The Direct and Indirect Effects of Income on the Consumption of Nutrients: Experimental Evidence from Kenya

by Silas Ongudi and Djiby Thiam

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Abstract

How does a temporary income change impact consumption of nutrients? To answer this question, we use a randomized controlled trial dataset from Hunger Safety Net Programme (HSNP) with 9,246 households spread across the four districts (Turkana, Marsabit, Wajir, and Mandera) of Kenya. In the experiment, treated households received a bi-monthly cash transfer of about USD 20 relative to households in control villages. We find that HSNP-eligible households in treated villages consume more non-heme iron rich diets, vitamins and minerals, while those in treated villages that are not HSNP-eligible consume more diets full of fats compared to those in control villages, which suggests substitution from cereal to animal based diets. We rule out alternative pathways that could potentially increase consumption, including changes in the labour supply, price increases of goods, and investment opportunities We, therefore, conclude that the rise in nutrition was primarily the result of sharing the HSNP transfers among social network members.

Keywords: Heme iron, Private transfer, Safety net program, Undernutrition, Villages

JEL classification: C14; O12; O15

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1. Introduction

Undernutrition is a global health problem, especially in developing countries, where it affects over 800 million poor households (IFPRI, 2018). In sub-Saharan Africa (SSA), for instance, the prevalence of undernutrition increased by about 1.5% per annum in absolute terms between 2014 and 2019, affecting approximately 250 million people in 2019 (FAO, IFAD, UNICEF, and WHO, 2020). The prevalence of undernutrition in SSA is estimated to be 8.9% – more than twice the world's average and the highest globally. Consequences of undernutrition include loss of gross domestic product (GDP), an increased risk of chronic diseases among adults, poor pregnancy outcomes, and high child mortality, especially when it interacts with infections like measles, diarrhea, and respiratory disorders (Black et al., 2008; Bailey, West, and Black, 2015; Gakidou et al., 2017).

Given these negative effects of undernutrition, social safety net programs such as Kenya's Hunger Safety Net Program (HSNP) - a cash transfer program - have been proposed to improve nutritional outcomes for poor households.[2] These public programs are intended to reduce poverty and social vulnerability, which are the main drivers of malnutrition (Ruel and Alderman, 2013). Anecdotal evidence stresses the important role these social programs play in helping poor households mitigate the effects of weather-induced vulnerabilities in instances where there are no formal credit markets and the cost of adaptation exceeds the benefits (Macours and Vakis, 2010; Davies et al., 2013; Mesquita and Bursztyn, 2016). However, there is limited empirical evidence on the effects of cash transfers on the consumption of nutrients. This is unfortunate given the important role that adequate consumption of nutrients plays in reducing child mortality and promoting physical and cognitive development especially during the early years of life (Hoddinott et al., 2013; Black et al., 2013; Horton and Steckel, 2013). Most of the extant research has focused only on the effect of social programs on eligible households (i.e., direct effects) and disregarded non-beneficiary households (i.e., indirect effects). However, in village economies where risk-sharing practices between communities are strong (see Townsend, 1995; Fafchamps and Lund, 2003; Dercon, et al., 2012), the effects of

[2] Other methods of solving malnutrition include food fortification, diet diversification, and micronutrient supplementation. However, these methods can be costly to implement and often do not reach the rural poor in the developing world because they are disconnected from wholesale markets, which are located in urban centres.

social programs can also accrue to ineligible households through familial or community-based channels,[3] and this has a significant effect on the design of policies aimed at reducing extreme poverty and enhancing nutritional uptakes in the rural areas of developing countries.[4] Failure to capture these indirect effects may bias the conclusions drawn from such analyses. Therefore, understanding both the direct and indirect effects (in terms of income elasticities of nutrient consumption) associated with social safety net programs is key when designing policies aimed at improving household nutrition in rural areas. This is because, estimates of the income elasticities of nutrition, obtained by using examples from the developing countries, are mixed: i.e., they vary from close to zero to as high as 0.54 (Tiwari et al., 2016; Bhalla, et al., 2018; Brugh, et al., 2018). We hypothesize that this variation in income elasticites obtained from developing countries can be attributed to three reasons. First, social programs are aimed primarily at reducing poverty and other social illnesses, and not necessarily addressing health problems. This means that improving health outcomes is a secondary objective. Second, it is often argued that poor households tend to consume processed foods and beverages, which are generally not rich in calories (Subramanian and Deaton, 1996). Finally, malnutrition is multidimensional, so no single intervention is likely to remedy its effects.

To fill these knowledge gaps identified in the literature, we (in this paper), estimate the magnitude of income elasticities (for both HSNP eligible and ineligible households) obtained from consumption of nutrients using HSNP dataset collected from Northern Kenya. The HSNP is a Randomized Controlled Trial (RCT) giving an unconditional cash transfer of 2,125 Kenyan shillings (KES) (about US$20) every two months to qualifying households or individuals with

[3] For instance, beyond the cash transfers often shared with non-eligible households, eligible households also host other family members who cannot afford to self-subsist, thereby increasing household sizes. This reinforces the child-fostering hypothesis, which has been shown to drive food and nutritional consumption, as well as saving rates. It is, therefore, a common practice for elderly parents (eligible households) to share a home with their adult children (non-beneficiary households) to ease care, or for richer households (eligible households) to support the children of less fortunate family members (non-beneficiary households) to enable them to attend distant schools.

[4] In HSNP districts, households share about 23.26% of the transfer they receive (ie., KES 500 out of KES 2,150 received every two months) with neighbours, other family members and friends. The slow adoption of unconditional cash transfers (UCT), especially in Africa, can be attributed to social and economic problems such as high poverty rates, recurrent food price hikes, and the prevalence of HIV/AIDS. These challenges have two important implications: 1) they make health, nutrition, and other important outcomes secondary objectives for households; and 2) they affect program design, acceptance, scalability, cost, and impact.

the goal of improving, among other things, the food and nutrition security of poor households.[5] The amount of cash transfer to HSNP treated households and or individuals was fixed at 75% of the value of food ration provided by the United Nations World Food Programme (which operated in the region in 2006) and is equivalent to about 12% of household baseline consumption expenditure. A unique feature of the HSNP is a contingency benefits plan (or drought emergency fund) for eligible households in the case of severe drought. In May 2019, 600,000 people were benefiting from HSNP transfers in the 48 sub-locations of northern Kenya.

We use an HSNP 2010–2011 longitudinal sample containing 9,246 eligible and ineligible households in treated and control villages (See appendix 1). We exploit the random allocation and panel nature of our dataset, to test whether an intervention intended to reduce poverty and social vulnerability can, at the same time, improve the nutritional status of rural households. Using difference-in-difference specifications, our results revealed that HSNP-eligible households in treated villages increased their consumption of diets rich in non-heme iron by about 9%. At the same time, they consumed more vitamin B12, vitamin C, riboflavin and beta-carotene dense foods by between 21 and 62 percentage points respectively as a result of a 1 percent rise in household income. Moreover, HSNP-eligible households in treated villages almost doubled consumption of foods rich in vitamin A (like cheese, eggs, oily fish, milk and fortified low fat spreads)– which are sourced from animals. Interestingly, HSNP-ineligible households in treated villages also increased their intake of riboflavin rich foods by about 27.6 percentage points, compared to those in control villages. We ruled out alternative pathways that households might have used to increase their consumption, such as increased earnings, savings, investments, and price increases of goods. We, therefore, conclude that the rise in nutrition was primarily the result of sharing the HSNP transfers among social network members.

[5] HSNP beneficiaries were selected based on three targeting mechanism, either community based targeting, dependency ratio or social pension. Under community based and dependency ratio targeting schemes, households were targeted while under social pension, individual persons were targeted. In this study, we use households to mean those beneficiaries selected through community based and dependency ratio targeting scheme and individuals to mean those selected under social pension schemes.

When we account for the mechanisms used to target beneficiary households, we observe a rise in consumption in households selected through community-based and dependency ratio targeting mechanisms.[6] Our results also show that HSNP households source their nutrients mainly from markets, indicating the importance of markets in meeting the nutritional needs of households. In addition, we show that HSNP-eligible households increased their savings by about 15 percentage points, while HSNP-ineligible households reduced their savings by 46 percentage points as a result of a percentage points increase in income.

Our paper makes three important contributions to the economic literature. First, it contributes to the discussion on nutrient-income elasticity[7] from a developing country perspective, where research is still limited. In Kenya, for instance, Dietrich and Schmerzeck (2020) found that changes in income did not affect available nutrients, while Haushofer and Shapiro (2018) found that income had a positive effect on protein consumption. At the international level, some studies have found a positive effect of income on nutrient intake (see Leroy et al., 2010 [for Mexico]; Jha, Bhattacharyya, and Gaiha, 2011 [for India]) while others have found little or no effect of income on nutrient deficiencies (Gertler, 2004 [for Mexico]; Caldés, Coady, and Maluccio, 2006 [for Mexico, Honduras, and Nicaragua]). Our result complements these previous studies' findings by showing that HSNP-ineligible households also increase their nutritional intake of vitamins and beta carotene. This allows us to identify potential spillover effects associated with the implementation of HSNP policies on non-eligible households.

Second, our study adds to the literature on the effectiveness of government aid (in the form of cash transfer) in improving household nutrition. Here, Hoddinott, and Skoufias (2004) showed that transfers helped households increase their consumption of fruits, vegetables, and animal products. In addition, Angelucci and De Giorgi (2009) showed that beneficiary households increased their food consumption by almost 10% compared to those in control

[6] Three methods were used to target HSNP households: community-based (CB), social pension (SP), or dependency ratio (DR). Under CB, households were selected by community members; approximately 50% of all households selected fell into this category. For social pension, beneficiaries were selected if they were 55 years or older, so the HSNP can be thought of as a form of pension insurance. Under DR targeting, households were selected if any of their members were aged or sick, or it was based on a threshold set by program officials.

[7] Income elasticity is the percentage change in consumption of nutrients as a result of a 1% change in income. This elasticity is important in understanding the determinant of nutrition and whether the social safety net is effective in promoting nutrition in poor households.

villages. Our results compliment these previous findings in two ways. First, we document that these positive effects of transfer received on nutrient consumption persist, even in a presence of drought, through existing risk-sharing mechanisms within rural communities of Kenya. Second, we show that these positive effects of income are more pronounced when households source their nutrients primarily from local markets rather than through self-production, signifying the important role these markets play in the nutrition of poor households.

Finally, our study extends the discussion on consumption smoothing in low-income countries. As noted by Dercon and Krishnan (2000), rural households tend to consume only what they produce, which often results in poor quality diets. In line with risk-sharing models (Udry, 1995), we show that HSNP-eligible households in treated sub-locations shift their consumption to diets rich in heme iron and vitamins compared to those in control sub-locations.

The remainder of the paper is organized as follows. Section 2 provides a brief description of food consumption and nutrition patterns in Kenya, whereas section 3 discusses the outcome variable: nutrition. In Section 4 we provide a summary of the HSNP experimental setup and the data sources. The estimation strategy is detailed in section 5. The results are discussed in section 6. Section 7 investigates the results under various scenarios. The last section 8 concludes the paper.

2. Food consumption and nutrition patterns in Kenya

Currently, the average food intake in Kenya is about 2,196.8 kcal/person/day, which is 2.4% below the recommended daily caloric intake of 2,250 Kcal/person/day (Kenya National Bureau of Statistics, 2019). About 55% of Kenyan households consume diets that are rich in cereals, especially maize, beans, rice, plantains, potatoes, and wheat (FAO, 2017). The consumption of animal products (milk and beef) is projected to grow by about 170% between 2010 and 2050, reaching 8.5 million metric tons (FAO, 2017). The main sources of these foods are self-production and food purchased from local markets, which contribute about 70% and 30%, respectively (Mohajan, 2013; Mohajan, 2014).

Compared to its East African neighbours (Uganda, Tanzania, Rwanda, and Burundi), Kenya has the highest food import bill, estimated at US$1.41 billion (UNCOMTRADE, 2013). The country imports processed agricultural products to bridge the consumption gap. Imports are dominated by cereals (wheat and rice), which constitute about 13% of dietary energy requirements (FAO, 2012). Other important products on the import list include palm oil, beans, and sweeteners. The export market is, however, limited and not well developed. The majority of the exported food products remain raw agricultural commodities such as soya beans. The import gap is supported partly by food aid from the World Food Programme (WFP) and the Overseas Development Aid, among others.[8] This aid specifically targets households that have been impacted negatively by climate-induced disasters such as drought, floods, or displacements from clan-related conflicts. Annually, the food aid budget is estimated at US$135 million and this is dominated by cereals and fortified commodities (Government of Kenya, 2005).

The prevalence of malnutrition in Kenya is among the highest in sub-Saharan Africa. The country is ranked 86th out of 117 qualifying countries with a Global Hunger Index of 25.2, indicating serious hunger (GHI, 2019). In 2007, about 36.5% of the population was classified as food insecure. The most vulnerable include pregnant and lactating women, children under the age of 5 years, the elderly (those over 55 years), orphans, people living with HIV/AIDS, and those suffering from malaria and tuberculosis (Government of Kenya, 2005). Food insecurity is attributed to several factors, including poor market linkages, low income, poverty, and drought. The high prevalence of malnutrition (See Figure 1) is responsible for diet-related complications like diabetes, cancers, and kidney, liver, and cardiovascular diseases (Saunders & Smith, 2010). These diet-related diseases are associated with a low quality of life and premature death, commonly witnessed in the rural areas of most developing countries.

[8] Countries that provide food donations to Kenya include the United States of America, the European Union (especially Germany and the United Kingdom), Japan, and China. For development partners, major stakeholders include the United States Agency for International Development (USAID), the Swedish International Cooperation (SIDA), the Department for International Development (DFID), and the German Society for International Cooperation (GIZ).

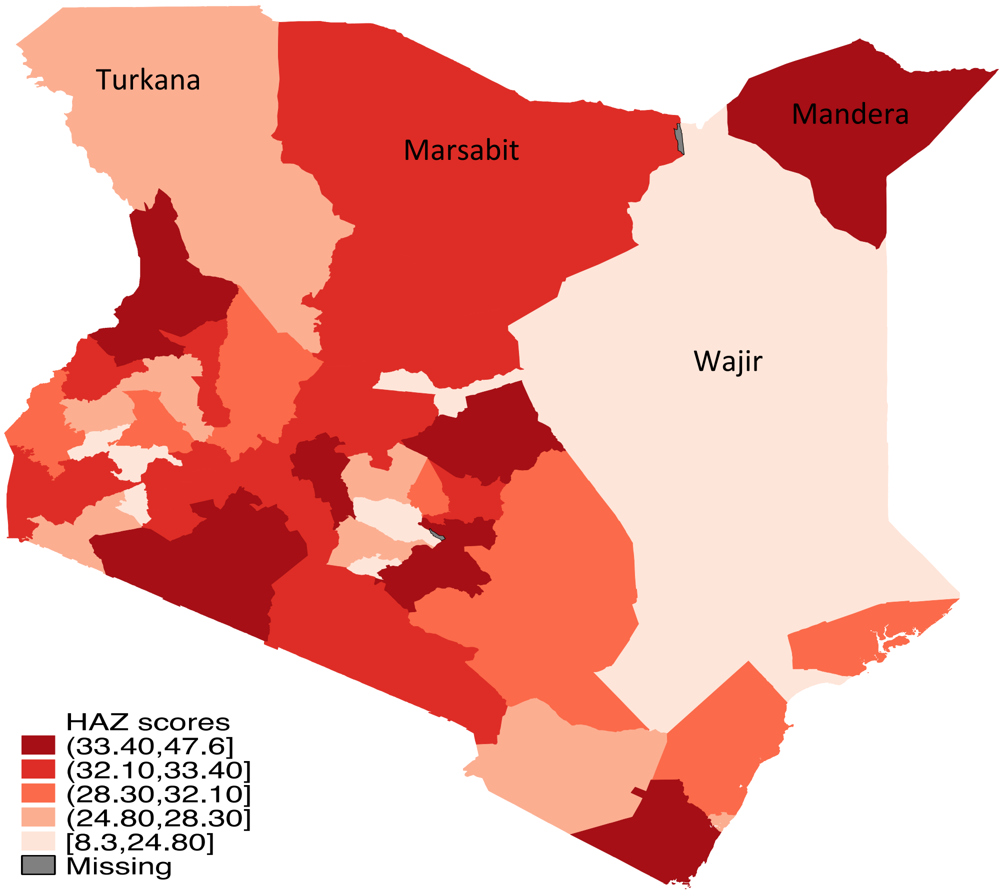

Figure 1: Height for age Z (HAZ) scores

Source: Constructed by the authors based on data collected from KEBS (2015)

An interesting fact, which we observe in Figure 1, is the higher incidences of malnutrition in Mandera and Marsabit districts than the national average of malnutrition in Kenya (Figure 1). Amongst the four HSNP districts, Mandera had the highest incidence of malnutrition (HAZ of 47.6 standard deviation), while Wajir has the lowest incidence of malnutrition (HAZ of 24.7 standard deviation) (KEBS, 2015). This high prevalence of malnutrition (in the Mandera district) can be attributed to two reasons. First is the nomadic lifestyle of households in the district. According to Mertens *et al.,* (2013), the Mandera district has the highest number of pastoralists compared to other HSNP districts. They attributed high attrition rates in follow-up surveys to this nomadic lifestyle of households.[9] Secondly, HSNP districts were severely impacted by two

[9] In Mandera, attrition rate was about 10 and 6% between 2010-2012 and 2010-2012 respectively. In Wajir, attrition rate was 5 and 11% between 2010-2011 and 2010-2012 respectively. in 2011, attrition rate was highest amongst HSNP non-eligible than eligible households (See Merttens *et al.,* 2013).

covariate shocks (i.e., drought and inflation) than other districts in Kenya which magnified the incidence of malnutrition. During these stressful periods, Merttens et al., (2013) showed that prices of cereals-based diets and kerosine increased by about 34 percent between 2010 and 2011.

3. Experimental design and data sources

We use a randomized controlled trial (RCT) dataset from the Hunger Safety Net Program (HSNP) collected by Oxford Policy Management in collaboration with other stakeholders.[10] The HSNP is an unconditional cash transfer program aimedat improving the food and nutritional security of poor households in northern Kenya, among other objectives. The program is ongoing and is currently benefiting 97,967 households (approximately 600,000 people) with a budget of KES 0.54 billion in May 2019.[11] The transfer is delivered in two tranches: a regular transfer and a drought emergency fund. Specifically, every beneficiary household or individual was entitled (at baseline) to about KES 2,150 (US$ 20)[12] every two months. This amount corresponds to about 12% of the average household consumption expenditure in 2009 or approximately 75% of the food ration of the World Food Programme in 2006.[13] The drought emergency fund (or contingency benefit plan) is a form of risk insurance that pays out about 75% of the HSNP cash transfer amount received by beneficiary households in the case of a severe drought. Situations of drought are determined by the Normalized Difference Vegetation Index (NDVI) of every HSNP district (Merttens et al., 2013).

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[10] These stakeholders include the Government of Kenya through the Ministry of Devolution and Arid and Semi-Arid Lands; the National Drought Management Authority of Kenya; the UK's Department for International Development (DFID); Equity Bank, Kenya; the International Development Association of the World Bank; the National Registration of Person's Bureau; the county governments of Wajir, Mandera, Turkana and Marsabit; the Ministry of Interior and Coordination of National Government; and the Ministry of Labour and Social Protection of Kenya.

[11] See www.hsnp.or.ke for up-to-date information.

[12] This amount was increased in September/October 2011 to KES 3,000 and to KES 3,500 in March/April 2012. In March/April 2011, the HSNP contingency fund made a once-off double the transfer payout to HSNP beneficiary households as a result of a severe drought.

[13] The WFP food ration is relief-based food assistance provided as a protection ratio for hunger-stricken households. The program operated in the Marsabit, Mandera, Turkana and Wajir districts of Kenya until 2006. It benefited over 425,000 households (women and children) by giving out cash entitlement of about KES 4,000 (US$39) every three months. This WFP transfer provides about 65% relief on food equivalent, based on local prices.

The HSNP covered four arid and semi-arid districts: namely Turkana, Mandera, Marsabit, and Wajir.[14] These districts are characterized by high levels of poverty with over 85% of residents living below the poverty line in 2005/06 (KNBS, 2005). The main economic activities of the selected households are nomadic pastoralism (about 70%) and subsistence farming of sorghum, maize, and beans. In these areas, crop yields are low and the application of improved technologies, like index insurance, is limited. The region is characterized by frequent droughts, which cause about 20% harvest losses. Moreover, the region suffers from communal conflicts over water and grazing land, and poor maternal and child health; cases of severe underweight, stunting, and wasting are almost double the national average (see Figure 1 above).

The design of HSNP is simple: it is made up of treatment and control arms only. A treatment sub-location or village is one selected to receive transfers, while control sub-location did not receive transfers until December 2012. Households in the control villages were also not told whether they would receive transfers in the future to prevent priming effects. Across the HSNP districts, 48 sub-locations (12 in each district) were randomly selected for inclusion in the program.[15] And because of a geographical phase-in, 24 sub-locations were randomized out and did not receive the treatment between 2010 and 2012. The randomly selected sub-locations were matched in pairs with the treated sub-locations based on population densities.

Household targeting involved three mechanisms: either community-based, dependency ratio or social pension. The selection process of households into either treatment or control sub-locations followed a similar pattern to ensure comparability. In community-based targeting (CBT), local leaders selected households, which they deemed poor, to receive the transfer. These comprise about 50% of all households under this mechanism. Under the dependency ratio targeting (DRT), a household was selected if a percentage of its members, younger than 18 years or older than 55 years, exceeded a threshold set by the project. The HSNP transfers can be thought of as a form of pension scheme because households were selected only if they had members aged 55 years and older. Under the social pension targeting, equal numbers of

[14] Source: https://microdata.worldbank.org/index.php/catalog/1915/related-materials.

[15] A sub-location is the smallest administrative unit, comprising about 200 households and is headed by a chief, assisted by local leaders.

men and women benefited from the program, but women were the majority recipients in the CBT (81.9%) and the DRT (73.7%).

Similar to the sub-locations, the program rollout and data collection followed a staggered approach. This meant that sub-locations were introduced on a month-by-month basis over 12 months to account for seasonal differences.[16] At baseline, one sub-location in each pair (either treatment or control) was selected through a public lottery attended by community leaders and HSNP officials. After selection, data collection started before any household received their first HSNP transfer. This staggered procedure was followed in other survey rounds. It is important to note that once a household started to receive the transfer, no other household was allowed to join the program until December 2012. This enables us to estimate the impact of the HSNP on nutrient consumption. HSNP eligible households were selected from a list obtained from administrative records. In each sub-location, 66 households were selected using a simple, random sampling procedure from a sampling frame containing HSNP eligible households (See Appendix 1). If there was no response, a replacement household was drawn randomly from the list of the remaining households on the administrative record until the required sample was reached. For HSNP ineligible households, households listings was undertaken in a sample of three settlements (either main, permanent or non-permanent) available within each sub-location. In total about 44 HSNP non-beneficiaries were sampled in each sublocation. In case of non-response, HSNP non-eligible households were sampled using a replacement list stratified by residency status (either resident or non-resident) and settlement type. In both treated and control arms, information was collected from poor (HSNP-eligible) and non-poor (HSNP-ineligible) households (See Appendix 1 for details).

The information was collected using a detailed questionnaire. In the HSNP sample, the attrition rate was low. For instance, between 2010 and 2011, the attrition rate averaged about 8%. At the household level, the average attrition rate was about 4.4% between the 2010 and 2011 HSNP samples. Across the four districts, Mandera and Wajir had the highest attrition rates, partly because of the nomadic nature of most households (Merttens et al., 2013). The low attrition rate meant that our results are unlikely to have been impacted by attrition bias. Our

[16] A treated sub-location is one selected to receive the HSNP transfer immediately after the baseline survey, while a control sub-location is one that did not receive any HSNP transfer until the end of the first phase (2010–2012) of the program.

final sample is HSNP 2010–2011 comprising 9,246 households (5,722 eligible and 3,524 ineligible households, See appendix 1 for details). We used this sample because we had detailed information on the HSNP ineligible and eligible households.

4. Measuring nutrition

In measuring household nutrition, we adopted a food consumption-based approach due to data availability.[17] We use household food consumption data collected in 2010 and 2011 to calculate nutritional indicators. The HSNP survey instrument contained detailed information on 54 food items collected on a seven-day recall period. We differentiated between food items that are self-produced, purchased from local markets, and received as gifts. Other important information included the quantity of each food item consumed, per unit costs (for market-sourced foods), and total expenditure incurred by each household.

In estimating the amount of nutrients consumed in a food item, we followed a flexible approach involving four main steps (Shapiro, Haushofer, and Almås, 2019). First, we converted all reported quantities of foods into a single unit (in this case grams) to be consistent with the food consumption tables of Kenya.[18] In doing so, we made assumptions about the local names and assigned weights of food items consumed by households but not available in Kenya's food consumption table.[19] In the second step, we converted these weekly amounts of food consumed into 100 grams, by taking into account edible portions of these food items.[20] In

[17] Other commonly applied methods for measuring household nutrition are clinical and anthropometric measures (De Haen, Klasen, and Qaim, 2011).

[18] Food consumption table for Kenya is available at: https://www.google.co.za/url?sa=t&rct=j&q=&esrc=s&source=web&cd=&cad=rja&uact=8&ved=2ahUKEwjFp_2dnartAhU6UhUIHb-LDgcQFjAAegQIAhAC&url=http%3A%2F%2Fwww.fao.org%2F3%2FI8897EN%2Fi8897en.pdf&usg=AOvVaw2eLZv_9jRaK9xn6KO_OnEh

[19] For instance, we assumed that 1 debe of maize grain is equivalent to 1 kilogram; 1 pachaka/tenga equals 500 grams of vegetables; 1 mango equals 150 grams; 1 head and 1 handful of milk powder equals 220 and 110 grams, respectively. In instances where households reported the unit of measurement of bread as 25 kilograms, we assumed this is equal to a 700 grams as this is the most common bread type in most Kenyan households; Changes in these assumptions will not affect the reliability of our results. We double checked these assumptions by conducting an online interview with key experts working in the nutrition fields in Kenya and Africa.

[20] We use the word nutrient available or consumed interchangeably. It is important to recognize that households reported only the quantities of foods available in the previous seven days without highlighting whether these foods were consumed or not, and in which form they were consumed. In all instances, for

doing so, we followed the Food and Agriculture Organization's (FAO's) guidelines on food matching and applied Kenya's food consumption tables 2018[21] (Stadlmayr et al., 2012; FAO/Government of Kenya, 2018). In the third step, we aggregated the amount of each nutrient consumed at the household level. In the final step, we standardized the amounts of nutrients consumed by household size, per adult equivalent (based on the OECD modified scale), to facilitate comparison with previous studies.[22] We used these standardized amounts of nutrients consumed per adult as outcome variables. We provide a brief overview of nutrients consumed per adult equivalent in Table 1. These nutrients were selected based on their importance for body growth (Subramanian and Deaton, 1996).

One can observe, at a glance, that the HSNP (eligible and ineligible) households in treated villages increased their consumption of diets rich in nutrients compared to those in control villages, who consumed more cereals, as evidence by high levels of nutrients per adult equivalent (see Table 1 and Appendix 1 for descriptive statistics and definition of HSNP eligible and ineligible households respectively). In rural villages, where agriculture is the mainstay of most households, cereal-based diets are cheap and, therefore, contribute a significant portion of the household caloric share. Given the high energy (Kcal) consumed by HSNP households, these households can be thought of as income poor, and this buttresses the effectiveness of targeting to reach them. As a result, we did not exclude any household based on the amount of nutrients consumed, contrary to previous studies which excluded households with energy consumption below a given threshold. For instance, Dietrich and Schmerzeck, (2020), excluded households in which energy per adult equivalent was below 500 Kcal or above 1,500 Kcal. Instead, in our study, we applied a natural logarithm to the consumed nutrients and vitamins

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the sake of simplicity, we assumed that all nutrients available in foods were consumed and we used the raw form of these foods. This assumption reflects the socio-economic realities of the households in rural Kenya; the lack of food storage facilities combined with a high level of food vulnerability makes it difficult to assume a situation where foods can be stored for a long time.

[21] The Kenyan food consumption tables did not classify chat/miraa and tobacco products as foods. So, we gave them zero nutrient values because they are not consumed but either smoked or chewed and then spat out.

[22] This scale assigns 1 to a household head, 0.5 to an additional adult and 0.3 to every child in the household. For instance, a household of three people (head, spouse, child) will have a score of 1.8 (Hagenaars, De Vos, and Zaidi, 1994).

per adult equivalent to minimize the influence of outliers and preserve the balanced nature of our sample.[23]

Table 1: Descriptive statistics of outcome variables at baseline

Outcome variables	HSNP eligible		HSNP ineligible	
	Full sample mean (SD)	Control-Treated households *(p-value)*	Full sample mean (SD)	Control-Treated households *(p-value)*
Nutrients consumed per adult equivalent				
Energy (Kcal)	17,440.550 (19,670.81)	353.812 (0.631)	20,445.139 (18,041.66)	428.778 (0.618)
Protein (g)	575.840 (1,207.427)	0.522 (0.991)	655.263 (984.497)	61.920 (0.187)
Fat (g)	336.545 (441.100)	3.366 (0.838)	424.276 (638.027)	3.856 (0.899)
Fibre (g)	356.156 (521.073)	8.395 (0.667)	385.617 (438.877)	-3.398 (0.871)
Carbohydrate(g)	2,825.486 (3,217.27)	73.950 (0.539)	3,285.238 (2,912.029)	41.414 (0.765)
Zinc (mg)	88.613 (109.195)	1.743 (0.669)	99.885 (94.791)	5.072 (0.262)
Calcium (mg)	4,308.612 (9,227.167)	22.489 (0.948)	5,383.346 (8,615.912)	883.397 (0.031)**
Iron (mg)	139.218 (161.773)	–3.514 (0.561)	158.272 (153.192)	–3.370 (0.644)
Heme iron (mg)	26.028 (72.079)	–2.511 (0.352)	29.967 (75.381)	5.949 (0.098)
Vitamin A (mcg RAE)	758.855 (786.281)	33.222 (0.259)	1056.678 (1,096.105)	70.318 (0.178)
Vitamin B_{12} (mcg)	17.236 (28.286)	1.805 (0.088)*	22.900 (37.617)	6.607 (0.000)***
Vitamin C (mg)	121.407 (300.684)	–45.448 (0.000)***	181.548 (479.385)	–68.966 (0.003)**
Food folate (mcg)	15.009 (4.493)	0.893 (0.000)***	14.593 (4.611)	1.090 (0.000)***
Riboflavin (mg)	68.136 (614.412)	–25.210 (0.273)	75.177 (472.634)	–13.774 (0.541)
Beta carotene (mcg)	1,467.832 (3,280.103)	–641.724 (0.000)***	2,168.513 (5,767.365)	–831.765 (0.002)**
Observations	**2,861**	**2,861**	**1,762**	**1,762**

Notes: Standard errors are in parentheses; *, ** and *** significant at 10%, 5% and 1% levels, respectively. Kcal is kilocalories; RAE is retinol per adult equivalence. All nutritional variables are weekly per adult equivalent. SD is the standard deviation; Control-Treated households captures the differences in means between HSNP (eligible and ineligible) households in control and treated sub-locations.

[23] We applied natural logarithm everytime we mention logarithm. However, some households reported zero values in the amount of nutrient consumed. This is problematic because a natural logarithm of zero is not defined and STATA software record them as missing values. For such households, we replaced missing values with zero values to maintain the balanced nature of our sample.

Another striking pattern is the high median compared to mean values for all nutrients consumed by both HSNP eligible and ineligible households. This difference is observed across all nutrients except for heme iron and riboflavin. This supports the symmetrical nature of the sample. Moreover, another important pattern relates to the high percentage of heme iron[24] in the diets of poor, HSNP households. In general, rich households (those in the top 25% of per capita consumption expenditure (PCE) consumed about 366% (or five times) more than those in the lowest 25% of PCE (See Table 11A, in appendix 2). This difference in the consumption of heme iron can be attributed to the high costs associated with animal products, which are assumed to be high among income-poor households. Here, our observations are similar to those of Skoufias, et al., (2009) who showed that households in the top 25% of PCE consumed about 6.5 times more heme iron than those in the lowest 25% PCE in Tanzania.

Third, we find a significant difference between the PCE of the top and bottom 25th percentile households in the consumption of foods rich in vitamins C, $B_{12,}$ and riboflavin at about 197%, 69%, and 64%, respectively (See Table 11A, in appendix 2).[25] The results for vitamin B_{12} and riboflavin are surprising given that these nutrients are sourced mainly from animal products which are kept by 70% of households. There are two possible explanations for this. The first relates to how we calculated the amount of nutrients available in food items. In this study, we applied nutrients available in raw forms of foods because the questionnaire did not detail the form in which the foods were consumed. Second, the HSNP households might keep livestock as a source of wealth and prestige rather than for consumption per se. This means that livestock is rarely sold to smooth consumption. However, for vitamin C, which is sourced mainly from fruits and vegetables, our result is consistent with the findings of Ongudi and Thiam (2020), who showed that exposure to drought negatively impacts crop yields. Another possible explanation is the isolation of food markets from major wholesale (or source) markets, which are located in urban centers. As shown by Dietrich and Schmerzeck (2019), the isolated nature of food markets in the HSNP districts was associated with high cereal prices.

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[24] Heme iron is sourced from blood and muscle tissues. It is rich in proteins, mainly found in animal products such as fish and poultry, and it is easily absorbed by the body.

[25] We calculated these figures by dividing the interquartile range with the figures found under the bottom 25 of consumption. For instance, energy (Kcal) = 0.615/10.003 = 0.0615. We follow this formula for all the outcome variables in Table 1.

These results bring two important facts to bear. First, a household's nutrient consumption tends to follow the availability of resources. We observed that households with higher financial resources (those in the top 25% of PCE) consumed more nutritious diets than those with fewer resources (See Table 11A, in appendix 2). This seems to support the notion that malnutrition is a result of poverty and, therefore, implementing social safety net programs could reduce malnutrition. Second, we find that resource-rich households are able to meet their nutritional requirement whereas resource-constrained households are not. This means that for the resource-poor households, food is a necessity, while for resource-rich households, food is a luxury.

4.1 Covariate balancing test of control variables

We report descriptive statistics and covariate balancing tests of the HSNP households (see Table 2 and Appendix 1). Our aim here was to assess the effectiveness of the randomization procedure in producing comparable groups from treatment and control sub-locations. In undertaking covariate balancing tests, we focused our analysis on the 2,861 eligible and 1,762 ineligible households interviewed in 2010 (i.e., baseline data for the HSNP households in our balanced panel). These households were reinterviewed in 2011, which allowed us to form a balanced panel sample for our final results. One message (from Table 2, i.e., baseline data) is that the HSNP-eligible samples are comparable in terms of covariates for about 50 percent of control variables used in our analysis. Specifically, we observed a statistically significant difference in Tropical Livestock Unit (TLU)[26], household size, productive asset ownership, and household participation in formal employment. To minimize possibility of randomization bias, we rely on DID estimators in evaluating treatment effects. Moreover, we control for baseline differences in all regressions. In the HSNP-ineligible households, only the household size, the age of the household head and employment participation are not comparable at baseline. This provided support for our empirical estimation that we were dealing with unblocked RCT dataset and that these groups of households are comparable. In addition, they provided suggestive evidence of the effectiveness of the HSNP randomization in reaching rural, poor households as evidenced by higher mean values (Column 2 and 4) amongst HSNP eligible

[26] TLU is an index used to aggregate different livestock types into one single indicator to facilitate international comparison (Jahnke, 1982). Typically, 1TLU is taken to be equivalent to 1 cattle, 0.1 of either a goat,sheep,donkey, ass or mule, 1.4 of camel and 0.01 of a poultry

households in treated and control sub-locations. As noted in Barrett and Carter (2010), the randomization bias common in small samples is not a problem in our dataset. To minimize any bias that may have remained, we applied a difference-in-difference estimation technique and control for baseline covariates in all our regression specifications.

Table 2: Covariate balance tests at baseline

Variables	**HSNP eligible households**		**HSNP ineligible households**	
	Full sample mean (SD)	Control-treated households (*P-value)*	Full sample mean (SD)	Control-treated households *(P-value)*
Tropical Livestock Unit (TLU)	7.585 (0.320)	–1.061 (0.098)*	9.214 (0.353)	–0.425 (0.547)
Household size AE	4.508 (0.330)	–0.291 (0.000)***	3.987 (0.423)	–0.244 (0.004)***
Gender of head (1=Male)	0.684 (0.009)	–0.018 (0.309)	0.811 (0.009)	0.007 (0.692)
Age of head (years)	52.583 (0.292)	0.176 (0.764)	42.735 (0.334)	–1.270 (0.057)*
Marital status of head (1=Married)	0.685 (0.008)	–0.004 (0.799)	0.821 (0.009)	0.014 (0.440)
Employment participation (1=Yes)	0.095 (0.005)	–0.040 (0.000)***	0.076 (0.006)	–0.048 (0.000)***
Economic activity of head (1=Agriculture)	0.450 (0.009)	0.000 (0.987)	0.442 (0.012)	0.006 (0.793)
Own production assets (1=Yes)	0.198(0.398)	–0.025(0.093)*	0.222 (0.416)	–0.064 (0.001)**
Observations	**2,861**		**1,762**	

Notes: Production assets include a water drum, animal cart, oxen plough, wheelbarrow, sickle, pick axe, fishing net, panga, and spade; **, and *** correspond to 5% and 10% significance level, respectively, SD is the standard deviation.

Another important observation is that HSNP households are income poor and they depend mainly on rainfed agriculture for livelihood. This implies that HSNP households do not benefit from the growing market of animal-sourced proteins. On average, households keep about eight TLUs (or 1.68 TLUs per household member) which translates into about eight beef cattle or six camels (See Jahnke, 1982). Therefore, they are unable to derive any surplus from selling eight beef cattle or six camels in the market. This figure of eight TLUs is below the recommended minimum of 15 TLUs necessary for a household to produce new stock in presence of drought. The high proportion of poor households in the HSNP sample is not surprising as this program was pro-poor. Finally, household heads were male, married, outside of the productive age group (i.e., 15–49 years), and with few members participating in employment activities that provided either food or cash grants.

5. Estimation strategy

We estimate the effect of the HSNP on a host of outcomes grouped into nutrients and access to credit resources. For each of the outcomes, we estimate Equation 1 with and without explanatory variables. Only results where baseline covariates are included are presented.

The model we estimate is specified as follows:

$$Y_{is} = \beta_0 + \beta_1 HSNP_i + \beta_2 X_i + \varepsilon_{is} \ldots\ldots\ldots (1)$$

Where Y_{is} is the outcome variable of interest (in this case, a log of the weekly amount of nutrients consumed by households per adult equivalent and access to credit resources) for a given household i residing in sublocation or village s; $HSNP$ is the participation dummy which equals one if a household lives in a sub-location selected to receive the transfer and zero otherwise; X_i are covariates while ε_{is} is the white noise. In estimating the model, we cluster standard errors at the household level and apply household weights to control for sample attrition. We estimate Equation 1 by using an Ordinary Least Squares (OLS) regression on a cross-sectional dataset- i.e., HSNP 2011 sample only.[27] The impact of the HSNP is captured by coefficients on β_1.

Although the OLS result provides a picture of how participation in the HSNP influences the consumption of nutrients, vitamins, and minerals, it does not account for possible unobserved heterogeneity. In addition, it fails to account for the non-zero outcomes observed at a baseline. This means that results generated from the OLS estimations can be thought of as similar to an

[27] We estimated OLS regression using the HSNP 2011 survey only with and without covariates for eligible and ineligible households separately. However, we present only regressions in which covariates are included in the model.

intention to treat effects but estimated at a cross-sectional level. To correct for these weaknesses, we benefit from the randomization and panel nature of the HSNP dataset to estimate a difference-in-difference (DID) approach.

5.1. Difference-in-Difference approach

When estimating a DID specification, one needs to define who the beneficiaries are in a study. One way of defining a beneficiary is to assume that all households residing in a sub-location selected to participate in the treatment (in this case the HSNP transfer) actually received the transfer, while those in the control villages did not receive this treatment until the program conclusion. In this case, the impact of an intervention can be obtained simply by comparing the households in the sub-locations selected to receive the treatment with those in control villages based on a given outcome of interest. The results from such analysis are commonly referred as intention-to-treat (ITT) or average intention-to-treat (AITT) effects. This is because they compare only the outcome variables between households in treated villages with those in control villages based on eligibility, but not on actual and effective program participation. The identification assumption is that any change in the outcome variable would have been the same for eligible households in control and treated villages had there not been an intervention (Moffitt, 2001).[28]

Under an ITT effect, we estimate the following equation:

$$Y_{ist} = \beta_0 + \beta_1 HSNP_{st} + \beta_2 Post_t + \beta_3 (HSNP_{st} * Post_t) + \beta_4 X_{it} + \epsilon_{ist} \ldots\ldots (2)$$

Where Y_{ist} is the outcome variable for a household i living in sub-location s in year t. $HSNP_{st}$ is an indicator variable, which equals one if a household resides in a sub-location s in year t, which was selected to receive the HSNP transfer and zero otherwise. $Post_t$ is a year dummy taking a value of one for a follow-up survey (i.e., if data collection happened in 2011) and zero otherwise. X_{it} captures household and community-level characteristics, while ϵ_{ist} is the mean zero and the constant variance error term. Equation 2 can be estimated using household fixed effects because the interaction term $(HSNP_{st} * Post_t)$ is a time variant at the household level.

[28] We do not present parallel trends analysis (in graphical form) because we only have one follow up period, i.e., HSNP 2011 survey only. Given that the program had just operated for one year, not much difference can be observed within our dataset.

The estimated β_3 is the ITT effect and it captures the difference in the HSNP program participation between HSNP-eligible households in treated sub-locations versus those in control sub-locations. We estimate this model for every outcome variable (in Table 1) by using the HSNP 2010–2011 panel sample.

There are two benefits associated with the estimation of ITT effects. First, it helps to overcome possible selection bias in the absence of a perfect balance in baseline characteristics. Second, the estimator accounts for time-invariant heterogeneity and non-zero outcome variables at the baseline level (Greene, 2012; Pamuk et al., 2015). Despite the above merits, however, ITT estimates may be misleading in the absence of full compliance (see footnote 29). This is because the ITT effect estimates do not account for possible non-compliance in program participation, which is a common problem encountered in many least developing countries (Angrist, 2006). For instance, in the HSNP 2011 survey, about 3% of HSNP-eligible households in sub-locations selected to receive the transfer did not actually receive the transfer.[29] Even among those who reported having received the transfer, there are variations in the number of months they reported having received the transfer. In the dataset, we find that median HSNP-eligible households received on average five transfers instead of the possible six transfers in the 2011 survey.

The reason for not receiving the transfer was exogenous to beneficiaries, so the estimate of the ITT effect is likely to be contaminated by errors arising from operational challenges, which are outside of the control of beneficiaries. The estimates are, therefore, biased downwards, given that the conditional mean of the outcome variable among HSNP-eligible beneficiaries would be calculated inclusive of those households that did not benefit or only partially benefited from the program. However, despite these limitations, the ITT effect is still important to policymakers in that it provides a first-hand overview of what the impact of a given program would look like in the absence of full compliance. In light of the above argument, we first

[29] About 33 out of the 1,431 HSNP-eligible households in villages selected to start receiving the transfer did not receive the transfer (or 33/1,431=2.3%) due to a technical hitch in registration. This means that about 2.3% of households who were supposed to receive the HSNP transfers did not actually receive their full amounts in the 2011 survey.

estimate the ITT effects and present our results alongside the estimates drawn from local average treatment effects.

5.2. Estimating the local average treatment effects

The best way of capturing non-compliance problems is to estimate the treatment-on-the-treated (ToT) effects, also known as the local average treatment effects. As the HSNP households did not meet full compliance (as discussed earlier), in addition to the ITT effect, we estimated ToT effects limiting our analysis to the HSNP-eligible households sample only. Hence, our aim was to examine whether actual receipt of the HSNP transfer would impact, in a different way, the outcome variables for households who reported having received the positive transfer amounts or the number of times they received the transfer.

We estimate ToT effect using the following equation:

$$Y_{ist} = \beta_0 + \beta_1 HSNP\_Transfer_{st} + \beta_2 Post_t + \beta_3 (HSNP\_Transfer_{st} * Post_t) + \beta_4 X_{it} + \epsilon_{ist} \ldots\ldots (3)$$

Where $HSNP\_Transfer_{st}$ is the participation variable. We captured participation in two ways. First, we estimated the model using a continuous variable calculated as a ratio of the number of times (in months) a household reported as having received HSNP transfer relative to the maximum number of times (in months) households reported having received the transfer in a given sub-location. We refer to this ratio as the HSNP intensity index and takes the value between zero and one. Second, we also captured actual participation as a dummy variable, which equals 1 if a household reported a positive value in the number of times they had received the HSNP transfer and zero otherwise. The HSNP participation dummy and HSNP intensity index varies between 0 and 1, with a median of 1, indication that most HSNP households had received the HSNP transfer at the time of the survey. All other remaining variables are as described in Equation 2. Finally, we cluster the standard errors at the household level and applied household weights, as provided in the dataset, to account for sample attrition.

There are two important conditions that must be met in estimating the ToT effects. First, the offer to participate in the program needs to be random and this means that households in control sub-locations should be an appropriate comparison group to those in treated villages. This condition is met in our data (for HSNP eligible households), given the fact that the introduction of sub-locations into the program was random and selection was done at a public lottery, which was attended by program officials and community leaders. A second condition that may bias result from ToT effect regression is when receipt of HSNP transfer is defined by household behaviour or choices made by a household head or other responsible member. However, given that the HSNP eligible households in treated sub-locations were left out (for those who experience technical challenges with mobile SIM registration) for reasons beyond their control, this was no longer a concern in this program.

6. Results and discussion

We organize our results and discussions based on the outcome variable: consumption of nutrients, and by the model estimated. We first provide a brief discussion of an OLS regression for the HSNP-eligible and HSNP-ineligible households separately (Table 3). We extend this cross-sectional result to a panel framework using the HSNP 2010–2011 sample covering 5,722 eligible households (Tables 4 and 5, columns 2, 3, and 4). We compare our result with 3,524 HSNP-ineligible households interviewed in the 2010 and 2011 survey periods (Tables 4 and 5, column 5).

6.1. Impact of the HSNP on household nutrient consumption, OLS estimates

We report Ordinary Least Squares (OLS) estimates for each nutrient consumed by households separately by eligibility criteria (either HSNP eligible or ineligible). One emerging pattern (in Table 3, column 2) is that, for HSNP-eligible households, estimates are negative and highly significant (at conventional levels), except for non-heme iron and fibre, suggesting that the HSNP had a high impact on nutrient consumption. Specifically, we find that a one percent increase in income (due to receipt of HSNP transfer for HSNP-eligible households in treated villages) caused a decrease of between 20-65 percentage points in the consumption of diets rich in macro-nutrients (i.e., Energy, Protein, Fats and Carbohydrates) compared to those in the control villages. Moreover, we show that a 1% rise in income among HSNP-eligible households in treated villages resulted in about 32 to 42 percentage points decrease in the consumption of heme iron and calcium compared to those in the control villages, respectively.

Here our results are contrary to those of Hoddinott and Skoufias (2004), and Skoufias et al. (2009), who found that a one percent rise in income resulted in an increase of 15 percentage points in the consumption of foods rich in nutrients, vitamins, and minerals in Mexico and Tanzania, respectively.

Table 3: Impact of the HSNP on consumption of nutrients

Outcome variables	HSNP eligible Intention to treat (ITT) effects	HSNP ineligible Indirect treatment effects (ITE)
Energy (Kcal)	–0.650*** (0.020) [0.217]	–0.934*** (0.345) [0.249]
Protein (g)	–0.405*** (0.116) [0.173]	–0.693*** (0.208) [0.223]
Fat (g)	–0.194* (0.103) [0.191]	–0.429** (0.172) [0.233]
Carbohydrate (g)	–0.231* (0.140) [0.263]	–0.208 (0.230) [0.265]
Fibre (g)	0.004*** (0.084) [0.164]	0.065 (0.149) [0.179]
Zinc (mg)	–0.266*** (0.080) [0.133]	–0.397*** (0.136) [0.171]
Calcium (mg)	–0.120 (0.157) [0.189]	–0.419 (0.288) [0.213]
Heme iron (mg)	–0.105 (0.071) [0.266]	–0.316** (0.153) [0.203]
Non-heme iron (mg)	0.168*** (0.025) [0.170]	0.154*** (0.038) [0.322]
Vitamin A (mcg RAE)	1.068*** (0.125) [0.119]	0.277 (0.237) [0.124]
Vitamin B_{12} (mcg)	0.063 (0.062) [0.170]	–0.224* (0.129) [0.121]
Vitamin C (mg)	1.266*** (0.097) [0.234]	1.090*** (0.191) [0.284]
Food folate (mcg)	–0.141 (0.148) [0.198]	–0.325 (0.260) [0.212]
Riboflavin (mg)	0.231*** (0.053) [0.286]	0.160 (0.103) [0.346]
Beta carotene (mcg)	1.322*** (0.138) [0.123]	1.120*** (0.246) [0.176]
Observations	**2,861**	**1,762**

Notes: Coefficients are shown with robust standard errors (in parentheses) clustered at household level; R-squared are in square brackets; *, ** and *** denote significance at 10%, 5%, and 1% levels, respectively. We controlled for attrition using household weights as provided in the dataset. Variables included in the regression, but not shown here for brevity, include the HSNP (dummy), which equals one if a household resides in a sub-location selected to start receiving the transfer and zero otherwise. Baseline covariates are household size per adult equivalent; ownership of a production asset (dummy); gender of a household head (dummy); age and age squared (in years) of a household head; marital status of household head (dummy); household head main economic activity (dummy); any member of the household participating in an employment program giving food or cash for work (dummy); district dummies with Turkana as the base district. Columns 2 and 3 are the HSNP 2010–2011 eligible and ineligible households, respectively; OLS estimates are derived from the HSNP 2011 sample only.

In addition, we observe a positive and statistically significant increase in the consumption of foods rich in vitamins and minerals among the HSNP-eligible compared to ineligible households (Table 3, column 2). Specifically, a one percent increase in income (due to the receipt of HSNP transfer) allowed HSNP-eligible households in treated villages to increase their consumption of diets rich in vitamin C, vitamin A, beta carotene, riboflavin and non-heme iron by 1.266, 1.068, 1.322, 0.231 and 0.168 percentage points, respectively, after 12 months of implementation of HSNP programme, compared to those in the control villages. Interestingly, the HSNP-ineligible households in treated villages tended to consume more nutritious foods (like animal based diets) than those in control villages.

As discussed in the estimation strategy, the OLS estimates disregard the fact that about 3% of households did not receive the HSNP transfers, so they do not account for non-compliance problems. Our preferred results are those derived from the DID estimates.

6.2 Impact of the HSNP on the consumption of nutrients, DID approach

In Table 4, we present regression outputs when macro and micronutrients are selected as outcome variables. Our result from ITT and ToT shows that estimates of 5 outcome variables (energy, carbohydrates, calcium, heme, and non-heme iron) were statistically significant at conventional levels for HSNP-eligible households in treated villages compared to those in control villages. However, the estimates are lower compared to OLS estimates, suggesting some level of bias in OLS estimates. Estimates derived from OLS regression overestimates the amount of nutrients consumed by up to 25% except heme iron which it underestimates by 33%. Furthermore, we find that HSNP-eligible households in treated sub-locations tend to consume diets rich in energy (Kcal), carbohydrates, calcium, and heme iron than those in control villages (Table 4). Specifically, we find that a one percent increase in household income (due to receipt of HSNP transfer) results in a 5 and 10 percentage points rise in consumption of energy (Kcal) and carbohydrate-dense diets, respectively. These nutrients are sourced from cereal products, thus pointing to the fact that HSNP-eligible households are income poor. The expenditure shares of food are almost identical between these two periods: 76 vs 77 in 2010 and 79 vs 80 for HSNP ineligible and eligible, respectively (see Table 3A, in appendix 2).

Table 4: Impact of HSNP on the consumption of macro and micronutrients

Outcome variables	ITT effect HSNP X Post	Treatment on the Treated (ToT) effects		HSNP Ineligible
		HSNP X Post	HSNP index X Post	ITE
Macronutrients				
Energy (Kcal)	–0.101 (0.271) [0.221]	–0.086 (0.271) [0.221]	–0.034 (0.293) [0.220]	0.356 (0.625) [0.260]
Protein (g)	0.019 (0.161) [0.172]	0.035 (0.161) [0.172]	0.098 (0.175) [0.171]	–0.012 (0.407) [0.213]
Fat (g)	0.447*** (0.144) [0.200]	0.419*** (0.144) [0.200]	0.540*** (0.155) [0.199]	0.382 (0.367) [0.240]
Carbohydrate (g)	–0.084 (0.198) [0.231]	–0.058 (0.198) [0.231]	–0.058 (0.215) [0.230]	0.489 (0.427) [0.241]
Fibre (g)	–0.256** (0.130) [0.143]	–0.250* (0.130) [0.143]	–0.228 (0.143) [0.143]	0.012 (0.256) [0.131]
Micronutrients				
Zinc (mg)	0.056 (0.118) [0.117]	0.076 (0.118) [0.117]	0.151 (0.127) [0.117]	0.012 (0.259) [0.160]
Calcium (mg)	0.248 (0.223) [0.179]	0.271 (0.223) [0.179]	0.290 (0.243) [0.179]	0.229 (0.543) [0.209]
Heme iron (mg)	0.147 (0.105) [0.260]	0.148 (0.105) [0.160]	0.182 (0.116) [0.161]	–0.071 (0.261) [0.152]
Non-Heme iron (mg)	0.094*** (0.034) [0.158]	0.080** (0.034) [0.158]	0.074** (0.037) [0.159]	0.026 (0.071) [0.228]
N	**5,722**	**5,722**	**5,722**	**3,524**

Notes: Coefficient estimates are shown with robust standard errors (in parenthesis) clustered at household level; R-squared are in square brackets; *, ** and *** denote significance at 10%, 5%, and 1% level, respectively; difference-in-difference estimation. We controlled for attrition using household weights as provided for in the dataset; Variables included in the regression but not shown here for brevity include HSNP (dummy) which equals one if a household resides in a sublocation selected to receive a transfer (column 2) while in columns 3 and 4 are a dummy which equals one if a household reported having received the transfer and HSNP intensity index respectively; baseline covariates are household size per adult equivalent; ownership of a production asset (dummy); gender of a household head (dummy); age and age squared (in years) of a household head; marital status of household head (dummy); household head main economic activity (dummy); any member of the household participating in employment program giving food or cash for work (dummy); district dummies with Turkana as a base district.

Additionally, we find that HSNP-eligible in treated villages increased their consumption of foods rich in fats and non-heme iron compared to those in control villages. We show, in Table 4 (column 2), that HSNP-eligible households in treated villages increased consumption of non-heme iron by 9.4 percentage points for a 1% rise in income compared to those in control villages. HSNP beneficiary households seem to substitute cereals with animal-based diets. This finding is consistent with the fact that about 70% of HSNP households practice agricture (i.e., nomadic pastoralism) as their main economic activity (See Table 1).

At the same time, we find that HSNP-eligible households in treated sub-locations reduced their consumption of foods that are rich in fatty acids by about 3 percentage points for a 1% rise in income compared to those in control areas (Table 4, column 2). Moreover, households reduced consumption of calcium and non-heme iron-based foods by about 2 and 4 percentage points respectively with a 1% rise in income. We do not observe any significant consumption of micro and macronutrients among HNSP-ineligible households during the survey period. This might be due to the effect of drought which has reduced the purchasing power of HSNP-eligible households in treated sub-locations, thereby resulting in fewer transfers.[30]

Finally, we show that ITT and ToT effects are almost similar when participation is measured as an index – HSNP intensity index (under ToT estimation, Table 4, column 4), implying that household food consumption can also increase even when they do not receive the transfer. This is possible and it underlines the important role social networks play in helping poor households smooth consumption when faced with shocks. Interestingly, we also observe a similar pattern among HSNP-ineligible (Table 4, column 5).

6.3 Impact of the HSNP on vitamins and minerals consumption

We present the result of an analysis in which vitamins and minerals are used as outcome variables. In Table 5, we provide the result of the HSNP-eligible households using ITT and ToT effect specifications (in columns 2, 3, and 4). For the ToT estimates, actual HSNP participation is captured first as a dummy variable (column 3) and as an intensity index (column 4). In Table 5, column 5, we provide results from indirect treatment effects (ITE) obtained using HSNP-ineligible households. In all regression, covariates are included, as shown in the notes to the table.

One important pattern (from Table 5) is that HSNP-eligible households in treated villages significantly increased their consumption of animal products compared to those in the control villages. Specifically, we find that a 1% rise in income in HSNP-eligible households in treated villages resulted in an increase of between 42 and 90 percentage points in the consumption of vitamins B_{12}, C, and A compared to those in the control villages. At the same time, they

[30] The total amount of private transfer received by households reduced by about 53.5% (i.e., from 5.55 in 2010 to 2.58 in 2011).

increased their consumption of vitamin A by about 69 percentage points, and beta carotine by between 58 and 61 percentage points compared to households in the control villages (column 5). These minerals are abundant in animal proteins which are consumed mainly by richer households. Our results for vitamins A and C are similar to those found by Skoufias et al. (2009), who showed that Mexican households increased their consumption of vitamins A by 0.8 and vitamin C by 0.69 percentage points compared to those in control villages as a result of social safety net transfers. In another study, Hoddinott and Skoufias (2004) showed that PROGRESA-eligible households in treated villages increased their consumption of vitamins A and C (found in fruit, vegetables, and animal products) by about 12 percentage points compared to those in the control villages.

Table 5: Impact of HSNP on vitamins and minerals consumption

Outcome variables	ITT effect HSNP X Post	ToT effect		HSNP ineligible (ITE)
		HSNP X Post	HSNP index X Post	HSNP X Post
Vitamin A (mcg RAE)	1.145*** (0.174) [0.074]	1.107*** (0.175) [0.075]	1.233*** (0.196) [0.076]	0.341 (0.452) [0.059]
Vitamin B_{12} (mcg)	0.424*** (0.086) [0.151]	0.425*** (0.086) [0.151]	0.456*** (0.096) [0.151]	0.064 (0.196) [0.110]
Vitamin C (mg)	0.431*** (0.139) [0.194]	0.467*** (0.140) [0.196]	0.401** (0.157) [0.193]	0.196 (0.339) [0.247]
Food folate (mcg)	0.234 (0.209) [0.194]	0.240 (0.209) [0.194]	0.329 (0.226) [0.193]	0.567 (0.472) [0.207]
Riboflavin (mg)	0.210*** (0.080) [0.244]	0.216*** (0.081) [0.244]	0.218** (0.088) [0.244]	0.276* (0.163) [0.278]
Beta carotene (mcg)	0.612*** (0.208) [0.089]	0.622*** (0.209) [0.091]	0.698*** (0.234) [0.092]	–0.005 (0.544) [0.103]
N	**5,722**	**5,722**	**5,722**	**3,524**

Notes: Coefficient estimates are shown with robust standard errors (in parenthesis) clustered at household level; R-squared are in square brackets; *, ** and *** denote significance at 10%, 5%, and 1% level, respectively; difference-in-difference estimation. We controlled for attrition using household weights as provided in the dataset. Variables included in the regression, but not shown here for brevity, include the HSNP (dummy), which equals one if a household resides in a sub-location selected to receive a transfer (column 2), while in columns 3 and 4, the HSNP is captured as a dummy, which equals one if a household reported having received the transfer and as an intensity index, respectively. Baseline covariates are household size per adult equivalent; ownership of a production asset (dummy); gender of a household head (dummy); age and age squared (in years) of a household head; marital status of a household head (dummy); a household's head main economic activity (dummy); any member of a household participating in an employment program giving food or cash for work (dummy); district dummies, with Turkana as the base district.

As a robustness check, we also estimated the effects of income on food expenditure. This is important because by estimating the amount of nutrients consumed, one needs the quantity of food and the total expenditure on every food item. This implies that if the estimated effects on nutrients are significant, we also expect to see this in food expenditure. We find a significant increase in the expenditure on food in both HSNP-eligible and HSNP-ineligible households by about 6 percentage points. These results are statistically significant at between 5% and 10% and they do not vary, even when we take into account the panel nature of our dataset (Table 3A, in appendix 2). The rise in expenditure is highest for animal products. For food share, HSNP households significantly reduced the food share in their budget allocations by over 100% (see Table 3A, in Appendix 2).

6.4. Alternative pathways that might cause potential household consumption to rise

A possible rise in a household's consumption may be caused by factors other than the HSNP transfer. For instance, increased consumption may be a result of a rise in labour earnings (Y^l), goods market (Y^g), low savings (S), higher loans and transfers (L), and, lastly, a rise in investment (I) opportunities. To understand how these factors impact the consumption of nutrients, we apply Angelucci-De Giorgi accounting identity (Angelucci and De Giorgi, 2009).

$$\Delta Y^l + \Delta Y^g + \Delta L = \Delta C + \Delta S + \Delta I \quad (4)$$

In equation (4), Δ captures both direct and indirect impact of each variable – which includes in this case labour income, goods market, savings, loan and transfers and investment. As a first step, we test whether the receipt of the HSNP changed HSNP-eligible and HSNP-ineligible households' labour market participation. This is because if households increase their labour market participation, their total income will increase, and this is likely to cushion them from shocks. In Table 7A (in the appendix 2), we report estimates of the treatment effects for HSNP-eligible and ineligible households and show that residing in an HSNP-treated village reduces the likelihood of household members' participation in the labour market by 31 percentage points, a result that is significant at 1%. Our result mirror those Holtz-Eakin, Joulfaian, & Rosen, (1993) and Joulfaian & Wilhelm, (1994) findings that heirs receiving or expecting to receive inheritance tend to lower their labour supply or work less hours. For HSNP-ineligible households, our result is not statistically different from zero, implying that a rise in consumption of nutrients among HSNP-ineligible households is not caused by higher labour earnings.

Secondly, we test whether the receipt of the HSNP affects the prices of major food items in treated and control villages. The HSNP works through two channels to influence a household's expenditure pattern. First, if the transferred amount is large enough, it could increase the price of food items in treated compared to control villages, which is a negative and undesired effect. Second, a rise in the price of food may force a household to substitute items that have risen in price, with alternative, cheaper options, probably also nutrient-dense items because of their increased income. In Tables 8A and 8B (in appendix 2), we compare the mean prices of food items in control and treated villages. Our results showed that HSNP-eligible households in treated villages in 2011 did not face systematically higher prices than those in control villages. While we find a significant rise in prices in treated villages for maize grain, loose rice, fresh milk, and kale, we also observe significantly lower prices for beans, cooking oils, sugar, and tea leaves. Equally, four items (cabbages, beef, mutton, and wheat flour) did not increase in price in 2011. Although the higher prices in treated villages for maize grain, loose rice loose, fresh milk, and kale did affect the ineligible households, they benefited from the lower prices for cooking oil, sugar, cabbages, and tea leaves. Overall, the differences are usually small for all food items. We, therefore, conclude that a rise in the consumption of nutrients is not caused by low prices in HSNP-ineligible villages. Our result is consistent with those documented by Angelucci and De Giorgi (2009), Attanasio and Lechene (2010), and Hoddinott, Skoufias, and Washburn, (2000).

Third, we investigated whether participating in the HSNP impacts a household's likelihood of having positive savings (using the Probit model) and the amount of savings held by these households (using a DID specification). This is because HSNP households are income poor and have limited savings to cushion them against shocks. We found that both HSNP-eligible and HNSP-ineligible households in treated villages were more likely to have positive savings than those in the control villages (see Table 9A). The HSNP-eligible households in treated villages increased their savings by about 8 percentage points compared to those in the control villages, which illustrates the important role of the HSNP in the lives of income-poor households in Kenya. At the same time, we observed that HSNP-ineligible households in a treated village experienced a reduction in their savings by about 72 percentage points compared to those in the control areas (see Table 9A). These results are consistent with the idea that HSNP-ineligible households are richer and might be donating some income to poorer households.

Finally, we tested whether the receipt of the HSNP impacts stock levels held by households. Animals herds can be thought of as a household's investment option, which can be used as a buffer against income shocks. We compared changes in stock levels in 2010 and 2011 in treated and control villages. Our results show that, for eligible households, the number of cattle and sheep decreased marginally, while poultry, goats, camels, and donkeys increased (see Table 10A). Ineligible households, on the other hand, decreased their stock levels of cattle, goats, sheep, donkeys, and poultry – there was a marginal increase only in the stock of camels. It seems that HSNP-ineligible households were sharing some of their livestock – especially goats, donkeys, and poultry – with HSNP-eligible households at the start of the program.

7. Heterogeneous treatment effects of the HSNP on nutrient consumption

We analysed the effect income had on the consumption of nutrients by nutrient sources.[31] This was because households could have been substituting their self-produced foods with market-sourced foods. This can be thought of as a positive effect given that market-sourced foods tend to be more processed and their supply more reliable, especially when farmers experience sudden changing weather patterns such as drought or floods, which negatively affect their self-production capacity. We observe that HSNP-eligible households in treated villages sourced most of their nutrients from the market (See Table 12A, in appendix 2). Foods sourced from the market tend to be either refined, processed and or fortified with nutrients like iron, vitamin D and calcium. This supports the ongoing discussion about the importance of local markets in supplementing the food demands of rural households in the developing world.

However, if the primary source of food is self-production, appropriate policies are needed to promote cheaper food fortification initiatives to improve nutrition at the rural household level, because in rural Kenya, farm-produced foods are not fortified and thus are low in nutrients.

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[31] In the questionnaire, households reported on the three main sources of the nutrients they consume, namely, from own production, market purchases, and in-kind donations. In-kind sources of nutrients are those obtained through bartering, aid, donations, and personal gifts.

One option is to promote the adoption of biofortified crops, which have been shown by Ongudi, Ngigi, and Kimurto (2017) to be a cheap source of nutrients for poor households living in arid and semi-arid areas.

According to Sibhatu and Qaim (2017), a household's diet and consequently nutritional status can be impacted negatively by production cycles, especially in rural areas where rainfall patterns dictate and influence harvest size. This means that seasonal rainfall variations can have a significant effect on the nutritional status of members of poor households: nutritional levels can peak during and immediately after long rainy seasons and decline in others.

As there are two rainy seasons (long and short rains) in the HSNP districts, nutrient intakes could be higher during the longer rainy periods. If this were the case, our results might be affected by the survey month and our estimates could subsequently be biased and inconsistent. To test for the effect of the potential impact of seasonal variation on nutrient consumption, we created a dummy variable, which equalled one if a sub-location had experienced drought in the six months before the survey month, otherwise, it was zero.[32] Table 4A (in Appendix 2) shows that HSNP-eligible households in treated villages consume more foods rich in vitamins and minerals, and non-heme iron compared to those in control villages. Specifically, a 1% rise in income led to an increase of between 1.1 – 3.0 percentage points in the consumption of foods rich in vitamin A, B12, folate and beta carotene during a drought, a result that is significant at conventional levels. At the same time, HSNP eligible and ineligible households tend to consume more (by up to 26 percentage points) non-heme iron dense foods due to a rise in income than HSNP households in control sub-locations. These findings are consistent with the hypothesis that during a drought, agricultural households tend to consume cereal-based foods, which can be stored for a long time.

Given that the HSNP districts experienced a severe drought in 2011, our results touch on an important function that food plays in the rural areas: the changes in the types of food consumed can be considered as a short term adaptation strategy for households when they

[32] We also tried other specifications in which drought is measured as a dummy variable that takes the value of one if a sub-location experienced drought in the three months prior to the survey. We do not present these result here, but the trend is similar to the one observed here. These results are available from the authors on request.

are affected by climate change, through seasonal weather variability. Here, our results are contrary to those found by Ogutu et al. (2020), that is, that seasonality does not affect nutritional indicators among poor households in western Kenya. This may be the result of differences in the weather patterns of the two regions: they evaluated farmers located in medium to high rainfall areas. Additionally, in our study, the local markets are well integrated with wholesale markets thus giving households alternative sources of foods. These alternative sources provide households with additional options that can be accessed to diversify their food consumption patterns, in the presence of drought.

In Table 5A (in Appendix 2), we look at whether the targeting type (whether the HSNP is given to males or females within the households) affects resource allocation and subsequently nutrient consumption. Previous studies have shown that transfers that are targeted at women tend to be used to support household-related expenditure (especially food, education, nutrition, and healthcare). For example, Armand et al. (2020) showed that, in Macedonia, giving cash transfers to women increases expenditure on food by between 4 and 5 percentage points. In Ecuador, Schady and Rosero (2008) also found a 3 to 4 percentage point increase in food expenditure when cash transfers were targeted at women. However, for developing countries like Kenya, Shapiro et al. (2019) found little evidence of a difference in caloric and food expenditure elasticities between male and female recipients of cash transfers.[33]

As 90% of households selected through the CBT and DR mechanisms were women, we created a dummy variable, which equals one if the targeting type is either CBT or DR, and zero otherwise. This approach allowed us to capture the gender implications associated with the HSNP transfers in Kenya. Our triple difference estimation (Table 5A, in Appendix 2) shows that HSNP-eligible households selected via CBT and DR targeting methods in treated villages had diets richer in micronutrients (especially food folate) and vitamins (A and C) than those selected through individual targeting. This can be interpreted as a rise in expenditure on these food components. For example, we found that a 1% rise in income in HSNP-eligible households led to an increase of about 50 percentage points in the consumption of heme iron-dense foods

[33] For overall food expenditure elasticities, they estimate the elasticity to be 0.720 and 0.715, respectively, for female and male recipients of cash transfer. For caloric elasticities, they found elasticities of 0.46 and 0.54 for female and male recipients, respectively, of cash transfer respectively.

compared to those in the control villages, and this result is highly significant at 1%. Moreover, we find that a 1% increase in household income (for HSNP eligible in treated sub-locations) led to about 1.8 percentage points increase in the consumption of foods rich in calcium compared to those in the control villages, and this result is highly significant at conventional levels. Our results support previous findings on the positive impact of targeting women as it tends to increase the percentage of the household budget spent on food. However, our result might have been weighed down by the presence of male-headed households in the sample, so should be interpreted with caution. Nevertheless, there was still evidence of the positive effect of targeting women over other household members.

8. Conclusion

Using a randomized control trial dataset, we analysed how the receipt of a temporary income (due to HSNP participation or actual receipt of HSNP transfer) impacts the consumption of nutrients in Kenya. Our results show that a rise in household income leads to an decrease of about 26 percentage points (ppt) in the consumption of fibre-dense foods in HSNP-eligible households in treated villages compared to those in control villages. The low impact of the HSNP on nutrient consumption is not surprising and is in line with previous studies using similar datasets. For example, Merttens et al. (2013) found that the HSNP had no impact on child growth nutrients. This finding of no impact was also confirmed by Dietrich and Shmerzeck (2020) in Kenya. In addition, HSNP-eligible households in treated villages consumed about 9% more non-heme iron-dense foods than those in control sub-locations. However, HSNP-ineligible households in treated villages increased their consumption levels of foods rich in riboflavin (like animal products, vegetables and fortified cereals) by about 27.6% compared to those in control sub-locations. Among the HSNP-eligible households in treated villages, a 1% rise in income resulted in an increase of between 21 and 61 percentage points in the consumption of vitamin B_{12}, riboflavin, beta carotene and vitamin C compared to those in the control villages. At the same time, HSNP-eligible households in treated sub-locations almost doubled their consumption of vitamin A rich foods as a result of a 1% rice in income, compared to household in control sub-locations. These nutrients are sourced from self-production and the market, suggesting the need for biofortification of self-produced foods. Given that self-produced products are not fortified, development partners should promote the adoption of biofortified crops that are cheaper and sustainable in the long run.

Another important finding is that HSNP-eligible households in treated villages increased their savings levels by about 15 percentage points compared to those in control villages. Moreover, we find that HSNP-ineligibles in treated villages reduced their savings levels by up to 46 percentage points compared to those in the control villages. As these households are not income poor compared to HSNP-eligible households, they may be offering some level of support to HSNP-eligible households, showing altruism, which is fairly common in rural areas of the developing world. A third important result is that HSNP-eligible households in treated villages increased their savings by about 8 percentage points compared to those in the control villages, which illustrates the important role of the HSNP in the lives of income-poor households in Kenya. At the same time, we observed that HSNP-ineligible households in a treated village experienced a reduction in their savings of 72 percentage points compared to those in the control areas. It seems that HSNP-ineligible households were sharing some of their livestock – especially goats, donkeys, and poultry – with HSNP-eligible households at the start of the program.

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Online Appendix

Appendix 1: Diagrammatic representation of HSNP households

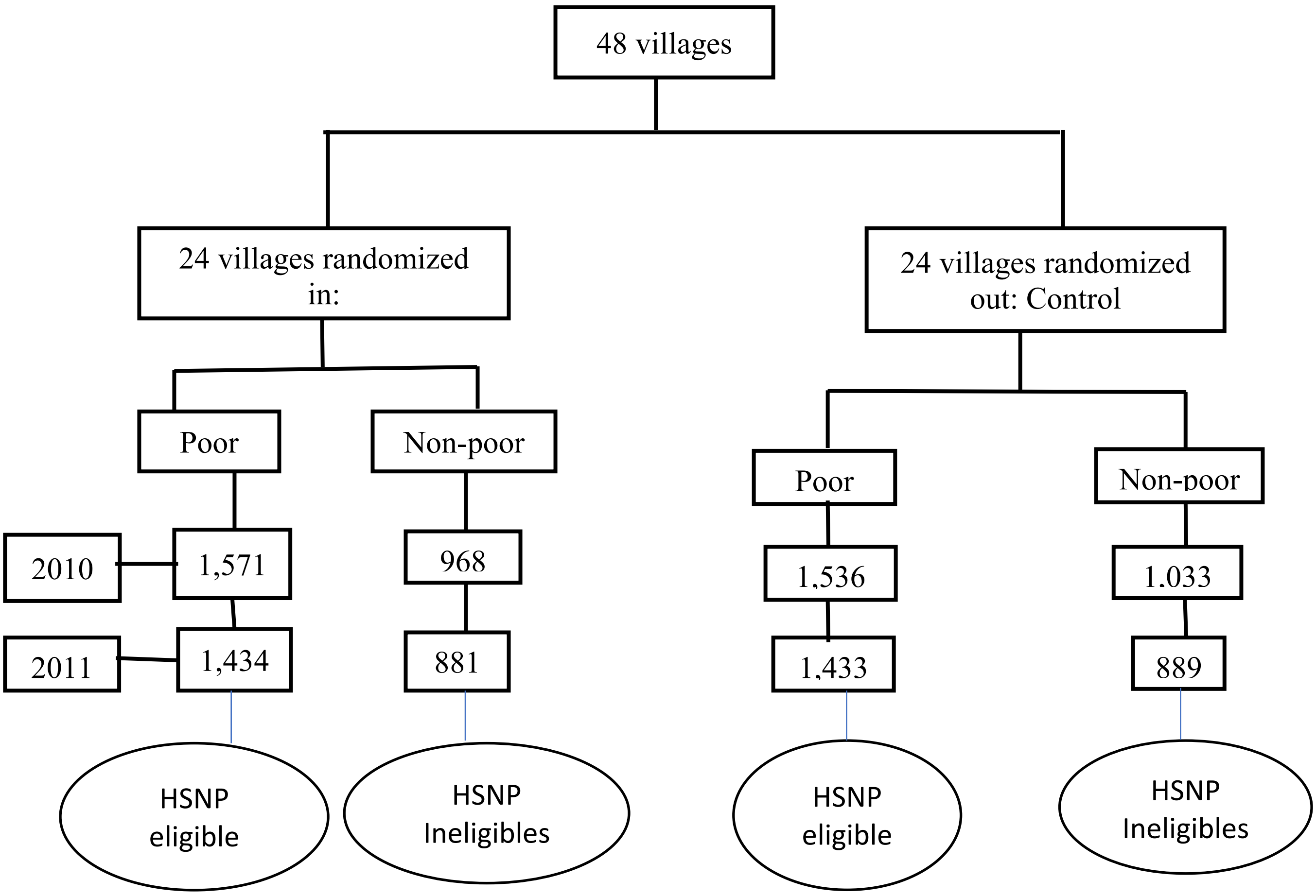

Figure 1: Experimental design of HSNP

Our impact evaluation is based on comparing HSNP households in treated and control villages: i.e., HSNP eligible in treated verses HSNP eligible in control sub-locations. Similarly, HSNP ineligible in treated verses HSNP ineligible in control sub-locations. A household is considered treated if it was selected for inclusion into the programme and reside in a sub-location selected to start receiving the transfer. We refer to these households as HSNP eligible households in treated sublocations. Likewise, HSNP eligible in control sub-locations are households selected for inclusion in the programme but with delayed payments (i.e., after 2 years) and is are resident in a sub-location not to start receiving transfer. Its important to note that our analysis is limited to HSNP 2010 and 2011 datasets because information on HSNP spillover households were not collected during HSNP 2012 survey.

In the dataset, we have information on households that were not selected into the programme based on targeting process. We call these households HSNP ineligible in treated and control sub-locations. These households were sampled from household listings undertaken in a sample of three settlemets (main, permanent and non-permanent) within each sub-location. Information from HSNP ineligible households were collected at baseline and follow up one to facilitate targeting analysis and to facilitate analysis of spill-over effects. The spill-over effects may occur either because HSNP impacts local markets or through sharing of transfer between HSNP beneficiary and non-beneficiary households. In analysing the spill-over effects, we assume that by comparing the trends in given outcome between HSNP eligible in treated and control sub-locations over time provides our basis of analysis. As HSNP ineligible in treated sb-locations live in the same locality as HSNP eligible from treated sub-locations, it is likely that they will share the transfer received with neighbours- who happen to be HSNP ineligible in treated sub-locations. Although this assumption is strong, it is possible. As previous literature show, HSNP districts have a tendency of sharing animals and other necessities especially after drought as a way of insuring the less fortunate members of the society.

APPENDIX 2: Additional robustness tests

Table 3A: Impact of HSNP on food consumption expenditure and food share in total household expenditure

Variables	Food share (OLS)	Food expenditure (OLS)	Food expenditure (DID)	Food share (DID)
Panel A: HSNP-eligible households				
ITT	–1.675*** (0.377) [0.306]	0.054*** (0.017) [0.271]	0.067*** (0.023) [0.265]	0.081 (0.529) [0.297]
Observations	2,861	2,861	5,722	5,722
Panel B: HSNP-ineligible households				
ITE	–2.242** (0.870)	0.061** (0.031)	0.072 (0.057)	0.194 (1.292)

	[0.299]	[0.368]	[0.306]	[0.286]
Observations	1,762	1,762	3,524	3,524

Notes: Standard errors in parentheses; significance level *** p<0.01, ** p<0.05, * p<0.1; quarterly amounts per adult equivalent; R-squared are in square brackets. Food expenditure is in monthly KES per adult equivalent. Coefficients under OLS estimation are for whether a household lives in a treated or a control sub-location, while under DID, it is the interaction between treatment and post dummy; standard errors are in brackets and are clustered at household level; the results are unchanged without covariates. All regression includes baseline controls similar to those used in Table 5.

Table 4A: Impact of the HSNP on the consumption of nutrients, by seasonality

Outcome variables	ITT	ToT		HSNP ineligible
	HSNP X Post X Drought	HSNP X Post X Drought	HSNP Index X Post X Drought	ITE
Energy (Kcal)	0.055 (0.067) [0.244]	-0.033 (0.606) [0.244]	0.035 (0.057) [0.244]	3.391** (1.322) [0.274]
Protein (g)	–0.081 (0.357) [0.199]	–0.069 (0.359) [0.198]	–0.033 (0.391) [0.198]	1.536* (0.820) [0.239]
Fat (g)	–0.070 (0.316) [0.219]	–0.061 (0.319) [0.219]	–0.048 (0.350) [0.219]	1.572** (0.737) [0.263]
Carbohydrate (g)	1.231*** (0.440) [0.219]	1.156***(0.439) [0.259]	1.258*** (0.476) [0.259]	2.792*** (0.960) [0.250]
Fibre (g)	1.082***(0.297) [0.182]	1.063***(0.298) [0.182]	1.104*** (0.326) [0.183]	0.657 (0.561) [0.148]
Zinc (mg)	0.153 (0.259) [0.134]	0.176 (0.259) [0.134]	0.193 (0.281) [0.134]	0.748 (0.549) [0.185]
Calcium (mg)	0.710 (0.488) [0.211]	0.690 (0.490) [0.211]	0.859 (0.538) [0.211]	2.093* (1.071) [0.233]
Heme iron (mg)	–2.203*** (0.260) [0.187]	–2.184*** (0.263) [0.187]	–2.096*** (0.293) [0.184]	–1.464** (0.650) [0.170]
Non-heme iron (mg)	0.162** (0.082) [0.183]	0.159* (0.081) [0.183]	0.179** (0.090) [0.184]	0.256* (0.134) [0.248]
Vitamin A (Mcg RAE)	0.981** (0.388) [0.103]	1.115***(0.395) [0.106]	1.198*** (0.449) [0.106]	1.147 (0.891) [0.094]
Vitamin B_{12} (mcg)	–1.1140*** (0.204) [0.171]	–1.146*** (0.208) [0.171]	–1.076*** (0.231) [0.169]	–0.537 (0.416) [0.137]
Vitamin C (mg)	0.156 (0.351) [0.208]	0.146 (0.355) [0.210]	0.173 (0.396) [0.208]	–3.134***(0.659) [0.269]
Folate (mcg)	1.045** (0.467) [0.222]	1.002** (0.468) [0.222]	1.038** (0.509) [0.222]	2.589** (1.028) [0.226]
Riboflavin (mg)	–0.615*** (0.186) [0.265]	–0.618*** (0.187) [0.265]	0.624*** (0.206) [0.265]	–0.165 (0.400) [0.291]
Beta carotene (mcg)	2.843***(0.452) [0.150]	2.820***(0.456) [0.152]	3.063***(0.517) [0.154]	1.727*(1.000) [0.148]
N	**5,722**	**5,722**	**5,722**	**3,524**

Notes: We used a Standardized Precipitation Evapotranspiration Index (SPEI) values in Ongudi and Thiam (2020) but classified a sub-location as experiencing drought in the last six months if SPEI value was below –0.5 and zero otherwise (Agnew, 2000). We used this drought dummy variable to capture seasonality. Coefficient estimates are shown with robust standard errors (in parenthesis) clustered at household level; R-squared are in square brackets; *, ** and *** denote significance at 10%, 5%, and 1% level, respectively. We controlled for attrition using household weights. Variables included in the regression, but not shown here for brevity, include the HSNP (dummy), which equals one if a household resides in a sub-location selected to receive a transfer (column 2), in column 3 and 4, the HSNP is a dummy variable, which equals one if a household actually received the transfer and HSNP intensity index, respectively; baseline covariates are household size per adult equivalent; gender of household head (dummy); age and age squared (in years) of a household head; marital status of a household head (dummy); a household head's main economic activity (dummy); any member of a household participating in an employment program giving food or cash for work (dummy); district dummies, with Turkana as the base district.

Table 5A: Impact of the HSNP on the consumption of nutrients, by targeting type

Outcome variables	ITT	ToT		HSNP ineligible
	HSNP X Post X Targeting	HSNP X Post X Targeting	HSNP Index X Post X Targeting	ITE
Energy (Kcal)	1.523** (0.646) [0.226]	1.578** (0.649) [0.226]	1.679** (0.733) [0.226]	1.135 (1.111) [0.267]
Protein (g)	0.753** (0.372) [0.177]	0.795** (0.373) [0.177]	0.828** (0.419) [0.176]	0.115 (0.677) [0.220]
Fat (g)	0.498 (0.347) [0.204]	0.459 (0.348) [0.203]	0.469 (0.387) [0.203]	0.068 (0.637) [0.244]
Carbohydrate (g)	1.412*** (0.473) [0.239]	1.448*** (0.475) [0.240]	1.485*** (0.539) [0.239]	1.721** (0.774) [0.253]
Fibre (g)	0.310 (0.286) [0.149]	0.324 (0.287) [0.149]	0.177 (0.320) [0.149]	0.559 (0.462) [0.154]
Zinc (mg)	0.177 (0.277) [0.121]	0.209 (0.278) [0.121]	0.179 (0.308) [0.120]	-0.103 (0.451) [0.164]
Calcium (mg)	1.874*** (0.509) [0.187]	1.899*** (0.510) [0.187]	2.024*** (0.579) [0.186]	1.934** (0.933) [0.221]
Heme iron (mg)	0.500*** (0.194) [0.162]	0.494** (0.193) [0.162]	0.576*** (0.214) [0.163]	–0.350 (0.434) [0.162]
Non-heme iron (mg)	–0.155** (0.073) [0.166]	–0.157** (0.074) [0.164]	–0.212*** (0.081) [0.165]	–0.242* (0.137) [0.239]
Vitamin A (mcg RAE)	0.695* (0.378) [0.080]	0.686*** (0.215) [0.147]	0.549 (0.426) [0.081]	0.639 (0.758) [0.071]
Vitamin B_{12} (mcg)	0.272 (0.165) [0.153]	0.272* (0.165) [0.153]	0.347* (0.184) [0.154]	–0.246 (0.336) [0.120]
Vitamin C (mg)	0.543** (0.261) [0.203]	0.533** (0.262) [0.205]	0.590** (0.285) [0.202]	0.966* (0.561) [0.255]
Folate (mcg)	1.680*** (0.492) [0.202]	1.716*** (0.494) [0.202]	1.761*** (0.557) [0.202]	1.562* (0.830) [0.223]
Riboflavin (mg)	0.197 (0.174) [0.246]	0.216 (0.174) [0.246]	0.250 (0.194) [0.246]	0.527 (0.332) [0.279]

Beta carotene (mcg)	0.658 (0.401) [0.092]	0.623 (0.402) [0.093]	0.564 (0.450) [0.094]	0.273 (0.853) [0.110]
Observations	**5,722**	**5,722**	**5,722**	**3,524**

Notes: Coefficient estimates are shown with robust standard errors (in parenthesis) clustered at household level; R-squared are in square brackets; *, ** and *** denote significance at 10%, 5%, and 1% level, respectively. We controlled for attrition using household weights. Variables included in the regression, but not shown here for brevity, include the HSNP (dummy), which equals one if a household resides in a sublocation selected to receive a transfer (column 2); in column 3 and 4, the HSNP is a dummy variable, which equals one if a household received the transfer and the HSNP intensity index, respectively. Baseline covariates are household size per adult equivalent; gender of a household head (dummy); age and age squared (in years) of a household head; marital status of a household head (dummy); a household head's main economic activity (dummy); any member of a household participating in an employment program giving food or cash for work (dummy); district dummies, with Turkana as a base district.

Table 7A: Effect of HSNP on labour market participation

Variables	HSNP eligible	HSNP ineligible
HSNP X Post	–0.308***	–0.195
	(0.111)	(0.147)
Observations	5,722	3,524
Control	Yes	Yes

Notes: Robust standard errors (in parentheses) clustered at household level; significance level *** p<0.01, ** p<0.05, * p<0.1; Probit regression; Coefficients are estimated at means; outcome variable is a dummy variable of whether anyone in the household participates in employment program giving food or cash for work; All regressions include covariates similar to those in Table 5 except that we now use the probability of a household's member participating in the labour market as a dependent variable.

Table 8a: Comparing community prices of major food items in 2010 and 2011 and between HSNP eligible in treated and control villages

	2010			2011		
	Control (N=1430)	Treated (N=1431)	Diff (SD)	Control (N=1368)	Treated (N=1431)	Diff (SD)
HSNP eligible						
Maize grain	40.731 (15.129)	42.002 (15.818)	–1.271 (0.579) **	51.546 (19.582)	59.280 (31.685)	–7.734 (1.189) ***
Dried beans	75.850 (17.981)	75.653 (18.525)	0.196 (0.682)	131.020 (194.385)	90.545 (37.384)	40.475 (5.237) ***
Wheat flour	71.920 (15.673)	73.781 (19.744)	–1.861 (0.667)	75.371 (23.456)	75.982 (18.751)	–0.611 (0.801)
Rice loose	69.101 (9.943)	74.762 (13.201)	–5.661 (0.437) ***	81.250 (17.453)	125.416 (177.720)	–44.166 (4.827) ***
Fresh milk	54.832 (26.771)	76.845 (99.953)	–22.013 (2.736) ***	61.955 (28.745)	64.672 (32.589)	–2.716 (1.163) ***
Goat/sheep meat	180.098 (44.560)	171.754 (50.585)	8.343 (1.782) ***	241.060 (86.189)	239.160 (70.955)	1.899 (3.010)

Beef	173.140 (61.660)	165.954 (69.712)	7.186 (2.461) **	220.855 (83.403)	207.639 (65.598)	13.216 (2.861)
Cooking oils	143.189 (28.004)	146.159 (32.600)	–2.971 (1.136) **	210.888 (82.020)	190.963 (60.726)	19.925 (2.751) ***
Sugar	102.895 (16.350)	101.355 (16.590)	1.539 (0.616) *	147.904 (63.067)	141.356 (55.337)	6.548 (2.260) **
Kale	13.238 (7.072)	11.398 (2.671)	1.840 (0.200) ***	16.210 (7.696)	19.287 (9.107)	–3.077 (0.322) ***
Cabbages	80.976 (35.408)	80.070 (33.316)	0.906 (1.285)	54.063 (30.844)	54.912 (26.831)	–0.850 (1.102)
Tea leaves	49.301 (61.888)	43.857 (43.903)	5.443 (2.006) **	161.884 (149.369)	123.983 (82.837)	37.902 (4.601) ***

Notes: Significance level *p<0.1; **p<0.05; ***p<0.001; student *t*-test; standard errors are in parenthesis. All prices are in Kenyan shillings per kilogram or per litre (for liquids). SD is the standard deviation

Table 8b: Comparing community prices of major food items in 2010 and 2011 and between HSNP ineligible in treated and control villages

	2010			2011		
	Control (N=885)	Treated (N=877)	Diff (SD)	Control (N=847)	Treated (N=833)	Diff (SD)
HSNP ineligible						
Maize grain	38.751 (11.155)	42.571 (17.570)	–3.820 (0.700) ***	50.425 (14.651)	62.641 (37.045)	–12.216 (1.370) ***
Dried beans	75.339 (17.207)	74.396 (16.399)	0.943 (0.801)	90.667 (29.119)	89.772 (24.703)	0.895 (1.318)
Wheat flour	71.057 (16.250)	69.835 (12.317)	1.221 (0.687)	76.606 (24.788)	76.596 (20.035)	0.009 (1.101)
Rice loose	70.708 (12.786)	74.213 (13.210)	–3.505 (0.619) ***	82.208 (17.831)	88.637 (39.511)	–6.430 (1.492) ***
Fresh milk	67.836 (58.675)	49.025 (27.625)	18.811 (2.188) ***	60.986 (19.102)	68.649 (47.600)	–7.664 (1.764) ***
Goat/sheep meat	179.571 (44.575)	169.145 (51.914)	10.426 (2.305) ***	240.366 (86.699)	236.267 (69.503)	4.099 (3.838)
Beef	173.040 (51.740)	164.082 (47.400)	8.957 (2.365) ***	218.571 (83.635)	212.796 (92.483)	5.776 (4.301)
Cooking oils (liquid)	144.429 (26.582)	147.121 (32.434)	–2.691 (1.412) *	212.279 (84.280)	192.355 (59.890)	19.923 (3.572) ***
Sugar	102.893 (16.648)	100.832 (16.781)	2.060 (0.796) **	147.899 (63.941)	141.112 (53.180)	6.787 (2.872) **

Kale	13.463 (7.132)	11.556 (2.755)	1.907 (0.258) ***	16.370 (7.561)	19.118 (9.164)	–2.748 (0.410) ***
Cabbages	78.147 (35.831)	78.666 (33.718)	–0.519 (1.658)	55.653 (29.881)	52.753 (27.225)	2.900 (1.395) **
Tea leaves	50.350 (60.130)	44.960 (43.475)	5.390 (2.502) **	163.636 (155.727)	125.420 (82.876)	38.216 (6.101) ***

Notes: Significance level *p<0.1; **p<0.05; ***p<0.001; student *t*-test; standard errors are in parenthesis. All prices are in Kenyan shillings per kilogram or per litre (for liquids). SD-standard deviation.

Table 9A: Impact of HSNP participation on household savings levels

Variables	Probit	DID
Panel A: HSNP-eligible households		
ITT	0.007	0.080
	(0.011)	(0.116) [0.060]
Observations	**5,722**	**5,722**
Panel B: HSNP-ineligible households		
ITE	0.015	–0.720**
	(0.019)	(0.303) [0.183]
Observations	**3,524**	**3,524**

Notes: Standard errors in parentheses; significance level *** p<0.01, ** p<0.05, * p<0.1; quarterly amounts per adult equivalent; R-squared are in square brackets; standard errors are in brackets are clustered at household level; All regressions include covariates similar to those in Table 5.

Table 10A: Treatment effect on the average monthly change in the stock of animals

Variables	Cattle	Goat	Camel	Sheep	Donkey	Poultry
Average treatment effects (ATE) (N=2,861)						
HSNP	–0.022	0.051	0.017	–0.044	0.002	0.002
	(0.023)	(0.103)	(0.028)	(0.056)	(0.005)	(0.009)
Indirect treatment effects (ITE) (N=1,762)						
HSNP	–0.030	–0.031	0.011	–0.060	–0.011	–0.017
	(0.036)	(0.173)	(0.029)	(0.073)	(0.012)	(0.026)

Notes: Monthly averages (in numbers) are computed by dividing a change in the stock of animals between 2010 and 2011 by the number of months between them (in this case 12 months). Standard errors (in parentheses) and clustered at the household level. First difference estimation; significance level *** p<0.01, ** p<0.05, * p<0.1. Our results are unchanged when we add explanatory variables.

Table 11A: Per Capita consumption Expenditure of the top and bottom 25th percentile households in the consumption of foods

Outcome variables	HSNP eligible households				HSNP ineligible households			
	Treated		Control		Treated		Control	
	p25	p75	p25	p75	p25	p75	p25	p75
Energy (Kcal)	10756.540	20043.960	11229.50	20772.840	12720.770	23275.750	12146.190	25399.500
Protein (g)	319.183	611.520	306.750	653.839	356.464	690.999	335.225	797.316
Fat (g)	175.473	371.850	167.223	405.894	196.482	438.951	196.478	494.498
Fibre (g)	197.600	418.000	207.186	436.164	222.056	473.011	215.848	477.889
Carbohydrate (g)	1683.834	3343.087	1781.85	3454.923	2003.674	3928.710	1959.851	4154.215
Zinc (mg)	52.708	100.256	54.157	103.303	59.205	114.011	58.641	123.847
Calcium (mg)	1727.500	4492.693	1789.496	4388.865	2025.379	5681.429	1998.491	6056.018
Iron (mg)	80.360	163.900	78.044	159.698	90.114	191.390	86.233	184.085
Heme iron (mg)	0.847	18.475	0.833	16.071	1.211	22.811	1.375	27.402
Vitamin A (mcg RAE)	221.875	1015.126	251.412	1067.797	336.200	1389.695	287.540	1482.143
Vitamin B_{12} (mcg)	4.177	19.209	4.326	19.347	5.975	23.600	6.667	27.227
Vitamin C (mg)	2.397	113.228	2.333	38.582	2.998	143.883	3.107	69.750
Food folate (mcg)	1,822.188	4257.031	1932.850	4519.489	2009.167	4628.709	2016.955	4951.090
Riboflavin (mg)	9.142	65.809	9.159	52.759	11.280	80.341	10.465	66.176
Beta carotene (mcg)	238.481	1197.157	224.242	900.889	272.642	1455.467	254.661	1000.565
Observations	**1,431**	**1,431**	**1,430**	**1,430**	**877**	**877**	**885**	**885**

Table 12A: Impact of the HSNP on the consumption of nutrients, by nutrient source

Outcome variables	HSNP eligible households			HSNP ineligible households		
	Production	Market	In-kind	Production	Market	In-kind
	HSNP X Post	HSNP X Post	HSNP Index X Post	HSNP Index	HSNP Index	HSNP Index
Energy (Kcal)	0.618*** (0.172) [0.245]	0.438*** (0.106) [0.239]	–1.157*** (0.213) [0.215]	0.392 (0.315) [0.310]	–0.173 (0.176) [0.226]	0.137 (0.057) [0.191]
Protein (g)	0.259** (0.107) [0.248]	0.464*** (0.087) [0.140]	–0.704*** (0.131) [0.236]	0.199 (0.212) [0.314]	–0.203 (0.155) [0.239]	–0.007 (0.274) [0.198]
Fat (g)	0.343*** (0.098) [0.241]	0.717*** (0.110) [0.138]	–0.613*** (0.119) [0.229]	0.318* (0.209) [0.303]	–0.168 (0.174) [0.156]	0.232 (0.256) [0.204]
Carbohydrate (g)	0.491*** (0.107) [0.194]	0.418*** (0.089) [0.259]	–0.993*** (0.173) [0.218]	0.584** (0.229) [0.243]	–0.078 (0.152) [0.275]	0.029 (0.345) [0.185]
Fibre (g)	0.164*** (0.051) [0.081]	0.602*** (0.092) [0.191]	–0.694*** (0.131) [0.238]	–0.045 (0.093) [0.113]	–0.119 (0.161) [0.175]	0.176 (0.266) [0.193]
Zinc (mg)	0.087 (0.069) [0.229]	0.498*** (0.083) [0.232]	–0.528*** (0.104) [0.214]	0.013 (0.147) [0.288]	–0.174 (0.135) [0.222]	0.073 (0.198) [0.181]
Calcium (mg)	0.686*** (0.172) [0.222]	0.381*** (0.102) [0.301]	–0.819*** (0.160) [0.238]	0.677** (0.344) [0.275]	–0.347* (0.204) [0.306]	–0.081 (0.332) [0.199]
Heme iron (mg)	0.000 (0.064) [0.205]	0.103 (0.075) [0.155]	0.044 (0.056) [0.043]	–0.001 (0.166) [0.278]	–0.151 (0.188) [0.209]	0.081 (0.101) [0.094]
Non-heme iron (mg)	–0.196*** (0.046) [0.081]	0.638*** (0.087) [0.225]	–0.507*** (0.105) [0.241]	–0.054 (0.074) [0.104]	–0.082 (0.161) [0.207]	0.140 (0.219) [0.188]
Vitamin A (Mcg RAE)	0.577*** (0.147) [0.223]	0.884***(0.135) [0.267]	–0.316*** (0.105) [0.224]	0.561**(0.278) [0.270]	0.130 (0.281) [0.324]	–0.350* (0.209) [0.187]
Vitamin B_{12} (mcg)	0.226*** (0.061) [0.217]	0.204*** (0.073) [0.347]	–0.006 (0.045) [0.025]	0.234* (0.128) [0.280]	–0.176 (0.160) [0.328]	0.006 (0.092) [0.093]
Vitamin C (mg)	0.190*** (0.049) [0.080]	0.483*** (0.114) [0.290]	–0.242*** (0.075) [0.204]	0.320**(0.151) [0.132]	–0.062 (0.311) [0.304]	–0.063 (0.150) [0.142]

Folate (mcg)	0.504*** (0.113) [0.205]	0.626*** (0.110) [0.181]	0.895*** (0.186) [0.235]	0.513** (0.212) [0.252]	–0.121 (0.193) [0.170]	0.175 (0.399) [0.189]
Riboflavin (mg)	0.171*** (0.050) [0.232]	0.255*** (0.066) [0.277]	–0.271*** (0.053) [0.263]	0.244***(0.094) [0.275]	–0.034 (0.109) [0.371]	0.024 (0.095) [0.204]
Beta carotene (mcg)	0.449*** (0.132) [0.191]	0.993*** (0.157) [0.253]	0.830*** (0.147) [0.208]	0.558** (0.256) [0.202]	–0.012 (0.344) [0.282]	–0.551* (0.308) [0.158]
N	5,722	5,722	5,722	3,524	5,722	5,722

Notes: Coefficient estimates are shown with robust standard errors (in parenthesis) clustered at household level; R-squared are in square brackets; *, ** and *** denote significance at 10%, 5%, and 1% level, respectively. We controlled for attrition using household weights. Variables included in the regression, but not shown here for brevity, include the HSNP (dummy), which equals one if a household resides in a sublocation selected to receive a transfer and zero otherwise; household size per adult equivalent; gender of a household head (dummy); age and age squared (in years) of a household head; marital status of a household head (dummy); a household head's main economic activity (dummy); any member of a household participating in an employment program giving food or cash for work (dummy); district dummies, with Turkana as a base district.