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Joseph Mensah, Joseph R. Oppong, and Christoph M. Schmidt[1]

Ghana's National Health Insurance Scheme in the Context of the Health MDGs – An Empirical Evaluation Using Propensity Score Matching

Abstract

In 2003 the Government of Ghana established a National Health Insurance Scheme (NHIS) to improve health care access for Ghanaians and eventually replace the cash-and-carry system. This study evaluates the NHIS to determine whether it is fulfilling its purpose in the context of the Millennium Development Goals #4 and #5 which deal with the health of women and children. We use Propensity Score Matching techniques to balance the relevant background characteristics in our survey data and compare health outcomes of recent mothers who are enrolled in the NHIS with those who are not. Our findings suggest that NHIS women are more likely to receive prenatal care, deliver at a hospital, have their deliveries attended by trained health professionals, and experience less birth complications. We conclude that NHIS is an effective tool for increasing health care access, and improving health outcomes.

JEL Classification: I18, O12, C21

Keywords: Health insurance, prenatal care, Millennium Development Goals, Propensity Score Matching

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1. Introduction

Effective solutions for the problem of escalating health care costs and under-funding in poor sub-Saharan African countries such as Ghana remain elusive. In the immediate post-independence era, Ghana provided 'free' medical services to all citizens. However, by the early 1980s, under the impression of difficult economic challenges, deteriorating health infrastructure, and massive emigration of health workers, the government implemented a cost recovery scheme (or *cash-and-carry* system), as part of its IMF- and World Bank-sponsored Structural Adjustment Programs (Mensah et al., 2006). Access and utilization of health services plummeted, as did health indicators. Facing very high treatment costs, many low-income households regularly postponed medical treatment, resorted to self-treatment, or used alternatives provided by unregulated healers, spiritualists, and itinerant drug vendors, often with disastrous results (Oppong, 2001).

In 2003 the government established a National Health Insurance Scheme (NHIS) to address these problems. It is envisaged that the NHIS will eventually replace the *cash-and-carry* system and, by making health care affordable, improve access and health outcomes. This paper examines whether the NHIS has accomplished its goal by contrasting the maternal health outcomes of members and non-members who experienced a pregnancy during the last four years before the survey date, controlling for their observable characteristics via matching techniques. We focus on maternal and child health outcomes of women (18-49 years) in line with the *Millennium Development Goals* (MDGs) #4 and #5 (UNDP, 2006). Propensity score matching is applied to survey data from two administrative regions of Ghana to compare the health outcomes of women in our treatment and comparison groups. Due to the difficulty of establishing a direct causal link between health insurance and maternal health outcomes (Mensah and Oppong, 2007), in this study we heavily rely on health indicators such as "uptake of prenatal care" and "birth at a hospital" as proxy measures of health outcomes.

The structure of the paper is as follows: After a brief description of Ghana's political economy and of the NHIS in section 2, in section 3 we present our data and report the relevant descriptive statistics for NHIS members and for the non-members who serve as the reservoir of potential comparison observations. Following our empirical strategy of constructing a balanced sample of treated and comparison individuals, in section 4 we discuss the estimation of a propensity score

equation, and present the results of a variety of matching algorithms, with an emphasis on their ability to ascertain the desired balancing. Overall, our empirical findings suggest that NHIS members and their newborn children experience better health outcomes than non-members. The paper concludes in section 5 with some comments on the policy implications of our main findings.

2. Ghana's Political Economy and the NHIS

At independence (in 1957), Ghana was a prosperous country with the highest per capita income in West Africa. Agriculture, based on cocoa production, accounted for about half of the nation's GDP (Bequele, 1983). Cocoa exports enabled the economy to grow at 4.1% annually from 1950 to 1960, and Ghana became the leading destination of migrant labor from across West Africa (Mensah, 2006a and 2006b). With cocoa prices falling after 1960, Ghana's post-independence economic strategy emphasized industrialization by state-owned enterprises (SOEs). However, poor performance of the SOEs led to further economic decline, and annual inflation jumped from about 6% during 1965-73 to 50% during the following decade. By 1982, per capita income had fallen by 30% in real terms, export earnings were halved, and import volumes had fallen to one-third of their 1970 levels (World Bank, 1985). With the nation's external debt standing at 105.7% of GDP, the government of Flight Lt. Jerry Rawlings and his military Provisional National Defense Council (PNDC) embraced a remarkably harsh Structural Adjustment Program (SAP) (Saris and Shames, 1991). Among other things, it required severe devaluation of the national currency, removal of subsidies on social services including health and education, and imposed user fees for health care services.

Ghana's SAP had mixed results: agricultural and industrial production increased; inflation fell from 31 percent in 1988 to 10 percent in 1992; domestic savings increased; and the budget deficit decreased (Mensah et al., 2006). However, income inequality increased substantially. While those engaged in the export of timber, gold and other raw materials prospered, for most Ghanaians, particularly rural dwellers that depended on subsistence farming, survival became more difficult. For example, between 1983 and 1994 the number of farmers living below the poverty line in the Northern region increased 4.5 times (Saris and Shams, 1991). Additionally, health conditions deteriorated dramatically throughout the country, as hunger and malnutrition

increased, and the sick, unable to afford payments, delayed seeking health care with often grave consequences (Oppong, 2001; Shaw and Griffin, 1995). Responding to pressure from the World Bank and IMF, the Rawlings government introduced multi-party democracy in 1992 and ruled the country till 2000, when the opposition presidential candidate, John Kuffour, defeated the former Vice-President, John Atta Mills, in a general election. Under Kuffour's New Patriotic Party (NPP) government, the economy improved considerably, with exports growing from 16% of GDP in 1980-83 to 28% in 1999-2001 (Mensah, 2006c). The NPP government, which ruled from 2000 to 2008, introduced the NHIS.

Progam Description: the Ghana NHIS

Following intense consultations with Ghana's international health development partners (e.g., WHO, DANIDA, DFID, and ILO) and relevant national agencies and NGOs, the Ghana NHIS was established with the *National Health Insurance Act* of 2003. The stated mission of the NHIS is "to ensure equitable universal access for all residents of Ghana to an acceptable quality of essential health services without out-of-pocket payment being required at the point of service use" (Ghana Ministry of Health, 2004a). The NHIS is regulated by the National Health Insurance Council (NHIC), headquartered in Accra. Regional and District offices of the NHIC are being set up to decentralize the operations of the Scheme. The Council manages the National Health Insurance Fund (NHIF) through the collection, investment, disbursement, and administration of the Scheme. The Council also undertakes the licensing, regulation, and accreditation of healthcare providers. By the end of 2007, the NHIS had accredited 800 private healthcare providers in addition to government health facilities (Ghana Ministry of Health, 2008). It is expected that this system of accreditation will eventually raise standards and quality of care throughout the country.

At the District level, there are Health Insurance Assemblies which comprise all members of the respective District Schemes in good standing. District Schemes are governed by Boards of Trustees, Scheme Managers, and District Health Insurance Committees. The management teams at the various Districts usually include an Administrator, Accountant, Publicity and Marketing Manager, Claims Managers, Accountant, Data Control Manager, and Data Entry Clerk (Ghana Ministry of Health, 2004b; Sabi, 2005). NHIS premiums are generally based on clients' ability to

pay. District Health Insurance Committees identify and categorize residents into four main social groups—the *core poor or the indigent; the poor and very poor; the middle class;* and *the rich and very rich*—and vary their respective contributions accordingly. The core poor or indigent, people over 70 years of age, and former Social Security and National Insurance Trust (SSNIT) contributors who already are in retirement are exempted from premium payments.

While premiums vary slightly from District to District, generally members pay no less than GH¢7.2 (US$8.00[1]), per annum. For members in the formal sector, 2.5% of their contribution to SSNIT is deducted monthly as their health insurance premium. Workers in the formal sector are members of the NHIS automatically, but they still have to register with their respective District Health Insurance Schemes. Those in the informal sector, as well as the self-employed, pay between GH¢7.2 and GH¢48.0 yearly, depending on their income. All contributors' premiums cover their children and dependents below age 18. Some District Schemes require both parents to be registered (except in single-parent households) before a child can be registered, while others only require the mother to be registered. In 2004, the government introduced a 2.5% sales tax (i.e., Health Insurance Levy) on selected goods and services to help fund the NHIS. Other notable sources of funding for the Scheme include money from the government's budget and donor contributions (Sabi, 2005).

The benefits package includes general out-patient and in-patient services, oral health, eye care, emergencies and maternity care, including prenatal care, normal delivery, and some complicated deliveries. Diseases covered include malaria, diarrhea, upper respiratory tract infections, skin diseases, hypertension, asthma, diabetes – in all about 95% of the common health problems in Ghana are covered (Ghana Ministry of Health, 2004a and 2004b). The required minimum benefit package for District Schemes excludes HIV antiretroviral therapy, hearing aids, dentures, and VIP accommodations.

– Table 1 –

By the middle of 2007, some 47% of the total national population had registered with the NHIS (Table 1). The largest numbers of enrollees were in the Ashanti Region (2.0 million), the Brong Ahafo Region (1.4 million), the Eastern Region (1.2 million), and the Northern Region (1.0

[1] In 2007, Ghana changed its currency from the old cedi (¢) to New GH Cedi (¢). One New GH¢ = 10,000 old Ghana ¢. The exchange rate to the US$ is now about US$1=New GH¢0.93.

million). Surprisingly, only 24.1% of Greater Accra's population had enrolled in the NHIS by June 2007. Of the total number of Ghanaians enrolled by that time, an estimated 7.4% was over 70 years of age and 1.9% comprised indigents—all of whom were essentially exempted from premium payments.

3. Data and Empirical Strategy

A first aim of our analysis is the construction of a balanced sample of treatment and comparison observations of women who recently went through a pregnancy and are distinct only in their coverage by the NHIS. Their differential experiences in terms of maternal and infant health problems are then serving as the basis for establishing a causal link between NHIS coverage and health outcomes. To procure our primary survey data, we used a combination of several sampling approaches, described below, collecting a sample 2000 respondents, comprising 400 NHIS members and 1600 non-members as their potential comparisons. Our interviews only included women of childbearing age (18-49 years), drawn from two of the ten administrative regions of Ghana—i.e., the Brong Ahafo and Upper East regions. For the purposes of our analysis we concentrated on those women who responded that they had experienced a pregnancy within the last four years, ending either in a live birth or a stillbirth. From the perspective of the survey year 2007, this retrospective period of four years spans the time between the implementation of the NHIS in 2003 and the survey. Correspondingly, the treatment indicator distinguishing the two sub-samples is NHIS membership as of the survey date.

Rather than conducting interviews across the vast expanses of the two study regions, we purposively selected two administrative districts (one urban and one rural) from each region: the Sunyani Municipal District (urban), and the Nkoranza District (rural) in the Brong Ahafo Region; and the Bolgatanga Municipal District (urban) and the Talensi-Nabdam District (rural) in the Upper East Region. Following this, systematic random sampling was used to identify 100 respondents from each of the 4 selected districts to constitute a total treatment group of 400. We used a two-pronged approach to ascertain our comparison group, in the absence of a sampling frame listing all the women who are non-members of the NHIS. First, for every treatment group member interviewed in the urban areas, we collected four comparison group members living north, south, east, and west of their residential location, respectively. Secondly, in small rural

communities we compiled the names of all women who were not enrolled in the Scheme to serve as a sampling frame, again aiming for interviewing four potential comparison individuals. This turned out to be manageable in the small rural communities, many of which have small populations.

Covariates: Descriptive Statistics

If NHIS membership was assigned randomly within the frame of a controlled trial and compliance with this assignment was ascertained, the resulting sub-samples of treatment and control observations would be balanced in terms of their personal characteristics and any regional attributes. In such an experimental study, the researcher could easily establish the causal link running from the (randomly allocated) treatment to the observable outcome differences. In our study, however, we attempt to retrospectively evaluate a program that has been operating for quite some time, precluding any random assignment. NHIS membership is a choice, and it is very likely that different individuals will make different enrolment choices. Thus, we have to rely on observational techniques to emulate the randomized controlled trial that we would have liked to pursue in the hypothetical ideal, conditional on observables. As a first step, we explore the differences between NHIS members and non-members in a wide range of personal characteristics and regional information. These characteristics are not only potential correlates of the enrolment decision, but are also likely to be related to the health outcomes under study. In a second step, they are serving as the principal pieces of information for constructing balanced samples of treatment and comparison observations.

– Table 2 –

Of the 393 NHIS women and 1589 non-members in the sample, 140 and 425 recently experienced at least one pregnancy episode, respectively. For this relevant sub-sample of 565 women, Table 2 documents their personal and regional characteristics in detail, documenting the means and formal tests for differences between members and non-members. While there is only a slight regional imbalance in our sample, it is evident that roughly 70% of NHIS members are typically living less than one hour commuting time from the relevant health care center, while this is the case for only under 60% of non-members. NHIS women tend to be younger, and are clearly better educated than non-members. Arguably, both these characteristics tend to be

important correlates of health outcomes. If we were unable to achieve balance in these covariates, the contrast between the average health outcomes of members and non-members could not be attributed reliably to the treatment.

A second set of covariates which tend to influence both the decision to enroll in the NHIS and health outcomes relates to the economic situation of the respondents' household. In our survey, we attempted to approximate the permanent income of respondents by a range of questions regarding their homes, the ownership of appliances and of means of motorized transport. Here we find considerable differences between NHIS women and those not being covered. Quite importantly, larger shares of the NHIS women had a flush toilet and pipe-borne water supply at their homes. NHIS members also had significantly more access to electricity and to electrical appliances, such as a TV, radio, a mobile phone, a computer or a refrigerator. Similarly, more NHIS members live in a household that owns a car than non-members. Finally, Table 2 documents a Probit regression of NHIS membership on these observable characteristics. Education and some, but not all, of the permanent income variables turn out to be important predictors of NHIS membership. In the second step of the analysis, this equation serves as the principal vehicle to construct balanced samples of treatment and controls.

Outcomes: Descriptive Statistics

In a direct comparison of the 140 treatments and 425 potential comparisons, we see dramatic differences in outcomes regarding maternal and infant health (Table 3, columns 1 and 2). We distinguish four sets of relevant health outcomes. Regarding the (i) recent episode of pregnancy and birth, NHIS members display a significantly lower frequency of experiencing a recent infant death or birth complications. They are also clearly more likely to have given birth at a hospital and with professional assistance. With respect to (ii) prenatal care, NHIS women are not only more likely to receive a prenatal check, it is also conducted significantly more often, and more often involves weight and blood pressure measurement. When it comes to (iii) postnatal care, NHIS members are clearly more likely to receive a postnatal check, and this check is more often conducted at a hospital. In addition, their children are also more likely to be vaccinated against TB and Tetanus. Finally, NHIS women are more likely to receive (iv) preventive checks – here we were also asking for the experience of a preventive check during the last four years. Given

the differences in the personal characteristics of NHIS members and non-members, it is necessary to account for them as well as possible in order to attribute these clear outcome differences to the treatment.

– Table 3 –

4. Estimation Results: Propensity Score Matching

The ultimate objective of our empirical strategy is the estimation of causal treatment effects in the presence of selection into treatment. Throughout our analysis, we impose the identification assumption that selection is exclusively based on observable characteristics. In effect, one aims at emulating an experiment, conditional on observables. We are confident that by comprising extensive information on personal and regional characteristics, in particular on several aspects of permanent income, our survey data cover the complete range of observables necessary to make this empirical strategy viable. The basic idea behind statistical matching (Rubin, 1974) is to identify in a large reservoir of potential comparison observations a sufficient number of candidates that closely resemble the treated units. If, conditional on these observables, selection into treatment can be considered as a random event, the contrast between treatment and comparison observations yields, on average, an estimate of the treatment parameter, most specifically the "average effect of treatment on the treated" (ATT).

Unfortunately, the set of conditioning factors necessary to identify valid comparison observations, i.e. those observations for which this assumption of conditional independence (CIA) holds, is typically required to be of high dimension, generating what is generally dubbed in the literature as the "curse of dimensionality". In their seminal contributions Rosenbaum and Rubin (1983, 1985) demonstrate that instead of conditioning the matching on the whole set of individual characteristics, it suffices to concentrate on a summary index, a balancing score. The most prominent balancing score is the conditional probability of selection into treatment, i.e. the propensity score. As a consequence of its beneficial practical implications, Propensity Score Matching has gained considerable currency in the evaluation of public health care programs (Heller et al., 2005; Ellis et al., 2003; Kneipp, 2000; Rubin, 1997); health finance and insurance schemes (White-Means and Hersch, 2005); employment and vocational programs (Heckman et al., 1999) and many other areas of evaluation research.

Using this approach, we match the women in our sample who are members of the NHIS to a subset of women from the comparison group reservoir on the basis of their observable characteristics. To account for the sensitivity of this technique we use a variety of specific approaches[2]. Out of the complete set here we report four sets of the results, namely nearest neighbor matching with and without replacement, radius matching and Kernel matching (Heckman et al., 1997, 1998; Imbens 2000, Lechner, 2001). To achieve a close balancing, we impose a caliper of width 0.02 in the nearest neighbor and radius approaches, and we use a bandwidth of 0.06 in the Kernel matching approach. All other variations on these themes generated qualitatively very similar results.

Covariate Balance

Propensity score matching can only lead to viable estimates of the causal effects of treatment, if the desired balancing of observable covariates is achieved. In Table 4 we demonstrate that our approach is quite successful in ascertaining covariate balance. While the differences between NHIS members and non-members in observable personal and regional characteristics have been documented in Table 2 to be substantial in the unmatched sample (replicated in column 1 of Table 4), all matching approaches, but nearest neighbor matching with replacement, achieve satisfactory balance in all observables. Thus, we can be quite confident that in our estimates of the causal impact of NHIS coverage on maternal and infant health we are comparing genuinely comparable respondents.

– Table 4 –

Program Effects

For all four variations of the principal strategy of propensity score matching, we document the estimated effects of treatment in Table 3. Overall, the matched comparisons tend to confirm the unmatched comparisons quite closely, despite the differences in observables that we have discussed above. Regarding (i) recent birth episodes, NHIS women display a lower probability to experience an infant death or birth complications than comparable non-members, and higher probabilities to deliver at a hospital and with professional assistance. With respect to (ii) prenatal

[2] For matching we were using the Stata routine ”psmatch2“ provided by Leuven and Sianesi (2003).

care, NHIS members not only have a higher probability of receiving a prenatal check and receiving it more often, it also seems to be significantly more extensive. Similarly, NHIS members receive significantly more extensive (iii) postnatal care, and their children are better protected by vaccinations. Finally, NHIS members more often benefit from (iv) preventive care than comparable non-members. While the point estimates of the NHIS effects tend to be larger in absolute value when employing Kernel matching, overall these results are very robust, both quantitatively and qualitatively.

Sensitivity: Timing

While our empirical results are robust to a wide range of variations in the employed econometric technique, this study is clearly limited by its non-experimental nature. Most specifically, since the questionnaire implemented a set of complicated retrospective questions, regarding episodes of pregnancy, health problems and NHIS coverage, the question of timing remains delicate. While NHIS coverage was quite low during the initial years of this program, it increased steeply starting in 2005. In our survey data we do have some information on the time of enrolment for NHIS members that confirms this impression. We also observe that some women in our sample who enrolled in the past and were covered in the survey year 2007 had been de-enrolling temporarily in between, and, even more critical, that some non-members as of survey time had been enrolled at some time before the survey date and left the NHIS program again. If we had more precise information regarding the timing of the (temporary) enrolments and de-enrolments and on that of the last pregnancy episode(s), we would of course also probe the sensitivity of our results further along these lines. Unfortunately, our retrospective data do not allow this. Yet, before this background of imperfect individual-level data, the strong qualitative results regarding the beneficial effects of NHIS membership on a wide range of maternal and infant health indicators and health outcomes seem all the more impressive.

5. Conclusions

We used a propensity score matching approach to empirically compare the maternal health outcomes of women enrolled in the Ghana NHIS and with those who are not, taking observable covariate differences into account. Our results suggest that members are more likely to use

prenatal care, deliver in hospitals and be attended by trained professionals compared to non-members. They are also less likely to experience birth complications and infant deaths. Thus, it very much appears that by facilitating affordable access to health care, the NHIS is producing better health outcomes. In contrast, non-members continue to face very high payments from hospitalization resulting from birth complications with probably poor outcomes. Furthermore, because NHIS members have more preventive checkups and outpatient attendance, including prenatal care, the uninsured clearly have unmet health needs. Unfortunately, it is such unmet health needs that result in birth complications and maternal or fetal death. Uninsured women are more likely to delay seeking care, develop obstetric complications and die (Mensah and Oppong, 2007). Increased enrolment in NHIS may produce better maternal and overall health outcomes for Ghanaians. Our empirical analysis confirms that Ghana's NHIS is accomplishing the purpose for which it was established – improving health care access for the insured.

Increased effort to expand membership is critically needed if this benefit is to cover all Ghanaians. Since cost was found to be a major obstacle to enrolment, more effective methods for identifying the poor and core poor for the purposes of premium exemption and discount are desirable. Also, our findings indicate that the availability of a health facility in a community is associated with higher likelihood of enrolment in the NHIS. Accordingly, extending geographical access is an important strategy for expanding NHIS membership and improving access to quality health care in the country. Moreover, because educational attainment of respondents is a strong determinant of NHIS enrolment, and those with low education are less likely to enroll, information on the NHIS has to be disseminated in ways that reach those with less or no education to ensure that these segments of the population are not excluded.

Finally, the effects of social health insurance scheme on overall health indicators usually take time to show up. However, changes in the practices that lead to better health, such as proper pre- and post-natal care, are more quickly observable. Consequently, any evaluation of newly introduced schemes such as this should focus more on these short-term outcome variables rather than on overall health indicators, which tend to be more informative regarding long term effects. In the final analysis, though, health insurance alone can hardly be an effective tool for the improvement of health care, unless the health care system as a whole is enhanced with reliable infrastructure, well-located health care facilities, efficient health care providers, and competent and accountable administration.

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Table 1: Ghana NHIS – Membership by Regions, June 2007

Region	Population in 1000	Total # Registered in 1000	% Registered
Ashanti	3,924	2,008	51.2
Eastern	2,274	1,161	51.0
Brong Ahafo	1,968	1,418	72.0
Central	1687	935	55.4
Western	2,042	826	40.5
Upper West	562	261	46.5
Upper East	963	367	38.1
Northern	1,790	1,030	57.5
Greater Accra	3,576	861	24.1
Volta	1,636	726	44.5
Total	*20,425*	*9,593*	*46.9*

Source: The NHIS, National Headquarters, August, 2007

Table 2: Covariates – Descriptive Statistics and the Propensity Score

	Means		Differences	Propensity Score Probit	
	Treated	Controls	t-values	Coeffs.	(t-values)
Regional Information					
District: Nkoranza	17.1	28.2	-2.62**	-0.062	(-0.26)
District: Bolgatanga	27.1	22.1	1.22	0.352	(1.13)
District: Telensi-Nandam	27.9	24.0	0.91	0.470	(1.32)
Close to health center	70.7	58.4	2.62**	0.384	(2.75)
Personal Characteristics					
Age 20-29	40.0	33.6	1.36	-0.075	(-0.25)
Age 30-39	43.6	44.7	-0.23	-0.224	(-0.74)
Age 40-49	11.4	14.4	-0.87	-0.260	(-0.77)
Never married	9.3	12.7	-1.08	-0.251	(-0.89)
Married/consensual union	80.0	75.8	1.03	0.109	(0.55)
Religion: Catholic	31.4	32.2	-0.18	-0.167	(-0.93)
Religion: other Christian	42.1	45.9	-0.77	-0.276	(-1.54)
Ethnicity: Akan	43.6	48.5	-1.01	0.085	(0.32)
Education: intermediate	40.7	32.9	1.68*	0.619**	(3.52)
Education: advanced	34.3	24.5	2.28**	0.355*	(1.82)
Permanent Income					
House owner	52.1	52.5	-0.07	0.010	(0.07)
Toilet: intermediate	37.1	43.1	-1.23	-0.293*	(-1.66)
Toilet: advanced	29.3	18.1	2.83**	-0.171	(-0.76)
Water: intermediate	32.9	30.4	0.55	0.029	(0.16)
Water: advanced	31.4	19.8	2.88**	0.158	(0.74)
Electricity	89.3	77.4	3.09**	0.379	(1.64)
TV	77.1	59.1	3.90**	0.042	(0.21)
Radio	90.7	84.2	1.91*	0.007	(0.04)
Home phone	17.9	13.9	1.15	-0.107	(-0.53)
Mobile phone	73.6	50.6	4.84**	0.406	(2.24)
Computer	22.9	10.8	3.61**	0.340*	(1.71)
Refrigerator	44.3	31.5	2.76**	-0.027	(-0.15)
Motorbike	26.4	29.6	-0.73	-0.556**	(-3.40)
Car	19.3	8.0	3.77**	0.385*	(1.82)
Observations	140	425	565	565	
Pseudo R-squared				0.1219	

"*","**", and "***" indicate asymptotic significance at the 10%-,5%-, and 1%-level, respectively. – Baseline categories are "District: Sunyani", "Age: less than 20", "Separated/divorced/widowed", "Religion: other", "Education: basic", Toilet: basic", and "Water: basic".

Table 3: Treatment Effects of NHIS Membership

	Means [%]		Effects [%age points, (t-values)]			
	Treated	Untreated	NN w/ Repl.	w/o Repl.	Radius	Kernel
Recent Birth Episode						
Stillbirth	25.0	22.8	10.45	-2.44	-1.50	-3.15
			(1.54)	(-0.44)	(-0.31)	(-0.67)
Infant death	1.4	9.4	-3.73	-8.13***	-9.65***	-11.27***
			(-1.02)	(-2.78)	(-4.15)	(-5.23)
Birth complications	1.4	7.5	-3.73	-3.25	-6.97***	-9.57***
			(-1.02)	(-1.44)	(-3.24)	(-4.79)
Birth at hospital	75.0	52.9	18.66**	17.07***	12.65**	15.19***
			(2.36)	(2.89)	(2.46)	(3.08)
Professional assistance	65.7	46.6	14.18*	15.45**	13.52**	15.32***
			(1.73)	(2.49)	(2.49)	(2.93)
Prenatal Care						
Prenatal check	85.7	72.0	9.70	13.82***	12.92***	15.47***
			(1.40)	(2.66)	(2.91)	(3.66)
At least 3 checkups	80.0	58.6	14.93*	22.76***	16.48***	17.82***
			(1.91)	(4.00)	(3.32)	(3.76)
Weight measurement	89.3	78.1	15.67**	14.63***	11.14***	10.91***
			(2.38)	(3.04)	(2.78)	(2.86)
Blood pressure taken	87.9	78.8	7.46	11.38**	7.21*	7.30*
			(1.18)	(2.35)	(1.76)	(1.87)
Blood testing	68.6	66.1	3.73	3.25	4.48	3.87
			(0.48)	(0.54)	(0.85)	(0.76)
Urine testing	72.9	69.4	-2.24	0.81	2.02	1.87
			(-0.30)	(0.14)	(0.40)	(0.38)
Postnatal Care						
Postnatal check	85.7	70.6	22.39***	16.26***	14.65***	12.74***
			(3.09)	(3.09)	(3.27)	(2.99)
Check at hospital	80.0	64.9	16.42**	13.01**	9.98**	8.52*
			(2.15)	(2.30)	(2.04)	(1.82)
Vaccination: TB	72.1	60.9	8.96	12.20**	14.16***	13.72***
			(1.14)	(2.03)	(2.70)	(2.72)
Vaccination: Polio	76.4	71.1	0.75	4.07	3.64	3.11
			(0.10)	(0.74)	(0.74)	(0.66)
Vaccination: Tetanus	81.4	71.5	7.46	8.94*	10.76**	10.66**
			(1.07)	(1.66)	(2.31)	(2.39)
Vaccination: Measles	78.6	73.9	0.00	3.25	4.83	4.04
			(0.00)	(0.60)	(1.02)	(0.89)
Vacc.: Yellow Fever	73.6	75.3	-3.73	0.81	-3.66	-3.60
			(-0.52)	(0.15)	(-0.74)	(-0.76)
Preventive Care						
Preventive check	40.7	23.5	23.88***	13.01**	13.42**	11.99**
			(3.29)	(2.16)	(2.57)	(2.37)
Preventive information	82.1	76.2	-5.22	-7.32	-1.44	-1.47
			(-0.85)	(-1.54)	(-0.32)	(-0.34)
Observations	140	425	134	123	134	134

"*","**", and "***" indicate asymptotic significance at the 10%-,5%-, and 1%-level, respectively. – Baseline categories are "District: Sunyani", "Age: less than 20", "Separated/divorced/widowed", "Religion: other", "Education: basic", Toilet: basic", and "Water: basic". – [1)]Imposed caliper width: 0.02. – [2)] Chosen bandwidth: 0.06.

Table 4: Covariate Balance – Individual t-Tests

	Unmatched	Nearest Neighbor[1)]		Radius[1)]	Kernel[2)]
		Replacement	No Replacement		
Regional Information					
District: Nkoranza	-2.62***	-0.62	-0.32	-0.08	-0.09
District: Bolgatanga	1.22	-2.08**	-0.56	-0.15	-0.03
District: Telensi-Nandam	0.91	-0.68	-0.44	0.16	0.22
Close to health center	2.62***	0.91	0.27	0.98	0.71
Personal Characteristics					
Age 20-29	1.36	-0.75	-0.39	-0.30	-0.54
Age 30-39	-0.23	0.99	0.38	-0.12	0.24
Age 40-49	-0.87	-0.88	-0.40	0.61	0.28
Never married	-1.08	-0.40	-0.21	-0.44	-0.34
Married/consensual/ widowed	1.03	0.15	-0.47	0.08	0.18
Religion: Catholic	-0.18	-0.26	-1.48	0.51	0.28
Religion: other Christian	-0.77	1.25	0.51	-0.56	-0.56
Ethnicity: Akan	-1.01	1.88	0.00	-0.54	-0.35
Education: intermediate	1.68*	-0.12	0.13	-0.30	-0.51
Education: advanced	2.28**	0.53	-0.27	-0.29	-0.01
Permanent Income					
House owner	-0.07	0.73	0.64	0.81	0.09
Toilet: intermediate	-1.23	0.89	0.13	0.11	0.06
Toilet: advanced	2.83***	1.43	0.29	0.39	0.02
Water: intermediate	0.55	2.03**	1.38	0.66	0.68
Water: advanced	2.88***	0.13	-0.56	-0.12	-0.36
Electricity	3.09**	0.38	-0.20	-0.18	0.03
TV	3.90***	0.42	-0.15	-0.14	0.12
Radio	1.91	0.20	0.96	0.14	0.37
Home phone	1.15	0.50	0.51	0.33	-0.03
Mobile phone	4.84***	0.93	0.55	0.08	0.31
Computer	3.61***	0.61	-0.48	0.32	-0.16
Refrigerator	2.76***	0.62	0.13	0.09	0.09
Motorbike	-0.73	0.00	-0.28	0.10	-0.00
Car	3.77***	1.40	-0.17	-0.05	0.06
Observations	140	134	123	134	134

"*","**", and "***" indicate asymptotic significance at the 10%-,5%-, and 1%-level, respectively. – Baseline categories are "District: Sunyani", "Age: less than 20", "Separated/divorced/widowed", "Religion: other", "Education: basic", Toilet: basic", and "Water: basic". – [1)]Imposed caliper width: 0.02. – [2)] Chosen bandwidth: 0.06.