

Anteneh, Zecharias; Celidoni, Martina; Rocco, Lorenzo

Working Paper

Pathways to Better Health? Assessing the Impact of Ethiopian Community-Based Health Insurance on Children Health Outcomes

GLO Discussion Paper, No. 1299

Provided in Cooperation with:

Global Labor Organization (GLO)

Suggested Citation: Anteneh, Zecharias; Celidoni, Martina; Rocco, Lorenzo (2023) : Pathways to Better Health? Assessing the Impact of Ethiopian Community-Based Health Insurance on Children Health Outcomes, GLO Discussion Paper, No. 1299, Global Labor Organization (GLO), Essen

This Version is available at:

<https://hdl.handle.net/10419/272931>

Standard-Nutzungsbedingungen:

Die Dokumente auf EconStor dürfen zu eigenen wissenschaftlichen Zwecken und zum Privatgebrauch gespeichert und kopiert werden.

Sie dürfen die Dokumente nicht für öffentliche oder kommerzielle Zwecke vervielfältigen, öffentlich ausstellen, öffentlich zugänglich machen, vertreiben oder anderweitig nutzen.

Sofern die Verfasser die Dokumente unter Open-Content-Lizenzen (insbesondere CC-Lizenzen) zur Verfügung gestellt haben sollten, gelten abweichend von diesen Nutzungsbedingungen die in der dort genannten Lizenz gewährten Nutzungsrechte.

Terms of use:

Documents in EconStor may be saved and copied for your personal and scholarly purposes.

You are not to copy documents for public or commercial purposes, to exhibit the documents publicly, to make them publicly available on the internet, or to distribute or otherwise use the documents in public.

If the documents have been made available under an Open Content Licence (especially Creative Commons Licences), you may exercise further usage rights as specified in the indicated licence.

Pathways to Better Health? Assessing the Impact of Ethiopian Community-Based Health Insurance on Children Health Outcomes

Zecharias Anteneh,* Martina Celidoni,† and Lorenzo Rocco‡

*** *This version: 31/12/2022* ***

Abstract

Publicly financed Community Based-Health Insurance (CBHI) schemes are typically implemented in developing countries to foster healthcare utilization and improve health outcomes among low-income households. Using the Demographic and Health Survey from 2005 to 2016, we estimate the effects of the Ethiopian CBHI on children's health. Difference-in-differences estimates show that CBHI reduced mortality and the probability of being underweight among children under five. We also find that CBHI significantly reduces wasting, a measure of short-term nutritional deficiency or health conditions, but not stunting, known to be an indicator of long-term chronic malnutrition. Potential mechanisms underlying our results are improved maternal health, access to health care, nutrition and a reduced risk of poverty.

JEL classification: G52 I13 J13

Keywords: Community-based health insurance, children health, infant feeding, Difference in Differences approach

*Department of Economics and Management "Marco Fanno", University of Padua, Italy, and University of York, UK

†Department of Economics and Management "Marco Fanno", University of Padua, Italy

‡Department of Economics and Management "Marco Fanno", University of Padua, Italy; IZA, Germany and GLO

1 Introduction

Community based health insurance (hereafter CBHI) is a relatively recent form of health insurance which is mainly used in rural areas of many developing countries to cover the costs of healthcare in case of sickness, and to improve the access to care for the poor and people working in the informal sector (Donfouet & Mahieu 2012, Carrin et al. 2005). Such schemes are generally non-profit, subsidised, and targeted to low income households. Premia are kept low to foster participation, enrollment is typically voluntary, and management is assigned to the local community itself (Mathauer et al. 2017).

Similar to other developing countries, Ethiopia has introduced CBHI relatively late in June 2011 (Mebratie et al. 2015). Initially thirteen woredas (districts) in four regions participated to a pilot intervention, with the aim of testing acceptance and sustainability. In 2013, CBHI was expanded to other districts in the originally participating regions (Feleke et al. 2015).

So far the literature evaluating the effects of the Ethiopian CBHI has focused on healthcare utilization and out-of-pocket expenditure providing mostly descriptive evidence. Based on cross-sectional data, some studies have found a positive association between insurance status and healthcare utilization (see Demissie & Negeri 2020, Tilahun et al. 2018) and a negative correlation with catastrophic healthcare spending (Mekonen et al. 2018). In particular, Mebratie et al. (2019)'s study reveals that the insured use more outpatient care than the non-insured, consult general practitioners and specialists more frequently, and pay at least 56% less per visit.

We complement the existing evidence focusing on the effects of CBHI on children's health. Using repeated cross-sectional data from the Ethiopian demographic and health survey (DHS), we estimate the effect of the scheme on children's mortality and the risk of malnutrition. We adopt a difference-in-differences (DiD) strategy, which compares treated and untreated regions before and after the introduction of CBHI. Hence, we identify an intention-to-treat effect (ITT) of CBHI, by exploiting its introduction across Ethiopian districts.

Our baseline results show that, among children under five, CBHI reduces mortality by 2 percentage points and the probability of being underweight by 4 percentage points in CBHI intervention regions.

However, CBHI seems to affect mainly short-term conditions, caused by temporary illnesses or inadequate nutrition. Indeed, we document improvements in terms of *wasting*, low weight-for-height, a measure related to short-term adverse conditions, but not in terms of *stunting*, low height-for-age, known to be an indicator of long-term chronic malnutrition.

We further provide evidence about some potential underlying mechanisms. The supply of plain water improves among children aged 6-23 months. CBHI has a positive effect on maternal health - measured through the body mass index -, maternal access to care during pregnancy, postnatal health check ups and poverty alleviation.

In a robustness check, by exploiting GPS data to locate the districts of residence, we redefine the treatment by district (rather than by region), at the cost however of using a much smaller sample.

Results turn to be qualitatively similar.

The paper unfolds as follows. Section 2 describes the Ethiopian community-based health insurance scheme. We review the existing literature on CBHI effects in Ethiopia in section 3. The data used for the analysis are presented in section 4. In section 5, we illustrate the empirical strategy and the identifying assumptions. In section 6, we present our baseline estimates and discuss the potential underlying mechanisms. Section 7 concludes.

2 The Ethiopian community-based health insurance

Achieving universal health services provision has been one of the priorities in Ethiopia’s healthcare policy agenda. Two schemes - the Social health insurance, and the Community-based health insurance - have been designed in 2010/2011 to achieve the goal of universal coverage. Both are cost-sharing schemes between the Government and insurance beneficiaries (EHIA 2021).

The former, not yet implemented, is mainly dedicated to individuals working in the formal sector. The latter targets rural and urban households employed in the informal sector (see Central Statistical Agency (CSA)[Ethiopia] and ICF (2016)). More precisely, the scheme is targeted to rural families working in agriculture, herding, to small-scale merchants, small-scale service entrepreneurs such as village hotels and street vendors, and urban households in general, without a formal employment (EHIA 2021).

From an administrative point of view, Ethiopia is divided into nine geographical regions and two chartered cities. Each region is sub-divided into zones, each zone into woredas (or districts), each districts into towns, and each town into kebeles. In 2011, the community-based health insurance scheme was introduced only in 13 districts of four regions as a pilot program. These regions were Tigray, Amhara, Oromia, and SNNPR¹ and the districts involved were South Achefer, Fogera, Tehuledere, Deder, Gimbichu, Kuyu, Limu Kossa, Yirgalem, Damot Woyde, Damboya, Ahferom, Kilde Awlalo, and Tahtay Adiabo, covering over 1.7 million people (Feleke et al. 2015). In 2015 the average enrollment rate in the pilot districts was 52.4 percent of the eligible households.

Afterwards, the scheme was gradually expanded to include many more additional districts within the same regions. In July 2013 coverage was extended to 161 districts and by 2016 to 366 districts (Feleke et al. 2015). Therefore, the share of eligible population increased overtime in the four treated regions, and in 2016 it reached 42% (EHIA 2020).

Participation to CBHI is voluntary; households pay a premium to the health insurer and receive full coverage for all family health services and curative care (outpatient services, inpatient services, and acute illnesses), which are part of Ethiopia’s essential health package (Mulat et al. 2022). Outpatient care includes delivery services, children’s treatments, mental health services, x-ray, diabetes treatments, dental and related services. Inpatient care includes intensive care, surgery, cancer, neonatal, maternity, pediatric, and other care types. However, beneficiaries have to bear the cost of transportation to health

¹SNNPR is the acronym for Southern Nation and Nationalities of People Region.

centres or hospitals.

To reduce adverse selection issues, the whole household is required to enrol (Mebratie et al. 2015). According to the CBHI enrollment policy, children under the age of five are automatically insured, once their family joins the program and pre-registers their name. CBHI take-up rates varied across regions. In 2016, Amhara region had the highest enrollment rate (56%) , while Oromia had the lowest 32%. SNNP had the second highest coverage (52%), followed by Tigray (43%).

Premia are generally low and depend on household and local characteristics to account for differential supply and costs of healthcare services. In 2020, the nationally determined minimum baseline value of the premium was 240 ETB² for a household living in a rural area and 350 ETB for a family living in a urban area.³ According to Shigute et al. (2020) the premium corresponds to a very low percentage of the monthly household income, between 0.5 to 1%. Given the low premia paid by enrolled households, the government covers the largest share of healthcare expenditures, with a substantial support from donor agencies.

The scheme assigns different responsibilities to the different governance levels involved (Yohannes 2021). The federal government formulates policy suggestions, designs strategies, develops a legal framework, and sets national level standards to guide the establishment of a premium pooling system. It also outlines alternative sources of funding healthcare costs and implements the necessary risk mitigation mechanisms to strengthen the sustainability of CBHI. The federal government also manages the allocation of annual subsidies to the very poor households by the respective CBHI implementing regions.

The regional authorities administer the premia collected in the region through CBHI memberships and manage the functioning of CBHI together with the administrative offices at the district level. They are also responsible for contracts with healthcare providers from either primary or secondary healthcare facilities. In addition, they organize community awareness initiatives, supervise member registrations, collect membership fees, distribute CBHI participation cards and prepare regular reports for the national CBHI Council and all other bodies involved.

Finally, contracted health facilities must provide information, services and treatments according to the national standards. They also collect and communicate information regarding household composition and any change that might occur (Yohannes 2021).

3 Literature review

The findings about the effect of CBHI on children’s health in the literature are rather mixed, mainly depending on the research design and the country in question. Hounton et al. (2012)’s paper shows that in Burkina Faso there are no significant differences in children’s mortality rates between insured and uninsured, despite the positive association between CBHI and healthcare utilization. But such findings

²ETB is Ethiopian Birr, the national currency name.

³At the household level, the annual premium during the initial years was 144 in Amhara, 126 ETB in SNNP, 132 ETB in Tigray, and 180 ETB in Oromia.

are not confirmed in Schoeps et al. (2015), where, among the insured, there is lower infant mortality. Differences in outcomes definition, empirical approach and data used might explain the diverging results for the same country.

The negative association between CBHI and infant mortality has been shown for Uganda (Haven et al. 2018), whereas multi-level logistic analysis suggests that being insured is associated with lower risk of being stunted among infants aged 6-24 months (Lu et al. 2016).

Although the literature in general supports the beneficial role of CBHI on children’s health, it mainly provides estimates of associations which do not account for the voluntary nature of the enrollment in CBHI. As individuals self-select into the program, insured and uninsured individuals might be potentially very different in several characteristics both observable and unobservable. Without accounting for selection, the causal effect of CBHI on the outcome of interest cannot be identified.

Two papers address the problem of selection when estimating the impact of CBHI on children’s health: Binagwaho et al. (2012) for Rwanda and Nshakira-Rukundo et al. (2020) for Uganda. Both adopt instrumental variables. The former exploits the variation in CBHI coverage rates at the local level and, using DHS data, it suggests that CBHI reduces stunting and infant mortality among children under two. Nshakira-Rukundo et al. (2020) exploits the variation in CBHI enrollment due to village level CBHI demand rate, computed as a proportion of non-CBHI people willing to enroll if given an opportunity relative to the total number of non-CBHI people in a village, the size of the funeral group to which a household belonged, and a social influence perception index from five Likert scale questions. They show that being insured leads to a lower probability of stunting in children below five years of age.

Nshakira-Rukundo et al. (2020) focused on a particular children’s health indicator -stunting-, but they haven’t empirically tested possible mechanisms bridging the observed effects of CBHI on stunting. Differently, we analyse several plausible pathways affecting children’s health, namely mothers’ (or caregivers’) behaviours regarding children’s and own health, and household level socio-economic factors.⁴

Moreover, while Binagwaho et al. (2012) looks at a narrow time window around the introduction of the CBHI program, necessarily capturing short-run effects, we evaluate the effect of CBHI in Ethiopia on a longer time horizon, as the treated children are observed up to 5 years after the beginning of the program.

In the Ethiopian context, much of the research has been conducted on the effect of CBHI on health care use and health care spending. The findings are generally consistent. For instance, according to Tilahun et al. (2018) and Demissie & Negeri (2020), being insured is positively associated with healthcare utilization. This result is confirmed also when household fixed-effects are accounted for, see Mebratie et al. (2019). Mebratie et al. (2019)’s paper shows also substantial decline in the cost of healthcare for the insured. Using a propensity score matching approach, Mekonen et al. (2018) confirm the negative effect of CBHI on out-of-pocket healthcare expenditure in Northeastern Ethiopia. According to Atnafu

⁴Among the papers aiming to identify causal effects, it is worth noting the randomized controlled trial conducted in the Philippines among poor and hospitalized children (Quimbo et al. 2011). In this context, health insurance reduces the risk of wasting and the likelihood of having an infection (using the level of C-reactive protein as an outcome).

& Gebremedhin (2020), insurance also increases healthcare utilization for children.

The ultimate goal of the CBHI program is to improve the health of the population, but, to our knowledge, in the Ethiopian context, there is very limited evidence on this regard, likely because of data limitations. We partly fill this gap by exploiting the Ethiopian DHS, which includes rich information about children’s health and, to a lesser extent, about adults’ health.

4 Data

The data are drawn from the Ethiopian demographic and health survey collecting nationally representative information on maternal and children’s health, family planning, fertility, and knowledge of HIV/AIDS. The Ethiopian DHS is administered by the Central Statistics Agency of Ethiopia with the support of the Federal Ministry of Health and Ethiopian Public Health Institute in collaboration with the international classification of functioning, disability, and health for technical assistance.

The first round of the survey refers to the year 2000. The survey has been then repeated in 2005, 2011, and 2016.⁵ The sample is designed to estimate health and demographic indicators at the national level (Central Statistical Agency (CSA)[Ethiopia] and ICF 2016).⁶

Our analysis considers the period 2005-2016; we do not use 2000 data because the survey period coincides with the final year of the Ethio-Eritrean war and because unfavorable meteorological conditions in 1998 and 1999 triggered a famine in most crop-growing areas in 2000, such as Tigray, some areas of Amhara and SNNPR (Hammond & Maxwell 2002). Within the time window considered, CBHI was first introduced in 13 district of four regions as a pilot program, and then many more districts were covered based on pilot results.

Although the program implementation is staggered, we can’t exploit this aspect empirically because we have data only for 2011 (immediately before program roll-out) and for 2016.

We define treatment at the regional level for three reasons. First, resources allocation and policy interventions are mainly defined by regional authorities, although some initiatives might be promoted at the district level. Second, defining the treatment at the regional level allows us to account for potential behavioural spillovers in non-treated districts of treated regions. Spillover effects can be relevant considering that districts are closely linked both geographically and socially. For instance, individuals in non-CBHI districts may be negatively affected by drug shortages caused by high demand in the nearby treated districts. On the other hand, if increased demand and revenues improve the quality of healthcare in CBHI districts, patients of non-CBHI areas may seek care in the treated areas. Additionally, some people living in remote and rural areas of non-CBHI districts may be able to obtain expensive drugs through relatives who are CBHI members.⁷ Third, our data allow to identify the district of residence

⁵The sampling frame for each round was the nearest Population and Housing Census (PHC). For instance, the sampling frame for 2016 DHS is the Ethiopian PHC conducted in 2007 (Central Statistical Agency (CSA)[Ethiopia] and ICF 2016).

⁶The sample was collected using the weighted, multi-stage, stratified cluster sampling method, which is common in other countries worldwide.

⁷Many papers in the development economics literature document the crucial role played by family and kin networks for

only for about 53 percent of children.⁸ Eventually, the treated regions are Tigray, Amhara, Oromia, and SNNPR where the districts offering CHBI are located.

This study mainly exploits Kids Record data, which contains the characteristics of all children under five years of age and their mothers. For most of our analysis, we restrict the sample to alive children. We consider all alive-born and children who died at birth when we study mortality. We focus on children under five years of age because they are automatically insured once their family joins the program.

- Table 1 here -

Table 1 reports the total number of sampled children classified by treated and control regions and survey years. The total number of children considered is 32,156. Most of them live in the treated regions, which are the more populated.

We analyze the impact of CBHI on the dummy *mortality*, which takes 1 if the child died before age 5, and three binary indicators of malnutrition recommended by the World Health Organization (WHO 2006), *underweight*, *stunting* and *wasting* which are based on three anthropometric measures. More precisely, underweight corresponds to abnormally low weight-for-age, stunting to abnormally low height-for-age, and wasting to abnormally low weight-for-height.⁹

According to Seetharaman et al. (2007), Richard et al. (2012), Central Statistical Agency (CSA)[Ethiopia] and ICF (2016) and Pomati & Nandy (2020), low *height-for-age* (stunting) indicates deprivation due to the inability to get enough sustenance for a long period of time, while low *weight-for-height* (wasting) reflects short-term weight loss, which may be associated with recent illness episodes or inadequate food consumption immediately before the survey (see for instance Pomati & Nandy (2020)).

We additionally investigate possible mechanisms explaining the effect of CBHI on children's health by examining 1) maternal (or caregivers') attitudes toward child's health, 2) maternal health and behaviours during and after pregnancy, and 3) socio-economic household-level factors.

Outcomes included in the first group are: mothers' (or caregivers') reporting any recent illness symptoms - cough, fever and diarrhea - and the decision to vaccinate the child. The former is a binary indicator taking 1 if the mother or the caregiver reports the child having symptoms in the two weeks before the interview. The latter refers to basic vaccination coverage among children of age two or three, i.e. Bacille Calmette-Guerin, three doses of DPT-containing vaccines (diphtheria, pertussis, and tetanus), and three doses of polio vaccine (excluding polio given at birth), and one dose of measles vaccine.¹⁰ Immunization information is collected through the children's health card, and the mother's recall in case the health card

safety nets, such as the seminal Rosenzweig & Stark (1989)

⁸Interviewers are asked to collect the GPS coordinates of all clusters, but these must be verified before being released to the public by the DHS program. If coordinates cannot be verified, DHS will set them to missing. It is hard to tell whether the probability of observing missing coordinates is systematically related to any relevant local or individual characteristic, or whether it is simply a random event. As a robustness, we redefine treatment by district, for the subset of districts we are able to identify - see section 6.3.

⁹The anthropometric measure is abnormally low if its the z-score is less than -2. Anthropometric measures are available for children who normally live with the family and slept in the household the night prior to the survey, while they are missing for children residing with other households.

¹⁰For more detailed information see <https://dhsprogram.com/data/Guide-to-DHS-Statistics/Vaccination.htm>.

is unavailable during the survey. In the first group, we also include the provision of micronutrients to infants. We define micronutrient intake for babies from six to twenty-three months old following official recommendations (see for instance WHO 2008, 2010). After six months of life, official guidelines suggest to introduce soft and solid food, as breast milk alone is not enough to promote healthy growth. Therefore, in order to investigate the impact of the program on infant feeding practices, we defined binary indicators for the provision of complementary food,¹¹ plain water, vitamin-rich food, iron-rich food, and an indicator called *Minimum Diet Diversity* (MDD)¹² in line with WHO recommendations (see WHO 2008, 2010).

To capture maternal health and behaviours during pregnancy, we consider mothers' weight, prenatal checkups by trained health workers, delivery at private or public facilities, postpartum health check-ups, and iron dose intake during pregnancy.¹³ We further consider whether prenatal care is received, by looking at whether mothers were informed about pregnancy-related complications or provided blood or urine samples during the visit for the most recent live birth. All these outcomes are binary variables. Regarding mothers' health, we exploit her body mass index (BMI)¹⁴ and define binary indicators to identify those who are underweight (if BMI is between 12-18.49 inclusive) or overweight/obese (if BMI is in the range of 25-60).

Among household-level factors which may affect children's health, there are household economic conditions proxied through a poverty index. The poverty indicator is equal to one if the household is in the first (the poorest) or second quintile of a wealth index obtained through a principal component analysis (Filmer & Pritchett 2001), and zero otherwise.¹⁵ We further defined a binary variable to capture household sanitation/hygiene. The dummy *hygiene* is one if the children stool is safely disposed (by using a toilet or latrine, put/rinsed into toilet/latrine, or buried), and zero otherwise.

- Table 2 here -

In Table 2 we show the weighted summary statistics of the outcomes of interest. Focusing on the main outcomes, the overall averages of mortality and underweight are 7% and 27%, respectively. Mean mortality and underweight decreased over time both in the treated and control regions. The treated regions show a decreasing trend in the percentage of wasted children, in the control regions the same trend is increasing. On average, stunting has reduced in both groups but more in the control group.

¹¹Complementary food refers to the provision of either baby formula- which usually contains the appropriate balance of vitamins, protein-rich animal food, (beef, pork, goat, etc.), fruit typically rich in vitamins and iron, or green leaf vegetables (recommended source of fiber, folate, and carotenoids)

¹²MDD is designed by the WHO to assess diet diversity as part of infant and young child feeding (IYCF) practices among children 6-23 months old. Breastfed children meet MDD if he or she consumes 5 out of 8 essential food groups.

¹³This information is available for the most recent live birth in the past 5 years.

¹⁴The body mass index is a measure of adult body fat based on height and weight.

¹⁵The Ethiopian DHS does not include detailed consumption or income information at the household level.

5 Empirical Strategy

We use a difference-in-difference specification to estimate the effect of CBHI on the outcomes of interest. We compare the change in outcome (before and after the introduction of the CBHI program) in *treated* regions with the corresponding change in *control* regions, conditional on a number of covariates. This allows us to take into account, in addition to observable characteristics, all unobserved time invariant individual factors and time-varying determinants that are common to individuals living in treated and control regions. Formally, we estimate the following linear probability model:

$$Y_{it} = \gamma_0 + \gamma_r + \lambda_t + \beta_3 Treated_i \times POST_{it} + \sum_j \theta_j X_{jit} + \epsilon_{it} \quad (1)$$

where Y_{it} is the outcome, γ_r denotes regions fixed effects; λ_t denotes survey year fixed effects. $Treated_i$ identifies children living in *treated* regions (Tigray, Amhara, Oromia, and SNNPR), whereas $POST_{it}$ is a dummy variable equal to one for observations in 2016, the post intervention period, and zero otherwise, i.e. 2005 and 2011. The year 2011 is included in the pre-treatment period because the survey was conducted between December 2010 and June 2011, just before the launch of the CBHI program, which took time to get fully operational in pilot districts. X_{jit} are the covariates included in the model, capturing observable characteristics of children, mother, husband, and household. ϵ_{it} is the error term.

We are interested in β_3 the parameter associated to the interaction term between $Treated_i$ and $POST_{it}$. In our framework, $\hat{\beta}_3$ will capture an Intention-To-Treat (ITT) effect of CBHI on outcomes because of imperfect compliance.¹⁶

As described, in our framework the program varies at the regional level. Hence, standard errors need to be clustered by region (Bertrand et al. 2004, Abadie et al. 2017). However, the number of clusters is small, causing clustered standard errors to be underestimated. To take into account this aspect, we provide wild bootstrapped standard errors, as described in Cameron & Miller (2015).

The key assumption in our framework is that trends in outcomes would have been parallel between treatment and control groups had the CBHI program not been implemented. We provide evidence supporting this assumption in section 6.1.

The controls included in the model are child’s gender, age in months, year of birth and birth order. We also control for mother’s and husband’s education, marital status, maternal employment status (being employed in the past 12 months preceding the survey), and her age. We include also mother’s height (in centimeters),¹⁷ which captures nourishment and reflects both aggregated investments she has been exposed to during the pre-childbearing period (see for instance Perez-Alvarez & Favara 2019) and hereditary factors (Subramanian et al. 2009). As mothers in our samples are between age 15 and 49, their height can be considered as predetermined and unaffected by CBHI.¹⁸ To capture media exposure,

¹⁶Participation in the program is voluntary, and some households that were offered the possibility to join the program in treated regions, refused to participate

¹⁷Maternal height is associated with children’s health and death (Baqui et al. 1994), (Subramanian et al. 2009)

¹⁸The majority of girls reach adult height during puberty, typically between age 12-14 (Perez-Alvarez & Favara 2019)

among controls we have a binary variable that takes value one if the mother listens to the radio or watched the television in the past twelve months preceding the interview.

We further include the household size, household head's age, gender and education, residence (urban versus rural), number of male and female household members of working age (15-64), number of young members aged 15-24, the maximum years of education in the household, cropland and farm animals ownership.¹⁹ and also control for ethnicity and religion.

The summary statistics describing all our covariates are reported in Table A.1. Looking at Table A.1, we can observe that 52% of children are male and the average age of children is 19 months and half. The treated and untreated groups show the same average level of male proportion. Husbands tend to be more educated than mothers in both groups. In control regions mothers and fathers are better educated than in treated regions. 44% and 95% of children have their mothers employed in the last 12 months and married, respectively. The percentage of employed mothers is higher in treated regions than in control regions. The average household size is 6, no significant differences can be notice through the comparison between treated and controls. In control regions, there is a higher proportion of household living in urban areas and more male household heads than in the treated regions. The average age of the household head is 38, and, on average, household heads in treated regions are one year older than in the control regions. According to the maximum years of education within household, families are better educated in the control regions than in treated areas. This is confirmed also looking at the household head's education.

6 Results

6.1 Testing parallel trends

A crucial assumption in our difference-in-difference framework is parallel trends in the treatment and control groups during the pre-intervention period. We use the 2005 and 2011 DHS data waves to test the reliability of this assumption. We provide evidence on this regard through placebo regressions; results are reported in Table A.2 in the Appendix.

Estimates in Tables A.2 refer to equation 1 when fictitiously anticipating the timing of the reform implementation to 2010. Under the hypothesis that trends are parallel, we should not find any significant effect of this placebo intervention on the outcomes of interest. We show no significant effects suggesting that treatment and control groups had a similar trend during the pre-intervention period (before June 2011).

6.2 Estimates of CBHI on children's health and potential mechanisms

We report in Table 3 the estimated intention-to-treat effect of CBHI on children's health, i.e. mortality, underweight, wasting, and stunting.

¹⁹We haven't included cropland and farm animals ownership when using the poverty index as outcome

- Table 3 here -

Estimates show that the availability of CBHI in treated regions significantly reduces the risk of children’s mortality by 2 percentage points (column 1). Likewise, CBHI decreases the probability of being underweight among children under five by 4 percentage points (column 2). Columns (3) and (4) in Table 3 report ITT estimates for wasting and stunting. CBHI reduces the probability of being wasted by 3 percentage points but does not significantly alter stunting. Qualitatively similar findings have been reported for Uganda and Rwanda (Nshakira-Rukundo et al. 2020, Binagwaho et al. 2012).

We now concentrate on the three groups of potential channels that might explain our baseline results in Table 3. The first group refers to maternal (or caregivers’) behaviors towards child’s health. ITT estimates in Table 4 reveal that CBHI increased by 5 percentage points the supply of plain water for children aged between six to twenty three months (Table 4 column 2). We do not find significant effects when looking at mother reported symptoms of cough, fever or diarrhea (Table 4 columns 6-8) and childhood vaccination (Table 4 column 9) for children aged two or three.²⁰

- Table 4 here -

The second set of channels, potentially explaining the role of CBHI on health, contains mother’s health indicators and her behavior during pregnancy and after the child’s birth. Regarding maternal health, the estimates reported in Table 5 show that the probability of being overweight/obese (Table 5 column 2) in the intervention regions decreased by 5 percentage points in the post-CBHI period, while no significant effects are detected for *Underweight*. Focusing on maternal behavior during pregnancy, we can observe that CBHI does not significantly impact prenatal visits with skilled providers (Table 5 column 3). However, among those who report having had antenatal care (ANC) visits, we find a 22 percentage point higher likelihood of actually receiving care (Table 5 column 4). According to Table 5 columns 5 and 6, CBHI also leads to a 9 percentage point increase in institutional delivery and a 15 percentage point increase in postpartum health check-ups, but it does not significantly impact iron take-up during pregnancy (Table 5 column 7).

- Table 5 here -

The third and final set of mechanisms examined involves household-level factors: poverty and hygiene. The effects presented in Table 6 show that CBHI reduces the risk of poverty by 5 percentage points (column 1), but there is no statistical significant effect on household hygiene practices.

- Table 6 here -

Overall, we find that the introduction of CBHI in Ethiopia has improved health among children aged under five confirming descriptive evidence. Among the potential underlying mechanisms analysed, there

²⁰We do not find significant effects on vaccination also when stratifying the analysis for vaccination information sources: children’s health card or mothers’ recall. In the case of dead children, there is no information about vaccinations and only a few mothers have shown children’s health cards.

are, on the one hand, improved economic conditions, and, on the other hand, improved maternal health and health care use before and after the child's birth.

In our data, we observe that the 26% of children's death occurred by the first day and nearly 50% within a month. Therefore, our findings suggest that inter-generational factors, including improved maternal health and proper access to care during and after pregnancy, might play a bigger role in explaining the effects of CBHI on children's health. The causal chain can be described in at least two ways. First, better behavioural choices during pregnancy, such as receiving prenatal care, can help mothers to assess the health and development of their fetuses and enables the detection of health problems that may jeopardize mother's and child's survival. The increased likelihood of delivering in private or public institutions is also related to better and more appropriate care with trained health care workers, in facilities able to deal with potentially dangerous situations. Second, the increase in postpartum health check-ups and reduction in excess weight might be related to good maternal well-being, which is essential for properly caring for the children.

Our result on the reduced risk of poverty is in line with Mebratie et al. (2019) and Yilma et al. (2015), which find that, in the Ethiopian context, CBHI significantly reduced out-of-pocket health expenditures and the probability of borrowing money while increasing household income.

The improvements in children's health may also reflect supply-side effects, not analysed in this paper. For example, Shigute et al. (2020)'s paper shows the positive effect of CBHI on the profitability of CBHI-affiliated healthcare facilities. This may increase the supply of drugs and healthcare appliances necessary to expand access to safe care. Related to this, the positive effects of CBHI on healthcare utilization reported by Mebratie et al. (2019) may imply improvements in the supply of health care personnel to accommodate the increasing demand for healthcare, which in turn increases children's exposure to appropriate care.

Although, due to data limitations, we cannot identify the effect of being enrolled in CBHI (the take-up effect) on the outcomes of interest, our ITT effect is robust (and accounts for) to two types of potential spillovers: 1) spillovers on the non-treated individuals in the treated districts of treated regions; and 2) spillovers on the non-treated districts of treated regions.

Spillover effects in control regions are unlikely: we can reasonably assume that the time window we consider, i.e. five years since the CBHI launch, may not be enough to attract people from control regions looking for health insurance. Moreover, it is reasonable to expect that moving across areas generates inevitable relocation costs, and this is a crucial deterrent as far as poor people - the main target of CBHI - are concerned. However, even if selective migration existed, such that the less healthy self-selected and moved in the CBHI areas, our estimates would be lower bounds of the true effect of CBHI.

It might be argued that, the increased health care use induced by CBHI in treated areas attracts resources away from control regions, with negative consequences for the health of people in the control areas. Reassuringly, the findings reported in Mebratie et al. (2019) show that being insured by Ethiopian CBHI does not induce such a crowd-out effect.

Macroeconomic shocks or food insecurity affecting differently treated and control regions in the post-intervention period might be a potential concern, but, at our knowledge, there are no documented events which had asymmetric effects on one group or the other.

Finally, the effect of CBHI could be confounded if people in treated regions had additional health insurance options but, considering that CBHI offers a complete benefit package with a low premium to be paid, we are confident that this issue is unlikely to occur. To date, the CBHI is the only formal health insurance that provides financial protection to people in the informal sector in Ethiopia. There are no competing policy interventions having the same temporal and regional set up.

6.3 Robustness

The DHS dataset includes spatial coordinates to geographically locate the units of observations (Mansour et al. 2012, Perez-Heydrich et al. 2013). In this section, we exploit this information, available only for a subset of our working sample, and provide a robustness analysis, defining treatment at the district (rather than regional) level.

To define CBHI treatment at the district level, we used the GPS coordinates of clusters to identify the names of CBHI districts (treated districts) and non-CBHI districts (control districts).²¹ We first plot these GPS coordinates on an Ethiopian map using Qgis software, and then we spatially joined the clusters' locations as reflected by the GPS coordinate points with the districts if they fall within the boundaries of a specific district. For 53 clusters, we do not have GPS coordinates. As a result, we were unable to assign them to any districts. We identify and retain the names of 130 districts that are observed across all survey rounds (before and after CBHI introduction), which makes up 53% of the children in the original sample. The CBHI operates in 50 of these districts (the treated districts), while the others are non-CBHI districts based in treated (32) and control regions (48).²²

We estimate the DiD model as explained in Section 5, but now consider as treated those children and mothers living in the districts (rather than the regions) covered by CBHI. We exclude non-treated districts in treated regions to avoid across-district spillovers. Standard errors are clustered by district and district fixed effects are included.

The results of this robustness check is reported in Table 7: the estimates confirm improvements in children's health in terms of mortality and underweight. The magnitude of parameters is slightly higher compared to what is reported in Section 6. In contrast to our baseline estimates, there is no significant impact on wasting.²³

- Table 7 here -

²¹Ethiopian DHS data is representative only at regional level. Thus, the names of the regions are included in the data, but not administration levels below regional level such as clusters and districts. This is done to keep the confidentiality of the respondents response. Instead, DHS offers the GPS coordinates of the household location (clusters) randomly displaced at about 0-2km for urban residents and 0-5km for rural households.

²²We obtain a list of CBHI operating districts in 2016 from the Ethiopian Health Insurance Agency, which manages the overall functioning of CBHI in Ethiopia.

²³The parallel trend assumption is not rejected for all outcomes.

7 Conclusions

In this paper, we estimated the impact of a government-run insurance program known as community-based health insurance on the health outcomes of children in Ethiopia. We focused on children under the age of five, and, to the best of our knowledge, this is the first study to report the health effects of the Ethiopian CBHI since it started in 2011. In addition, a key contribution of this paper is the analysis of potential mechanisms explaining the effect of CBHI on children's health.

Our findings suggest that CBHI reduces children's mortality, the likelihood of being underweight and wasted (a short-term acute condition of nutritional deficiency) while we do not detect any significant effect on the likelihood of being stunted (a symptom of chronic nutritional deficiency).

The mechanisms underlying these findings are improvements in maternal health, access to care during pregnancy, better postnatal health check-ups and poverty reduction.

Further research on the Ethiopian CBHI may focus on evaluating the effects of actual enrollment into the program. It may also be interesting to investigate intra-household distributional effects. The participation into the scheme is determined at the household level, to reduce adverse selection issue, but its health effects might be unequally distributed among household members and individual health data for all family components can shed light on this regard.

References

- Abadie, A., Athey, S., Imbens, G. W. & Wooldridge, J. (2017), When Should You Adjust Standard Errors for Clustering?, Nber working papers, National Bureau of Economic Research, Inc.
- Atnafu, A. & Gebremedhin, T. (2020), ‘Community-based health insurance enrollment and child health service utilization in northwest ethiopia: A cross-sectional case comparison study’, *Clinicoeconomics and Outcomes Research: CEOR* **12**, 435.
- Baqui, A. H., Arifeen, S. E., Amin, S. & Black, R. (1994), ‘Levels and correlates of maternal nutritional status in urban bangladesh.’, *European Journal of Clinical Nutrition* **48**(5), 349–357.
- Bertrand, M., Duflo, E. & Mullainathan, S. (2004), ‘How Much Should We Trust Differences-In-Differences Estimates?’, *The Quarterly Journal of Economics* **119**(1), 249–275.
- Binagwaho, A., Hartwig, R., Ingeri, D. & Makaka, A. (2012), Mutual health insurance and its contribution to improving child health in rwanda, Technical report, Passauer Diskussionspapiere-Volkswirtschaftliche Reihe.
- Cameron, A. C. & Miller, D. L. (2015), ‘A Practitioner’s Guide to Cluster-Robust Inference’, *The Journal of Human Resources* **50**(2), 317–372.
- Carrin, G., Waelkens, M.-P. & Criel, B. (2005), ‘Community-based health insurance in developing countries: a study of its contribution to the performance of health financing systems’, *Tropical medicine & international health* **10**(8), 799–811.
- Central Statistical Agency (CSA)[Ethiopia] and ICF (2016), ‘Ethiopia demographic and health survey 2016.’. Addis Ababa, Ethiopia, and Rockville, Maryland, USA: CSA and ICF; 2016.
- Demissie, B. & Negeri, K. G. (2020), ‘Effect of community-based health insurance on utilization of outpatient health care services in southern ethiopia: a comparative cross-sectional study’, *Risk management and healthcare policy* **13**, 141.
- Donfouet, H. P. P. & Mahieu, P.-A. (2012), ‘Community-based health insurance and social capital: a review’, *Health economics review* **2**(1), 1–5.
- EHIA (2020), ‘CBHI Members’Registration and Contribution 2011-2020 GC: Ethiopian health insurance agency. Addis Ababa, Ethiopia.’, <https://ehia.gov.et/>. Accessed: 2022-02-20.
- EHIA (2021), ‘Proclamation and Regulation: EHIA establishment council of ministers regulation number 191/2010’, <https://ehia.gov.et/>. Accessed: 2021-08-19.
- Feleke, S., Mitiku, W., Zelelew, H. & Ashagari, T. (2015), ‘Ethiopia’s community-based health insurance: a step on the road to universal health coverage’, *Washington: World Bank Group* .

- Filmer, D. & Pritchett, L. H. (2001), ‘Estimating wealth effects without expenditure data—or tears: an application to educational enrollments in states of india’, *Demography* **38**(1), 115–132.
- Hammond, L. & Maxwell, D. (2002), ‘The ethiopian crisis of 1999–2000: lessons learned, questions unanswered’, *Disasters* **26**(3), 262–279.
- Haven, N., Dobson, A. E., Yusuf, K., Kellermann, S., Mutahunga, B., Stewart, A. G. & Wilkinson, E. (2018), ‘Community-based health insurance increased health care utilization and reduced mortality in children under-5, around bwindi community hospital, uganda between 2015 and 2017’, *Frontiers in public health* **6**, 281.
- Hounton, S., Byass, P. & Kouyate, B. (2012), ‘Assessing effectiveness of a community based health insurance in rural burkina faso’, *BMC health services research* **12**(1), 1–9.
- Lu, C., Mejía-Guevara, I., Hill, K., Farmer, P., Subramanian, S. & Binagwaho, A. (2016), ‘Community-based health financing and child stunting in rural rwanda’, *American journal of public health* **106**(1), 49–55.
- Mansour, S., Martin, D. & Wright, J. (2012), ‘Problems of spatial linkage of a geo-referenced demographic and health survey (dhs) dataset to a population census: A case study of egypt’, *Computers, Environment and Urban Systems* **36**(4), 350–358.
- Mathauer, I., Mathivet, B., Kutzin, J., Organization, W. H. et al. (2017), Community based health insurance: how can it contribute to progress towards uhc?, in ‘Community based health insurance: how can it contribute to progress towards UHC?’, Health Financing Policy Brief, chapter 1.1.
- Mebratie, A. D., Sparrow, R., Yilma, Z., Abebaw, D., Alemu, G. & Bedi, A. S. (2019), ‘The impact of ethiopia’s pilot community based health insurance scheme on healthcare utilization and cost of care’, *Social Science & Medicine* **220**, 112–119.
- Mebratie, A. D., Sparrow, R., Yilma, Z., Alemu, G. & Bedi, A. S. (2015), ‘Enrollment in ethiopia’s community-based health insurance scheme’, *World Development* **74**, 58–76.
- Mekonen, A. M., Gebregziabher, M. G. & Teferra, A. S. (2018), ‘The effect of community based health insurance on catastrophic health expenditure in northeast ethiopia: A cross sectional study’, *PloS one* **13**(10), e0205972.
- Mulat, A. K., Mao, Wenhui, B., Ipchita, B., Belete, R. & Yamey, G. (2022), ‘Scaling up community-based health insurance in ethiopia: a qualitative study of the benefits and challenges’, *BMC Health Services Research* **22**(473).
- Nshakira-Rukundo, E., Mussa, E. C., Gerber, N. & von Braun, J. (2020), ‘Impact of voluntary community-based health insurance on child stunting: Evidence from rural uganda’, *Social Science & Medicine* **245**, 112738.

- Perez-Alvarez, M. & Favara, M. (2019), ‘Maternal age and offspring human capital in india’.
- Perez-Heydrich, C., Warren, J. L., Burgert, C. R. & Emch, M. (2013), *Guidelines on the use of DHS GPS data*, ICF International.
- Pomati, M. & Nandy, S. (2020), ‘Assessing progress towards sdg2: Trends and patterns of multiple malnutrition in young children under 5 in west and central africa’, *Child Indicators Research* **13**(5), 1847–1873.
- Quimbo, S. A., Peabody, J. W., Shimkhada, R., Florentino, J. & Solon, O. (2011), ‘Evidence of a causal link between health outcomes, insurance coverage, and a policy to expand access: experimental data from children in the philippines’, *Health economics* **20**(5), 620–630.
- Richard, S. A., Black, R. E., Checkley, W., Gilman, R. H. & Guerrant, R. L. (2012), ‘Wasting is associated with stunting in early childhood’, *The Journal of nutrition* **142**(7), 1291–1296.
- Rosenzweig, M. R. & Stark, O. (1989), ‘Consumption smoothing, migration, and marriage: Evidence from rural india’, *Journal of Political Economy* **97**(4), 905–926.
- Schoeps, A., Lietz, H., Sie, A., Savadogo, G., De Allegri, M., Müller, O., Sauerborn, R., Becher, H. & Souares, A. (2015), ‘Health insurance and child mortality in rural burkina faso’, *Global health action* **8**(1), 27327.
- Seetharaman, N., Chacko, T., Shankar, S., Mathew, A. et al. (2007), ‘Measuring malnutrition-the role of z scores and the composite index of anthropometric failure (ciaf)’, *Indian Journal of Community Medicine* **32**(1), 35.
- Shigute, Z., Mebratie, A. D., Sparrow, R., Alemu, G. & Bedi, A. S. (2020), ‘The effect of ethiopia’s community-based health insurance scheme on revenues and quality of care’, *International Journal of Environmental Research and Public Health* **17**(22), 8558.
- Subramanian, S., Ackerson, L. K., Smith, G. D. & John, N. A. (2009), ‘Association of maternal height with child mortality, anthropometric failure, and anemia in india’, *Jama* **301**(16), 1691–1701.
- Tilahun, H., Atnafu, D. D., Asrade, G., Minyihun, A. & Alemu, Y. M. (2018), ‘Factors for healthcare utilization and effect of mutual health insurance on healthcare utilization in rural communities of south achefer woreda, north west, ethiopia’, *Health economics review* **8**(1), 1–7.
- WHO (2006), *WHO child growth standards: length/height-for-age, weight-for-age, weight-for-length, weight-for-height and body mass index-for-age: methods and development*, World Health Organization.
- WHO (2008), *Indicators for assessing infant and young child feeding practices: part 1: definitions: conclusions of a consensus meeting held 6-8 November 2007 in Washington DC, USA*, World Health Organization.
- WHO (2010), ‘Indicators for assessing infant and young child feeding practices: part 2: measurement’.

Yilma, Z., Mebratie, A., Sparrow, R., Dekker, M., Alemu, G. & Bedi, A. S. (2015), 'Impact of ethiopia's community based health insurance on household economic welfare', *The World Bank Economic Review* **29**(suppl.1), S164–S173.

Yohannes, A. (2021), 'Community Based Health Insurance Proclamation', <https://chilot.me/2021/02/08/community-based-health-insurance-proclamation/>. Accessed: 2021-08-19.

Table 1: Sample size of children under five years of age

Survey year	Treated			Control		
	Dead	Alive	Total	Dead	Alive	Total
2005	565	5,541	6,106	294	3461	3755
2011	417	5,454	5,871	429	5354	5783
2016	248	4,620	4,868	387	5386	5773
Total	1,230	15,615	16,845	1110	14201	15311

Note: Treated regions are Tigray, Amhara, Oromia, and SNNPR.

Table 2: Outcome variables. Summary statistics.

Dep. Var	All	Treated (mean)		Control (mean)	
		2005-2011	2016	2005-2011	2016
Health outcomes					
Mortality	0.07	0.08	0.06	0.08	0.06
Underweight	0.27	0.30	0.24	0.29	0.24
Wasted	0.11	0.11	0.10	0.13	0.16
Stunted	0.42	0.46	0.39	0.41	0.28
Maternal (or caregivers') behaviors towards child's health					
Complementary	0.21	0.20	0.27	0.21	0.23
Plain water	0.85	0.85	0.86	0.92	0.87
Vitamin A	0.29	0.26	0.37	0.20	0.32
Iron	0.15	0.12	0.20	0.11	0.19
MDD	0.06	0.03	0.09	0.05	0.11
Cough	0.20	0.19	0.21	0.16	0.11
Fever	0.17	0.18	0.15	0.18	0.11
Diarrhea	0.14	0.16	0.12	0.15	0.08
Basic Vaccination	0.29	0.27	0.34	0.28	0.37
Maternal health and behaviours during pregnancy and after the child's birth					
Underweight	0.22	0.23	0.21	0.27	0.24
Overweight/Obese	0.05	0.03	0.04	0.12	0.20
Prenatal with skilled	0.56	0.51	0.60	0.58	0.62
ANC received	0.70	0.53	0.82	0.85	0.89
Delivery at private/public	0.16	0.07	0.26	0.25	0.40
Postnatal health check	0.07	0.06	0.06	0.19	0.07
Iron takeup	0.25	0.13	0.42	0.20	0.45
Household-level factors					
Poverty	0.45	0.44	0.46	0.50	0.56
Hygiene	0.30	0.27	0.39	0.34	0.37

Note: Sample weights used. Treated regions are Tigray, Amhara, Oromia, and SNNPR. Underweight is low weight-for-age; wasting is low weight-for-height; Stunting is low height-for-age. MDD is Minimum Diet Diversity given to children, and ANC is Antenatal Care.

Table 3: ITT effects of CBHI on Children’s outcomes: OLS estimates.

Dep. Var	(1) Mortality	(2) Underweight	(3) Wasted	(4) Stunted
treated_post	-0.017** (0.008)	-0.036** (0.016)	-0.034** (0.013)	0.026 (0.017)
P value	[0.048]	[0.028]	0.024]	[0.590]
Obs	29,435	21,123	21,013	20,956
R ²	0.056	0.053	0.029	0.106
Mean of Dep. var	0.070	0.270	0.110	0.420

Non-bootstrapped standard errors are in round brackets. The wild bootstrapped adjusted P values are in the square bracket. Asterisks refer to the regular P-values for significance levels: *** ≤ 0.01 , ** ≤ 0.05 , * ≤ 0.1

Table 4: ITT effects of CBHI on mother’s behaviours towards children’s health: OLS estimates.

Dep. Var	(1) Complementary	(2) Plain water	(3) Vitamin A	(4) Iron	(5) MDD	(6) Cough	(7) Fever	(8) Diarrhea	(9) Basic Vaccination
treated_post	0.05 (0.019)	0.047** (0.017)	-0.019 (0.021)	0.007 (0.018)	-0.006 (0.013)	0.047 (0.012)	0.023 (0.012)	0.033 (0.011)	-0.009 (0.016)
P value	[0.320]	[0.025]	[0.758]	[0.880]	[0.850]	[0.459]	[0.568]	[0.431]	[0.880]
Obs	12,070	12,244	12,168	12,192	11,928	27,626	27,586	27,624	24,169
R ²	0.123	0.093	0.127	0.095	0.096	0.027	0.029	0.050	0.202
Mean of Dep. var	0.213	0.849	0.288	0.152	0.0561	0.195	0.166	0.142	0.294

Note: Sample weights used. MDD is Minimum Diet Diversity given to children aged 6-23 months. Non-bootstrapped standard errors are in round brackets. The wild bootstrapped adjusted P values are in the square bracket. Asterisks refer to the regular P-values for significance levels: *** ≤ 0.01 , ** ≤ 0.05 , * ≤ 0.1 .

Table 5: ITT effects of CBHI on Mother’s health and behaviors during pregnancy and after the child’s birth: OLS estimates.

Dep. Var	(1) Underweight	(2) Overweight or obese	(3) Prenatal with skilled	(4) ANC received	(5) Delivery private/public	(6) Postnatal health check	(7) Iron takeup
treated_post	0.017 (0.016)	-0.051*** (0.012)	-0.014 (0.015)	0.220** (0.016)	0.091* (0.011)	0.147** (0.011)	0.063 (0.018)
P value	[0.297]	[0.002]	[0.844]	[0.030]	[0.088]	[0.017]	[0.542]
Obs	19,274	19,274	22,188	12,808	27,872	21,615	19,019
R ²	0.042	0.134	0.235	0.208	0.371	0.121	0.177
Mean of Dep. var	0.224	0.048	0.555	0.701	0.157	0.070	0.250

Note: Sample weights used. Non-bootstrapped standard errors are in round brackets. The wild bootstrapped adjusted P values are in the square bracket. Asterisks refer to the regular P-values for significance levels: *** ≤ 0.01 , ** ≤ 0.05 , * ≤ 0.1 .

Table 6: ITT effects of CBHI on Household-level factors: OLS estimates.

Dep. Var	(1)	(2)
	Poverty	Hygiene
treated_post	-0.048** (0.012)	0.106 (0.017)
P value	[0.012]	[0.179]
Obs	30,056	25,538
R ²	0.198	0.152
Mean of Dep. var	0.452	0.304

Note: Sample weights used. Non-bootstrapped standard errors are in round brackets. The wild bootstrapped adjusted P values are in the square bracket. Asterisks refer to the regular P-values for significance levels: *** ≤ 0.01 , ** ≤ 0.05 , * ≤ 0.1 .

Table 7: ITT effects of CBHI on Children's outcomes: Robustness OLS estimates.

Dep. Var	(1)	(2)	(3)	(4)
	Mortality	Underweight	Wasted	Stunted
treated_post	-0.024** (0.011)	-0.054*** (0.020)	0.017 (0.017)	-0.043 (0.030)
P value	[0.040]	[0.008]	[0.332]	[0.161]
Obs	12,819	8,985	8,915	8,902
R ²	0.068	0.105	0.057	0.149
Mean of Dep. var	0.073	0.261	0.112	0.386

Note: Sample weights used. Treatment is at the district level. The control group is composed by all districts within a control region. Standard errors clustered by district level. Asterisks refer to the regular P-values for significance levels: *** ≤ 0.01 , ** ≤ 0.05 , * ≤ 0.1

Appendix A

Table A.1: Independent variables: Weighted Summary statistics

	All	Treated (mean)		Control (mean)	
		2005-2011	2016	2005-2011	2016
Birth order					
Reference category ≥ 4 th born					
Birth order (1-3)	0.49	0.48	0.48	0.54	0.55
Male child	0.52	0.52	0.52	0.52	0.52
Age in months	19.31	19.01	19.86	19.66	18.17
Children year of birth					
Reference category 1992					
Child birth year 1993	0.06	0.10	0.00	0.10	0.00
Child birth year 1994	0.06	0.09	0.00	0.10	0.00
Child birth year 1995	0.05	0.09	0.00	0.10	0.00
Child birth year 1996	0.06	0.09	0.00	0.10	0.00
Child birth year 1997	0.05	0.09	0.00	0.08	0.00
Child birth year 1998	0.03	0.05	0.00	0.04	0.00
Child birth year 1999	0.07	0.11	0.00	0.10	0.00
Child birth year 2000	0.07	0.12	0.00	0.11	0.00
Child birth year 2001	0.06	0.09	0.00	0.10	0.00
Child birth year 2002	0.06	0.10	0.00	0.10	0.00
Child birth year 2003	0.07	0.06	0.08	0.06	0.05
Child birth year 2004	0.08	0.00	0.21	0.00	0.20
Child birth year 2005	0.08	0.00	0.20	0.00	0.20
Child birth year 2006	0.07	0.00	0.18	0.00	0.21
Child birth year 2007	0.08	0.00	0.21	0.00	0.21
Child birth year 2008	0.05	0.00	0.12	0.00	0.13
Mother education					
Reference category no education					
Primary	0.24	0.23	0.27	0.17	0.21
Above primary	0.05	0.03	0.06	0.12	0.17
Father education					
Reference category no education					
Primary	0.37	0.37	0.42	0.22	0.22
Above primary	0.10	0.09	0.11	0.18	0.25

Table A.1 continued from previous page

Mother employed	0.44	0.45	0.46	0.28	0.34
Mother married	0.95	0.95	0.96	0.94	0.95
Mother age	29	29	30	29	29
Mothers height (cm)	156.97	156.71	156.84	158.77	159.66
Read newspaper	0.01	0.01	0.01	0.03	0.03
Watch television	0.07	0.05	0.06	0.16	0.26
Listen to radio	0.14	0.14	0.13	0.16	0.15
Urban residence	0.11	0.08	0.08	0.37	0.36
Mothers religion denomination					
Reference category other					
Orthodox	0.38	0.42	0.36	0.21	0.20
Protestant	0.21	0.23	0.23	0.07	0.07
Muslim	0.38	0.32	0.38	0.71	0.72
Household characteristics					
Own farm animals	0.86	0.89	0.87	0.65	0.56
Own cropland	0.82	0.87	0.83	0.53	0.36
Household size	6.01	6.02	6.01	6.04	5.91
Male household head	0.87	0.88	0.88	0.78	0.71
Age of household head	38	38	38	37	37
Number of labour age male [15-64]	1.22	1.25	1.18	1.26	1.06
Number of labour age female [15-64]	1.36	1.36	1.34	1.45	1.40
Number of youth [15-24]	0.65	0.71	0.56	0.73	0.59
Household maximum years of education	4.35	3.57	5.32	4.32	7.03
Head years of education	2.44	2.08	2.81	2.81	3.95
Ethnicity background					
Reference category other					
Afar	0.01	0.00	0.00	0.10	0.09
Amhara	0.25	0.28	0.23	0.15	0.13
Anyiwak	0.00	0.00	0.00	0.02	0.02
Argobe	0.09	0.10	0.10	0.01	0.01
Ari	0.10	0.11	0.10	0.01	0.01
Gumuz	0.01	0.00	0.00	0.07	0.07
Guragie	0.03	0.03	0.03	0.06	0.06
Harerrie	0.01	0.00	0.01	0.00	0.00
Oromo	0.39	0.39	0.45	0.15	0.12
Somalie	0.04	0.00	0.00	0.41	0.45

Table A.1 continued from previous page

Tigraway	0.06	0.07	0.07	0.01	0.03
----------	------	------	------	------	------

Note: Sample weights used.

Table A.2: Parallel trend test: OLS estimates-Children health

Dep. Var	(1) Mortality	(2) Underweight	(3) Wasted	(4) Stunted
treated_time	-0.011 (0.010)	-0.028 (0.026)	-0.084 (0.019)	0.094 (0.027)
P value	[0.474]	[0.604]	[0.256]	[0.337]
Obs	19,762	12,686	12,686	12,686
R ²	0.059	0.046	0.030	0.103
Mean of Dep. var	0.0830	0.300	0.109	0.456

Non-bootstrapped standard errors are in round brackets. The wild bootstrapped adjusted P values are in the square bracket. Asterisks refer to the regular P-values for significance levels: *** ≤ 0.01 , ** ≤ 0.05 , * ≤ 0.1 .