) are predicted using a Tobit model.

Table 1.10: Effect of Insurance Coverage on Health (IV and Reduced-form)

Dependent variable:	# of days been ill in the last one month		Could not perform normal daily activities due to illness		# of days could not perform normal daily activities due to illness		days waited before seeking care	
	IV	Reduced-form	IV	Reduced-form	IV	Reduced-form	IV	Reduced-form
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Insured	-0.339*		-0.027		-0.805**		-1.572	
	(0.203)		(0.030)		(0.340)		(0.987)	
Education		-0.073		-0.015		-0.363		-0.951
		(0.213)		(0.016)		(0.428)		(0.628)
Subsidy only		-0.163		-0.029**		-0.622*		-0.416
		(0.172)		(0.012)		(0.350)		(0.941)
Conve. regist.		0.061		0.039		0.228		5.212***
		(0.267)		(0.019)		(0.501)		(0.682)
Educ & conve		0.018		0.016		-0.394		0.450
		(0.328)		(0.009)		(0.544)		(1.015)
Subsidy & educ		-0.421***		-0.044**		-0.880***		-0.683
		(0.139)		(0.010)		(0.329)		(0.756)
Subsidy & conve		-0.343*		-0.028**		-0.755*		-0.407
		(0.179)		(0.012)		(0.442)		(1.014)
Subsidy&educ&conve		-0.391**		-0.040***		-0.828**		-0.509
		(0.177)		(0.015)		(0.331)		(0.932)
Control mean	0.809		0.063		1.582		2.733	
N	**4281**	**4281**	**4281**	**4281**	**4281**	**4281**	**391**	**391**
R^2	**0.0219**	**0.0170**	**0.0228**	**0.0365**	**0.1627**	**0.1465**	**0.1388**	**0.1686**

Notes: Robust standard errors clustered at community level reported in brackets. *, ** and *** denote statistical significance at 10%, 10 and 1% levels respectively. Even-numbered columns report IV estimates; odd-numbered columns report reduced-form estimate. All regressions include both individual-level and household/community-level variables. Individual-level covariates are: age-group (<18 and 70+, 18-69 is omitted), gender, indicator for having a health condition, indicator for visiting a health facility at baseline, education status. Household/community-level covariates are: household wealth (poorest third and richest third, middle third omitted), household size, religion, ethnicity, distance to nearest health facility and distance to NHIS registration point.

Table 1.11: Effect of Insurance Coverage on Self-Reported Health (IV and Reduced-form)

Dependent variable:	happy or very happy (1)	healthy or very healthy (2)	health has improved (3)	depressed (4)	hopeful (5)	days in poor mental health (6)	days of poor physical health (7)
Panel A: IV results							
Insured	0.218**	0.137**	-0.011	-0.043	0.125**	-0.684*	-0.259
	(0.101)	(0.060)	(0.097)	(0.036)	(0.052)	(0.371)	(0.902)
Panel B: Reduced-from results							
Education	0.213***	0.136***	0.078	0.016	0.049	0.094	0.084
	(0.063)	(0.034)	(0.088)	(0.089)	(0.038)	(0.718)	(0.711)
Subsidy only	0.061	0.011	-0.034	0.017	0.031	-0.047	-0.038
	(0.062)	(0.068)	(0.083)	(0.110)	(0.043)	(0.481)	(0.578)
Conve. regist.	-0.055	0.001	-0.121	0.098	-0.061	0.381	0.367
	(0.091)	(0.066)	(0.087)	(0.138)	(0.044)	(0.879)	(0.578)
Educ & conve	-0.024	0.037	0.027	0.088	-0.002	0.376	0.838
	(0.081)	(0.061)	(0.078)	(0.071)	(0.057)	(0.586)	(0.963)
Subsidy & educ	0.337***	0.148***	0.306***	-0.138***	0.127***	-0.035	-0.038
	(0.063)	(0.039)	(0.085)	(0.064)	(0.036)	(0.541)	(0.578)
Subsidy & conve	0.089	0.001	-0.044	0.034	0.019	-0.730*	-0.736
	(0.109)	(0.059)	(0.085)	(0.072)	(0.070)	(0.371)	(0.751)
Subsidy & educ & conve	0.325***	0.141***	0.066	-0.031	0.084**	-0.086	-0.419
	(0.062)	(0.042)	(0.062)	(0.064)	(0.033)	(0.590)	(0.777)
Control mean	0.603	0.817	0.106	0.229	0.882	0.683	1.665
N	**1335**	**1335**	**1335**	**1335**	**1335**	**1335**	**1335**

Notes: Robust standard errors clustered at community level are reported in brackets. *, ** and *** denote statistical significance at 10%, 5% and 1% levels respectively. All regression restricted to sample of household heads or adult members present at the time of survey. All regressions include individual-level and household/community-level covariates. Individual-level covariates are: age-group (<18 and 70+, 18-69 is omitted), gender, indicator for having a health condition, indicator for visiting a health facility at baseline, education status. Household/community-level covariates are: household wealth (poorest third and richest third, middle third omitted), household size, religion, ethnicity, distance to nearest health facility and distance to NHIS registration point.

Chapter 2

Intrahousehold Allocation of Health Resources: Experimental Evidence from Rural Ghana

2.1 Introduction

Allocation of resources within a household is a subject of long-standing interest among economists and policy makers. Previous research showing the lasting impact of early childhood conditions on later health and labor market outcomes highlights the significance of the pattern of parental investment in early childhood (Almond and Currie, 2011; Royer, 2009; Almond, 2006). From a Pareto-optimality standpoint, intrahousehold allocation provides insights into whether household resources are being allocated efficiently (Berhman, 1997). From a policy point of view, intrahousehold allocation may have a strong bearing on gender and other forms of inequalities, and understanding of the underlying motivations could inform appropriate design of transfer programs and other interventions to mitigate such inequalities. A growing body of recent empirical work has devoted attention to understanding the process and nature of intrahousehold resource allocation. [1]

This chapter contributes to this literature by seeking to understand allocation of health resources among resource-constrained rural households. It presents analyses based on the same experimental design to encourage take-up of Ghana's social health insurance program, the National Health Insurance Scheme (NHIS), in the Wa West district of the Upper West Region of Ghana described in detail in the first chapter. Intrahousehold allocation in this setting without other forms of formal insurance is important because which member a resource-constrained household insures has important implication for its ability to maintain its consumption flow with realization of health risk. For instance, if a household insures its children over its breadwinners, it might not be able to maintain its consumption in case of adverse health shocks.

I study intrahousehold allocation using aspects of the subsidy intervention that randomly

[1] See Almond & Mazumder (2013) for a review of the recent empirical literature.

varied the ability of households to decide allocation of subsidies among its members. Specifically, households that did not recieve full subsidies under the subsidy intervention were given two types of vouchers. One type of voucher assigned an amount to each household member that could not be altered (specified voucher). The other type of voucher only assigned a total amount, allowing the household to decide the allocation among its members (unspecified voucher). I compare enrollment rates within households across these two vouchers.

My results suggest that households prioritize children over other household members in the presence of resource constraints. Households receiving 1/3 subsidy enrolled 15 percentage points more children (under 17 years of age) compared to adults. Households who received unspecified vouchers enrolled 20 percentage points fewer elderly people (70 years or more) compared to adults. No such differences are found for households who received specified vouchers or full subsidies. I present suggestive evidence to show that this pattern of allocation cannot be explained by baseline differences in health history or differences in expected health.

Focussing on allocation among children, I find that among households given unspecified vouchers enrollment of boys was 11.7 percentage points or 18% higher than girls. Here again, this differential is not explained by differences in risky behaviors between boys and girls, health history or expected future health. I provide additional evidence in support of this pattern of allocation among children by showing that similar gender difference in allocation of non-experimentally assigned mosquito bednets.

Previous literature has identified socio-cultural and economic factors behind gender bias in allocation of resources in other contexts. In East Asia, for instance, persistent son preference resulting from high dowry payments and patrilineal system of inheritance is commonly cited as an explanation for gender differences in resource allocation (Das Gupta et al 2003). Marriage in this setting involves bride price and not dowries. However, the inheritance system is strictly patrilineal and could be an explanation for the gender differences in allocation. On the other hand, I find suggestive evidence that labor market participation is a possible

explanation for the differential enrollment in this setting. Among children aged 7-17 years of age, labor market participaton is 5 percentage points higher for boys than girls at the baseline and 3.5 percentage points higher at follow-up.

This chapter contributes to a growing literature studying intrahousehold allocation. One strand of this literature has shown that control of resources and other assets within the household affect allocation and expenditure patterns (Briado et al, 2012; Duflo and Udry, 2004; Duflo, 2003). This chapter is among the first to study intrahousehold allocation using an experimental design. Ashraf (2009) and Kebede et al (2011) also use experimental designs to study intrahousehold allocation decisions but they focus on the effect of information and communication on spousal choices.[2] The chapter also differs from existing studies in its focus on health insurance.

The chapter is more closely related to the strand of the intrahousehold literature that focus on parental allocation of resources among children and examine factors that account for differential enrollment. A few studies have shown an association between parents' characteristics and their investment in children (Guryan et al, 2008; and Sayer et al, 2004). Recent work has focused on whether parents invest in children to compensate for or reinforce early life endowments (using birth weight and measures of IQ) and shocks to these endowments. The vast majority of these studies find that parental investment tend to reinforce children's endowments (Adhvaryu and Nyshadham, 2012; Aizer and Cunha, 2012; Akresh et al, 2012; Venkataramani, 2012; Datar et al, 2010; Almond et al, 2009) although a few studies find evidence of compensating investment behavior (Del Bone et al, 2012; Bharadwaj et al, 2013; Conti et al, 2012). The results presented in this chapter does not examine the relation-

[2] A large part of this literature has focused on husband-wife allocations in unitary and non-cooperative household models (Chiappori, 1997; Udry, 1996; Pitt et al, 1984).

ship between resource allocation and early childhood endowments. Instead, it introduces an exogenous variation in household resources while also varying the ability of households to assign resources to learn about allocation among children.

Another strand of this literature finds gender differences in duration of breastfeeding, childcare, parental time devoted to cognition-related inputs, vacccination rates and vitamin supplementation (Baker and Milligan, 2013; Chen et al, 2013; Barcellos et al, 2011; Jayachandran & Kuziemko, 2011).[3] Parental preference for sons over daugthers has been identified as an explanation for gender differences. This chapter contributes to this literature by showing that differences in labor market participation could explain gender differences in resource allocation. Moreover, I show this in a setting with no documented evidence of sex-selection, overcoming empirical challenges the plaque studies from such settings (Barcellos et al, 2011; Jensen, 2005)

The rest of the chapter is organized as follows: section two explains the experimental design. Section three describes the data and empirical estimation procedure. Section four presents the results and section five concludes the chapter.

2.2 Experimental Design

Chapter 1 (Sections 2 and 3) provides detailed description of the setting and the experimental design. This section summarizes the aspect of the design relevant for the analysis presented in this chapter.

[3] Other studies have found no evidence of differential treatment by gender. Examples include Duflo (2005) and Deaton (2003, 1997).

The study was conducted in the Wa West district in the north-western part of Ghana. Wa West is a poor and remote rural district located in the Savanna High Plains with a population of about 81,000 in 2010. The economy is largely agrarian, dominated by subsistent farmers who grow food crops such as maize, sorghum and vegetables. Latest estimates of household incomes from the Ghana Living Standard Survey (GLSS V) in 2006 indicates that per capita income for a person living in a rural savannah locality, like Wa West, was GH¢232 or $252.80, 58% of the national average (GSS, 2008). The district is one of the most deprived in Ghana with limited economic infrastracture and formal financial services. It also has one of the lowest enrollment rates in the NHIS: baseline enrollment rate for the study sample was 21%.

The project introduced three interventions: a subsidy towards the payment of NHIS premium and fees, an education campaign and a convenience intervention as well as a complete set of their interactions to encourage take up of NHIS. All interventions were randomized at the community level but the subsidy level was then randomized at the household level. Households were assigned to receive a full subsidy (GH¢12.20 or $8.13), subsidy worth 2/3 (GH¢8.10 or $5.40) or 1/3 (GH¢4 or $2.67) of insurance premiums and fees (See Figure 2.1). In all cases, children (aged less than 18 years) and the elderly (aged 70 years or more) who are exempt from premiums received an amount sufficient to pay for the full cost of enrolling in the NHIS. Therefore the variation in subsidy level applies only to adult household members. Subsidies were given in the form of vouchers with a two-month validity period and redeemable only at the Wa West District Mutual Health Insurance Scheme. The voucher specified names, ages and gender of all household members, expiration date and where it should be redeemed.

Households not receiving full subsidy were informed about the extra amount needed to register all members. To learn about intrahousehold allocation the vouchers for such households took one of two forms. In one case, the voucher listed household members along with the total amount of subsidy, allowing the household to allocate the amount among

its members (henceforth, unspecified voucher). In the other case, the voucher specified an amount against the name of each member and reallocation was not possible (henceforth, specified voucher). Figure 2.2 presents an illustrative example. Adult members in the two households in the top panel of the figure are both assigned to receive 2/3 subsidy. In the top left panel, an amount is specified against the name of each household member (specified voucher). In the top right panel, no amount is specified for each member but the total subsidy for the household is specified (unspecified voucher). The value of the subsidy is the same in this case because of the household size and age structure. Households in the bottom panel received 1/3 subsidy.

Both the level of subsidy and voucher type were stratified by the broader treatment arms. To avoid contamination from possible interactions among interventions, the main analyses presented in this chapter is restricted to pure control households and households who received the subsidy only intevention.

2.3 Data and Empirical Estimation

2.3.1 Data

The data used for the analysis comes from a household survey conducted as part of the experimental study. The sampling frame for the study was limited to communities with 30-400 residents that are at least 1km from the nearest other community. The size restriction was informed by budgetary considerations because interventions were randomized at the community level. The distance restriction was to minimize spillover of education and convenience interventions to neighboring communities. All 61 communities meeting these criteria were included and all households in these communities were interviewed.

The baseline survey was conducted in September 2011. Interventions were implemented in October 2011 with the follow-up survey in April 2012. The baseline survey collected information on demographic characteristics, employment, health history, general health and utilization of healthcare services, expected future health, enrollment in the NHIS and health behaviors for all household members. Information on knowledge of health insurance was collected from household heads or an adult respondent present if the household head was absent. The follow-up survey successfully relocated almost 94% of individuals from the baseline sample and collected similar information as the baseline.

In addition to the survey, the follow-up also collected administrative records of voucher redemption from the Wa West DMHIS. These records include information on voucher redemption status, date(s) vouchers were redeemed, household members for whom vouchers were applied in cases where all the members were not enrolled. This information is used to cross-check survey information on subsidy take-up. The survey information matched administrative records 97% of the time so the analysis is restricted to survey data.

Table 2.1 presents descriptive characteristics from the baseline survey and tests of balance between treatments and control groups. The first column reports summary values for the full sample. The baseline survey collected information on 4625 individuals from 680 households in the 61 communities. The average household has 6.8 members, including 3.9 children under 18 years of age. The average age is 23 years. Forty-eight percent (48%) of individuals are male and 80% of households are headed by males. Fifty-one percent (51%) of households own a farmland and 59% own a mosquito net. Half of the households belong to the Dagaaba ethnic group and about 43% are Christian. A third of all individuals have some formal education.

In terms of health characteristics of the sample, 7% reported having a chronic health condition lasting more than six months and 12% reported a sickness or injury in the last four weeks. Utilization of formal healthcare is low even among those with illnesses. Only

8.7% of all respondents (including 36% of those reporting illness or injury) visited a health facility in the last four weeks. About 12.6% made a positive out-of-pocket health expenditure. Among those reporting a positive expenditure, the average expenditure was GHC11.95 ($6.64) over the four-week period. The average household lives within 5.36km of a health facility and 18.43km from the district capital where registration for NHIS takes place. The subjective probability of being sick over the next 12 months is 0.447. Eleven percent (11%) of adults respondents (18 years and above) are current or past smokers and 53% had an alcoholic beverage in the two weeks before the baseline survey. About 54% of individuals reported sleeping under a mosquito net the night before the survey. Although 96% of adult respondents had heard about the NHIS, on average, they answered less than 11 of 18 questions on knowledge of NHIS premiums levels, exemptions and benefits correctly. Enrollment rate in the NHIS is 21% but 37% of individuals had registered with the scheme once before. The re-enrollment rate is 63%.

The remaining columns of Table 2.1 present a balance test between the control group and subsidy treatments by level of subsidy and voucher type. All tests are pairwise comparisons between each treatment and the control group that adjust standard errors for intra-cluster (intra-community) correlation. The table shows a good balance between treatments and control groups. Although there are some statistically significant differences for some variables, the magnitude of differences are small and the number of such significant differences is not very different from what would be expected by chance for the number comparisons.

2.3.2 Estimation

I estimate the effects of voucher type on allocation of subsidies within households by ordinary least squares estimation of the following equation:

$$enrolled_{ihc} = \rho + \beta_1 specified_{hc} + \beta_2 unspecified_{hc} + \beta_3 full_{hc} + X_{ihc}\theta + Z_{hc}\delta + W_{ihc}\gamma$$
$$(specified_{hc} * W_{ihc})\alpha_1 + (unspecified_{hc} * W_{ihc})\alpha_2 + (full_{hc} * W_{ihc})\alpha_3 + V_c\omega + \varepsilon_{ihc} \quad (2.1)$$

where i denotes an individual, h denotes a household and c denotes a community and $enrolled_{ihc}$ refers to an indicator that an individual is enrolled in the NHIS at follow-up. $specified_{hc}$, $unspecified_{hc}$ and $full_{hc}$ indicate assignment to specified, unspecified vouchers and full subsidy respectively. X_{ihc} denote a set of individual-level covariates (indicator for having some formal education, indicator for having a health condition at baseline, indicator for visiting a health facility at baseline and indicator for having ever registered with the NHIS). Z_{hc} and V_c denote household-level covariates (household size, religion, ethnicity, wealth) and community-level covariates (distance to nearest health facility, distance to the district capital) respectively. W_{ihc} refers to a vector of individual-level characteristics that identify the individual's position in the household (relationship to the head of the household, gender and age grouping: under 18, 18-69 or 70+). α_1, $\alpha_2$and $\alpha_3$are vectors whose elements denote the effect of assignment to specified voucher, unspecified voucher and full subsidy respectively on the elements of the vector W_{ihc}. In all estimations standard errors are clustered at the community level.

2.4 Results

I begin by showing the effect of voucher type received on enrollment rates. Figure 2.3 presents enrollment rates by voucher type at baseline and follow-up. As expected the enrollment rate is higher among full subsidy recipients compared to recipients of specified or unspecified vouchers (less than full subsidy). Enrollment is also higher among households with unspec-

ified than specified vouchers. Column 1 of Table 2.2 regresses the fraction of household members enrolled on subsidy level after controlling for receipt of education and convenience interventions. As expected, the fraction of household members enrolled is increasing in the level of subsidy. Column 2 shows that the enrollment rate is higher in unspecified voucher households than in specified voucher households. This may have resulted from unspecified voucher households adding up to the subsidy to enroll more members or taking advantage of the flexibility of the voucher to use up the total amount of subsidy. Column 4 probes this by regressing the average amount households spent to enroll its members on voucher type received. Since children and the elderly pay less to enroll in the NHIS, I control for the fraction of children and elderly in the household. The results show that unspecified voucher households did not spend more on average to enroll its members, suggesting that they probably took advantage of the flexibility of the voucher to enroll more members.

The remaining columns of Table 2.2 focus on the fraction of children enrolled. Column 5 shows that child enrollment is increasing in the level of subsidy. The fraction of children enrolled is highest with unspecified subsidy and lowest with specified voucher (column 6). The last four columns present results separately for boys and girls. Enrollment rates are similar under full subsidies but lower for girls otherwise. A comparison of columns 8 and 10 shows that this difference is mainly from households receiving unspecified vouchers as enrollment rate is similar when voucher is the specified type.

Next, I examine allocation within households more explicitly. Table 2.3 shows the effect of subsidy levels (column 1) and voucher type (column 2) on enrollment across three age groups: less than 18 years (children), 18-69 years (adults) and 70 years and above (elderly). These age groups are chosen based on the pricing regime under NHIS. Column 1 shows that among recipients of 1/3 subsidy enrollment of children is 14.7 percentage points higher than other age groups but there is no statistically significant difference in enrollment rates of adults and elderly. There are no differences across age groups when households receive either 2/3 or

full subsidy. Column 2 shows enrollment by voucher type. Households enroll 13.3 percentage points more children than adults when given specified vouchers but this difference vanishes with unspecified vouchers. There is no significant difference between enrollment rates of adults and the elderly when voucher is specified or full subsidy but enrollment of the elderly falls by 20 percentage points with unspecified subsidy.

The results in Table 2.3 suggest that households prioritize children when subsidy is not enough to enroll every member. When such households are given the option to decide allocation, they enroll a lower proportion of the elderly. Panel A of Table 2.4 investigates whether this allocation pattern may be explained by differences in baseline health conditions or expected health. The health conditions reported here are i) indicator that an individual reported an injury in the last two weeks, ii) an indicator that individual reported an illness in the last two weeks, iii) an indicator that an individual has a health condition lasting more than 6 months, and iv) an indicator that an individual is expected to be sick over the next 12 months. Columns 1-3 shows that current health conditions cannot explain the allocation patterns documented in Table 2.3. Although children reported better and the elderly reported worse health conditions than adults, enrollment of children is higher than other age groups. Column 4 shows that both children and the elderly are expected to be in worse health than adults. While the higher expected incidence of ill health among children is consistent with their higher enrollment rate, the lower enrollment of elderly is not consistent with their higher incidence of expected ill health. Taken together, the results in Panel A of Table 2.4 cannot explain within household enrollment by age.

Figure 2.4 shows enrollment rates among members of the household - fathers, mothers, male child, female child and other relatives - by type of voucher. The “other relatives” category refers to parents of the head or spouse, brothers/sisters, cousin and other extended

family members.[4] The figure is restricted to households in which all 5 categories of household members are present. As expected, the fraction of each category of household members enrolled is not higher with specified/unspecified voucher than with full subsidy. Overall enrollment rate is highest for male children. A comparison of specified versus unspecified vouchers shows that with the exception of female children, enrollment rates are higher under unspecified than specified although the differences are not statistically significant. Moreover, for children, enrollment is identical under specified voucher but increases marginally for males and falls for females with unspecified voucher.

Table 2.5 presents the corresponding regression results. Father is the omitted category of household members. The interaction between voucher type and status in the household identifies the effect of voucher type on allocation within the household. Column 1 reports regression without other covariates while column 2 includes a full set of covariates. Within households, enrollment rates is highest among male children and lowest among other relatives. There are no significant differences in enrollment rates among various members for full subsidy households. For households receiving specified vouchers, enrollment of children is higher than other household members and there is no significant difference between boys and girls. For households receiving unspecified voucher however, enrollment of girls is 13.3 percentage points lower than fathers and 14.5 percentage points lower than boys. These differences are statistically significant at 10% level.[5]

[4] I have repeated this analysis by further disaggregating other relatives by age, gender and baseline health status. The results are not reported here due to statistical power issues arising from the disaggregations.

[5] I have also repeated this analysis by comparing allocations between Christian and non-Christian religions and the results are similar to those reported here but with weaker statistical power.

The remainder of this section focuses on allocation among children. Enrollment of children is of special interest because children are a highly vulnerable sub-population. Moreover, a growing body of work has shown that health conditions in early life have lasting impact on human capital accumulation (Almond and Currie, 2011).

Figure 2.5 shows enrollment of children by level of subsidy (left panel) and by voucher type (right panel). Enrollment rate is higher for boys when households receive less than full subsidy. The right panel shows that this difference is from from households receiving unspecified vouchers: enrollment rates are nearly identical with specified vouchers or full subsidy voucher and about 10 percentage points lower for girls when households receive unspecified vouchers. Table 2.6 presents the corresponding regression results. Columns 1 and 2 present enrollment by subsidy levels and columns 3-4 by voucher type. Among less than full subsidy households, enrollment rate of boys is 6.9 and 10.8 percentage higher than girls if subsidy levels are 1/3 and 2/3 respectively. This differential vanishes with full subsidy. Column 4 confirms that this differential is mainly from households receiving unspecified vouchers. The enrollment rate is similar between boys and girls among specified voucher households but 11.7 percentage points (17.7%) higher for boys among unspecified voucher households.

Next, I show that this pattern of allocation is found in other (not experimentally allocated) health resources. Table 2.7 presents regression results with an indicator for sleeping under a mosquito net as the outcome variable at both baseline and follow-up. The table shows that allocation of mosquito nets favor boys. Boys are 9.5 percentage points more likely to report sleeping under a mosquito net the night before the baseline survey compared to girls. The corresponding estimate for the follow-up is 6.4.

The results in the preceding paragraphs show that household prioritize boys over girls in the allocation of resources. However, it is possible that households are making allocations based on other child characteristics that may be correlated with gender. For instance, boys

may be engaging in more risky behavior and households could be responding by optimally enrolling more boys. It is also possible that boys are less healthy in general. Panel B of Table 2.4 compares indicators of risky behavior and current and expected health of children at baseline by gender. To the extent that the incidence of injuries reflects risky behavior, column 1 finds no evidence that boys engage in more risky behavior than girls. The remaining columns also find no evidence that boys suffer more illness, have higher incidence of chronic health conditions or are expected to less healthy than girls. Overall, these results suggest that health conditions and expected health at baseline do not explain the gender difference in allocation of subsidies among children.

Previous literature has identified socio-cultural and economic factors as common reasons for parental allocation of resources in favor of boys (Das Gupta et al, 2003). Cultural factors include rigid patrilineal inheritance lineages and economic factors include old age insurance, male labor force participation and presence of substantial dowries for females. Marriage customs in this setting do not involve dowries but the inheritance system is strictly patrilineal and could be a potential explanation of the allocation patterns among children. There is also anecdotal evidence that old age insurance could be an explanation for the higher investment in boys. In informal conversations, several residents of the districts mentioned that importance of males staying at home and helping out on farms. Female migration to the south is very common in this setting.

Another potential explanation for the gender differrences in this predominantly rural agricultural setting where subsistent farmers rely on family labor for farm production is labor market participation. Indeed, Table 2.8 presents evidence consistent with a labor market participation as the motive for the differential insurance enrollment by gender. I regress an indicator that a child aged 7-17 years worked on family farm or for wage on gender and other covariates. The results show that boys have 3.6 percentage points higher probability of working compared to girls.

2.5 Conclusion

Intrahousehold allocation of resources in resource-constrained household have important long-term implications for human capital formation and policy design. This chapter sought to learn about allocation of health resources among rural household in Ghana. It uses an experimental design that randomly gave households in a rural district different levels of subsidies to enroll in Ghana's National Health Insurance Scheme. The design varied the ability of households to determine allocation of subsidies in cases where subsidies were not enough to enroll all members of the household.

The results suggest that households prioritize children in the allocation when resources are not sufficient to enroll every household member. Such households also enroll a lower fraction of the elderly (70 years or older) in favor of adults (18-69) when given the option to decide allocation of resources even though the cost of enrolling the latter is three times the cost of enrolling the former. Focusing on allocation among children, I find that households given unspecified vouchers enroll more boys than girls. This pattern of allocation among children is also found in distribution of bednets within household. I present suggestive evidence that this allocation pattern cannot be explained by differences in risky behaviors, health history or expected future health.

Previous studies identify socio-cultural and economic factors as common reasons for gender differences in allocation of resources among children. Unlike other settings, son preference is not a likely explanation for the gender difference reported in this chapter. While I cannot rule out socio-cultural factors such as patrilineal inheritance as explanation of the allocation patterns in this setting, I find suggestive evidence that differential labor market participation rates between girls and boys could be an explanation. Further research is needed to identify the exact causes of gender differences in allocation of resources to inform appropriate policy response.

Figure 2.1: Subsidy Intervention by level and voucher type

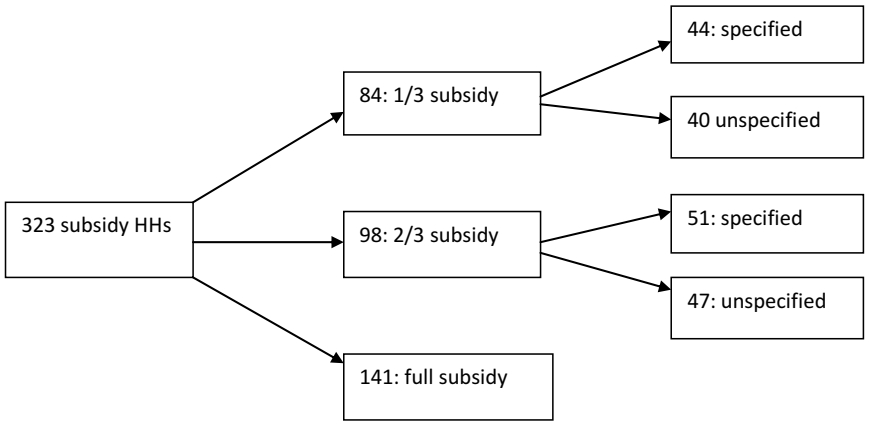
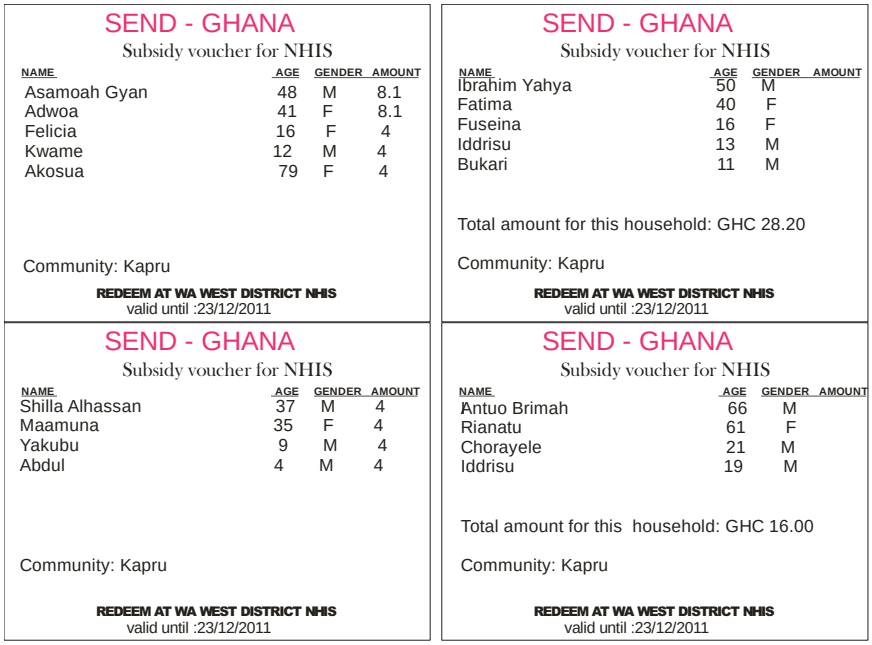


Figure 2.2: Sample Subsidy Voucher



SEND - GHANA

Subsidy voucher for NHIS

NAME	AGE	GENDER	AMOUNT
Asamoah Gyan	48	M	8.1
Adwoa	41	F	8.1
Felicia	16	F	4
Kwame	12	M	4
Akosua	79	F	4

Community: Kapru

REDEEM AT WA WEST DISTRICT NHIS
valid until :23/12/2011

SEND - GHANA

Subsidy voucher for NHIS

NAME	AGE	GENDER	AMOUNT
Ibrahim Yahya	50	M	
Fatima	40	F	
Fuseina	16	F	
Iddrisu	13	M	
Bukari	11	M	

Total amount for this household: GHC 28.20

Community: Kapru

REDEEM AT WA WEST DISTRICT NHIS
valid until :23/12/2011

SEND - GHANA

Subsidy voucher for NHIS

NAME	AGE	GENDER	AMOUNT
Shilla Alhassan	37	M	4
Maamuna	35	F	4
Yakubu	9	M	4
Abdul	4	M	4

Community: Kapru

REDEEM AT WA WEST DISTRICT NHIS
valid until :23/12/2011

SEND - GHANA

Subsidy voucher for NHIS

NAME	AGE	GENDER	AMOUNT
Antuo Brimah	66	M	
Rianatu	61	F	
Chorayele	21	M	
Iddrisu	19	M	

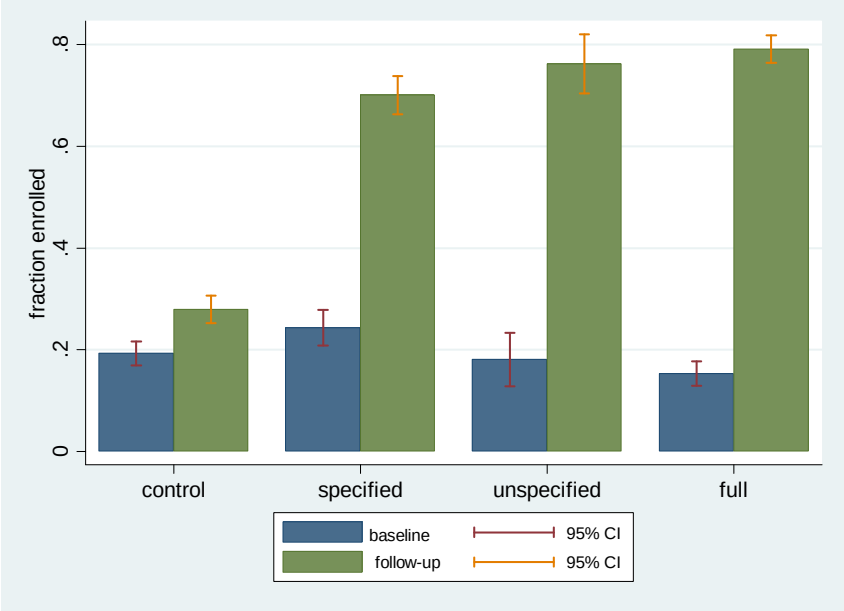
Total amount for this household: GHC 16.00

Community: Kapru

REDEEM AT WA WEST DISTRICT NHIS
valid until :23/12/2011

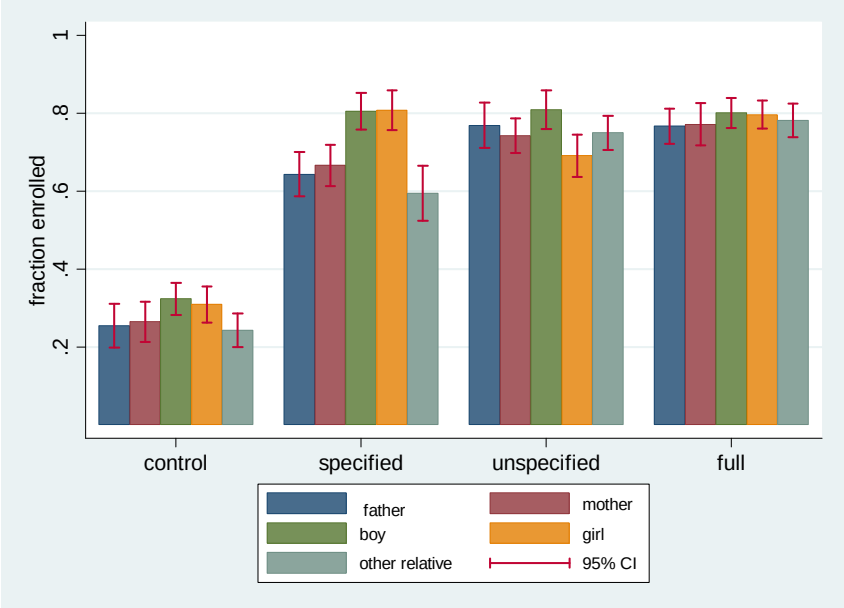
Notes: Households in top panels receive 2/3 subsidy; those in the bottom panels receive 1/3 subsidy. Left panels receive specified vouchers; right panels receive unspecified vouchers. Total amount required to enroll in NHIS in Wa West District are GHC4 for children (less than 18 years), GHC12.20 for adults (aged 18-69) and GHC4 for elderly (70 years or more). Children and the elderly always receive GHC4 with specified voucher. $1=1.5GHC.

Figure 2.3: Enrollment by voucher type at baseline and follow-up



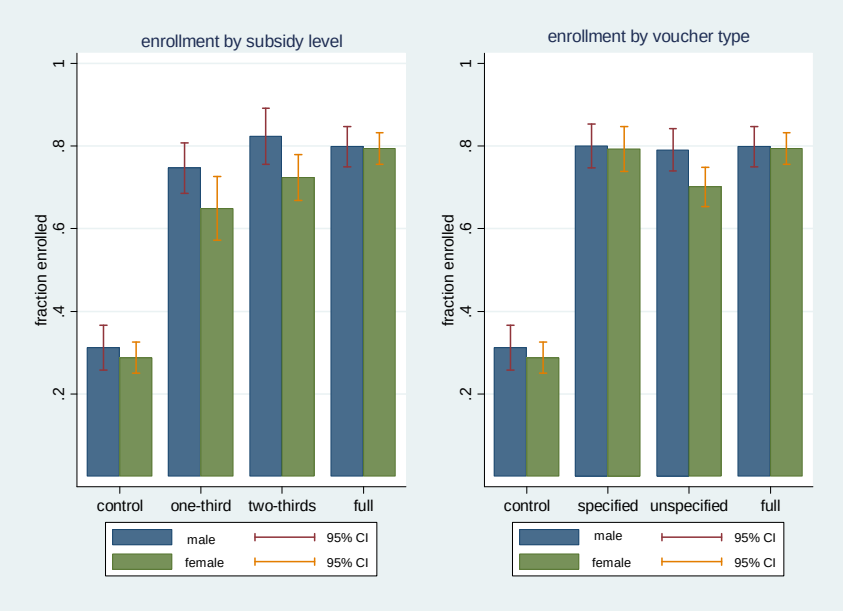
Notes: Figure is based on subsample of subsidy only and pure control households (N=2022)

Figure 2.4: Within Household Enrollment by Voucher Type



Notes: Figure restricted to subsample of subsidy only and pure control households with mothers, fathers, at least one child and another household member (N=1989)

Figure 2.5: Child Enrollment by Subsidy Level and Voucher Type (gender)



Notes: Figure restricted to subsample of 1121 children under 18 years of age from subsidy only and pure control.

Table 2.1: Balance Between Treatments and Control Groups

	Control Mean	1/3 subsidy minus control	2/3 subsidy minus control	full subsidy minus control	specified minus control	unspecified minus control
Number of individuals	**1313**	**476**	**559**	**983**	**551**	**484**
Age	24.313	-1.696	0.399	1.458	-1.326	1.304
Male	0.476	-0.015	0.012	-0.021	0.012	-0.018
Has some formal education	0.337	0.005	0.001	-0.015	0.013	-0.019
Has a health condition	0.072	-0.015	-0.014	-0.006	-0.012	-0.019
Has been ill in the last month	0.109	-0.049	-0.031	-0.019	-0.056*	-0.038
Has visited health facility	0.085	0.033	-0.019	0.004	-0.015	-0.023
Made out of pocket expense	0.133	-0.004	-0.049	0.015	-0.037	-0.047
Health expend. in last month	13.07	0.614	-0.638	0.884	-0.447	0.689
Probably will be sick next year	0.468	-0.006	0.018	0.041	-0.011	0.034
Heard of the NHIS	0.958	0.002	0.001	-0.002	-0.003	0.004
Knowledge of NHIS	10.576	-0.089	-0.412	0.130	-0.229	0.221
Ever enrolled in NHIS	0.338	0.139*	-0.056	-0.077	-0.061	-0.082
Currently enrolled in NHIS	0.201	-0.057	-0.040	0.042	-0.036	-0.033
Re-enrolled in NHIS	0.700	0.106	0.020	0.172**	0.055	0.066
Ever smoked	0.117	-0.001	0.057**	-0.001	0.028	0.016
Drank alcohol in last 2 weeks	0.524	0.028	0.027	-0.013	-0.025	0.101
Slept under mosquito net	0.452	-0.108	-0.105	-0.008	-0.172*	-0.022
Christian	0.422	-0.133	-0.110	-0.076	-0.143	-0.057
Dagaaba	0.438	-0.158	-0.140	0.025	-0.203**	-0.030
Household size	6.944	0.271	-0.081	-0.567	0.067	-0.042
Number of children under 18	3.697	-0.055	-0.162	-0.699	-0.032	-0.270
Head is male	0.808	0.037	-0.049	-0.048	-0.014	-0.034
Owns farming land	0.480	-0.102	-0.052	-0.107	-0.052	-0.102
Owns a mosquito net	0.544	-0.141	-0.209**	-0.096	-0.199**	-0.109
Distance to NHIS regist. (km)	21.286	-3.122	-1.659	4.601	-3.031	-1.885
Distance to health fac. (km)	5.501	0.046	0.096	0.573	0.567	0.909

Notes: *, ** and *** refers to statistical significance at 10%, 5% and 1% levels respectively. All tests of differences adjust standard errors for intra-cluster correlation ie intra-community/village correlation. Specified refers to households receiving 1/3 or 2/3 subsidy with specified amount assigned for each household member. Unspecified refers to households receiving 1/3 or 2/3 subsidy with no specified amount for each household member and therefore household could decide how to allocate subsidy among its members. Dagaaba refers to an ethnic group.

Table 2.2: Effect of Subsidy Level and Voucher Type on Enrollment Rates

Dependent variable:	fraction of HH members enrolled		per capita amount spent on NHIS regis		fraction of children enrolled		fraction of boys enrolled		fraction of girls enrolled	
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**	**(9)**	**(10)**
1/3 Subsidy	0.269***		-1.873*		0.277***		0.294***		0.223**	
	(0.052)		(0.980)		(0.068)		(0.086)		(0.088)	
2/3 subsidy	0.359***		-4.065***		0.332***		0.384***		0.304***	
	(0.050)		(1.727)		(0.064)		(0.069)		(0.083)	
Full subsidy	0.386***	0.386***	-6.368***	-6.368***	0.376***	0.376***	0.391***	0.391***	0.405***	0.405***
	(0.058)	(0.058)	(1.402)	(1.402)	(0.059)	(0.049)	(0.060)	(0.060)	(0.071)	(0.070)
Education	0.139**	0.088*	1.572*	1.911**	0.067	0.065	0.031	0.034	0.026	0.029
	(0.061)	(0.051)	(0.943)	(0.906)	(0.065)	(0.064)	(0.066)	(0.066)	(0.082)	(0.081)
Conve regist. `	0.002	-0.003	1.518	1.222	-0.024	-0.018	-0.009	-0.006	-0.024	-0.016
	(0.053)	(0.054)	(1.141)	(1.15)	(0.057)	(0.057)	(0.068)	(0.069)	(0.062)	(0.063)
1/3 or 2/3 specified		0.283***		-3.366*		0.307***		0.306***		0.309**
		(0.053)		(1.689)		(0.069)		(0.074)		(0.089)
1/3 or 2/3 unspecified		0.341***		-2.539*		0.407***		0.452***		0.231**
		(0.057)		(1.402)		(0.074)		(0.086)		(0.090)
N	**638**	**638**	**638**	**638**	**576**	**576**	**488**	**488**	**476**	**476**
F-statistic	**29.13**	**33.23**	**6.45**	**5.24**	**22.58**	**22.41**	**16.58**	**15.93**	**17.56**	**16.96**
R^2	**0.2882**	**0.2907**	**0.0416**	**0.0425**	**0.2587**	**0.0433**	**0.2633**	**0.2622**	**0.2399**	**0.2427**

Notes: Robust standard errors clustered at community level are reported in brackets. *, *** and *** denote statistical significance at 10%, 5% and 1% levels respectively. Per capita amount spent on NHIS registration is defined as the total amount household spent to enroll members in NHIS divided by the total number of household members enrolled. All regressions include the following covariates: the household head's age and its square, his/her religion and ethnicity and education status, household wealth index, indicator that a household member has chronic condition, distance to the NHIS registration center and nearest health facility. In addition to these covariates, columns 1 and 2 include number of children under 18 years.

Table 2.3: Intrahousehold Allocation by Age Group

	Dependent variable: indicator = 0 for not enrolled, 1 for enrolled	
	(1)	**(2)**
1/3 Subsidy	0.314***	
	(0.075)	
2/3 subsidy	0.466***	
	(0.060)	
Full subsidy	0.517***	0.496***
	(0.058)	(0.068)
Aged ≤17 years	0.080**	0.080**
	(0.030)	(0.030)
Aged ≥70 years	-0.052*	-0.052
	(0.050)	(0.050)
Aged ≤17 years*1/3 subsidy	0.147*	
	(0.078)	
Aged ≥70 years * 1/3 subsidy	0.034	
	(0.069)	
Aged ≤17 years*2/3 subsidy	0.007	
	(0.044)	
Aged ≥70 years * 2/3 subsidy	-0.047	
	(0.103)	
Aged ≤17 years*full subsidy	0.015	0.015
	(0.037)	(0.037)
Aged ≥70 years * full subsidy	-0.061	-0.061
	(0.081)	(0.081)
Amounts specified		0.343***
		(0.066)
Amounts unspecified		0.550***
		(0.075)
Aged ≤17 years* specified		0.133*
		(0.075)
Aged ≥70 years * specified		0.036
		(0.051)
Aged ≤17 years* unspecified		0.007
		(0.070)
Aged ≥70 years * unspecified		-0.199*
		(0.109)
N	**2022**	**2022**
Adj. R2	**0.3096**	**0.3109**

Robust standard errors clustered at community level reported in brackets. *, *** and *** denote statistical significance at 10%, 10 and 1% levels respectively. Age group 18-69 is the omitted category for age group variable. 1/3 subsidy and 2/3 subsidies refers to households receiving amount that pays for 1/3 and 2/3 of the cost of enrolling in insurance. All regressions include controls for gender, religion, ethnicity, distance to the insurance registration center and distance to the nearest health facility.

Table 2.4: Current and Expected Health at Baseline (full sample and children)

Dependent var:	injured in last two weeks	illness in last two weeks	has chronic health condition	expects to be ill next year
	Panel A: Full sample			
age<18	-0.004**	-0.027***	-0.074***	0.047***
	(0.002)	(0.009)	(0.008)	(0.013)
age>69	0.000	0.039*	0.157***	0.086***
	(0.001)	(0.023)	(0.028)	(0.028)
N	**4313**	**4313**	**4313**	**4313**
	Panel B: Children(gender)			
male	0.002	0.013	0.004	-0.001
	(0.002)	(0.008)	(0.005)	(0.013)
N	**2309**	**2309**	**2309**	**2309**

Notes: Robust standard errors clustered at community level are reported in brackets. *, *** and *** denote statistical significance at 10%, 5% and 1% levels respectively. Sample for regressions are restricted to baseline sample of children under 18 years of age. All regressions include the following covariates: age, mother's education status, household wealth (poorest third and richest third, middle third omitted), household size, religion, ethnicity, distance to nearest health facility and distance to NHIS registration point. In panel A, the omitted category is adults (age 18-69).

Table 2.5: Allocation Within Households by Voucher Type

	Dependent variable: indicator = 0 for not enrolled, 1 for enrolled	
	(1)	**(2)**
Specified	0.360***	0.326***
	(0.075)	(0.061)
Unspecifed	0.481***	0.534***
	(0.083)	(0.072)
Full subsidy	0.449***	0.484***
	(0.084)	(0.089)
mother	0.009	-0.017
	(0.032)	(0.054)
boy child	0.078*	0.098**
	(0.041)	(0.048)
girl child	0.028	-0.016
	(0.057)	(0.061)
Other relative	-0.077*	-0.086*
	(0.040)	(0.046)
mother * specified	0.016	0.008
	(0.082)	(0.071)
boy child * specified	0.158*	0.121**
	(0.083)	(0.067)
girl child * specified	0.153*	0.132*
	(0.089)	(0.076)
Other relative * specified	-0.033	0.007
	(0.086)	(0.099)
mother * unspecified	-0.028	-0.043
	(0.056)	(0.050)
boy child * unspecified	0.056	0.015
	(0.057)	(0.050)
girl child * unspecified	-0.097*	-0.133*
	(0.057)	(0.073)
Other relative * unspecified	-0.007	0.003
	(0.105)	(0.103)
mother * full subsidy	-0.000	-0.016
	(0.076)	(0.070)
boy child * full subsidy	0.074	0.051
	(0.062)	(0.060)
girl child * full subsidy	0.045	0.033
	(0.062)	(0.059)
Other relative * full subsidy	0.025	0.004
	(0.094)	(0.094)
Other covariates		X
N	**2022**	**2022**

Notes: Robust standard errors clustered at community level are reported in brackets. *, ** and *** denote statistical significance at 10%, 5% and 1% levels respectively. Sample restricted to subsidy only and pure control households. Specified refers to less than full subsidy voucher that specifies subsidy amount for each household member. Unspecified refers to less than full subsidy voucher which allows household to decide the allocation among its members. Column 2 include a full set of covariates.

Table 2.6: Child Enrollment by Gender

	Dependent variable: Indicator =1 for enrolled; = 0 for not enrolled			
	(1)	**(2)**	**(3)**	**(4)**
1/3 subsidy	0.311***	0.214**		
	(0.098)	(0.096)		
2/3 subsidy	0.343***	0.283***		
	(0.056)	(0.052)		
Full subsidy	0.372***	0.359***	0.372***	0.359***
	(0.065)	(0.063)	(0.065)	(0.063)
1/3 subsidy * male	0.057	0.069*		
	(0.041)	(0.036)		
2/3 subsidy * male	0.083*	0.108*		
	(0.045)	(0.046)		
Full subsidy * male	-0.028	-0.022	-0.018	-0.021
	(0.048)	(0.043)	(0.049)	(0.050)
Male	0.002	-0.003	0.002	-0.003
	(0.023)	(0.022)	(0.023)	(0.023)
1/3 or 2/3 specified			0.307***	0.221***
			(0.070)	(0.071)
1/3 or 2/3 unspecified			0.405***	0.377***
			(0.079)	(0.077)
1/3 or 2/3 specified * male			0.001	0.007
			(0.039)	(0.043)
1/3 or 2/3 unspecified * male			0.103*	0.117**
			(0.054)	(0.055)
Other covariates		X		X
N	**1121**	**1121**	**1121**	**1121**

Notes: Robust standard errors clustered at community level are reported in brackets. *, ** and *** denote statistical significance at 10%, 5% and 1% levels respectively. 1/3 or 2/3 specified refers to less than full subsidy voucher that specifies subsidy amount for each household member. 1/3 or 2/3 unspecified refers to less than full subsidy voucher which allows household to decide the allocation among its members. Sample for all regressions restricted to children aged under 18 years from subsidy only and pure control households. Other covariates include both individual-level and household/community-level variables. Individual-level covariates are: indicator for having a health condition, indicator for visiting a health facility at baseline, education status. Household/community-level covariates are: household wealth (poorest third and richest third, middle third omitted), household size, religion, ethnicity, distance to nearest health facility and distance to NHIS registration point.

Table 2.7: Allocation of Mosquito Nets Among Children

Dependent variable: **Indicator for slept under a mosquito net last night**	Baseline		Follow-up	
	(1)	**(2)**	**(3)**	**(4)**
Male	0.102***	0.095***	0.076**	0.064**
	(0.031)	(0.027)	(0.029)	(0.028)
Covariates		X		X
N	**2108**	**2108**	**2031**	**2031**
F-statistic	**10.61**	**14.51**	**6.70**	**4.14**
R^2	**0.0105**	**0.0940**	**0.0059**	**0.0729**

Notes: Robust standard errors clustered at community level are reported in brackets. *, *** and *** denote statistical significance at 10%, 5% and 1% levels respectively. Sample for regressions are restricted to children under 18 years.

Table 2.8: Children's Labor Market Participation

Dependent variable: Indicator =1 worked last week; = 0 for did not work		
	(1)	**(2)**
Male	0.037*	0.036**
	(0.020)	(0.017)
Other covariates		X
N	**2125**	**2125**

Notes: Robust standard errors clustered at community level are reported in brackets. *, ** and *** denote statistical significance at 10%, 5% and 1% levels respectively. Sample for regressions is restricted to children aged 7-18 years. Other covariates include both individual-level and household/community-level variables. Individual-level covariates are: indicator for having a health condition, indicator for visiting a health facility at baseline, education status. Household/community-level covariates are: household wealth (poorest third and richest third, middle third omitted), household size, religion, ethnicity, distance to nearest health facility and distance to NHIS registration point.

Chapter 3

Fertility Behavior of Various Socio-Economic Groups in Response to the Introduction of Reproductive and Family Planning Services in Rural Africa: Longitudinal Evidence from the Kassena-Nankana Districts of Northern Ghana

3.1 Introduction

The relationship between socio-economic status and fertility is a subject of long-standing research interest among economists and other social scientists. Following seminal work of Becker and Lewis (1973), a number of empirical studies have demonstrated that family size has negative effect on socio-economic outcomes of children (Rosenzweig and Wolpin, 1980; Gruber et al, 1999; Donohue et al, 2002; Charles and Stephens, 2006; Pop-Eleches, 2006). However, recent studies from developed countries fail to find any causal effect of family size on socio-economic status (Black et al, 2005; Angrist et al, 2006; Aaslund and Gronquist, 2007). Another body of work has sought to shed light on the effect of socio-economic status on fertility outcomes, mostly showing a negative gradient (Gertler and Molyneaux1994; Bongaarts, 2003; Breierova and Duflo, 2004; Dust, 2005; Al Kandari, 2007; Schellekens, 2009; Kim, 2010; Pop-Eleches, 2010; Brand and Davis, 2011; Dribe and Scalone, 2011).

This chapter seeks to explore how the quasi-experimental introduction of reproductive and family planning services affect the fertility behavior of different socio-economic groups in a rural African setting. The chapter combines a rich longitudinal data with quasi-experimental introduction of reproductive and family planning interventions in the Kassena-Nankana districts of northern Ghana to show how women of different socio-economic status respond to such interventions. We follow 24204 women who were of reproductive age (15-49 years) in 1993 for 18 years. We document the association between socio-economic status, measured by women's education status, her husband's education status and wealth status, and fertility preferences, regulation and outcomes before the introduction of the reproductive health interventions. We then investigate how the responses to the interventions differed by socio-economic status.

Most existing studies on the fertility-socio-economic status gradient focus on the role of educational attainment of women. The existence of a strong negative gradient has been

used as a basis for promoting female education as a tool for fertility reduction in many developing countries (Cochrane, 1979; Jeejeboy, 1992). However, in settings where social and cultural traditions emphasize male dominance in marriages, the effectiveness of such policies may be uncertain. For instance, in Sub-Saharan Africa the predominance of marriage and reproductive customs and norms that accentuate the dominance of men in reproductive decision-making within the family may render female education a less effective strategy for reducing fertility (Caldwell and Caldwell, 1987, 1988 and 1990). In such settings husband's education may be as strong a predictor of fertility as a woman's education.

We find that at baseline educated women did not have significantly fewer children, but desired lower family sizes and were more likely to use modern contraceptives. However, husband's education was associated with lower fertility especially when their wives were also educated. Wealth was associated with higher fertility. Moreover, controlling for wealth does not affect the effect of education on fertility. We find that the reproductive health interventions affected both educated and uneducated women but the effect on educated women was stronger, leading to the emergence of an education-fertility differential 16 years after the introduction of the interventions. Furthermore, our results show that this fertility differential by women's education status is concentrated in women with educated husbands.

Our results highlight the importance of men in reproductive decision in settings like ours. Marriage arrangements in this setting is characterized by customs and traditions that severely restrict the autonomy of women and emphasize male dominance in reproductive decision-making. For instance, married women who adopt contraception without the consent of their husbands face punishments that could be as severe as being ostracized from their communities (Debpuur et al, 2002). Our findings demonstrates that in such settings, education of men has an equally important, if not more important role in fertility control.

The chapter makes two main contributions to the literature on relationship between socio-economic economic status and fertility. Firstly, we use more diverse measures of socio-

economic status. Gertler and Molyneax (1994), Dust (2005) and Al Kandari (2007) also use both income/wealth and educational attainment in their study but none of them attempt to assess the relative effects of women's and men's educational attainment on fertility. To the best of our knowledge, Breierova and Duflo (2004) is the only other paper that explicitly use men's and women's education to understand fertility behavior in Indonesia. They find that female education is a stronger determinant of age at marriage and early fertility than male education. Secondly, we also use a plausibly exogenous source of variation in the cost of contraception to study fertility behavior.

The chapter is structured as follows. The next section describes the context of the study and the nature of reproductive interventions that were introduced. Section three describes the data and analytical methods employed. Results are presented in section 4. Section 5 presents concluding discussions of the results.

3.2 Setting

The setting is the Kassena-Nankana districts[1] of the Upper East Region of Ghana, two impoverished rural districts located on the North-eastern corner of Ghana. Until recently, the highly dispersed settlement patterns and limited access to modern communication left these remote districts largely isolated from the outside world. Illiteracy rates are high and access to formal health care services is limited access. Pervasive animist religious practices and traditional forms of social organization and cultural traditions that limits the autonomy of women and emphasize the dominance of men in decision-making process contributed to high fertility rates in the area (Debpuur, et al. 2002).

In the mid-1990s, the Navrongo Community Health and Family Planning Project (CHFP) was launched in the district to test the hypothesis that family planning services can induce

[1]The Kassena-Nankana District was split into Kassena-Nankana East and West in 2008

sustained reproductive change in a traditional rural African population (Binka et al 1995). The CHFP employed a quasi-randomized design that assigned treatments to different parts of the district called treatment cells.[2] One cell (CHO) received a community health nurse who provided doorstep family planning and ambulatory services. A broad of range of family planning and reproductive health services were provided under this intervention. These include oral contraceptives and condoms, and injectable contraceptives as well as treatment of common ailments and immunization. This intervention also included scheduled visits by nurses to all compounds within an assigned catchment area in 90-day cycles to provide these services although this requirement was not strictly regulated (Debpuur et al 2002). In another cell (YZ), existing traditional social and political structures were mobilized in support of community health and family planning services. Known as the zurugelu (togetherness), it involved constituting health action committees from existing social-political structures and mobilizing traditional peer networks to provide outreach to men. A third cell received both interventions (CHO+YZ) while a forth cell was designated a control cell.

To monitor the impact of the project, a district-wide longitudinal health and demographic surveillance system (HDSS) was put in place to provide basic indicators of interest, particularly fertility and mortality indictors. The HDSS was instituted in 1993 to serve as the bedrock of research by the Navrongo Health Research Center (NHRC) into mortality, morbidity and other health issues in the Kassena-Nankana districts. The districts currently have a total population of about 150,000 individuals under continuous monitoring. Data from this HDSS shows substantial reduction fertility in response to the CHFP project: total fertility rates fell by over 1.2 births in just fifteen years after the launch of the project (Philips et al 2012).

[2]Detailed description of the design can be found in Debpuur et al (2002)

3.3 Methods

3.3.1 Data

The data resources for this paper are from the Navrongo Health and Demographic Surveillance System (HDSS). Over the last 20 years, the HDSS has collected information on births, deaths, relationships and migration and other demographic information on all residents of the two Kassena-Nankana districts that provides a unique platform for monitoring health and demographic change over time. The HDSS also includes an annual update of educational attainment, immunization and frequent updates of compound belongings.[3] In addition, the NHRC conducted an open-cohort panel survey of over 5,000 women (henceforth Panel) drawn from approximately 1,900 randomly sampled compounds from the HDSS database that involves all married women of reproductive age and their co-resident husbands. For more than 10 years (1993-2003), these women were surveyed annually to assess their reproductive behavior and preferences, contraceptive use and fertility determinants, as well as indicators of health seeking behavior. In 1999, a socio-economic survey that collects detailed information about household assets, sources of drinking water, and materials for the construction of their homes was added to the Panel survey.

The information from these two data resources is complementary for the current analyses. The continuous updating system of the HDSS provides accurate information about women's total live births and surviving children, in addition to basic demographic information. It also contains information on educational and wealth for measuring relationship between fertility and socio-economic status before and during the demographic transition in our setting. Though the HDSS contains essential information over an extended period for the

[3] A compound is composed of one or more households. Prior to 2004, assets information was collected at the compound level. Since 2004 these have been collected at the household level.

entire population, it contains no information about fertility preferences and regulations that may explain fertility outcomes during demographic transition. By contrast, the Panel, while shorter in terms of duration, contains detailed annual information on fertility preferences and contraceptive use. We use the Panel mainly for our analyses of fertility regulation and preferences.

3.3.2 Empirical Strategy

The paper first describes the relationship between fertility preferences, regulation and outcomes and socio-economic before the start of the CHFP project. We estimate this relationship using the following regression equation:

$$fertilit_{wc} = \delta_0 + \delta_1 socio_{wc} + X_{wc}\theta + \mu_{wc} \tag{3.1}$$

where $fertility_{wc}$ denotes fertility desires/preference, regulation or outcome of woman w living in compound c, $socio_{wc}$ denotes socio-economic status, X_{wc} is a vector of baseline characteristics of women and μ_{wc} is the error term. Fertility preference is measured by desired family size; fertility regulation is measured by self-reported indicator for using modern contraceptives; fertility outcome is measured by total number children ever born to a woman and the number of surviving.

We investigate differential response to the CHFP project by socio-economic status by interacting baseline socio-economic status with treatment cell assignment from the CHFP project. The general regression equation used for these estimations is:

$$fertility_{wct} = \beta_0 + \beta_1 treat_{wc} + \beta_2 socio_{wct-1} + \beta_3 (treat_{wc} * socio_{wct-1}) + X_{wct-1}\sigma + \varepsilon_{wct} \tag{3.2}$$

Where $socio_{wct-1}$ denotes socio-economic status measured at baseline, treatwc indicates CHFP treatment assignment, and X_{wct-1} is a vector of baseline characteristics of women. The coefficient β_3, measures the differential fertility responses to CHFP treatment assignment by socio-economic status. Because our main fertility measures – number of children ever born and number of surviving children – are both count variables we use the Poisson model in our estimations. In regressions not reported here, we used the negative binomial model and the results are identical to those reported here. When the outcome variable is contraceptive use we use logistic model in our estimations.

We use two samples for our estimations: one from the Panel survey (Panel sample) and another sample from the surveillance data (HDSS sample). The Panel sample is used only for estimations before the start of the CHFP project and is restricted to 3858 women of reproductive (15-49) who were included in the original sample in 1993. The HDSS is restricted to a sample of 24204 women in their reproductive age in 1993 and who report all relevant variables used for the analyses. We measure children ever born and surviving children in 1993 and 2011. We retain women who died between 1993 and 2011 in the analyses sample in order to prevent maternal mortality from biasing our results. For such women, current fertility outcomes are measured at the time of death. The measure of wealth used here is a three-category wealth indicator. This is generated from the year 2000 round of compound-level ownership of assets using the method of principal component. While a wealth measure before the start of the CHFP (1995) would have been preferred this is not available. However, since wealth does not change rapidly overtime, we are confident that the 2000 wealth status is a good proxy. Our measure of education for both women and their status is an indicator for having any formal education.

3.4 Results

3.4.1 Descriptive Statistics

Table 3.1 presents descriptive statistics of the samples. The variables for the HDSS sample are measured in 1993 to enable comparison of the two samples. The Panel sample is largely representative of the HDSS with the exception of the age distribution. The HDSS sample is almost evenly distributed across age groupings 15-24, 25-34 and 35-49 while the Panel sample has fewer women under the age of 25 (22%) and more older women (41% aged 35-49). The fraction of married women is identical at 81% and about 42% of women (41% in the Panel) are in polygamous marriages. About 90% of women have at least one child but the number of number children per woman (4.33) and number of surviving children (3.77) is slightly higher in the Panel than in the HDSS. Majority of women (70% in the Panel and 66% in the HDSS) practise traditional African religion with just under 30% being Christians and under 5% being Muslims. About 76% of women (77% in the HDSS sample) have no formal education while 86% of their husbands (85% in the HDSS sample) have no formal education. The distribution of women across the CHFP treatment groups is comparable across the two samples. Our measure of fertility preference (desired family size) and fertility regulation (use of modern contraceptives) are available only in the Panel. The average woman wants a family size of 6 people. About 11% of women report using modern contraceptives.

Table 3.2 reports differences in various characteristics of both samples by education and wealth status. We group compounds into three categories: poorest third (poor), middle third (middle) and richest third (rich). Panel A reports tests from the HDSS sample while Panel B reports tests from the Panel sample. The table shows that women with some education have significantly higher marriage rates, marry a little later, have fewer total live births and surviving children, and are less likely to be in polygamous marriages.

Women from relatively wealthy compounds have significantly higher marriage rates,

marry a little later, have fewer total live births and surviving children but are more likely to be in polygamous marriages. The Panel sample (panel B) shows similar patterns qualitatively and quantitatively. Educated women desire fewer children and are more likely to use modern contraceptives. Women from relatively wealthy compounds desire few children and more likely to use modern contraceptives.

3.4.2 Fertility and socio-economic Status at Baseline

Figures 3.1-3.4 and Tables 3.3 and 3.4 show the relationship between socio-economic status and fertility preference, outcomes and regulation before the start of the CHFP project. Figures 1 and 2 show the distributions of children per woman by education and wealth status respectively using the HDSS sample. The top panels use children ever born while the bottom panels use number of surviving children. The left panels shows relationships before the start of the CHFP (1993) and the right panels show those for 2011. The relationship between age and the number of children is estimated non-parametrically using the lowess smoothing command in Stata. (This command has been used to estimate the relationship between age and other variables presented in all graphs in this paper). The top left panel of Figure 3.1 shows that in 1993, the distributions of children ever born are remarkably similar for both educated and non-educated women up to the age of 40 years at which point the distribution for educated women is distinctively above those with no education. The same picture emerges when using surviving children as the measure of fertility. This is consistent with other studies that find that educated women tend to have higher fertility rates in the early cohorts but lower fertility in later cohorts (Jejeebhoy, 1995; Schnieder & Schneider, 1996; Kim, 2010). The bottom left panel of Figure 3.2 shows a similar relationship by wealth status (poor, middle or rich). The distributions are almost identical. Taken together, Figures 3.1 and 3.2 show the absence of a relationship between socio-economic status and fertility

prior to the start of the CHFP project.

Figures 3.3 and 3.4 depict the relationship between fertility (preference, outcome and regulation) and age by education and wealth status using the Panel sample in 1993. The top panels are for children ever born (top left) and number of surviving children (top right). The top panels of Figure 3.3 reveal nearly identical distributions among educated and non-educated women. The top panel of Figure 3.4 also shows nearly identical distributions of children ever born and surviving children among women of different wealth status. This confirms the findings from the HDSS sample: there are no significant differences in fertility outcomes between women of various socio-economic status before the start of the CHFP project.

The bottom panels of Figures 3.3 and 3.4 depict fertility regulation (use of modern contraceptives) and preference (desired family size) by education and wealth status respectively. Although actual births are almost identical among women from various socio-economics groups, the bottom left panels of Figures 3 and 4 show marked differences in their desired family size. Unsurprisingly, the lower right panels show significant differences in the use of modern contraceptive by socio-economic status.

To confirm the findings from the graphical analysis, we now use regression techniques that allows us to control for proximate determinants of fertility which may affect the fertility-socio-economic gradient. Moreover, the regression techniques will allow us to estimate the additional effect of education on fertility after controlling for the effect of wealth. Table 3.3 presents results using the HDSS sample. The outcome variable in columns 1-3 present is number of children ever born and columns 4-6 report regressions where the number of surviving children is the outcome variable. Column 1 uses woman's own education status and husband's education status as measures socio-economic status. There is no statistically significant relationship between women's education status and the number of children. However, there is a negative and significant (at 10% level) relationship between husband's

education status and the number of children. In column 2 we include an interaction between woman's education status and her husband's education status. The interaction term is negative is statistically significant at 5% level but neither education coefficient alone is significant. This implies that the effect of husband's education status on fertility is almost entirely driven by couples in which both women and husband are educated. In column 3, we include our measure of wealth. The coefficients are positive and statistically significant indicating that women from relatively richer compounds had more children. The effect of education remains even after adding wealth, an indication that education status captures a different aspect of socio-economic status from wealth. Columns 4-6 estimate the same models as 1-3 using number of surviving children as outcome. Qualitatively, the results from columns 4-6 are identical to those from columns 1-3. However, there some differences in terms of magnitudes. The coefficients on both education and wealth and fertility are larger when using number of surviving children, reflecting the negative socio-economic-status-child survival gradient that is widely documented in the literature (Caldwell, 1979; Prichett & Summers, 1996; Breierova & Duflo; 2004; Dust; 2005).

Table 3.4 presents regression results of the relationship between socio-economic status and fertility preference, outcome and regulations using the Panel sample. The first two columns show the relationship between socio-economic status and the number of children ever born. As with the HDSS sample, column 1 shows that neither woman's education status nor her husband's education by itself explains fertility but their interaction is negatively associated with fertility. Column 2 shows that adding wealth status does not alter this relationship. Unlike the HDSS sample however, wealth has no effect on fertility. Column 2 shows that these relationships remain after controlling for the effect of compound wealth. Wealth itself has no effect on the number of children women give birth to. Columns 3-4 show the relationship between socio-economic status and desired family size. Column 3 shows that both a woman's education status and her husband's education status affect desired family

size but the effect of husband's education is stronger. Column 4 shows that women from relatively richer compounds desire smaller family sizes. Again, the addition of the wealth effect has little effect on the size of the education coefficients. Columns 5 and 6 report log odd-ratios from logistic regressions showing the association between socio-economic status. Column 5 shows that both women's and husband's education are associated with higher odds of using modern contraceptives but their interaction is not. Column 6 shows that women from richer compounds have higher odds of contraceptive use.

3.4.3 Fertility Response to the CHFP by Socio-economic Status

Figure 3.5 shows distribution of children by CHFP assignment in 1993 and 2011. The left panel of the figure shows identical distributions among women who were 30 years old or younger. The distributions diverge after age 30, an indication that the CHFP assignments may not have been completely random. The right panel shows the distributions in 2011. After 18 years, the distributions diverge across all ages with much greater divergence across among those aged 45 years and above (or 27 years and above in 1993). The right panel shows the largest effect of the CHFP is come from the YZ and YZ+CHO treatment arms.

Figures 3.1 and 3.2 show how the relationship between socio-economic status and fertility has changed in the years since the CHFP was introduced. The right panels of each figure show the distribution of births by socio-economic status in 2011 while the left panels show the distribution in 1993. The right panel of Figure 1 shows that by 2011 the distribution for educated women clearly lies below that of uneducated women. This is the case for both children ever born and surviving children. Figure 3.2 replicates this same graph using wealth as the measure of socio-economic status. The top panel shows that there is not much change in the number of children ever born by wealth status between 1993 and 2011. The bottom right panel however shows a difference between surviving children by wealth status. The

distribution of surviving children for women from richest third of compounds lies above those for middle third and poorest third of compounds. A comparison of top right panel and bottom right panel suggests that this difference is driven by relatively higher child survival rates in richer compounds as found elsewhere. Taken together, Figures 3.1 and 3.2 suggest that while there was no difference in fertility in 1993, 17 years after the start of CHFP program educated women have fewer children. There is no such change in children ever born by wealth status although differences in child mortality rates by wealth led to lower surviving children by women from relatively poorer compounds.

Tables 3.5 (with results continued in Table 3.6) presents the effect of CHFP on the association between fertility and socio-economic status using children ever born as outcome variable. All regressions include controls for age group, marital status, indicator for being in a polygamous marriage, religion, age at first marriage and its square. Column 1 shows that the CHO and CHO+YZ each has significant negative effect on births but the YZ intervention alone has no effect on births. The effect of CHO is stronger than the combined effect of CHO+YZ. Column 1 also shows that both women's own education and her husband's education now have negative and statistically significant effect on births and size of these effects are identical. In column 2, we include an interaction between woman's education and husband's education. The interaction term is negative and statistically significant, an indication that when both couple are educated there is a stronger negative effect on births. Moreover, adding the interaction reduces the coefficients on both women's education status and husband's education status, the former becoming insignificant. This indicates that all the negative fertility effect of women's education is driven by couple in which both spouses are educated. Also among uneducated women, fertility is lower when a woman is married to educated men. Column 3 estimates a model that includes interaction between women's education and CHFP assignment. Adding these interaction terms does not change the size or significance of CHO and CHO+YZ treatments. All the interaction terms are negative

but only the interaction between women's education status and CHO+YZ is significant at 10% level. This indicates the while CHO and CHO+YZ affected educated and uneducated women the effect of CHO+YZ was stronger among educated women.

Column 4 adds interaction between husband's education and CHFP treatments. Although these interaction terms are negative they are not statistically significant. Inclusion of these interactions has no effect on the other coefficients. Finally, column 5 includes wealth and interaction between wealth and CHFP assignment. The coefficients on wealth status are positive and statistically significant for the richest third of compounds, suggesting that women from richest third of compounds had more births relative to those from the poorest third of households. The interaction terms are negative but not statistically significant. Moreover, adding the wealth controls does not alter the effect of the education status, suggesting that education has an independent effect on fertility after controlling for the effect of health.

Table 3.7 (results continued in Table 3.8) replicates the regressions from Table 3.4 using number of surviving children as the outcome variable. The results are consistent with those from Tables 3.5 and 3.6 although the magnitudes of some coefficients differ somewhat. Column 1 shows that both CHO and CHO+YZ had negative and significant effect on births but the coefficient are lower than those from Table 3.4. The coefficients on women's education and husband's education are also smaller. Adding the interaction between the two education coefficients knocks out the effect of the individual education variables. As in Tables 3.5 and 3.6, interacting the CHFP and woman's education does not affect size or significance of the coefficients on CHFP interventions and the interactions are negative and significant for CHO+CHFP, an indication that the interventions affected both educated and uneducated women but stronger effects for educated women. The size of this interaction term is larger than that found in Tables 3.5 and 3.6, a reflection of the child mortality differentials by woman's education status. As in Tables 3.5 and 3.6, interaction between CHFP interven-

tions and wealth are negative but not statistically significant. However, the coefficient on women from the richest compound is positive and significant, and larger than that found in the Tables 3.5 and 3.6, another confirmation of the effect of wealth on child mortality.

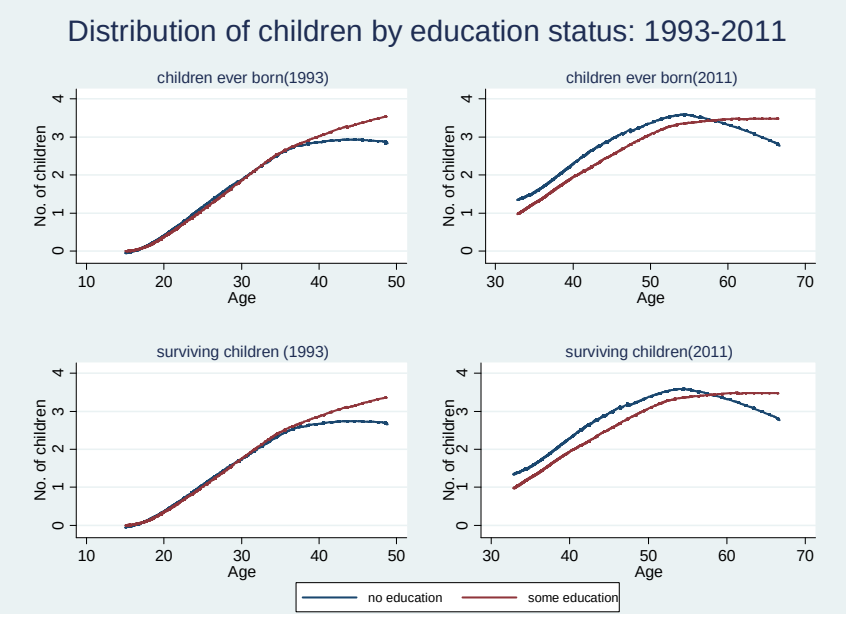
3.5 Summary and Conclusion

We combine longitudinal data from Kassena-Nankana District in rural northern Ghana with quasi-experimental introduction of a reproductive health and family planning program – the Navrongo Community Health and Family Planning Project (CHFP) – to study the association between socio-economic status and fertility. We find that prior to the start of the CHFP there was no statistically significant differences in fertility between educated and non-educated women although educated women desired smaller family sizes and had higher odds of contraceptive use. Fertility was however lower for women with educated husbands especially when the women herself was educated. We found no differences in children ever born by wealth but a positive relationship between surviving children and wealth, reflecting the negative correlation between childhood mortality and wealth.

We find that placement of nurse into communities to provide family planning and ambulatory services reduced both the number of children ever born to a woman and the number of surviving children but mobilization social and political institutions in support of family planning had no effect on number of births. Combining the two interventions also resulted in lower births. Our results hold for both educated and non-educated women but are stronger among educated women especially when the two interventions were combined. We also find the negative effect of husband's education on total births and surviving children persist following the introduction of the CHFP but there are no statistically significant differences in the effects of the interventions by husband's education status. Moreover, the effect of the interventions was not different among women from different wealth backgrounds.

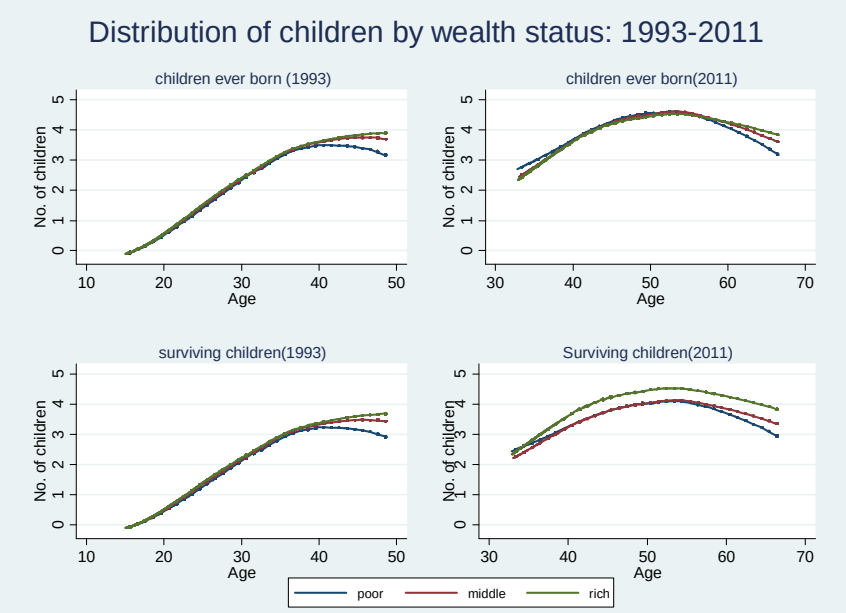
Our results suggest that introduction of reproductive health and family planning interventions had stronger impact on educated women as suggested by some previous studies (Schultz, 1975; Kim, 2010). Our results also indicate that education has independent effect on fertility outside of any income effect. Finally, our results also suggest that in settings with sociocultural customs and practices that lead to male dominance in reproductive health decisions as is the case in many rural African societies, education of men may be play an important role in fertility.

Figure 3.1: Women's Education and Fertility Outcome



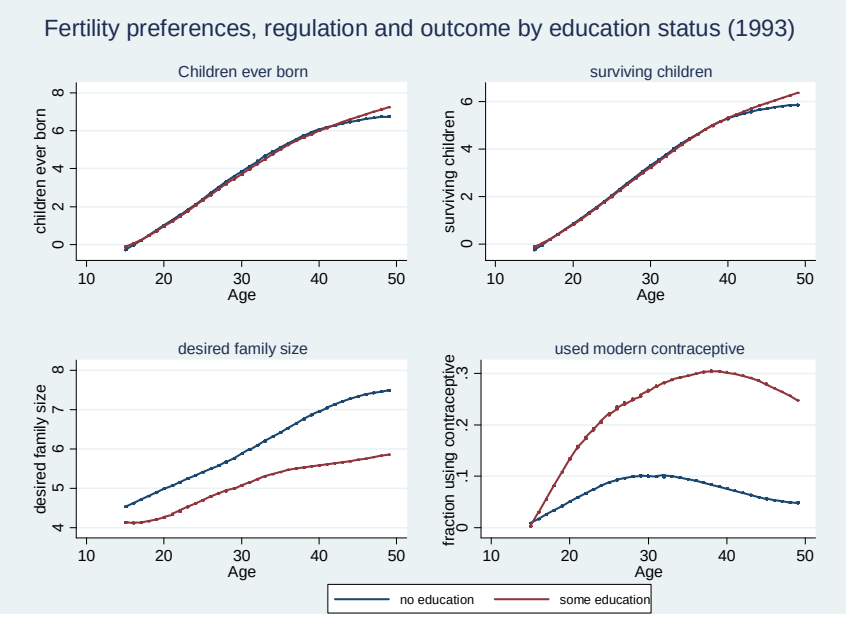
Note: All graphs are based on predicted values from non-parametric estimation of the using the *lowess* command in STATA

Figure 3.2: Wealth Status and Fertility Outcome



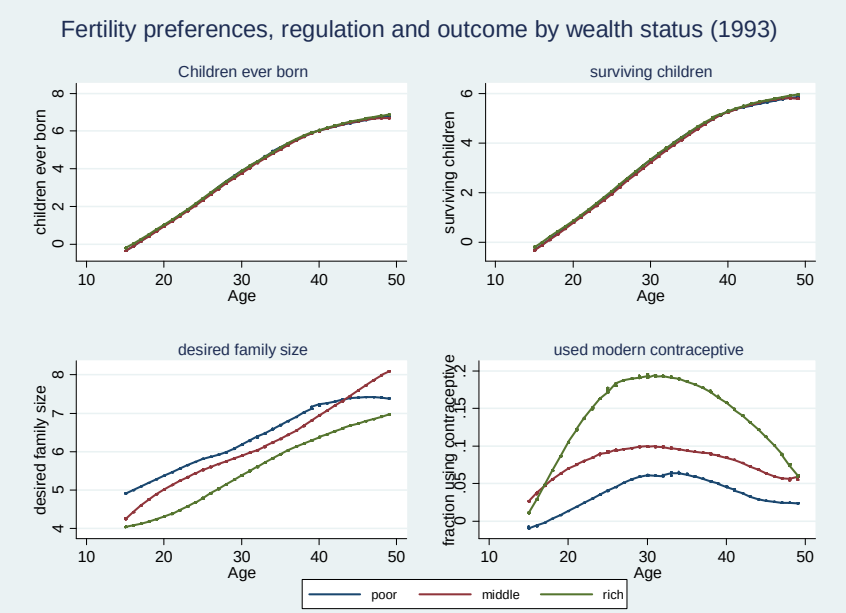
Note: All graphs are based on predicted values from non-parametric estimation of the using the *lowess* command in STATA

Figure 3.3: Women's Education and Fertility Preferences, Desires and Outcomes



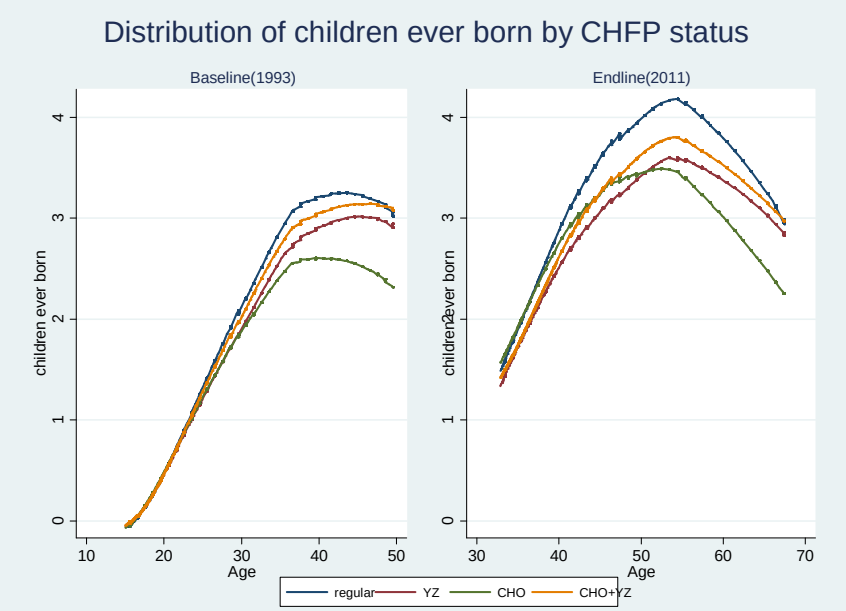
Note: All graphs are based on predicted values from non-parametric estimation of the using the *lowess* command in STATA

Figure 3.4: Wealth Status and Fertility Preferences, Desires and Outcomes



Note: All graphs are based on predicted values from non-parametric estimation of the using the *lowess* command in STATA

Figure 3.5: Effect of CHFP on Fertility Outcomes



Note: All graphs are based on predicted values from non-parametric estimation of the using the *lowess* command in STATA

Table 3.1: Descriptive Statistics

	Panel	HDSS (1993)
Number of women	3858	24204
Demographics		
15-24	22.25%	32.61%
25-34	36.65%	33.57%
35-49	41.10	33.82%
Married	80.71%	80.62%
Age at first marriage	18.06(2.82)	18.72(3.56)
In polygamous marriage	41.20%	42.33%
Fertility		
At least one child	89.49%	90.31%
Children ever born	4.33(2.74)	3.978(2.13)
Surviving children	3.77(2.45)	3.57(1.96)
Desired family size	5.99(0.66)	-
Currently using modern contraceptive	10.83%	-
Religion		
Traditional African	69.75%	65.67%
Christian	27.24%	29.78%
Muslim	3.01%	4.5%
Education:		
No education	76.31%	77.55%
Some education	23.69%	22.45%
Husband's education		
No education	86.18%	85.21%
Some education	13.82%	15.79%
CHFP assignment		
Regular (control)	35.27%	36.16%
Yezura (YZ) only	16.58%	13.95%
CHO only	13.42%	15.98%
CHO + YZ	34.72%	33.90%

Notes: Standard deviations are reported in parenthesis. HDSS sample is the universe of women in aged 15-49 years as of 1993 whose education status do not change over the next 18 years of the study. The Panel sample is a random sample of these women who were sampled in 1993 and interviewed annually until 2003 with the exception of 1995.

Table 3.2: Fertility and Proximate Determinants by socio-economic Status

	Educated	Uneducated	Diff	Poor	Middle	Rich	p-value
PANEL A: HDSS							
Married	0.840	0.807	0.037***	0.782	0.803	0.821	0.000
Age at first marriage	18.500	18.120	0.379***	18.080	18.088	18.594	0.000
Children ever born	3.464	4.096	-0.631***	4.063	4.012	3.999	0.000
Surviving children	3.189	3.681	-0.492***	3.618	3.602	3.626	0.000
In polygamous marriage	0.339	0.421	-0.082***	0.296	0.431	0.455	0.000
PANEL B: Panel							
Married	0.848	0.797	0.052***	0.744	0.796	0.838	0.000
Age at first marriage	18.328	17.993	0.335***	18.263	18.100	17.904	0.000
Children ever born	3.111	4.696	-1.584***	4.679	4.386	4.178	0.000
Surviving children	2.771	4.073	-1.302***	4.064	3.816	3.651	0.000
Desired family size	4.863	6.351	-1.488***	6.648	6.255	5.525	0.000
In polygamous marriage	0.352	0.427	0.075***	0.278	0.419	0.451	0.000
Using modern contraceptive	0.210	0.077	0.133***	0.044	0.079	0.150	0.000

*, ** and *** denote statistical significance at 10%, 5% and 1% respectively.

Table 3.3: socio-economic Status and Fertility at Baseline: HDSS Sample

Dependent variable:	# of children ever born			# surviving children		
	(1)	(2)	(3)	(4)	(5)	(6)
Age group						
15-24(ref)						
25-34	1.690***	1.690***	1.697***	1.721***	1.721***	1.724***
	(0.021)	(0.021)	(0.023)	(0.022)	(0.022)	(0.023)
35-49	2.145***	2.147***	2.172***	2.348***	2.213***	2.219***
	(0.023)	(0.023)	(0.024)	(0.023)	(0.024)	(0.025)
Currently married	0.139***	0.125***	0.124***	0.124***	0.124***	0.124***
	(0.012)	(0.012)	(0.012)	(0.012)	(0.012)	(0.013)
In polygamous marriage	-0.087***	-0.089***	-0.099***	-0.101***	-0.099***	-0.111***
	(0.008)	(0.008)	(0.009)	(0.008)	(0.009)	(0.009)
Marriage age	-0.029***	-0.029***	-0.031***	-0.028***	-0.032***	-0.034***
	(0.006)	(0.006)	(0.006)	(0.006)	(0.007)	(0.006)
Marriage age squared	-0.000**	-0.000***	-0.000***	-0.000***	-0.000**	-0.000**
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Woman is educated	0.002	0.024	0.019	0.000	0.023	0.021
	(0.012)	(0.018)	(0.019)	(0.012)	(0.019)	(0.019)
Husband is educated	-0.019*	-0.006	-0.013	-0.026**	0.009	-0.010
	(0.011)	(0.014)	(0.014)	(0.012)	(0.014)	(0.010)
Couple are educated		-0.083***	-0.079**		-0.078**	-0.072*
		(0.031)	(0.031)		(0.031)	(0.031)
Wealth quintile						
Poor (ref)						
Middle			0.030***			0.043***
			(0.013)			(0.012)
Rich			0.051***			0.072***
			(0.011)			(0.012)
N	24204	24204	23924	24204	24204	23924
Pseudo R^2	0.2696	0.2697	0.2708	0.2744	0.2650	0.2662
Wald Statistic	11962.84	12062.60	11313.59	12237.66	11961.57	11182.97

Robust standard errors clustered at compound level are reported in parenthesis. *, ** and *** denote p<0.10, p<0.005 and p<0.001 respectively. All regressions are estimated using Poisson models. All regressions include control for religion and ethnicity of the woman.

Table 3.4: socio-economic Status and Fertility at Baseline: Panel Sample

Dependent variable:	Total children ever born		Desired No of children		Using modern contraceptive	
	(1)	(2)	(3)	(4)	(5)	(6)
Age group						
15-24(ref)						
25-34	0.946***	0.954***	0.113***	0.108***	1.956***	1.953***
	(0.043)	(0.042)	(0.033)	(0.032)	(0.384)	(0.387)
35-49	1.455***	1.457***	0.268***	0.262***	1.941***	1.940***
	(0.042)	(0.041)	(0.033)	(0.032)	(0.372)	(0.368)
Currently married	0.008	0.012	-0.055	-0.051	0.769	0.693
	(0.035)	(0.034)	(0.048)	(0.045)	(0.220)	(0.194)
In polygamous marriage	-0.051***	-0.052***	-0.024	-0.016	0.976	0.915
	(0.016)	(0.016)	(0.020)	(0.020)	(0.126)	(0.120)
Marriage age	-0.033*	0.016	-0.037**	-0.037**	0.986	0.973
	(0.019)	(0.019)	(0.018)	(0.018)	(0.109)	(0.111)
Marriage age squared	-0.002***	-0.001**	0.001**	0.001*	1.000	1.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.002)	(0.003)
Women is educated	-0.019	-0.015	-0.102***	-0.104***	2.425***	2.172***
	(0.021)	(0.022)	(0.029)	(0.029)	(0.331)	(0.360)
Husband is educated	-0.003	-0.005	-0.149***	-0.136***	2.141***	1.871***
	(0.022)	(0.025)	(0.030)	(0.030)	(0.436)	(0.389)
Couple are educated	-0.050*	-0.057*	0.014	0.025	0.968	1.081
	(0.029)	(0.030)	(0.043)	(0.045)	(0.261)	(0.304)
Wealth quintile						
Poor (ref)						
Middle		-0.013		-0.001		1.414
		(0.023)		(0.032)		(0.365)
Rich		0.006		-0.107***		2.504***
		(0.022)		(0.031)		(0.610)
Observations (N)	2548	2448	2080	1880	2552	2452
Pseudo R^2	0.1548	0.1557	0.0337	0.0372	0.1104	0.1221
Wald Statistic	2334.13	2445.16	318.04	308.37	199.14	231.89

Robust standard errors clustered at compound level are reported in parenthesis. *, ** and *** denote p<0.10, p<0.005 and p<0.001 respectively. Columns 1-4 reports results from Poisson regression models. Columns 5-6 reports regressions from logistic regressions. All regressions include controls for religion and ethnicity of the woman.

Table 3.5: Effect of CHFP on Children Ever Born

Dependent variable:	Number of children ever born				
	(1)	(2)	(3)	(4)	(5)
CHFP treatment					
YZ	-0.019	-0.014	-0.015	-0.012	0.016
	(0.022)	(0.020)	(0.021)	(0.021)	(0.031)
CHO	-0.055***	-0.054***	-0.054***	-0.054***	-0.078***
	(0.013)	(0.012)	(0.013)	(0.014)	(0.028)
YZ+CHO	-0.041***	-0.039***	-0.034***	-0.033***	-0.023
	(0.011)	(0.011)	(0.011)	(0.011)	(0.022)
Woman is educated	-0.057***	-0.010	0.015	0.012	0.014
	(0.011)	(0.010)	(0.019)	(0.023)	(0.023)
Husband is educated	-0.057***	-0.030***	-0.031***	-0.028*	0.032***
		(0.011)	(0.011)	(0.017)	(0.011)
Couple are educated		-0.127***	-0.125***	-0.123***	-0.125***
		(0.020)	(0.020)	(0.020)	(0.020)
CHO * woman is educated			-0.014	-0.008	-0.008
			(0.032)	(0.031)	(0.032)
YZ * woman is educated			-0.013	-0.008	-0.014
			(0.039)	(0.038)	(0.039)
YZ+CHO * woman is educated			-0.049*	-0.045*	-0.045*
			(0.028)	(0.026)	(0.026)
CHO * husband is educated				-0.018	
				(0.031)	
YZ * husband is educated				-0.001	
				(0.025)	
YZ+CHO * husband is educated				-0.013	
				(0.024)	
Wealth quintile					
Poor (ref)					
Middle					0.009
					(0.014)
Rich					0.024*
					(0.013)

Table 3.6: Effect of CHFP on Children Ever Born (Table 3.5 continued)

Dependent variable:	Number of children ever born				
	(1)	(2)	(3)	(4)	(5)
Middle*YZ					-0.025
					(0.035)
Middle * CHO					0.028
					(0.035)
Middle* CHO+YZ					-0.011
					(0.027)
Rich*YZ					-0.042
					(0.031)
Rich* CHO					0.016
					(0.032)
Rich* CHO+YZ					-0.022
					(0.024)
Observations (N)	24204	24204	24204	24204	23924
Pseudo R^2	0.0502	0.0505	0.0502	0.0505	0.0503
Wald Statistic	3196.31	3202.09	3224.89	3238.54	3239.68

Robust standard errors clustered at compound level are reported in parenthesis. *, ** and *** denote p<0.10, p<0.005 and p<0.001 respectively. All regressions estimated using poisson models. All regressions include controls for age group, marital status, indicator for being in a polygamous marriage, religion, age at first marriage and its square.

Table 3.7: Effect of CHFP on Surviving Children

Dependent variable:	Number of surviving children				
	(1)	(2)	(3)	(4)	(5)
CHFP treatment					
YZ	-0.008	-0.009	-0.008	-0.005	0.007
	(0.017)	(0.017)	(0.018)	(0.018)	(0.029)
CHO	-0.049***	-0.049***	-0.048***	-0.051***	-0.081***
	(0.013)	(0.012)	(0.013)	(0.014)	(0.026)
YZ+CHO	-0.031***	-0.032***	-0.025***	-0.024**	-0.021
	(0.010)	(0.010)	(0.011)	(0.011)	(0.022)
Woman is educated	-0.038***	0.011	0.054**	0.052**	0.051**
	(0.011)	(0.013)	(0.023)	(0.023)	(0.023)
Husband is educated	-0.037***	-0.007	-0.008	-0.005	-0.012
	(0.011)	(0.011)	(0.011)	(0.018)	(0.011)
Both woman and husband are educated		-0.129***	-0.126***	-0.123***	-0.125***
		(0.020)	(0.020)	(0.021)	(0.021)
CHO * woman is educated			-0.037	-0.031	-0.029
			(0.030)	(0.031)	(0.031)
YZ * woman is educated			-0.025	-0.029	-0.027
			(0.037)	(0.038)	(0.037)
YZ+CHO * woman is educated			-0.073***	-0.071***	-0.069***
			(0.028)	(0.027)	(0.028)
CHO * husband is educated				-0.018	
				(0.033)	
YZ * husband is educated				0.020	
				(0.034)	
YZ+CHO * husband is educated				-0.008	
				(0.024)	
Wealth quintile					
Poor (ref)					
Middle					0.010
					(0.014)
Rich					0.039***
					(0.013)

Table 3.8: Effect of CHFP on Surviving Children (Table 3.6 continued)

Dependent variable:	Number of surviving children				
	(1)	(2)	(3)	(4)	(5)
Middle*YZ					-0.012
					(0.034)
Middle * CHO					0.045
					(0.034)
Middle* CHO+YZ					-0.001
					(0.027)
Rich*YZ					-0.032
					(0.034)
Rich* CHO					0.019
					(0.030)
Rich* CHO+YZ					-0.019
					(0.024)
N	24204	24204	24204	24204	23924
Pseudo R^2	0.0487	0.0490	0.0491	0.0505	0.0490
Wald Statistic	3210.52	3217.03	3231.11	3245.07	3232.50

Robust standard errors clustered at compound level are reported in parenthesis. *, ** and *** denote p<0.10, p<0.005 and p<0.001 respectively. All regressions estimated using Poisson models. All regressions include controls for age group, marital status, indicator for being in a polygamous marriage, religion, age at first marriage and its square.

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Appendix A

Getting the Poor to Enroll in Health Insurance and Its Effect on Their Health: Evidence from a Field Experiment in Ghana

Table A.1: Attrition

PANEL A: attrition rate				
	Full	**control**	**All treatments**	**p-value test**
Percent of baseline sample	6.48%	7.62%	6.82%	0.3351
	% of individuals not re-interviewed			
Panel B: reasons for attrition				
Deceased			7.65%	
Relocated outside district			26.23%	
Travelled			57.92%	
Other			8.20%	

Table A.2: Effect of Interventions on enrollment (with subsidy levels)

	Outcome variable: indicator = 0 for not enrolled, 1 for enrolled					
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
1/3 Subsidy	0.287***	0.287***	0.271***	0.270***	0.293***	0.235***
	(0.114)	(0.077)	(0.075)	(0.082)	(0.089)	(0.091)
2/3 subsidy	0.357***	0.308***	0.322***	0.332***	0.326***	0.343***
	(0.067)	(0.070)	(0.070)	(0.072)	(0.104)	(0.096)
Full subsidy	0.473***	0.443***	0.435***	0.405***	0.473***	0.386***
	(0.086)	(0.082)	(0.080)	(0.083)	(0.094)	(0.066)
Education	0.213**	0.186**	0.176*	0.175**	0.246**	0.098
	(0.103)	(0.090)	(0.092)	(0.089)	(0.108)	(0.108)
Conve regist.	0.046	0.039	0.035	0.023	-0.022	0.054
	(0.082)	(0.062)	(0.048)	(0.048)	(0.060)	(0.082)
1/3 subsidy& conve.	0.287**	0.231***	0.186**	0.223***	0.185***	0.139
	(0.115)	(0.086)	(0.074)	(0.064)	(0.039)	(0.104)
1/3 subsidy& educ	0.398***	0.301***	0.316***	0.322***	0.449***	0.223*
	(0.124)	(0.074)	(0.078)	(0.074)	(0.097)	(0.087)
2/3 subsidy & conve.	0.478**	0.432***	0.371***	0.362***	0.355***	0.368***
	(0.070)	(0.059)	(0.054)	(0.056)	(0.064)	(0.069)
2/3 subsidy & educ	0.489***	0.454***	0.454***	0.455***	0.475***	0.419***
	(0.053)	(0.063)	(0.058)	(0.064)	(0.064)	(0.083)
Full subsidy & conve.	0.475***	0.369***	0.421***	0.445***	0.490***	0.390***
	(0.096)	(0.058)	(0.059)	(0.056)	(0.065)	(0.063)
Full subsidy & educ	0.637***	0.554***	0.568***	0.578***	0.603***	0.534***
	(0.044)	(0.048)	(0.049)	(0.049)	(0.058)	(0.066)
Individual controls	N	Y	Y	Y	Y	Y
Household controls	N	N	Y	Y	Y	Y
Community controls	N	N	N	Y	Y	Y
N	**4298**	**4298**	**4298**	**4298**	**1995**	**2283**
F-statistic	**26.38**	**24.67**	**28.83**	**30.39**	**26.00**	**25.29**
R^2	**0.1778**	**0.2557**	**0.2811**	**0.2822**	**0.2426**	**0.2640**

Notes: Robust standard errors clustered at community level reported in brackets. *, ** and *** denote statistical significance at 10%, 10 and 1% levels respectively. F-statistic is for excluded instruments (interventions). Individual covariates are: age group (<18 years, 18-69, and 70+), gender, education status, indicator for having ever registered with the NHIS at baseline, and indicator having visited a health facility at baseline. Household covariates are: household size, religion, ethnicity and wealth index (poor third, middle third and rich third). Community covariates are: distance to nearest health facility, distance to NHIS registration center. Columns (5) and (6) restricts sample to adults aged 18 and above and children under 18 respectively.

Table A.3: Heterogeneous response to interventions by wealth status

	Outcome variable: indicator = 0 for not enrolled, 1 for enrolled	
	(1)	**(2)**
Education	0.150**	
	(0.078)	
Subsidy	0.336***	
	(0.060)	
Conve regist	0.053	
	(0.076)	
Educ. &conve reg	0.156*	
	(0.086)	
Subsidy & conve reg.	0.348***	
	(0.079)	
Subsidy & educ.	0.488***	
	(0.085)	
Subsidy & educ & conve	0.462***	
	(0.079)	
Poorest third	-0.131**	
	(0.053)	
Poorest third * educ	0.030	
	(0.069)	
Poorest third* subsidy	0.105	
	(0.088)	
Poorest third * conve	-0.067	
	(0.061)	
Poorest third * educ & conve	-0.029	
	(0.104)	
Poorest third*subsidy & conve	0.113	
	(0.093)	
Poorest third*subsidy & educ	0.277***	
	(0.074)	
Poorest third*subsidy & educ & conve	0.253***	
	(0.071)	
1/3 subsidy		0.202***
		(0.071)
2/3 subsidy		0.320***
		(0.074)
Full subsidy		0.418***
		(0.053)
Poorest third		-0.132***
		(0.033)
Poorest third *1/3 subsidy		0.355***
		(0.104)
Poorest third*2/3 subsidy		0.132*
		(0.078)
Poorest third*full subsidy		-0.028
		(0.091)
N	**4298**	**2022**

Notes: Robust standard errors clustered at community level are reported in brackets. *, ** and *** denote statistical significance at 10%, 5% and 1% levels respectively. All regressions include full set of covariates (individual, household, community). Regressions in columns (3) and (4) are restricted to the pure control group and households receiving subsidy only.

Table A.4: Heterogeneous response to interventions by education status

	Outcome variable: indicator = 0 for not enrolled, 1 for enrolled	
	(1)	**(2)**
Education	0.152**	
	(0.068)	
Subsidy	0.315***	
	(0.056)	
Conve regist	-0.021	
	(0.061)	
Educ. &conve reg	0.190*	
	(0.105)	
Subsidy & conve reg.	0.336***	
	(0.073)	
Subsidy & educ.	0.472***	
	(0.084)	
Subsidy & educ & conve	0.430***	
	(0.075)	
HH educated * educ	0.036	
	(0.053)	
HH educated * subsidy	0.144**	
	(0.058)	
HH educated * conve	0.057	
	(0.048)	
HH educated * educ & conve	-0.023	
	(0.103)	
HH educated *subsidy & conve	0.107	
	(0.071)	
HH educated *subsidy & educ	0.155**	
	(0.068)	
HH educated *subsidy & educ & conve	0.180***	
	(0.073)	
HH educated	-0.019	0.011
	(0.039)	(0.027)
1/3 subsidy		0.215***
		(0.079)
2/3 subsidy		0.324***
		(0.065)
Full subsidy		0.390***
		(0.053)
HH educated *1/3 subsidy		0.056
		(0.088)
HH educated *2/3 subsidy		0.088**
		(0.040)
HH educated* Full subsidy		0.089*
		(0.048)
N	**4298**	**2022**

Notes: Robust standard errors clustered at community level are reported in brackets. *, ** and *** denote statistical significance at 10%, 5% and 1% levels respectively. All regressions include full set of covariates (individual, household, community). Regressions in columns (3) and (4) are restricted to the pure control group and households receiving subsidy only.

Table A.5: Heterogeneous response to interventions by health condition

	Dependent variable: indicator = 0 for not enrolled, 1 for enrolled	
	(1)	**(2)**
Education	0.144**	
	(0.072)	
Subsidy	0.357***	
	(0.052)	
Conve regist	-0.004	
	(0.065)	
Educ. &conve reg	0.196**	
	(0.098)	
Subsidy & conve reg.	0.354***	
	(0.077)	
Subsidy & educ.	0.420***	
	(0.078)	
Subsidy & educ & conve	0.448***	
	(0.064)	
Chronic condition * educ	0.156***	
	(0.038)	
Chronic condition * subsidy	0.047	
	(0.087)	
Chronic condition * conve	0.037	
	(0.105)	
Chronic condition * educ & conve	-0.044	
	(0.107)	
Chronic condition *subsidy & conve	0.066	
	(0.080)	
Chronic condition *subsidy & educ	0.105*	
	(0.062)	
Chronic condition *subsidy & educ & conve	0.163***	
	(0.047)	
Chronic condition	-0.056*	-0.019
	(0.033)	(0.036)
1/3 subsidy		0.243***
		(0.071)
2/3 subsidy		0.344***
		(0.066)
Full subsidy		0.417***
		(0.043)
Chronic condition *1/3 subsidy		-0.004
		(0.103)
Chronic condition *2/3 subsidy		-0.016
		(0.066)
Chronic condition * Full subsidy		0.058
		(0.068)
N	**4298**	**2022**

Notes: Robust standard errors clustered at community level are reported in brackets. *, ** and *** denote statistical significance at 10%, 5% and 1% levels respectively. All regressions include full set of covariates (individual, household, community). Regressions in columns (3) and (4) are restricted to the pure control group and households receiving subsidy only.

Table A.6: Heterogeneous response to interventions by "unmet need" for health care

	Dependent variable: indicator = 0 for not enrolled, 1 for enrolled	
	(1)	**(2)**
Education	0.141*	
	(0.077)	
Subsidy	0.339***	
	(0.049)	
Conve regist	0.001	
	(0.062)	
Educ. &conve reg	0.209	
	(0.148)	
Subsidy & conve reg.	0.349***	
	(0.074)	
Subsidy & educ.	0.524***	
	(0.077)	
Subsidy & educ & conve	0.443***	
	(0.065)	
Unmet need * educ	0.172**	
	(0.067)	
Unmet need * subsidy	0.027	
	(0.079)	
Unmet need * conve	0.016	
	(0.105)	
Unmet need * educ & conve	0.006	
	(0.163)	
Unmet need *subsidy & conve	0.016	
	(0.175)	
Unmet need *subsidy & educ	0.226**	
	(0.101)	
Unmet need *subsidy & educ & conve	0.255***	
	(0.061)	
Unmet need for health facility	-0.077	-0.083
	(0.054)	(0.041)
1/3 subsidy		0.343***
		(0.075)
2/3 subsidy		0.457***
		(0.056)
Full subsidy		0.481***
		(0.060)
Unmet need *1/3 subsidy		0.192**
		(0.085)
Unmet need *2/3 subsidy		0.093
		(0.202)
Unmet need * Full subsidy		0.016
		(0.096)
N	**4298**	**2022**

Notes: Robust standard errors clustered at community level are reported in brackets. *, ** and *** denote statistical significance at 10%, 5% and 1% levels respectively. All regressions include full set of controls (individual, household, community). An individual is defined to have unmet need for health care if he/she reports a chronic condition lasting for more than 6 months but do not seek regular treatment for the condition.

Table A.7: Effect on utilization of health care services by age (IV)

Dep. variable:	Visited health facility in the last 4 weeks		Visited health facility in last 6 months		# of facility visits in last 6 months		visited health facility for malaria treatment	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Insured	0.121**	0.139**	0.126**	0.155***	0.239*	0.350***	0.017	0.053***
	(0.060)	(0.057)	(0.063)	(0.060)	(0.139)	(0.138)	(0.022)	(0.017)
Control mean	0.120	0.113	0.106	0.098	0.210	0.197	0.019	0.017
N	**1995**	**2303**	**1995**	**2303**	**1995**	**2303**	**1995**	**2303**
R^2	**0.0614**	**0.0975**	**0.0618**	**0.0768**	**0.0424**	**0.0560**	**0.0146**	**0.0195**

Notes: Robust standard errors clustered at community level are reported in brackets. *, ** and *** denote statistical significance at 10%, 5% and 1% levels respectively. All regressions include controls for both individual-level and household/community-level variables. Individual-level controls are: age-group (<18 and 70+, 18-69 is omitted), gender, indicator for having a health condition, indicator for visiting a health facility at baseline, education status. Household/community-level controls are: household wealth (poorest third and richest third, middle third omitted), household size, religion, ethnicity, distance to nearest health facility and distance to NHIS registration point. Sample regressions in (1), (3), (5) and (7) restricted to adult sample (18+) while regressions in (2), (4), (6) and (8) are restricted children (<18 years).

Table A.8: Included and excluded services: NHIS minimum coverage

Included Services	**Exclusion List**
1. Out-Patient Services i) General and specialized consultation and review ii) Requested investigations (including laboratory investigations, x-rays and ultrasound scanning) iii) Medication (prescription drugs on the NHIS Drug List) iv) HIV/AIDS symptomatic treatment for opportunistic infection v) Out-patient/Day Surgery Operations including hernia repairs, incision and drainage, hemorrhoidectomy vi) Out-patient physiotherapy 2. In-Patient Services i) General and specialist in-patient care ii) Requested investigations iii) Medication (prescription drugs on the NHIS Drug List) iv) Cervical and Breast Cancer Treatment v) Surgical Operations vi) In-patient physiotherapy vii) Accommodation in general ward viii) Feeding (where available) 3. Oral Health Services i) Pain relief which includes incision and drainage, tooth extraction and temporary relief ii) Dental restoration which includes simple amalgam fillings and temporary dressing 4. Eye Care Services i) Refraction, visual fields and A-Scan ii) Keratometry iii) Cataract Removal iv) Eye lid surgery 5. Maternity Care i) Antenatal care ii) Deliveries (normal and assisted) iii) Caesarian section iv) Postnatal care 6. Emergencies i) Medical emergencies ii) Surgical emergencies including brain surgery due to accidents iii) Pediatric emergencies iv) Obstetric and gynecological emergencies v) Road traffic accidents vi) Industrial and workplace accidents vii) Dialysis for acute renal failure	1. Rehabilitation other than physiotherapy 2. Appliances and protheses including optical aids, hearing aids, orthopedic aids and dentures 3. Cosmetic surgeries and aesthetic treatment 4. HIV retroviral drugs 5. Assisted reproduction eg artificial insemination and gynecological hormone replacement therapy 6. Echocardiography 7. Photography 8. Angiography 9. Orthotics 10. Dialysis for chronic renal failure 11. Heart and brain surgery other than those resulting from accidents 12. Cancer treatment other than cervical ad breast cancer 13. Organ transplanting 14. All drugs that not listed on the NHIS Drug List 15. Diagnosis and treatment abroad 16. Medical examinations for purposes of visa applications, education and institutional driving license 17. VIP ward accommodation 18. Mortuary services

Source: NHIA (2011)