ZEF-Discussion Papers on Development Policy No. 270

Emmanuel Nshakira-Rukundo, Essa Chanie Mussa, Nathan Nshakira, Nicolas Gerber, and Joachim von Braun

Can Community-Based Health Insurance Nudge Preventive Health Behaviours?

Evidence from Rural Uganda

Bonn, January 2019

Emmanuel Nshakira-Rukundo, Essa Chanie Mussa, Nathan Nshakira, Nicolas Gerber, and Joachim von Braun, Can Community-Based Health Insurance Nudge Preventive Health Behaviours? Evidence from Rural Uganda, ZEF – Discussion Papers on Development Policy No. 270, Center for Development Research, Bonn, January 2019, pp. 37.

ISSN: 1436-9931

Published by:
Zentrum für Entwicklungsforschung (ZEF)
Center for Development Research
Genscherallee 3
D – 53113 Bonn
Germany
Phone: +49-228-73-1861
Fax: +49-228-73-1869
E-Mail: zef@uni-bonn.de
www.zef.de

The author[s]:
Emmanuel Nshakira-Rukundo, Center for Development Research (ZEF), University of Bonn.
Contact: erukundo@uni-bonn.de
Essa Chanie Mussa, Center for Development Research (ZEF), University of Bonn.
Contact: essachanie@gmail.com
Nathan Nshakira, Kabale University.
Contact: nnshakira@yahoo.co.uk
Nicolas Gerber, Center for Development Research (ZEF), University of Bonn.
Contact: ngerber@uni-bonn.de
Joachim von Braun, Center for Development Research (ZEF), University of Bonn.
Contact: jvonbraun@uni-bonn.de

Acknowledgements

We thank Chaira Kofol, Christoph Kronenberg, Andrew Mirelman and the participants of the Royal Economic Society Conference 2018, Makerere University School of Public Health research seminar and ZEF Research Colloquiums for their insightful comments.

Abstract

Community-based health insurance (CBHI) schemes have emerged as strong pathways to universal health coverage in developing countries. Their examination has largely focussed on their impacts on financial protection and on the utilisation of curative health services. However, very little is known about their possible effect on utilisation of preventive health services and strategies and yet developing countries continue to carry a burden of easily preventable illnesses. To understand if this effect exists, we carry out a cross-sectional survey in communities served by a large CBHI scheme in rural south-western Uganda. We then apply inverse probability weighting of the propensity score to analyse quasiexperimental associations. We find that the probabilities for using long-lasting mosquito nets, vitamin A and iron supplementation and child deworming were significantly increased with participation in CBHI. We postulate that this effect is partly due to information diffusion and social learning within CBHI-participating burial groups. This work gives insight into the broader effects of CBHI in developing countries, beyond financial protection and utilisation of hospital-based services.

Keywords: Community-based health insurance, Preventive Health, Inverse Probability Weighting, Rural Uganda

JEL Codes: I130, I150, I100

1 Introduction: Community-based health insurance and preventive health

Community-based health insurance (CBHI) schemes have been proposed as pathways to achieving universal health coverage in developing countries (Wang & Pielemeier, 2012; WHO, 2010) mainly through their contribution to financial protection (Borghi et al., 2013; Devadasan, Seshadri, Trivedi, & Criel, 2013; Habib, Perveen, & Khuwaja, 2016) and improving health utilisation (Browne et al., 2016; Jutting, 2004; Mebratie, Sparrow, Alemu, & Bedi, 2013; Ranson et al., 2007). However, developing countries continue to suffer from easily preventable communicable illnesses such as malaria, with an estimated 212 million infections in 2015 (WHO, 2016) and diarrhoea, which accounted for over 36 million episodes and about 700,000 childhood deaths happened globally. Nearly 75 percent of diarrhoea mortality happened in only 15 low-income countries in sub-Saharan Africa and south-east Asia (Das, Salam, & Bhutta, 2014; Fischer Walker et al., 2013).

A question that has been rarely asked, and for which evidence remains mixed is whether health insurance influences the uptake of preventive health strategies. This is especially important for developing countries such as Uganda, which is undergoing policy changes aimed at universal health coverage (Basaza, O'Connell, & Chapčáková, 2013; Nabyonga Orem & Zikusooka, 2010) and have a high burden of preventable illnesses. This question is important due to the unavoidable bottlenecks that hamper the effectiveness of preventive health strategies, such as timely immunisation, water treatment or the correct use of long-lasting insecticide-treated mosquito nets (LLIN). While many children die of vaccine-preventable illnesses (Rainey et al., 2011), timely immunisation remains a challenge in many developing countries (Akmatov & Mikolajczyk, 2012). Similarly, access to preventive treatment of malaria is accessed by a small section of those in need (WHO, 2016) and over one billion people still practice open defecation (WHO, 2015). Due to the low uptake of preventive strategies, a number of interventions have been designed and implemented to facilitate improvements. Yet as the literature in the next section shows, these interventions do not reach the target populations in desired proportions.

The aim of this paper is to explore the possible usefulness of CBHI in inducing take-up of preventive health. By evaluating the scheme after two decades since it started, we are able to show medium and possible long-term effects of insurance on preventive health behaviour. Evaluating programmes after considerable time of implementation is important. For instance, in analysing the effect of another preventive health intervention – energy saving and smoke reducing cooking stoves in India, Hanna, Duflo, and Greenstone (2016) consider evaluating after four years a central contribution. The paper demonstrates that CBHI can effectively influence the uptake of preventive health interventions and strategies. In particular, the study found a significant average treatment effect of enrolment in CBHI corresponding to increasing the probability of using an LLIN, receiving iron and vitamin A supplementation and child deworming. Moreover, significant average treatment effects on the treated (ATET) were also found regarding four of the seven outcomes measured.

The rest of this paper is organised as follows. Section 2 explains our problem statement where we make a case for the importance of preventive health in developing countries and specifically on Uganda. We review the literature on interventions to nudge take-up of preventive interventions in the same section. Section three focuses on the theoretical framework using Dupas (2011b) model of investments in preventive health and section five gives the empirical framework of analysis, the inverse probability weighting. Section five provides the results of average treatment effects and average treatment effects on the treated. Section six and seven discuss the results and make concluding remarks respectively.

2 Preventive health in developing countries

Kenkel (2000) defines the scope of preventive health as a range of services classified into three main categories, namely; primary prevention, secondary prevention, and tertiary prevention. Primary prevention refers to actions that reduce the occurrence or incidence of disease that include but not limited to vaccinations, clinical care, and advice (such as antenatal and postnatal services), nutrition and sanitation. Secondary prevention refers to actions to limit the health consequences of a disease such as screening for chronic illnesses which allow for early detection and management. Tertiary prevention refers to actions to reduce disability associated with chronic illnesses. For the purpose of this study, preventive health is narrowed to ex-ante services before the onset of detrimental health conditions (Kremer & Snyder, 2015) and hence limited to only primary prevention in Kenkel (2000) scope of services. Such services include, for instance, sleeping under LLINs which prevent malaria, treating drinking water which prevents water-borne diseases, taking de-worming tablets which prevents intestinal worms and general immunisation which prevents diseases such as polio, measles, and tuberculosis. Also, these are services commensurate with prevention in developing countries in which the burden of diseases is skewed to communicable vector, air and water-borne diseases.

2.1 Disease burden from preventable illnesses

It is important to focus on preventive health because a large proportion of developing countries' disease burden is composed of such easily preventable illnesses. Statistics on the disease burden of preventable illnesses are astounding. For instance, while all the other regions have advanced in providing safe drinking water, 663 million people in Sub-Saharan Africa still lack access to safe drinking water (WHO, 2015). An estimated 1 billion people around the world defecate openly, more than 60 percent of them in India (Burki, 2015). Lack of access to safe water and sanitation facilities is one of the major causes of preventable illnesses such as diarrhoea and pneumonia (Pruss-Ustun & Corvalan, 2006). It is estimated that in 2011, there were over 36 million episodes of diarrhoea accounting for 700,000 childhood deaths with nearly 75 percent of diarrhoea mortality happening in only 15 low-income countries. More than half of diarrhoea episodes happened in sub-Saharan Africa and south-east Asia (Das et al., 2014; Fischer Walker et al., 2013). Similarly, over 14 million episodes of sanitation-related pneumonia resulted in 1.3 million mortalities (Fischer Walker et al., 2013) and diarrhoea fatalities are estimated between 700,000 (Fischer Walker et al., 2013) and 840,000 (Pruss-Ustun et al., 2014).

A recent Malaria Status Report (WHO, 2016) indicated that in 2015, 212 million cases were registered worldwide with an estimated mortality between 235,000 and 639,000 lives. 90 percent of morbidity and 92 percent of mortality is in sub-Saharan Africa. Another issue that has not received due focus and attention in prevention is the effect of indoor population from bio-fuels. This is associated with respiratory infections such as tuberculosis and asthma, which have a disproportional effect on women and children (Franklin, 2007; Zar & Ferkol, 2014). It is estimated by the World Health Organisation that about 1.6 million deaths accounting for about 38.5 million disability-adjusted life years are attributed to indoor smoke caused by the use of solid fuels (Torres-Duque, Maldonado, Pérez-Padilla, Ezzati, & Viegi, 2008). Last but not the least, soil-transmitted helminthiasis and other worms also present a public health crisis with estimated infections in about 24 percent of the world's population or about 1.5 billion people (WHO, 2017). This is an increase from 1.22 billion reported as the prevalence in the 1990s (de Silva et al., 2003). These are just some of the many examples of illnesses that are easily preventable and yet affecting a significant population in developing countries.

2.2 Preventive health in Uganda

The provision of preventive health services in Uganda is synchronised with the current policy of free access to all health services in public health facilities (Nabyonga Orem et al., 2005; Nabyonga Orem, Mugisha, Kirunga, MacQ, & Criel, 2011). Private-not-for-profit (PNFP) health facilities receive government subsidies for primary health, including the provision of preventive health services (Amone et al., 2005; Okwero, Tandon, Sparkes, McLaughlin, & Hoogeveen, 2010). Services availability for the majority of preventive services is close to universal (MOH 2013). Moreover, products such as LLINs are highly subsidised or provided for free through donor-supported programmes (USAID, 2015). Since preventive services are available and subsidised, it would be assumed that their utilisation is high. In fact, utilisation of such services is low. For instance, while LLIN ownership rates have increased substantially, evidence suggests that less than half of the households who owned an LLIN actually slept under one (Ahmed & Zerihun, 2010). Malaria infection rates remain very high at 433 per 1000 people, leading to 15.8 million patients (MOH, 2016). Only 59% of the population had a hand washing facility and 26% had an improved sanitation facility (UBOS & ICF, 2018). Diarrhoea and pneumonia (and other acute respiratory infections) also pose a heavy disease burden for children accounting for 23% of under-five deaths (WHO, 2015). Only 35% of the population has access to an improved sanitation facility (UBOS & ICF International, 2012) and only 8% have hand washing facilities (WHO & UNICEF, 2015). Over 90% of the population have constant exposure to biomass pollution leading to over 16 prevalence in chronic obstructive pulmonary disease (Van Gemert et al., 2015), which can be reduced significantly by adopting energy saving stoves. We highlight on some indicators of preventive health in the Uganda and in the region of focus in the table below.

Table 1: Some preventive health indicators for Kigezi region

	2011		2016	
	Region	Country	Region	Country
LLIN	89.4	80.0	77.8	74.0
Hand washing	8.7	12.1	22.1	29.0
Vitamin A supplement	12.0	8.4	60	56.8
Iron Supplement	11.9	6.5	4.7	7.1
Deworming	73.2	60.7	52.7	50.0

Source: Demographic and Health Surveys 2011 & 2016. The differences between 2011 and 2016 survey might be the changes in sampling frames to include subregions.Western region in 2011 is divided into four regions - Bunyoro, Tooro, Ankole & Kigezi

This health situation landscape, therefore, calls for new, strategic and consistent as well as a re-invigoration of existing preventive interventions. Two dimensions of behaviour change effects are expected. The first dimension is with the utilisation of home-based preventive strategies such as water treatment, handwashing and using of long-lasting insecticide nets (LLINs). The second dimension is with the utilisation of clinically provided preventive services such as deworming or PCV vaccine. Though clinically provided preventive services are in principle free, they still require households to make an investment such as time and transport, to access the health facility or health outreach post in order to utilise them.

2.3 Improving the uptake of preventive health interventions

Interventions to nudge take-up of preventive health strategies can be categorised into two. The first category is price and demand instruments such as cash transfers, subsidies, vouchers or waivers (Cohen & Dupas, 2010; Dupas, 2014; Kremer & Miguel, 2007; Van de Poel, Flores, Ir, O'Donnell, & Van Doorslaer, 2014). the other category is education and social learning (Dupas, 2011a; Jalan & Somanathan, 2008; Luby et al., 2004; Madajewicz et al., 2007). The general finding from both these categories of interventions is that take up of preventive strategies improves, albeit with significant unavoidable bottlenecks. The first category of interventions are not only riddled with errors and ethics of targeting (Devereux et al., 2017; Kidd, 2017; Mishra & Kar, 2017) but also lead to wastage (Cohen, Dupas, & Schaner, 2015; McLean et al., 2014). Moreover, conditions on cash transfers and similar instruments sometimes limit access (Attanasio, Augsburg, Brugues, & Caeyers, 2015). Education and social learning interventions are limited by short time frames in which deeply held beliefs are not changed (Glanz & Bishop, 2010; Mobarak, Dwivedi, Bailis, Hildemann, & Miller, 2012).

The central question of this study is whether participation in community-based health insurance can supplement other channels of nudging the utilisation of preventive health services - a possible behaviour change effect. Studying the effect of health insurance on health behaviour and health outcomes requires that three issues are understood. The first issue is that the primary role of health insurance is financial protection (Acharya et al., 2013; Cutler & Zeckhauser, 2000) and due to this, improvements in health that are as a result of consuming more care are conventionally taken as moral hazard – the tendency to consume more health care because one does not directly pay the cost (Ehrlich & Becker, 1972; Pauly, 1974). However, the second issue is that not always the case that increasing health service utilisation is moral hazard (Mendoza, 2016; Seog, 2012) and so it is important to separate moral hazard induced service utilisation from the positive effect of insurance from service utilisation.

Grignon (2014) provides a framework in which this separation can be made. He introduces the concepts of need and preference, where need is not moral hazard while preference is. A situation would be inferred as a preference in consumption of health services only when an individual simply feels that because of the subsidised health costs or income effect from being insured (Nyman, 2001), prefers to consume more health care. One example can be teeth whitening or beautification surgeries. On the other hand, Grignon (2014) suggests that needed care is the type which is clinically necessary to maintain health, for instance, routine dental check-up and mammography screening. It is our understanding that preventive health treatments fall within needed care rather than preferred care. And when preventive health practices reduce both the probability of illness, insurance can be complementary to both treatment and prevention (Barigozzi, 2004). In this regard, there are a number of studies that analyse the effects of health insurance on different health outcomes in developing countries.

Few studies, majority of them from Latin America, have researched this relationship with mixed findings. Giedion et al. (2010) found an 8 percentage point increase in child immunisation and 6 percentage point increase in antenatal visits for mothers enrolled in the subsidised insurance program for the poor in Colombia. They also find that enrolment in the contributory health insurance was associated with increasing preventive dental check-ups by up to 45.6 percentage points among the self-employed households. Still, in Colombia, Miller, Graefe, and De Jong (2013) found that utilisation of a preventive physician visit increased by 29 percentage points while the number of growth monitoring assessments increased by 1.5 times more, associated with enrolment in the public health insurance for the poor. Other studies have also found effects regarding full immunisation and growth monitoring (Bitrán, Muñoz, & Prieto, 2010; Cercone, Pinder, Jimenez, & Briceno, 2010). Studies in Mexico however, seem to indicate a mixed picture. Insured adults were more likely to use preventive screening for hypertension, cholesterol, and cancer (Pagan, Puig, & Soldo, 2007; Rivera-Hernandez & Galarraga, 2015) but other researchers do not find this evidence (King et al., 2009; Spenkuch, 2012). In Africa, two studies in Ghana further provide a mixed picture. Gajate-Garrido and Ahiadeke (2015) found improvements in anti-malarial treatment associated with CBHI participation but Yilma, Van Kempen, and De Hoop (2012) found an opposite reduction in the use of LLINs for insured households. However, studies in Nigeria have indicated a sustained effect on blood pressure among CBHI participating households (Hendriks et al., 2016, 2014). By and large, there is still a dearth of evidence on the effect of insurance on preventive health and it is hoped that this paper shades more light on the issue.

2.4 Our contribution to literature

We aim to make a twofold contribution to literature. The first contribution is to utilise the opportunity of evaluating a community self-sustaining insurance scheme that has been in operation for close to two decades. The time factor is important for health insurance evaluations (Victora & Peters, 2009) as well as broader development economics evaluations. Evaluations after a considerably longer time of implementation are encouraged because treatment effects might change as has been seen in the case of cooking stoves on mothers in India (Hanna et al., 2016). It has therefore been suggested that sufficient time for evaluating health intervention should be between 5 and 7 years (Bryce & Victora, 2005).

The second distinction relates to the type of scheme we study. Our case study scheme is different from other CBHI schemes in two distinct ways. The first distinction relates to the centrality of community in the scheme. The foundations of these CBHI are in kin-associated burial groups, which have existed in the area for a long time (Katabarwa, Mutabazi, & Richards, 1999). Moreover, these kin-related groups are central to the permeation of preventive health knowledge (Katabarwa et al., 2010; Katabarwa, Mutabazi, & Richards, 2000; Katabarwa, Richards, & Rakers, 2004). And yet, to the best of our knowledge, we do not find any studies that make this connection between these kinds of CBHI and preventive health endeavors. While our study does not delve deeper into the social networks and capital in these groups, we assume this feature makes them distinct from a host of many other schemes in sub-Saharan Africa and elsewhere which are not based on such kin relationships. The second distinction of the scheme is that it is solely community owned and financed, and does not have any subsidisation from any government or non-government institution on its premiums. This makes it unique in that schemes in other countries are subsidised by the government or donors and therefore the actual premiums are not fully paid by the insured individuals. We therefore contribute to preventive health literature in this manner by studying the effect of CBHI on seven practices and treatments that enhance health through prevention. Moreover, for some practices such as long-lasting insecticide nets (LLIN), we go a step further simply knowing if a household owned one, but if it was actually used the night immediate before the survey.

3 Theoretical Model of Preventive Health

Joining and remaining in insurance can be taken as an investment which has income returns in form of lower prices for health services in the instance of sickness (Nyman, 2001). We therefore use a model of health investments by Dupas (2011b) as a pathway through which insurance membership nudges preventive health behaviour. We consider that a household maximises utility expressed in a function such as:

$$\sum_{i=1}^{T} E_t \left(\frac{1}{1+\sigma}\right)^t U_t + B\left(A_{T+1}\right),$$

where σ is a discount rate, B is a bequest rate (a starting point value of wealth as suggested in Mitchell and Carson (1985)), A are the asset holding and U_t (Utility) is given by

$$U_t = U\left(H_t, C_t, L_t\right),$$

Where H_t denotes the stock of health of a household, C_t is the consumption of other goods and L_t denotes leisure. The health stock is a commodity that households value and have a certain degree of control over. For instance, a household might decide to immunize their children, seek health care from any provider of choice or invest in any other preventive health technology. As Dupas (2011b) provides, a household can make either preventive health investments/decisions which reduce the susceptibility of a health shock or sickness. A household can also make remedial investments such as seeking tertiary care. If remedial health investments are not undertaken household health stock remains permanently diminished after a health shock. The household health stock evolves over time as follows:

$$H_t = H_{t-1} + \pi_t min\left(remedy_t - shock_t, 0\right),$$

Where π_t is the probability of an illness or other health shock is at a time *t;* $shock_t$ is the severity of the shock and $remedy_t$ measures the adequacy of the response to the shock (that is; how much the remedial investment mitigates the loss caused by the health shock). As Dupas further provides, the probability of the shock π_t is endogenous because it depends on the preventive investment being made up to time $t-1$ which can be denoted as $prevent_{t-1}$. It also depends on a random variable ϵ_t, which is independently and identically distributed for all t and captures the fact that the health shock is subject to randomly varying threats outside the household's control. For example, the likelihood of malaria might depend not only on the household's use of mosquito nets but also rainfall intensity. This can be formally presented as:

$$\pi_t = \pi\left(prevent_t, \epsilon_t\right).$$

This implies that the health shock will depend first on how much the household previously invested in preventive strategies and, second, on the adequacy of response to those shocks that did occur. If the response to the shock is inadequate ($remedy_t < shock_t$), then the health shock carried forward to the next period is reduced. Households have the following budget constraint:

$$p_c C_t + p_p prevent_t + remedy_t = w\left(\bar{T} - L_t\right) + rA_t + W_t,$$

Where the *p's* denote prices, w the wage, $\bar{T}$ the total time endowment and W represents the unearned income such as remittances. In this model, some of the health investments might be time investments, for instance, travelling to the health centre and waiting time, in which case, their price is the opportunity cost of time. At each period, after having observed whether a health shock has occurred and the unearned income, the households choose the levels of preventive investment, remedial investment, household consumption, and leisure to make. This model indicates that while preventive health investments in one period enter utility in the immediate future period, remedial (curative) health investments enter directly in the utility of the current period. This implies that preventive health investments decrease faster with the discount rate than remedial investments. As Dupas (2011b) submits, while this model is simplified, it, however, gives us a basis to understand the key determinants of households' health investment decisions. As discussed in the literature review above, some key issues that affect these decisions at the household level are the level of information, financial constraints. The literature discussed basically looks at these two broad issues - information access and financial constraints.

While the review by Dupas (2011b) review touches on the effect of social learning as a way in which information spreads in networks, the studies reviewed do not look at the effect of membership in a socially-controlling community organisation in which norms, practices, loyalty and expectation of mutual support are held in high regard. This is the addition we bring to this literature by studying the effect of membership in an organically formed community health insurance scheme.

4 Empirical Strategy

4.1 The Data: Kisiizi Community-based Health Insurance Scheme

The data used for this study is from a cross-sectional survey undertaken in the districts of Kabale and Rukungiri in south-western Uganda between August 2015 and April 2016. Specifically, the survey was carried out in 14 villages in two sub-counties served by Kisiizi hospital, a rural community hospital which operates the Kisiizi CBHI. Kisiizi CBHI started in 1997 and is currently the largest CBHI scheme in Uganda, providing coverage to over 7,200 households with over 42,000 individuals. The scheme and hospital do not have a comprehensive way in which they limit self-selection and moral hazard from pre-existing health conditions. Instead, it has two main features regarding enrolment and coverage for members. The first one is that membership in the scheme is at two levels, that is; household level and group level. At the household level, the scheme implements a "full household enrolment" policy such that for a household to be a member, all the known members of the household have to be registered too. In principle, it is not accepted that some members of the household are insured while others are not.

The second level of enrolment is a group. Households do not insure as single households but rather as groups. This originates from how the scheme was founded, building on existing informal insurance mechanisms that existed in form of burial groups. A household, therefore, has to be part of a burial group to qualify for enrolment. For a burial society to be registered in insurance, two conditions have to be met. The first condition is that the group has to have at least 30 households. For these smaller groups, all the households in the group have to subscribe. The second condition pertains to larger groups. In these larger groups, some with more than 100 households, at least 50% of households have to subscribe and all members of the subscribing households are required to enrol. Most of the groups in insurance had over 95% of all households registered in insurance. Households pay premiums ranging from Uganda shillings 10,000 per person for households of 8 to 12 members to 28,000 for households of 2 people. an equivalent of $4 to $8 per individual, depending on household size[1]

Another important feature of this scheme is the timing of coverage. In order to further control moral hazard and adverse selection, members are fully covered once they have been in insurance for at least one year. Insurance covers only 10 percent of health costs when a member uses hospital services within a year of enrolling. These kinds of strategies to limit adverse selection have been applied in other community insurance scheme but for this scheme, waiting time to full coverage is generally more

[1] This is equivalent to about $3 to $8 using the average annual exchange rate of US$ 1=3400 UGX in 2015. According to the 2012 National Household Survey (UBOS, 2014) average annual household incomes for Kigezi region were Uganda shillings 4.1 million, derived from reported monthly income of Uganda shillings 343,000. This implies that total premiums for a household of 11 members would be 2.4 percent of total annual household income and 1.4 percent of household income for a household of 2 members. Using the 2016 survey (UBOS, 2017), annual premiums are equivalent to 1.8 percent of average annual household incomes for a 11 member household and 1 percent for a 2 member household

conservative. For instance in a Nigerian scheme, enrolled people wait for about 36 days before they can be covered by insurance (Bonfrer, Van De Poel, Gustafsson-Wright, & van Doorslaer, 2015). Typically, insurance covers basic primary care, maternity care, surgeries, and outpatient and inpatient services. Outpatient services for chronic illnesses and substance abuse related illnesses and injuries are excluded.

In partnership with this scheme staff and burial group leaders, we used a multi-stage simple random sampling and surveyed 464 households in the fourteen villages. The survey modules included a household demographic module which collected information on household occupancy; a child and maternal health module which collected information on health care seeking behaviour for mothers and children; a nutrition module which collected information on household food availability and intake. The survey collected detailed information on household social and economic welfare using durable assets holdings and other endowments in agriculture, water and sanitation, and housing. The health insurance and social connectivity modules collected information regarding household insurance status, group membership and participation, and knowledge of insurance such as premiums and benefits package. In line with emerging tools for understanding enrolment in community insurance in sub-Saharan Africa, the survey incorporated a detailed module on perceptions about several aspects of health insurance.

Ethical approvals for data collection were conducted by the Mengo Hospital Research and Ethics Review Committee and an ethical certificated was provided by the Uganda National Council of Science and Technology (Reference Number SS-39369). Further ethical reviews were undertaken by the Centre for Development Research, University of Bonn research committee and the local research partner, Kisiizi Hospital Research Committee. The research was carried out in the full knowledge of the district administration health teams, local government authorities, village leaders and verbal consent was obtained from the respondents.

4.2 Inverse probability weighting of the propensity score

In the absence of experimental or longer observation time frame for quasi-experimental analysis, to understand the relationships of interest, we use inverse probability weighting (IPW) on the propensity score. IPW is a variant of propensity score matching techniques which provide robust quasi-experimental associations after controlling for observed determinants of the treatment (Austin, 2011; Austin & Stuart, 2015). IPW is preferred over the conventional propensity score matching techniques because it is doubly robust. It's doubly robust nature allows for estimating both the propensity score model as well as the regression model (Austin, 2010). Moreover, IPW does not only remove bias in treatment assignment but also removes differences in the covariates (Hirano, Imbens, & Ridder, 2003). Two conditions must be fulfilled for IPW to be unbiased. The first is that the treatment selection model is well fit. The second is that the treatment group and control group are well balanced and bias is effectively removed (Austin & Stuart, 2015). IPW can be applied on both pane data (for instance (Huber, 2014)) as well as cross-sectional anaylsis like ours (for instance, (Djimeu, 2014; Hirano & Imbens, 2001; Woode, 2017)) to get consistent and efficient results.

The econometric analytical approach used is from Hirano and Imbens (2001) who apply the approach on data assessing the effect of right heart catheterisation on patient survival. For our case, the summary of their framework is given in a weighted least squares regression given as:

$$Y_i = \alpha_0 + \tau * T_i + \beta_1 Z_i + \beta_2 \left(Z_i - (\bar{Z}_i) \right) * T_i + \epsilon_i$$

Where Y_i is the preventive health outcome (use of long-lasting insecticide treated mosquito net (LLIN) the previous night, water treatment, handwashing facility, vitamin A supplementation, iron supplementation, child deworming and pneumococcal conjugate vaccine (PCV) for child pneumonia). T_i is the treatment dummy that indicates whether a households was enrolled in CBHI or not, Z_i is a vector of covariates in the model and the error term is given by ϵ_i. All covariates are weighted by the inverse of the probability of receiving the treatment, given by the term $(Z_i - (\bar{Z}_i)) * T_i$. Accordingly, the inverse probability weights are equivalent to:

$$\omega(t,z) = t + (1-t) * \frac{(\hat{\epsilon}(z))}{1-\hat{\epsilon}(z)}$$

This main estimation is undertaken in StataCorp (2015) treatment effects framework. The output in this framework also indicates the potential outcomes, which refers to the prevalence level of the outcomes at the mean, without treatment. An important ingredient in attaining efficient estimates is in the selection and balancing diagnostics for the observables. In order to attain covariate balancing, we again use weighted least squares regressions for each covariate and the CBHI status weighted by the inverse probability weight following Guo and Fraser (2015). Results are shown in Table 2 below.

5 Results

5.1 Descriptive results

Twenty-eight base variables were included in the treatment selection model of CBHI participation. Table 3 shows summary statistics of all base variables, the treatment, and the outcomes. 43.8 percent of the respondents were enrolled in CBHI and the mean age of the children in the sample was 30.2 months. Slightly over 55 percent of the children were born in a health facility. 48 percent of the children were male. The mean age of the mothers was 30.2 years. Mother's and father's education were merged into one indicator of parental education where we assign 1 if one of the parents had attended some secondary level education and 0 otherwise. 30.4 percent of the households had at least one parent with some secondary level education. Slightly more than half of all the respondents identified as Catholics.

Table 2: Covariate balancing with weighted least squared regressions

VARIABLES	CBHI	SE	Constant	SE	R-squared / Pseudo R-squared
Child age (months)	−1.285	(2.299)	30.410***	(1.555)	0.002
Mother's age (years)	−0.293	(1.051)	29.700***	(0.832)	0.000
Child's birth weight	−0.054	(0.095)	3.217***	(0.077)	0.003
Child is male	0.313	(0.417)	−0.454	(0.288)	0.004
Parent attended secondary school	0.307	(0.476)	−1.085***	(0.252)	0.000
Delivered in a health facility	0.043	(0.442)	0.353	(0.323)	0.000
Catholic	−0.003	(0.445)	0.165	(0.304)	0.000
Wealth index	0.192	(0.207)	−0.109	(0.090)	0.006
Has neighbour in CBHI	−0.084	(0.539)	0.958***	(0.242)	0.000
Casual employment (man)	0.132	(0.396)	−0.868***	(0.303)	0.000
Casual employment (woman)	−0.127	(0.500)	−2.429***	(0.252)	0.000
Household diet diversity score	−0.108	(0.326)	4.524***	(0.284)	0.002
Household size	0.342	(0.327)	5.638***	(0.186)	0.007
Postnatal visit	0.100	(0.405)	1.786***	(0.282)	0.000
IPTP for malaria	0.235	(0.430)	2.880***	(0.269)	0.000
ANC essential components	0.230	(0.425)	0.0207	(0.316)	0.000
Size of funeral group (log)	−0.007	(0.094)	4.028***	(0.088)	0.000
Village funeral groups (log)	0.077	(0.172)	1.567***	(0.102)	0.003
Access to information	0.089	(0.087)	0.620***	(0.069)	0.008
Perceptions index	0.011	(0.482)	0.11	(0.353)	0.000
Leader influence	0.642**	(0.301)	−0.162	(0.269)	0.040
Social connectivity	−0.057	(0.282)	0.265	(0.259)	0.001
Know traditional birth attendant	0.421	(0.410)	−0.316	(0.285)	0.000
Know CBHI premium	0.395	(0.525)	0.349	(0.277)	0.000
Waiting time (hours)	0.381	(0.298)	1.302***	(0.204)	0.012
Village has a TBA	0.112	(0.358)	1.374***	(0.267)	0.000
Village has a health centre	0.186	(0.450)	−0.844***	(0.253)	0.000
Village has a school	0.067	(0.438)	0.429	(0.342)	0.000
Village economy - banana	−0.108	(0.460)	−0.717*	(0.368)	0.000
Village economy - pastoral	−0.506	(0.760)	−1.614***	(0.221)	0.000
Distance to nearest health facility	−0.048	(0.708)	3.739***	(0.234)	0.000

Robust standard errors. Each variable is an individual weighted least square (if continuous) or weighted logit (if dummy) regression. R-squared & Pseudo R-Squared for the respective models
*** p<0.01, ** p<0.05, * p<0.1

Principal Components Analysis (Vyas & Kumaranayake, 2006) was used to develop six continuous variables, indices for household wealth, perceptions on health insurance in four dimensions (premiums, management of the scheme, health beliefs and influence from leaders). The variable access to information is a dummy that measures if a household listened to radio daily or had a television, or read a newspaper at least once in the week. Households had an average size of 6 members and almost 70 percent of the households knew at least one neighbour participating in CBHI. 53

percent knew actual annual premiums. The average waiting time at a health facility was close to 1.5 hours. In 35 percent of the households, husbands were in unstable casual employment while in only 10 percent, wives casually employed. 52.8 percent of the mothers had had an interface with a traditional birth attendant. Burial group size ranged from 18 to 200 households with the average burial group having 72 households while each village had about 6 burial groups.

Nineteen percent of the respondents were in villages which were predominantly livestock villages and about 26 percent were in predominantly banana cultivating villages. The average distance from a village to the nearest health centre, calculated on a motor vehicle usable road, was 4 kilometres. 40 percent of the respondents were from villages with a health centre and 63 percent from a village with a school. For the outcomes of focus, 44.2 percent of the households reported sleeping under an LLIN. Water was classified as treated if a respondent reported using any of the households' water treatment techniques such as sedimentation, disinfection or filtration, in line with WHO (2013). 53 percent of the households reported using at least one water treatment technique. Only 12 percent of the households had a handwashing facility at their toilets. 77.2, 74.1, 10.1 and 30.2 percent of the sampled children were reported to have received Vitamin A supplementation, deworming, iron supplementation and PCV vaccination respectively.

5.2 Empirical results

In this section, we first show the results of a logit regression that predicts the probability of selecting into CBHI. We use this model to generate the propensity scores. In order to ascertain that the propensity score model is well fit, we present several post-estimation checks including the variance information factor, the goodness of fit and the link test. In these results, we show that household wealth, being a Catholic (which was the dominant faith), husband's casual employment, receiving all four essential components of antenatal care, access to information and knowledge of CBHI premiums were all positively associated with enrolling in CBHI. However, child's age, women's employment in casual work, living in a village that had a traditional birth attendant or a pastoralist village were negatively associated with enrolment.

Table 3: Descriptive results

Variable	Mean	Min	Max	SD
CBHI Participation	0.438	0	1	0.497
Child's age (in months)	30.202	5.550	60.580	15.152
Mother's age (in years)	30.204	14.010	56.540	7.164
Birthweight	3.165	2.00	5.60	0.479
Child is male	0.481	0	1	0.500
Parental (some) secondary education	0.304	0	1	0.460
Health facility delivery	0.554	0	1	0.498
Catholic	0.504	0	1	0.501
Wealth index	8.94e-10	−1.754	8.365	1.344
Neighbour in CBHI	0.692	0	1	0.462
Husband employment - casual	0.351	0	1	0.478
Mother employment - casual	0.101	0	1	0.302
Household diet diversity score	4.080	0	8	1.280
Household size	5.679	2	15	2.175
Burial group size	71.366	18	200	26.054
Postnatal care visit	0.827	0	1	0.378
IPTP dose	0.922	0	1	0.268
Essential ANC services	0.407	0	1	0.492
Number of burial groups in the village	5.601	1	10	3.349
Perception of premiums	1.71e-09	−2.041	3.447	1.249
Perception of insurance management	-1.82e-08	−5.579	2.431	1.477
Health beliefs & perceptions	1.98e-09	−1.572	5.435	1.127
Perception of social (leader's) influence	-6.79e-09	−5.006	2.014	1.506
Access to Information	0.599	0	1	0.491
Interface with TBA	0.528	0	1	0.500
Knows premium	0.528	0	1	0.500
Waiting time (minutes)	1.477	0.083	9	1.814
Village has TBA	0.752	0	1	0.432
Village has health centre	0.401	0	1	0.491
Village has school	0.634	0	1	0.482
Village economic activity - banana	0.261	0	1	0.440
Village economic activity - pastoralism	0.192	0	1	0.394
Distance to nearest health facility (kms)	4.001	0	11.500	2.919
N		464		

The number of burial groups in the village was associated with enrolment but households belonging to larger size burial groups were less likely to enrol. Households that reported feeling more influence from leaders on household insurance participation decisions were more likely to enrol.

Table 4: Descriptive results: Outcomes

Variable	Mean	Min	Max	SD
Used LLIN	0.442	0	1	0.497
Household water treatment	0.528	0	1	0.499
Handwashing facility	0.120	0	1	0.313
Vitamin A supplement	0.772	0	1	0.420
Deworming	0.741	0	1	0.438
Iron supplement	0.101	0	1	0.302
PCV vaccine	0.302	0	1	0.460
N		464		

5.2.1 Average Treatment Effect of participation in CBHI

Results of the average treatment effects (ATE) presented in indicate that enrolling in CBHI was positively associated with all the seven measured outcomes and a significant association was present in four of the seven outcomes. The outcomes can be categorized into two ways; (1) home-based preventive health practices, namely use of LLIN, water treatment, and handwashing shown in models 1-3 and (2) facility-based preventive health interventions, namely, vitamin A supplement, iron supplement, deworming and PCV vaccine, in models 4 through 7.

Starting with the home-based preventive health practices, results indicate that compared to households not in CBHI, the probability of using LLIN increased by 23.6 percentage points if the households enrolled in CBHI. The probability of water treatment increased by 10 percentage points but was not statistically significant. We observe a negative association of CBHI participation and handwashing, though not statistically significant too.

Regarding the treatment effects on facility-based preventive health interventions, positive associations were observed in all the measured outcomes. It was observed that CBHI participation increased the probability of taking vitamin A supplements by 19 percentage points while that of iron supplementation increased by 9 percentage points. The largest impact of facility-related outcomes is observed in deworming

Table 5: Logistic regression for determinants of CBHI enrolment

VARIABLES	Coef	SE	95% CI		
Child age (months)	−0.029**	(0.012)	−0.053	-	−0.005
Mother's age (years)	0.038	(0.033)	−0.026	-	0.103
Child's birthweight	−0.236	(0.364)	−0.950	-	0.478
Child is male	0.347	(0.332)	−0.304	-	0.997
Parent attended secondary school	−0.408	(0.488)	−1.364	-	0.549
Delivered in a health facility	0.173	(0.385)	−0.582	-	0.927
Catholic	0.818**	(0.383)	0.066	-	1.569
Wealth index	0.610***	(0.231)	0.157	-	1.063
Wealth index squared	−0.118**	(0.058)	−0.232	-	−0.003
Has neighbour in CBHI	0.621	(0.467)	−0.294	-	1.536
Casual employment (man)	0.981**	(0.424)	0.150	-	1.811
Casual employment (woman)	−1.232*	(0.633)	−2.473	-	0.009
Household diet diversity score	−0.129	(0.152)	−0.427	-	0.169
Household size	−0.089	(0.103)	−0.291	-	0.113
Postnatal visit	0.634	(0.481)	−0.309	-	1.576
IPTP for malaria	−0.194	(0.539)	−1.251	-	0.863
ANC essential components	0.659*	(0.400)	−0.125	-	1.443
Size of funeral group (log)	−1.478***	(0.483)	−2.424	-	−0.532
Village funeral groups (log)	0.756**	(0.382)	0.007	-	1.504
Access to information	0.930***	(0.354)	0.236	-	1.625
Perceptions on scheme management	0.008	(0.154)	−0.293	-	0.309
Perceptions on premiums	−0.308	(0.200)	−0.699	-	0.084
Health beliefs & perceptions	0.047	(0.194)	−0.335	-	0.428
Perceptions on social (leader's) influence	0.295*	(0.152)	−0.003	-	0.593
Social connectivity	0.271	(0.167)	−0.055	-	0.598
Know premiums	3.009***	(0.378)	2.267	-	3.751
Know traditional birth attendant	−0.767	(0.483)	−1.714	-	0.180
Waiting time at facility (hours)	−0.018	(0.101)	−0.215	-	0.179
Village has a traditional birth attendant	−1.163*	(0.605)	−2.350	-	0.023
Village has a health centre	−0.184	(0.717)	−1.589	-	1.221
Village has a school	−0.090	(0.618)	−1.300	-	1.120
Village economy - banana cultivation	−0.920	(0.591)	−2.080	-	0.239
Village economy - pastoralism	−2.374***	(0.874)	−4.087	-	−0.662
Distance to nearest health facility	0.188*	(0.105)	−0.018	-	0.394
Constant	3.192	(2.808)	−2.311	-	8.695
Pseudo R-squared	0.5941				
Mean VIF	8.72				
Link test (hat square)	−0.059	0.040	−0.138	-	0.020
Pearson χ^2 goodness of fit (p-value)	0.4021				
Observations			458		

Robust standard errors in parentheses.
*** p<0.01, ** p<0.05, * p<0.1

Table 6: Average Treatment Effect of CBHI participation

	(1) LLIN	(2) Water treatment	(3) Hand washing	(4) Vitamin A supplement	(5) Iron supplement	(6) Deworming	(7) PCV
ATE	0.236**	0.100	-0.062	0.190**	0.090*	0.240***	0.023
	(0.094)	(0.086)	(0.084)	(0.092)	(0.050)	(0.085)	(0.059)
Potential Outcomes	0.282***	0.554***	0.157**	0.628***	0.068***	0.605***	0.215***
	(0.048)	(0.063)	(0.069)	(0.079)	(0.022)	(0.077)	(0.037)
N	458	458	458	458	458	458	458

Robust standard errors in parentheses.
*** p<0.01, ** p<0.05, * p<0.1

where a 24 percentage points increase in the probability of deworming was observed once a child's household joined CBHI. In the same direction, the probability for receiving PCV increased by 2.3 percentage points but was not statistically significant. However, we find a negative effect of CBHI participation and receiving PCV for pneumonia, equivalent to a reduction in the probability by 10.6 percentage points.

The effect of CBHI enrolment can be intuitively presented as a proportion of the potential outcome that CBHI participation induces. These results of the differences in point estimates are presented in Table 7 below

Table 7: Percentage size of the ATE

	Diff in Coeff	SE	95 % CI		
LLIN	0.836**	(0.419)	0.015	-	1.657
Water Treatment	0.181	(0.172)	-0.155	-	0.518
Handwashing	-0.396	(0.386)	-1.153	-	0.360
Vitamin A	0.302*	(0.183)	-0.056	-	0.660
Iron supplement	1.322	(0.971)	-0.581	-	3.225
Deworming	0.397**	(0.188)	0.028	-	0.766
PCV	0.110	(0.290)	-0.459	-	0.678

Robust standard errors in parentheses.
*** p<0.01, ** p<0.05, * p<0.1

The study findings indicate that an increase in the probability of using LLINs was equivalent to 84.6 percent of the potential outcomes, once a household adopts CBHI. Summary results indicated that while there were no significant differences in LLIN ownership among treated and control households, CBHI participating households reported more LLIN usage (55.2 percent) compared to control households (35.6

percent). Without CBHI, the probability of a household to practice some form of water treatment was only 52.3 percent and CBHI participation increased this probability by 10 percentage points: equivalent to an 18.1 percent improvement.

In an alternate direction, while the ATE for handwashing was not statistically significant, a 6.2 percentage point reduction in the probability of owning a handwashing facility was equivalent to 39.6 percent reduction. The probability of receiving a vitamin A supplement increased by 30.2 percent once a household participated in CBHI while utilising iron supplementation for children increased by 132 percent. A 24 percentage point increase in the probability of child deworming was equivalent to 39.7 percent improvement on the potential outcomes estimate. The probability of receiving PCV also increased by 11 percent.

5.2.2 Average Treatment Effect on the Treated

A precise measure of the effect of CBHI participation is the Average Treatment Effect on the Treated (ATET) which measures the effect of participation on only those households which enrolled comparing them with their counter-factual outcome had they not been treated. Implementing the same treatments effects procedure and conditioning to only these households, we observe an increase in effects' size regarding mosquito net use, vitamin A supplement, deworming and PCV. In particular, for these households, the magnitude of change was larger than ATE for LLIN, vitamin A supplementation, and deworming. Moreover for PCV, probability increased 17.1 percentage points while the ATE was not significant.

Table 8: Average Treatment Effect on the Treated

	(1) LLIN	(2) Water treatment	(3) Hand washing	(4) Vitamin A supplement	(5) Iron supplement	(6) Deworming	(7) PCV
ATET	0.344***	-0.024	-0.091	0.274**	0.070*	0.266*	0.171***
	(0.089)	(0.110)	(0.129)	(0.137)	(0.037)	(0.137)	(0.053)
Potential Outcomes	0.211**	0.603***	0.190	0.508***	0.049	0.511***	0.117***
	(0.082)	(0.109)	(0.128)	(0.137)	(0.033)	(0.136)	(0.042)
N	458	458	458	458	458	458	458

Robust standard errors in parentheses.
*** p<0.01, ** p<0.05, * p<0.1

However, we also observe worsening results for water treatment and owning a handwashing facility, though not statistically significantly different from non-enrolled households.

5.3 Robustness Checks

In order to affirm that the results indicated in this analysis are stable, we employ several robustness checks based on alternative estimation strategies. First, as an alternative to Stata's Treatment Effects framework (StataCorp, 2015), we implement two-stage weighted least squares (WLS) regressions, where weights are manually generated (Cerulli, 2014; Nichols, 2008). As expected, these results (see supplementary tables) are identical to the main analysis strategy. IPW is sometimes sensitive to extreme weights, where units have large weights when their treatment status is 0 or weights close to 0 when their treatment status is 1 (Austin & Stuart, 2017). In such a scenario, it is advised to conduct weight stabilisation through truncating (Harder, Stuart, & Anthony, 2010). We, therefore, implement the weight stabilisation procedure by Harder et al. (2010) and rerun WLS We, therefore, utilise stabilised weights and estimate weighted least squares regressions of the effect of CBHI. Results shown in Table 7 indicate that the effects relating tin LLIN, iron supplements and deworming persist as in the main estimation strategy.

Table 9: ATE using Harder et al. (2010) stabilised weights

	(1) LLIN	(2) Water treatment	(3) Hand washing	(4) Vitamin A supplement	(5) Iron supplement	(6) Deworming	(7) PCV
ATE	0.262***	0.146**	0.010	0.079	0.099*	0.135**	0.024
	(0.067)	(0.070)	(0.041)	(0.058)	(0.051)	(0.056)	(0.053)
Constant	0.309***	0.434***	0.0939***	0.720***	0.0758***	0.695***	0.238***
	(0.043)	(0.049)	(0.027)	(0.047)	(0.024)	(0.048)	(0.034)
Observations	464	464	464	464	464	464	464
R-squared	0.068	0.020	0.000	0.008	0.023	0.023	0.001

Robust standard errors in parentheses.
*** $p<0.01$, ** $p<0.05$, * $p<0.1$

Knowing how much the instability of the weights affects the results is essential. Seaman and White (2013) suggest a simple method of assessing this by observing whether the sum of weights of the top 10% of treated units are larger than half the sum of weights of all treated units. If this is the case, the weights are unacceptably unstable. We carry out this simple analysis and conclude that our weights are not unstable.

6 Discussion of results

This paper aims at studying the impact of CBHI enrolment on the utilisation of various preventive health strategies. By using IPW on the propensity score, we apply a doubly robust method that not only balances the probability of enrolling in CBHI but also balances other covariates in the outcome regression (Austin, 2010; Glymour & Rudolph, 2016). Enrolment in CBHI was associated with an increase in the probability of utilising LLIN by 23.6 percentage points. This is important because despite the increase in ownership of LLIN and usage is generally low (Ahmed & Zerihun, 2010). Regarding vitamin A supplementation, we observe that participation was associated with improving the probability of receiving the supplements by 19 percentage points. Vitamin A supplements reduce a range of illness incidences including diarrhoea and child mortality for HIV infected children (Mayo-Wilson, Imdad, Herzer, Yakoob, & Bhutta, 2011; Semba, Pee, Sun, Bloem, & Raju, 2010)

Turning to iron supplementation participation was associated with increasing the probability by 9 percentage points which was equivalent to improving the probability of take-up by 132 percent. This was due to a very low average reception of iron supplement of only 10 percent. 53 percent of children in Uganda are anaemic (UBOS & ICF, 2018) which is associated to iron deficiency (Pasricha, Hayes, Kalumba, & Biggs, 2013) therefore even with lower statistical significance, the results are of important policy relevancy. Finally, regarding the average treatment effects, we observe that participation in CBHI increased the probability of receiving deworming children by 24 percentage points. The case for deworming is well elaborated going beyond health effects to education and labour market outcomes (Baird, Hicks, Kremer, & Miguel, 2016; Miguel & Kremer, 2004). Overall it is observed that the point estimates of the associations were even larger for households that actually participated in CBHI (ATET) than for the population average (ATE) save for PCV vaccine where the ATET was significant and larger than the ATE. A possible explanation for this might be the general availability of the vaccine itself. PCV was only introduced in 2014 (WHO, 2014) and data collection for this study started was conducted in from August 2015 to March 2016. Moreover, the vaccine is only administered to children below 1 year (WHO, 2014). This implied that a majority of our under-5 sample households did not have an opportunity of being offered the vaccine. This is, therefore, an early evaluation. It, however, points to early results that CBHI nudges even the take-up of newly introduced services.

Despite the positive effects observed, we did not observe statistically significant effects regarding household water treatment and owning a handwashing facility. One dimension of this finding is that since the results are not significant by conventional levels, we cannot say much about the effect of CBHI participation. However, the other dimension is that the coefficients are negative especially for the ATET. Negative coefficients, in this case, are an indicator of moral hazard. In a way, households reduce health improving practices such as hand washing and water treatment because they enrol in insurance. This is the kind of moral hazard detected in Ghana regarding using LLIN (Yilma et al., 2012). Though we cannot with confidence suggest that this moral hazard exists, we suggest that efforts be made to monitor behaviour and undertake continuous health promotion to avoid moral hazard.

6.1 Pathways of Impact

A major question, therefore, remains through which participation in CBHI actually affects utilisation of preventive services. We postulate two main pathways of effect. The first one is savings, investments and hence affordability of supplementary services. This is, therefore, a financial protection pathway. While most of these preventive health services are publicly provided for free or at highly subsidised costs, 44.7 of women state lacking money to access services and 37.4 state distance to health facilities as main barriers to access health services (UBOS and ICF 2018). Moreover, even with publicly-provided services, informal fees are common (Hunt 2010; Bouchard et al. 2012). Through financial protection, households in insurance are able to reduce the indirect barriers of financial reasons for accessing services such as transport when the direct costs of accessing health services are reduced. To observe if financial protection was present, we undertake OLS regressions on the association of income with enrolment and income with reported hospital cost of care in the last 6 months. Results in Table 10 indicate that there was no significant association between household income and enrolment status but we observed a significant association indicating that households in insurance paid lower health care costs.

Table 10: Association of household income and CBHI participation and CBHI participation and cost of care

VARIABLES	(1) CBHI Participation	(2) Cost of Participation (ugx)
Household income (log)	-0.0145	
	(0.0697)	
CBHI participation		-25,273**
		(10,977)
Constant	-0.0963	55,759***
	(0.749)	(9,018)
Observations	464	304
R-squared		0.018

Robust standard errors in parentheses.
*** p<0.01, ** p<0.05, * p<0.1

The second pathway is through information diffusion and social learning. We elaborate on this in three ways. The first one is that information diffusion might happen through prolonged exposure to information for behaviour change (Behrman, Cheng, & Todd, 2004; Beshears, Choi, Laibson, & Madrian, 2013) in such a manner that the longer the exposure period, the more learning and behaviour change.

This pathway suggests households that participated in CBHI longer than others would have higher probabilities of utilising a preventive health strategy. To test this pathway, multinomial logit treatment effects models are implemented where CBHI participation was categorised into 1-4 years for low exposure and 5 years or more for higher exposure. As shown in Table 11, we do not find evidence of this pathway. Instead we find that the effect is dominated by low exposure households. This might also point to moral hazard or reduced learning in the way that those insured for longer tend not to utilise these services as much compared to those insured for few years. A question of central importance there is whether insurance can be coupled with health promotion (Coe & Beyer, 2014).

Table 11: Multivalued treatments ATE for the effect of different levels of CBHI participation on preventive health.

	(1) LLIN	(2) Water treatment	(3) Hand washing	(4) Vitamin A supplement	(5) Iron supplement	(6) Deworming	(7) PCV
ATE							
CBHI 1-4 years	0.216	0.270**	-0.109	0.217*	0.181	0.264**	-0.023
	(0.160)	(0.105)	(0.085)	(0.121)	(0.112)	(0.109)	(0.089)
CBHI 5> years	0.181	0.023	-0.055	0.018	0.015	0.084	-0.023
	(0.129)	(0.118)	(0.073)	(0.168)	(0.036)	(0.178)	(0.070)
Potential	0.307***	0.540***	0.151**	0.619***	0.065***	0.588***	0.214***
outcomes	(0.056)	(0.065)	(0.064)	(0.087)	(0.020)	(0.082)	(0.038)
N	457	457	457	457	457	457	457

Robust standard errors in parentheses.
*** $p<0.01$, ** $p<0.05$, * $p<0.1$

In addition to longer exposure to information intended for behaviour change, shorter but intensive exposure can also lead to behaviour change and improve adoption rates (Kilian et al., 2016; MacIntyre et al., 2012). As mentioned earlier, all households belong to a funeral group but funeral groups have different schedules and extent of objectives. Some funeral groups operate as village savings and loans associations and their work goes beyond only funeral insurance. Some groups, therefore, meet more than others. Our data shows that funeral groups in CBHI met on average 2.4 times while those not in CBHI met only 2.1 times per month. Moreover, households can also belong to other social groups in addition to their funeral group membership. Households in CBHI belonged in about 2.4 groups while those not enrolled were in only 1.5 groups. This points to further social learning and information possibilities of information diffusion. The funeral group line of thought has been previously tested in a series of papers (Katabarwa, 1999; Katabarwa et al., 2010, 2015; Katabarwa, Mutabazi, & Richards, 2000; Katabarwa, Richards Jr, & Ndyomugyenyi, 2000) which find significant impacts of funeral groups in prevention interventions for river blindness. Our work in this paper further endorses this effect.

7 Conclusions

In conclusion, this study contributes to the limited evidence on the effect of health insurance on preventive health in developing countries. The study indicates that CBHI can be used to complement other various interventions that have been applied to increase the uptake of preventive health treatments and strategies. After applying a doubly robust IPW procedure, the study finds that participation in CBHI was associated with increasing the probability of sleeping under an LLIN, receiving vitamin A and iron supplements, deworming and receiving a vaccine for childhood pneumonia. Apart from demonstrating that CBHI can be added to a range of interventions for preventive health, the study is of further policy relevancy for Uganda. Ugandan policymakers are currently in the process of introducing a national health insurance. though this process has stalled for over two decades (Basaza et al., 2013), new evidence suggests a readiness for insurance (Biggeri, Nannini, & Putoto, 2018; UBOS & ICF, 2017). This paper, therefore, gives more evidence about the usefulness of health insurance and the necessity to hasten the policy process for a country-wide health insurance programme. However, there are two limitations which this paper is not able to address. The first one is the possible unobserved heterogeneity between CBHI participating and non-participating households. While double-robust IPW achieves balance between the two groups of households, it is not able to fully account for this residual bias because of cross-sectional data. The paper is therefore limited to interpreting associations rather than causal effects. Our results should therefore be interpreted with this in mind. Future work in this area should aim at using experimental or panel data analysis which can overcome these concerns. The second limitation is in regard to self-assessed outcomes. In our data collections, we did not carry out any tests for for instance on hemoglobin or amount of E-coli to test how much household drinking water was treated. It might therefore be the case the social desirability bias (Grimm, 2010) actually exists. This has been found in other studies (Luoto, Levine, Albert, & Luby, 2014; Meshnick, 2015) and so this might bias our results upwards. Bar these limitations, this paper breaks ground for more research on insurance and preventive health in developing countries.

References

Acharya, A., Vellakkal, S., Taylor, F., Masset, E., Satija, A., Burke, M., & Ebrahim, S. (2013). The Impact of Health Insurance Schemes for the Informal Sector in Low- and Middle-Income Countries: A Systematic Review. *The World Bank Research Observer*, *28*(2), 236–266.

Ahmed, S. M., & Zerihun, A. (2010). Possession and usage of insecticidal bed nets among the people of Uganda: Is BRAC Uganda health programme pursuing a pro-poor path? *PLoS ONE*, *5*(9), 1–7.

Akmatov, M. K., & Mikolajczyk, R. T. (2012). Timeliness of childhood vaccinations in 31 low and middle-income countries. *Journal of Epidemiology & Community Health*, *66*(7), e14–e14.

Amone, J., Asio, S., Cattaneo, A., Kweyatulira, A. K., Macaluso, A., Maciocco, G., ... Santini, S. (2005). User fees in private non-for-profit hospitals in Uganda: a survey and intervention for equity. *International Journal for Equity in Health*, *4*, 6.

Attanasio, O., Augsburg, B., Brugues, F., & Caeyers, B. (2015). *Understanding the Links and Interactions between Low Sanitation and Health Insurance in India: Baseline report* (Tech. Rep.). London: Institute for Fiscal Studies.

Austin, P. C. (2010). The performance of different propensity-score methods for estimating differences in proportions (risk differences or absolute risk reductions) in observational studies. *Statistics in Medicine*, *29*(20), 2137–2148.

Austin, P. C. (2011). A Tutorial and Case Study in Propensity Score Analysis: An Application to Estimating the Effect of In-Hospital Smoking Cessation Counseling on Mortality. *Multivariate Behavioral Research*, *46*(1), 119–151.

Austin, P. C., & Stuart, E. A. (2015). Moving towards best practice when using inverse probability of treatment weighting (IPTW) using the propensity score to estimate causal treatment effects in observational studies. *Statistics in Medicine*, *34*, 3661–3679.

Austin, P. C., & Stuart, E. A. (2017). The performance of inverse probability of treatment weighting and full matching on the propensity score in the presence of model misspecification when estimating the effect of treatment on survival outcomes. *Statistical Methods in Medical Research*, *26*(4), 1654–1670.

Baird, S., Hicks, J. H., Kremer, M., & Miguel, E. (2016). WORMS AT WORK : LONG-RUN IMPACTS OF A CHILD HEALTH INVESTMENT. *The Quarterly Journal of Economics*, 1637–1680.

Barigozzi, F. (2004). Reimbursing preventive care. *GENEVA Papers on Risk and Insurance Theory*, *29*(2), 165–186.

Basaza, R., O'Connell, T. S., & Chapčáková, I. (2013). Players and processes behind the national health insurance scheme: a case study of Uganda. *BMC Health Services Research*, *13*, 357.

Behrman, J. R., Cheng, Y., & Todd, P. E. (2004). Evaluating Preschool Programs When Length of Exposure to the Program Varies: A Nonparametric Approach. *Review of Economics and Statistics*, *86*(1), 108–132.

Beshears, J., Choi, J. J., Laibson, D., & Madrian, B. C. (2013). Simplification and saving. *Journal of Economic Behavior and Organization*, *95*, 130–145.

Biggeri, M., Nannini, M., & Putoto, G. (2018). Assessing the feasibility of community health insurance in Uganda: A mixed- methods exploratory analysis. *Social Science & Medicine*, *200*(January), 145–155.

Bitrán, R., Muñoz, R., & Prieto, L. (2010). Health Insurance and Access to Health Services, Health Services Use, and Health Status in Peru. In M.-L. Escobar, C. C. Griffin, & R. P. Shaw (Eds.), *Impact of health insurance in low and middle income countries* (pp. 106–121). Brookings Institution Press.

Bonfrer, I., Van De Poel, E., Gustafsson-Wright, E., & van Doorslaer, E. (2015). *Effects of a subsidized voluntary health insurance on insured and uninsured in Nigeria* (No. April).

Borghi, J., Maluka, S., Kuwawenaruwa, A., Makawia, S., Tantau, J., Mtei, G., ... Macha, J. (2013). Promoting universal financial protection: a case study of new management of community health insurance in Tanzania. *Health Research Policy and Systems*, *11*, 21.

Browne, J. L., Kayode, G. A., Arhinful, D., Fidder, S. A. J., Grobbee, D. E., & Klipstein-Grobusch, K. (2016). Health insurance determines antenatal, delivery and postnatal care utilisation: evidence from the Ghana Demographic and Health Surveillance data. *BMJ open*, *6*(3), e008175.

Bryce, J., & Victora, C. G. (2005). Ten methodological lessons from the Multi-Country Evaluation of Integrated Management of Childhood Illness. *Health Policy and Planning*, *20*(SUPPL. 1), i94–i105.

Burki, T. (2015). Prioritising clean water and sanitation. *The Lancet. Infectious diseases*, *15*(2), 153–154.

Cercone, J., Pinder, E., Jimenez, J. P., & Briceno, R. (2010). Impact of Health Insurance on Access, Use, and Health Status in Costa Rica. In M.-L. Escobar, C. C. Griffin, & R. P. Shaw (Eds.), *The impact of health insurance in low- and middle-income countries* (pp. 89–106). Washington DC: The Brookings Institution.

Cerulli, G. (2014). treatrew: A User-written command for estimating avarege treatment effects by reweighting on the propensity score. *The Stata Journal*, *14*(3), 541–561.

Coe, G., & Beyer, D. (2014). The imperative for health promotion in universal health coverage. *Global Health: Science and Practice*, *2*(1), 10–22.

Cohen, J., & Dupas, P. (2010). Free Distribution or Cost-Sharing? Evidence from a Randomized Malaria Prevention Experiment. *Quarterly Journal of Economics*, *CXXV*(1), 1–45.

Cohen, J., Dupas, P., & Schaner, S. (2015). Targeting of Malaria Treatment : Evidence from a Randomized Controlled Trial. *American Economic Review*, *105*(2), 609–645.

Cutler, D. M., & Zeckhauser, R. J. (2000). The Anatomy of Health Insurance. *Handbook of Health Economics*, *1*, 563–643.

Das, J. K., Salam, R. A., & Bhutta, Z. A. (2014). Global burden of childhood diarrhea and interventions. *Current Opinion in Infectious Diseases*, *27*(5), 451–458.

de Silva, N. R., Brooker, S., Hotez, P. J., Montresor, A., Engels, D., & Savioli, L. (2003). Soil transmitted helminth infection: updating the global picture. *Trends in Parasitology*, *19*(12), 547–51.

Devadasan, N., Seshadri, T., Trivedi, M., & Criel, B. (2013). Promoting universal financial protection: evidence from the Rashtriya Swasthya Bima Yojana (RSBY) in Gujarat, India. *Health Research Policy and Systems*, *11*(1), 29.

Devereux, S., Masset, E., Sabates-Wheeler, R., Samson, M., Rivas, A.-M., & te Lintelo, D. (2017). The targeting effectiveness of social transfers. *Journal of Development Effectiveness*, *9*(2), 162–211.

Djimeu, E. W. (2014). The impact of social action funds on child health in a conflict affected country : Evidence from Angola. *Social Science & Medicine*, *106*, 35–42.

Dupas, P. (2011a). Do teenagers respond to HIV risk information? Evidence from a field experiment in Kenya. *American Economic Journal: Applied Economics*, *3*(January), 1–34.

Dupas, P. (2011b). Health Behavior in Developing Countries. *Annual Review of Economics*, *3*, 425–49.

Dupas, P. (2014). Short-Run Subsidies and Long-Run Adoption of New Health Products: Evidence From a Field Experiment. *Econometrica*, *82*(1), 197–228.

Ehrlich, I., & Becker, G. S. (1972). Market Insurance, Self- Insurance, and Self-Protection. *Journal of Political Economy*, *80*(4), 623–648.

Fischer Walker, C. L., Rudan, I., Liu, L., Nair, H., Theodoratou, E., Bhutta, Z. A., ... Black, R. E. (2013). Global burden of childhood pneumonia and diarrhoea. *The Lancet*, *381*(9875), 1405–1416.

Franklin, P. J. (2007). Indoor air quality and respiratory health of children. *Paediatric Respiratory Reviews*, *8*(4), 281–286.

Gajate-Garrido, G., & Ahiadeke, C. (2015). *The effect of insurance enrollment on maternal and child health care utilization: The case of Ghana.* Washington DC.

Giedion, U., Flórez, C. E., Díaz, B. Y., Alfonso, E., Pardo, R., & Villar, M. (2010). Colombia's Big Bang Health Insurance Reform. In M.-L. Escobar, C. C. Griffin, & R. P. Shaw (Eds.), *The impact of health insurance in low- and middle-income countries* (pp. 155–177). Washington DC: The Brookings Institution.

Glanz, K., & Bishop, D. B. (2010). The Role of Behavioral Science Theory in Development and Implementation of Public Health Interventions. *Annual Review of Public Health*, *31*, 399–418.

Glymour, M. M., & Rudolph, K. E. (2016). Causal inference challenges in social epidemiology: Bias, specificity, and imagination. *Social Science and Medicine*, *166*, 258–265.

Grignon, M. (2014). Access and Health Insurance. In A. J. Culyer (Ed.), *Encyclopedia of health economics* (Volume 1 ed., pp. 13–18). Elsevier Inc.

Grimm, P. (2010). *Social Desirability Bias* (J. N. Sheth & N. K. Malhotra, Eds.) (No. 1999). John Wiley & Sons.

Guo, S., & Fraser, M. W. (2015). *Propensity Score Analysis: Statistical Methods and Applications*. SAGE Publications.

Habib, S. S., Perveen, S., & Khuwaja, H. M. A. (2016). The role of micro health insurance in providing financial risk protection in developing countries- a systematic review. *BMC Public Health*, *16*(1), 281.

Hanna, R., Duflo, E., & Greenstone, M. (2016). Up in Smoke: The Influence of Household Behavior on the Long-Run Impact of Improved Cooking Stoves. *American Economic Journal: Economic Policy*, *8*(1), 80–114.

Harder, V. S., Stuart, E. A., & Anthony, J. C. (2010). Propensity score techniques and the assessment of measured covariate balance to test causal associations in psychological research. *Psychological Methods*, *15*(3), 234–249.

Hendriks, M. E., Rosendaal, N. T. A., Wit, F. W. N. M., Bolarinwa, O. A., Kramer, B., Brals, D., . . . Schultsz, C. (2016, jan). Sustained effect of health insurance and facility quality improvement on blood pressure in adults with hypertension in Nigeria: A population-based study. *International Journal of Cardiology*, *202*, 477–484.

Hendriks, M. E., Wit, F. W. N. M., Akande, T. M., Kramer, B., Osagbemi, G. K., Tanovic, Z., . . . Schultsz, C. (2014, apr). Effect of Health Insurance and Facility Quality Improvement on Blood Pressure in Adults With Hypertension in Nigeria: A Population-Based Study. *JAMA Internal Medicine*, *24*(4), 555–563.

Hirano, K., & Imbens, G. W. (2001). Estimation of Causal Effects using Propensity Score Weighting: An Application to Data on Right Heart Catheterization. *Health Services & Outcomes Research Methodology*, *2*, 259–278.

Hirano, K., Imbens, G. W., & Ridder, G. (2003). Efficient Estimation of Average Treatment Effects Using the Estimated Propensity Score. *Econometrica*, *71*(4), 1161–1189.

Huber, M. (2014). IDENTIFYING CAUSAL MECHANISMS (PRIMARILY) BASED ON INVERSE PROBABILITY WEIGHTING. *Journal of Applied Econometrics*, *29*, 920–943.

Jalan, J., & Somanathan, E. (2008). The importance of being informed: Experimental evidence on demand for environmental quality. *Journal of Development Economics*, *87*(1), 14–28.

Jutting, J. P. (2004). Do community-based health insurance schemes improve poor people's access to health care? Evidence from rural senegal. *World Development*, *32*(2), 273–288.

Katabarwa, M. (1999). Modern health services versus traditional engozi system in Uganda. *The Lancet*, *354*, 343.

Katabarwa, M., Habomugisha, P., Agunyo, S., McKelvey, A. C., Ogweng, N., Kwebiiha, S., . . . McFarland, D. (2010). Traditional kinship system enhanced classic community-directed treatment with ivermectin (CDTI) for onchocerciasis control in Uganda. *Transactions of the Royal Society of Tropical Medicine and Hygiene*, *104*(4), 265–272.

Katabarwa, M., Habomugisha, P., Eyamba, A., Byamukama, E., Nwane, P., Arinaitwe, A., . . . Khainza, A. (2015). Community-directed interventions are practical and effective in low-resource communities: Experience of ivermectin treatment for onchocerciasis control in Cameroon and Uganda, 2004-2010. *International Health*, *8*(2), 116–123.

Katabarwa, M., Mutabazi, D., & Richards, F. O. (1999). Monetary incentives and community-directed health programmes in some less-developed countries. *Lancet*, *354*(9193), 1909.

Katabarwa, M., Mutabazi, D., & Richards, F. O. (2000). Controlling onchocerciasis by community-directed, ivermectin-treatment programmes in Uganda: why do some communities succeed and others fail? *Annals of Tropical Medicine and Parasitology*, *94*(4), 343–352.

Katabarwa, M., Richards, F. O. J., & Rakers, L. (2004). Kinship structure and healthcare improvement in sub-Saharan Africa. *The Lancet*, *363*(9427), 2194.

Katabarwa, M., Richards Jr, F. O., & Ndyomugyenyi, R. (2000). In rural Ugandan communities the traditional kinship/clan system is vital to the success and sustainment of the African Programme for Onchocerciasis Control. *Annals of Tropical Medicine and Parasitology*, *94*(5), 485–495.

Kenkel, D. S. (2000). Prevention. In A. J. Culyer & J. P. Newhouse (Eds.), *Handbook of health economics* (Vol. 1, pp. 1675–1720). Elsevier B.V.

Kidd, S. (2017). Social exclusion and access to social protection schemes. *Journal of Development Effectiveness*, *00*(00), 1–33.

Kilian, A., Lawford, H., Ujuju, C. N., Abeku, T. A., Nwokolo, E., Okoh, F., & Baba, E. (2016). The impact of behaviour change communication on the use of insecticide treated nets: a secondary analysis of ten post-campaign surveys from Nigeria. *Malaria Journal*, *15*(1), 422.

King, G., Gakidou, E., Imai, K., Lakin, J., Moore, R. T., Nall, C., . . . Llamas, H. H. (2009). Public policy for the poor? A randomised assessment of the Mexican universal health insurance programme. *The Lancet*, *373*(9673), 1447–1454.

Kremer, M., & Miguel, E. (2007). The Illusion of Sustainability. *Quarterly Journal of Economics*, *122*(3), 1007–1065.

Kremer, M., & Snyder, C. M. (2015). Preventives Versus Treatments. *The Quarterly Journal of Economics*, *130*(3), 1167–1239.

Luby, S. P., Agboatwalla, M., Painter, J., Altaf, A., Billhimer, W. L., & Hoekstra, R. M. (2004). Effect of Intensive Handwashing Promotion on Childhood Diarrhea in High-Risk Communities in Pakistan. *JAMA*, *291*(21), 2547–2554.

Luoto, J., Levine, D., Albert, J., & Luby, S. (2014). Nudging to use: Achieving safe water behaviors in Kenya and Bangladesh. *Journal of Development Economics*, *110*, 13–21.

MacIntyre, K., Littrell, M., Keating, J., Hamainza, B., Miller, J., & Eisele, T. P. (2012). Determinants of hanging and use of ITNs in the context of near universal coverage in Zambia. *Health Policy and Planning*, *27*(4), 316–325.

Madajewicz, M., Pfaff, A., van Geen, A., Graziano, J., Hussein, I., Momotaj, H., . . . Ahsan, H. (2007). Can information alone change behavior? Response to arsenic contamination of groundwater in Bangladesh. *Journal of Development Economics*, *84*(2), 731–754.

Mayo-Wilson, E., Imdad, A., Herzer, K., Yakoob, M. Y., & Bhutta, Z. a. (2011). Vitamin A supplements for preventing mortality, illness, and blindness in children aged under 5: systematic review and meta-analysis. *BMJ*, *343*, d5094.

McLean, K. A., Byanaku, A., Kubikonse, A., Tshowe, V., Katensi, S., & Lehman, A. G. (2014). Fishing with bed nets on Lake Tanganyika: a randomized survey. *Malaria Journal*, *13*(1), 395.

Mebratie, A., Sparrow, R., Alemu, G., & Bedi, A. S. (2013). *Community-Based Health Insurance Schemes: A Systematic Review.*

Mendoza, R. L. (2016). Which moral hazard? Health care reform under the Affordable Care Act of 2010. *Journal of Health Organization and Management*, *30*(4), 510–529.

Meshnick, S. R. (2015). Editorial: Malaria control: Tortoises and hares. *American Journal of Tropical Medicine and Hygiene*, *92*(5), 885–886.

Miguel, E., & Kremer, M. (2004). Worms: Identifying Impacts on Education and Health in the Presence of Treatment Externalities. *Econometrica*, *72*(1), 159–217.

Miller, J. A., Graefe, D. R., & De Jong, G. F. (2013). Health insurance coverage predicts lower childbearing among near-poor adolescents. *Journal of Adolescent Health*, *53*(6), 749–755. Retrieved from http://dx.doi.org/10.1016/j.jadohealth.2013.06.024

Mishra, A. K., & Kar, A. (2017). Are Targeted Unconditional Cash Transfers Effective? Evidence from a Poor Region in India. *Social Indicators Research*, *130*(2), 819–843.

Mitchell, R. C., & Carson, R. T. (1985). Option Value: Empirical Evidence From a Case Study of Recreation and Water Quality. *The Quarterly Journal of Economics*, *100*(1), 291–294.

Mobarak, A. M., Dwivedi, P., Bailis, R., Hildemann, L., & Miller, G. (2012). Low demand for nontraditional cookstove technologies. *Proceedings of the National Academy of Sciences*, *109*(27), 10815–10820.

MOH. (2016). *Annual Health Sector Performance Report 2015/2016* (Tech. Rep.). Kampala: Ministry of Health.

Nabyonga Orem, J., Desmet, M., Karamagi, H., Kadama, P. Y., Omaswa, F. G., & Walker, O. (2005). Abolition of cost-sharing is pro-poor: Evidence from Uganda. *Health Policy and Planning*, *20*(2), 100–108.

Nabyonga Orem, J., Mugisha, F., Kirunga, C., MacQ, J., & Criel, B. (2011). Abolition of user fees: The Uganda paradox. *Health Policy and Planning*, *26*, ii41–ii51.

Nabyonga Orem, J., & Zikusooka, C. M. (2010). Health financing reform in Uganda: How equitable is the proposed National Health Insurance scheme? *International Journal for Equity in Health*, *9*(23), 1–8.

Nichols, A. (2008). Erratum and discussion of propensity-score reweighting. *The Stata Journal*, *8*(4), 532–539.

Nyman, J. A. (2001). The income transfer effect, the access value of insurance and the Rand health insurance experiment. *Journal of Health Economics*, *20*(2), 295–298.

Okwero, P., Tandon, A., Sparkes, S., McLaughlin, J., & Hoogeveen, J. G. (2010). *Fiscal Space for Health in Uganda.* Washington DC.

Pagan, J. A., Puig, A., & Soldo, B. J. (2007). Health Insurance Coverage and the Use of Preventive Services by Mexican Adults. *Health economics*, *16*, 1359–1369.

Pasricha, S. R., Hayes, E., Kalumba, K., & Biggs, B. A. (2013). Effect of daily iron supplementation on health in children aged 4-23 months: A systematic review and meta-analysis of randomised controlled trials. *The Lancet Global Health*, *1*(2), e77–e86.

Pauly, M. V. (1974). Overinsurance and Public Provision of Insurance : The Roles of Moral Hazard and Adverse Selection. *The Quarterly Journal of Economics*, *88*(1), 44–62.

Pruss-Ustun, A., Bartram, J., Clasen, T., Colford, J. M., Cumming, O., Curtis, V., ... Cairncross, S. (2014). Burden of disease from inadequate water, sanitation and hygiene in low- and middle-income settings: A retrospective analysis of data from 145 countries. *Tropical Medicine and International Health*, *19*(8), 894–905.

Pruss-Ustun, A., & Corvalan, C. (2006). *Preventing Disease Through Healthy Environments: Towards an Estimate of the Enviromental Burden of Disease*. World Health Organization.

Rainey, J. J., Watkins, M., Ryman, T. K., Sandhu, P., Bo, A., & Banerjee, K. (2011). Reasons related to non-vaccination and under-vaccination of children in low and middle income countries: Findings from a systematic review of the published literature, 1999-2009. *Vaccine*, *29*(46), 8215–8221.

Ranson, M. K., Sinha, T., Chatterjee, M., Gandhi, F., Jayswal, R., Patel, F., ... Mills, A. J. (2007). Equitable Utilisation of Indian Community Based Health Insurance Scheme Among its Rural Membership: Cluster Randomised Controlled Trial. *British Medical Journal*, *334*(7607), 1309.

Rivera-Hernandez, M., & Galarraga, O. (2015). Type of Insurance and Use of Preventive Health Services Among Older Adults in Mexico. *Journal of Aging and Health*, *27*(6), 962–982.

Seaman, S. R., & White, I. R. (2013). Review of inverse probability weighting for dealing with missing data. *Statistical Methods in Medical Research*, *22*(3), 278–295.

Semba, R. D., Pee, S. D., Sun, K., Bloem, M. W., & Raju, V. K. (2010). The Role of Expanded Coverage of the National Vitamin A Program in Preventing Morbidity and Mortality among Preschool Children in India. *The Journal of Nutrition*, *140*(1), 208S–212S,.

Seog, S. H. (2012). Moral Hazard and Health Insurance When Treatment Is Preventive. *Journal of Risk and Insurance*, *79*(4), 1017–1038.

Spenkuch, J. L. (2012). Moral hazard and selection among the poor: Evidence from a randomized experiment. *Journal of Health Economics*, *31*(1), 72–85.

StataCorp. (2015). *TREATMENT-EFFECTS REFERENCE MANUAL: POTENTIAL OUTCOMES / COUNTERFACTUAL OUTCOMES (Stata Statistical Software)*. College Station, Texas: StataCorp LP.

Torres-Duque, C., Maldonado, D., Pérez-Padilla, R., Ezzati, M., & Viegi, G. (2008). Biomass fuels and respiratory diseases: A review of the evidence. *Proceedings of the American Thoracic Society*, *5*(5), 577–590.

UBOS. (2014). *Uganda National Household Survey 2012/2013* (Tech. Rep.). Kampala: Uganda Bureau of Statistics.

UBOS. (2017). *Uganda National Household Survey 2016/2017* (Tech. Rep.). Kampala: Uganda Bureau of Statistics.

UBOS, & ICF. (2017). *Uganda Demographic and Health Survey 2016: Key Indicators Report* (Tech. Rep.). Kampala, Uganda and Rockville Maryland: Uganda Bureau of Statistics; ICF.

UBOS, & ICF. (2018). *Uganda Demographic and Health Survey 2016* (Tech. Rep.). Kampala, Uganda and Rockville Maryland: Uganda Bureau of Statistics and ICF.

UBOS, & ICF International. (2012). *Uganda Demographic and Health Survey* (Tech. Rep.). Kampala, Uganda; Calverton, Maryland.

USAID. (2015). *Mass Distribution of Long Lasting Insecticidal Nets for Universal Coverage in Uganda: Evaluation Report* (Tech. Rep. No. September). Kampala: USAID Monitoring Evaluation and Learning Program.

Van de Poel, E., Flores, G., Ir, P., O'Donnell, O., & Van Doorslaer, E. (2014). Can vouchers deliver? An evaluation of subsidies for maternal health care in Cambodia. *Bulletin of the World Health Organization*, *92*(5), 331–339.

Van Gemert, F., Kirenga, B., Chavannes, N., Kamya, M., Luzige, S., Musinguzi, P., . . . van der Molen, T. (2015). Prevalence of chronic obstructive pulmonary disease and associated risk factors in Uganda (FRESH AIR Uganda): A prospective cross-sectional observational study. *The Lancet Global Health*, *3*(1), e44–e51.

Victora, C. G., & Peters, D. H. (2009). Seguro Popular in Mexico: is premature evaluation healthy? *The Lancet*, *373*(9673), 1404–1405.

Vyas, S., & Kumaranayake, L. (2006). Constructing socio-economic status indices: How to use principal components analysis. *Health Policy and Planning*, *21*(6), 459–468.

Wang, H., & Pielemeier, N. (2012). Community-Based Health Insurance : An Evolutionary Approach to Achieving Universal Coverage in Low-Income Countries. *Journal of Life Sciences*, *6*, 320–329.

WHO. (2010). *The World Health Report: Health Systems Financing: The Path to Universal Coverage* (Tech. Rep.). Geneva: World Health Organisation.

WHO. (2013). *Household Water Treatment and Safe Storage: Manual for the Participant* (Tech. Rep.). Geneva: World Health Organisation.

WHO. (2014). *Uganda rolls out the Pneumococcal Conjugate Vaccine (PCV).* Retrieved 2017-08-21, from http://www.afro.who.int/news/uganda-rolls-out-pneumococcal-conjugate-vaccine-pcv

WHO. (2015). *Uganda: WHO Statistical Profile.* Retrieved 2017-07-28, from http://www.who.int/gho/countries/uga.pdf

WHO. (2016). *World Malaria Report* (Tech. Rep.). Geneva: World Health Organisation.

WHO. (2017). *Soil-transmitted helminth infections.* Retrieved 2017-07-27, from http://www.who.int/mediacentre/factsheets/fs366/en/

WHO, & UNICEF. (2015). *Progress on Sanitation and Drinking Water: 2015 Update and MDG Assessment* (Tech. Rep.). Geneva: World Health Organisation & UNCEF.

Woode, M. E. (2017). Parental health shocks and schooling : The impact of mutual health insurance in Rwanda. *Social Science & Medicine*, *173*, 35–47.

Yilma, Z., Van Kempen, L., & De Hoop, T. (2012). A perverse 'net' effect? Health insurance and ex-ante moral hazard in Ghana. *Social Science and Medicine*, *75*(1), 138–147.

Zar, H. J., & Ferkol, T. W. (2014). The global burden of respiratory disease-Impact on child health. *Pediatric Pulmonology*, *49*, 430–434.

A Supplementary Tables

Table 12: Weighted Least Squares - Average treatment effects

	(1) LLIN	(2) Water treatment	(3) Hand washing	(4) Vitamin A supplement	(5) Iron supplement	(6) Deworming	(7) PCV
CBHI	0.236**	0.100	-0.0622	0.190*	0.0904*	0.240**	0.0235
	(0.111)	(0.106)	(0.0892)	(0.0971)	(0.0532)	(0.0941)	(0.0678)
Constant	0.282***	0.554***	0.157*	0.628***	0.0684***	0.605***	0.215***
	(0.0615)	(0.0810)	(0.0834)	(0.0881)	(0.0237)	(0.0874)	(0.0435)
Observations	458	458	458	458	458	458	458
R-squared	0.057	0.010	0.008	0.041	0.021	0.066	0.001

Robust standard errors in parentheses.
*** p<0.01, ** p<0.05, * p<0.1

Table 13: Weighted Least Squares - Average Treatment Effects on the Treated

	(1) LLIN	(2) Water treatment	(3) Hand washing	(4) Vitamin A supplement	(5) Iron supplement	(6) Deworming	(7) PCV
CBHI	0.341***	-0.0268	-0.0917	0.276*	0.0697	0.267*	0.169***
	(0.105)	(0.144)	(0.154)	(0.160)	(0.0424)	(0.160)	(0.0594)
Constant	0.211**	0.603***	0.190	0.508***	0.0485	0.511***	0.117**
	(0.0993)	(0.139)	(0.153)	(0.157)	(0.0358)	(0.157)	(0.0502)
Observations	459	459	459	459	459	459	459
R-squared	0.124	0.001	0.016	0.079	0.016	0.074	0.046

Robust standard errors in parentheses.
*** p<0.01, ** p<0.05, * p<0.1