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**Video-Based Behavioral Change Communication to Change  
Consumption Patterns**

**Experimental Evidence from Urban Ethiopia**

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## ABSTRACT

Poor diet quality has been widely identified as a primary reason for malnutrition and the increasing burden of non-communicable diseases in low- and middle-income countries. Low consumption of fruits and vegetables contributes to poor diet quality, and one factor leading to low fruit and vegetable consumption is limited consumer awareness of the health and nutrition benefits of consumption. In this study, we experimentally assess a method of increasing consumer awareness, specifically, through showing households two different versions of a video embedded with messages about increasing fruit and vegetable consumption. The first video included just the basic recommended consumption behavior messages, while the second video also explained why and how fruit and vegetable consumption could improve health and nutrition outcomes. Even four months after viewing the video, average household consumption of fruits and vegetables increased by about 10 percent in both treatment groups relative to the control group, both in kilocalorie and consumption expenditure terms. The videos were developed to eventually show on national TV, suggesting that embedding dietary BCC messages in popular media can have positive impacts on diet quality at scale.

**Keywords:** Behavioral Change Communication, Diet quality, Ethiopia, Fruits and Vegetables

## **ACKNOWLEDGMENTS**

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## ACRONYMS

ASF	Animal-source foods
BCC	Behavior change communication
ICT	Information and communications technology
ITT	Intention to treat
LMIC	Low- and middle-income countries
NCD	Noncommunicable disease
OLS	Ordinary Least Squares
WHO	World Health Organization

## I. INTRODUCTION

Malnutrition in all its forms presents a major challenge everywhere in the world (IFPRI, 2016). One in three people worldwide is affected by some form of malnutrition, and poor diet quality has been widely identified as a primary reason (Pradeilles et al., 2019). While undernutrition, defined as insufficient food intake, has become somewhat less common in recent years, two other types of malnutrition are becoming more prominent, even in low- and middle-income countries (LMICs). Awareness has grown that hundreds of millions of people suffer from micronutrient deficiencies, and simultaneously the number of people suffering from overweight and obesity are rapidly increasing almost everywhere (IFPRI, 2016).

Dietary risk factors have been major contributors to communicable diseases in LMICs in the past, but are now also being linked to the increasing burden of non-communicable diseases (NCDs) (Melaku et al., 2018). The latter increase coincides with the transition from a traditional, minimally processed diet to a diet including increasing amounts of ultra-processed food, as well as more sedentary lifestyles in urban areas (Monteiro et al., 2018). According to estimates from the Global Burden of Disease, poor diet is now the leading cause of death and NCDs worldwide (Afshin et al., 2019), with low consumption of fruits and vegetables in particular associated with higher all-cause mortality (Miller et al., 2017). Not surprisingly, almost all of the existing food-based dietary guidelines in the world promote the consumption of fruit and vegetables for optimal health (Herforth et al., 2019). The World Health Organization (WHO) recommends the consumption of at least five servings of fruits and vegetables per day (~400 g) as part of a set of healthy dietary choices to prevent all forms of malnutrition and related NCDs (WHO/FAO, 2003).

Despite recommendations for regular and substantial consumption of fruits and vegetables, consumption is well below the WHO target in most countries (Miller et al., 2016). There are three potential causes to which we can attribute the gap between recommended and actual consumption. First, fruit and vegetable supply might simply be too low for the average consumption to reach recommended levels, besides other household-specific reasons that limit consumption (Mason-D'Croz et al., 2019;

Miller et al., 2016). Second, given that prices for fruits and vegetables are relatively high and incomes are relatively low among consumers, consuming recommended amounts of fruits and vegetables may be unaffordable (e.g., Herforth et al., 2020; Hirvonen et al., 2020). Third, consumers may not prefer to consume recommended amounts of fruits and vegetables, and they either may not be aware that their consumption should increase for health reasons, or may have misinformation about recommended amounts of fruits and vegetables to consume. We can summarize this as informational reasons for lower fruit and vegetable consumption.

One way to address the third reason could be through behavioral change communication (BCC) campaigns designed to improve dietary habits. Indeed, there is a growing body of evidence that BCC interventions can improve nutritional knowledge and promote adoption of improved dietary habits in low-income settings (Bhandari et al., 2004; Dewey and Adu-Afarwuah, 2008; Kim et al., 2019; Menon et al., 2016b; Penny et al., 2005; Zaman et al., 2008). However, the scalability and sustainability of such resource-intensive activities – which often involve home visits and/or support groups – is uncertain. Moreover, BCC campaigns have traditionally focused on educating communities on “what food” is good for them to eat, putting little emphasis on explaining “why” and “how” the (non)consumption of different food types affect their health (Schneider and Masters, 2019). It remains unclear whether a BCC intervention that integrates the “why” and “how” leads to better consumption outcomes than a campaign solely based on general advice to regularly consume fruits and vegetables.

Against this background, we assess the impact of a light-touch video-based BCC intervention on household fruit and vegetable consumption in Addis Ababa, Ethiopia. We produced two videos for the intervention. The first one contains general advice on recommended consumption behaviors with a focus on fruits and vegetables, corresponding to the current messages and approach used by Ethiopia’s health extension workers, though not via video. The second video added an in-depth explanation on the mechanisms by which the consumption of fruits and vegetables can lead to better nutrition and health outcomes. This second intervention was reinforced by a poster distributed to households illustrating the health and nutrition benefits of regularly consuming fruits and vegetables. Through our partner, the videos

can be shown on national TV at relatively low cost. Measured against a control group that were not exposed to videos, the results indicate that the interventions increased household fruit and vegetable consumption by about 10 percent, both in kilocalorie and consumption expenditure terms. However, we do not find differences in impact between the two video types.

We tested this intervention in Ethiopia for several reasons. First, Ethiopia is the second largest country in Africa and, in recent years it has been one of the fastest growing economies in the world (World Bank, 2015). While undernutrition is in steady decline, the prevalence of overweight/obesity is rapidly increasing, particularly in urban areas like the capital, Addis Ababa (Baye and Hirvonen, 2020). Ethiopia also hosts one of the largest community health programs in the world, with more than 40,000 health extension workers conducting home visits and outreach activities, including the promotion of healthy and nutritious diets (Assefa et al., 2019). Despite these efforts, the diets of only 2.4 percent of Ethiopians meet the WHO fruit and vegetable recommendation of five servings per day (Gelibo et al., 2017). Moreover, cardiovascular diseases are now the leading cause of age-standardized death in Ethiopia (Misganaw et al., 2014). Considering the combination of these trends, there is an urgent need to help strengthen the existing government BCC program and promote the regular consumption of fruits and vegetables.

The approach we use relates to recent research on the effectiveness of using information and communications technology (ICT) along with local content and/or characters to change attitudes and behaviors. For example, Chong and Ferrara (2009) and Jensen and Oster (2009) show that exposure to TV soap operas featuring strong women and smaller families led to reduced fertility and increased women's autonomy. Berg and Zia (2017) find positive messages related to debt management and gambling embedded in popular soap opera scripts in South Africa led to higher financial knowledge scores and reduced likelihood to gamble. Banerjee et al. (2019) test a series of videos with messages related to HIV prevention and find that those exposed to the videos had increased knowledge related to HIV; moreover, women who were exposed have lower sexually transmitted disease rates than those who were not. Bernard et al. (2014) screen short documentaries featuring rural individuals who improved their life

outcomes through perseverance and hard work, and the screenings led to significant changes in viewers' aspirations and future-oriented behavior. Similarly, Riley (2017) shows that screening an inspirational movie to secondary school students containing a locally relevant theme and a strong role model significantly improved educational attainment. ICT technology have also been shown to be an effective complement to agricultural extension in lower income countries (Spielman et al., 2021). We extend this literature into messaging around the nutritional and dietary value of specific foods (fruits and vegetables) and test whether a relatively short and light-touch engagement through viewing a video can change behavior.

## II. EXPERIMENTAL DESIGN AND DATA

### 2.1. The intervention and experimental design

To promote the consumption of fruits and vegetables by households in Addis Ababa, we produced two high-quality drama videos that covered WHO-recommended consumption of fruit and vegetables (i.e., at least two servings of fruit and three servings of vegetables per day) and featured local characters. While the [first video](#) mimics the current messages and approach of Ethiopia’s public health extension workers (teaching recommended consumption behaviors), the [second video](#) incorporated an in-depth description of some of the mechanisms through which the consumption of fruit and vegetables can lead to better nutrition and health outcomes as well as the recommended consumption behaviors. The latter presentation was complemented with a [poster](#) (Appendix E) illustrating the vitamins and minerals available in fruits and vegetables and their health and nutrition benefits. The intervention on mechanisms was intended to address the “why” and “how” aspect in recommended behaviors, often overlooked in standard BCC approaches (Schneider and Masters, 2019).

The video medium, shot with local characters, was chosen to ascertain whether equipping public health extension workers with ICT tools can improve their impact, for several reasons. First, the ability of an intervention to change behaviors toward some desired outcome depends on whether the message is framed so that individuals can relate to it. With video content, exposure to local characters with whom a viewer identifies can substitute for an individual’s experience or the experience of actual peers and can be a particularly persuasive way of framing a message to promote attitude and behavior change—that is, people tend to receive, accept, and internalize messages better from those whom they recognize as similar to them (Bandura, 1986). Second, the video medium allows for consistent content delivery, thereby reducing potential errors in conveying technical messages requiring specialized knowledge or more accuracy than a health extension worker may be able to retain and communicate correctly. Moreover, videos can have recognition and medium effects, meaning they can be easy to understand or more convincing and lead to greater attention than lectures that might be part of standard health extension. The

poster is added to make the message even more salient through a reminder effect. The interventions were implemented by trained survey enumerators who screened the videos at the households after the baseline interview.

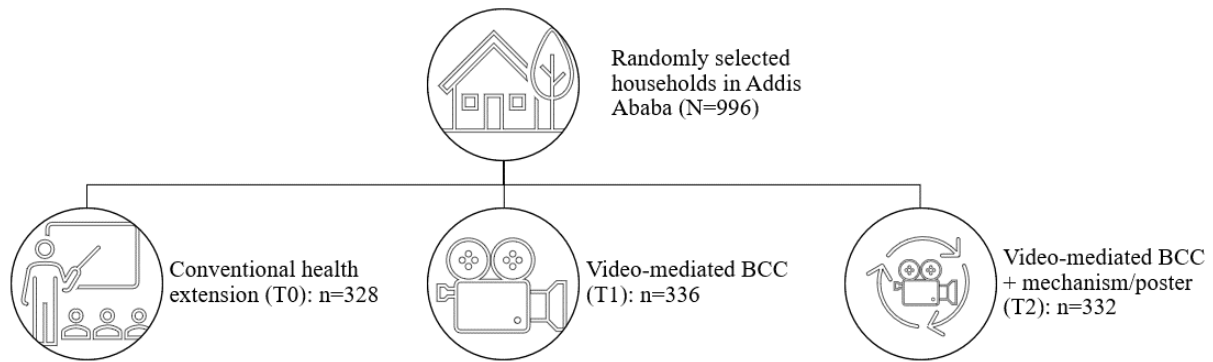
To assess the effect of video-based BCC on intake of fruit and vegetables, we compare how households respond to the same information on recommended consumption behaviors when disseminated through different medium/approaches. To this end, we randomly allocated a representative sample of households in Addis Ababa (initially interviewed in late 2017 as part of a food consumption diagnostic survey) into the following three study groups (Figure 1).

- T0. A group of households that did not receive any video-based intervention. Instead, this group was subjected to the standard BCC occurring within the Ethiopian health extension program.<sup>1</sup> We call this group the *Control* arm.
- T1. A group of households to which the video that mimics the current practice of Ethiopia’s public health extension workers (teaching recommended consumption behaviors) was screened using tablets by trained enumerators after the baseline interview. The length of this video was 36 minutes. We call this group the *Video* arm.
- T2. A group of households to which the video with in-depth discussion of the mechanisms (the “why” and “how” aspect in recommended behaviors) was screened using tablets by trained enumerators after the baseline interview. Households in this treatment arm also received a poster that summarize the key discussion points in the video. The length of this video was also 36 minutes. We call this group the *Video+* arm.

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<sup>1</sup> Note that both the treatment and control groups could have been exposed to the previously described public health extension program, but there is no reason they should have been differentially affected.

**Figure 1. Experimental design**



Source: Authors' diagram.

With this design, we are able to assess the impact of the video-based BCC on the consumption of fruit and vegetables for the distinct treatment arms separately (T1, T2) and for any household participating in one of the two treatments (T1+T2).

The experiment (screening videos) was implemented from August 21 to September 20, 2019, along with the baseline survey. For treatment households, enumerators first collected baseline data and screened the appropriate video afterwards. Thus, the video was screened at the household level after getting their willingness to participate (watch the video) without any inducement. The endline survey was conducted four months later, between January 24 and February 11, 2020, and measured changes in knowledge and consumption of fruits and vegetables.

## **2.2. Sampling and data**

The sampling was based on a 2017 survey covering representative households from Addis Ababa selected following a multi-stage sampling approach (see Melesse et al., 2019). First, stratified random sampling was used to select sub-cities and districts (*woredas*) for the survey. More specifically, sub-cities were grouped according to their welfare level, after which six sub-cities were randomly drawn from these groups. A similar welfare-based stratification was applied when 20 districts (*woredas*) were randomly selected from these sub-cities. Second, two urban neighborhoods (*ketenas*) from each *woreda* were then

randomly selected, and from each *ketene* (i.e., 40 *ketenas*: 20 woredas \* 2 *ketenas* per woreda), 25 households were randomly selected for a total of 1000 households (i.e., 40 *ketenas* \* 25 households per *ketena*) and almost all (996) were successfully interviewed. Of the 996 total households randomly allocated to the three study groups, 930 households were interviewed at the baseline for this study in September and October in 2019. The endline survey took place in January and February 2020, and attempted to re-interview all 930 households who had been interviewed in September 2019. Of the households who had been interviewed in September 2019, 35 households were not interviewed at the endline,<sup>2</sup> resulting in a sample of 895 panel households and an attrition rate of 3.7 percent.

In both survey rounds, the survey instrument included a module on household food consumption over the past 7 days.<sup>3</sup> The survey module on consumption targeted the household member most knowledgeable about the household's food shopping and preparation as the primary respondent. More than 90 percent of the respondents were women. The consumed amounts were reported/measured in terms of quantity (grams, kg, liter, etc.) and we converted the consumed amounts to calories using food consumption tables (EPHI, 2013). We used item-specific edible portions found in USDA (2013).<sup>4</sup> For the purposes of the analysis, we then categorized consumed items into five food groups: Fruit and vegetables; Staple foods (including cereals, roots, and tubers); Legumes; Animal-source foods (ASF); and Other foods (including oils, fats, sugar, spices, and beverages). After removing five panel households with implausibly high per capita food consumption values, the final sample used for analyses is 890 households observed at both baseline and endline.

Table 1 shows basic household characteristics measured at baseline. The average household in our sample has five members and about half of the households are headed by a male. The average

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<sup>2</sup> Sixteen households refused to sit for the interview, 15 could not be found in their house during the survey visit, survey enumerators were unable to track 3 households, and sadly 1 respondent had passed away.

<sup>3</sup> The endline survey included a survey experiment to quantify the degree of telescoping bias in recalled food consumption by experimentally varying the recall method (but not recall period). The results of the survey experiment are reported in Abate et al. (2020a). Importantly, to ensure the survey experiment does not affect the outcomes of the video experiment reported here, we cross-randomized the survey experiment study arms into the three study arms used in the current experiment. Consequently, the (random) assignment into the video experiment study arms is orthogonal to the (random) allocation into the telescoping experiment groups (see Abate et al., 2020).

<sup>4</sup> Wolle et al. (2020) use the baseline data to provide an overview of household diets in Addis Ababa.

household head is 51 years old and has six years of education. The statistical tests show the sample is balanced across the study arms based on these household characteristics.

**Table 1. Baseline characteristics, by treatment status**

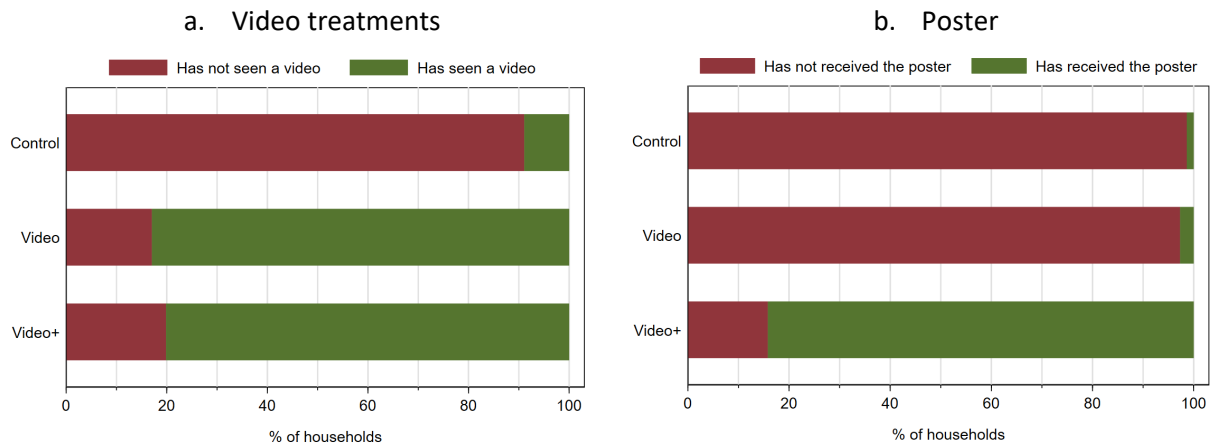
Variable	(1)	(2)	(3)	t-test	t-test	t-test
	Control	Video	Video+	Difference	Difference	Difference
	Mean/[SE]	Mean/[SE]	Mean/[SE]	(1)-(2)	(1)-(3)	(2)-(3)
Household size	4.92 [0.13]	5.22 [0.19]	5.02 [0.14]	-0.30	-0.10	0.20
Male-headed household	0.55 [0.03]	0.57 [0.04]	0.54 [0.04]	-0.02	0.01	0.03
Head's education in years	6.74 [0.24]	6.37 [0.38]	6.16 [0.33]	0.37	0.58	0.21
Age of the household head	50.97 [1.04]	50.92 [1.24]	52.24 [0.95]	0.05	-1.28	-1.32
Number of observations	293	301	298			

*Source:* Authors calculation based on the September 2019 Addis Ababa food consumption survey data.

### 2.3. Treatment compliance

Figure 2 shows that the treatment compliance was high. More than 80 percent of the households in the video treatment arms reported having seen the video during the endline survey, while less than 10 percent of the control households reported the same. Similarly, more than 80 percent of the households in the *Video+* treatment arm reported receiving the information poster. As intended, hardly anyone in the other two study arms reported having received the poster.

**Figure 2. Treatment compliance**



*Note:* N=888 households.

*Source:* Authors calculation based on the February 2020 Addis Ababa food consumption survey data.

The endline questionnaire contained a series of questions about the videos. The breakdown of the responses to these questions are provided in Tables A1 to A11 in the Appendix. Generally, the videos were well received by the respondents. Although the families in the videos were somewhat different than the respondents' families (Table A1 in Appendix A), most respondents reported that the videos were easy to understand (Tables A2 and A3) and of high quality (Table A4). The information provided in the videos was also reported to have been highly useful (Table A5). More than 80 percent of the respondents were able to recall specific scenes from the video they saw (Table A6). However, the share of respondents who were not able to remember any video scenes was considerably higher among the small number of control group households who reported having seen the video, suggesting that many of these respondents may have been referring to an entirely different video that was not shown by the research team. More than 80 percent said that their household practices at least some of the nutritional advice provided in the videos (Table A7). Interestingly, most respondents who did not use any of the nutritional advice reported they could not afford to buy fruits and vegetables. Nearly all respondents saw value in screening the videos on national TV (Table A8). Moreover, the differences in responses to these questions between the respondents in the *Video* and *Video+* treatment arms were almost identical.

Most respondents who received the poster found its informational content useful (Table A9) and easy to understand (Table A10). More than two thirds of the respondents in the *Video+* treatment group still had the poster when we visited them at the endline (Table A11).

#### **2.4. Nutritional knowledge**

The endline questionnaire included a short quiz to test respondents' nutritional knowledge with a particular focus on fruits and vegetables. Table B1 in Appendix B includes these questions, their marking, and the mean points scored by the respondents. An Ordinary Least Squares (OLS) regression shows respondents in both treatment arms scored higher on the nutritional knowledge questions than control group respondents (Table 2), indicating the video improved respondents' nutritional awareness. However, while the differences in knowledge scores between the video arms and control arm are statistically significant, they are not large in magnitude. The scores are roughly 0.2 points higher in the treatment arms, corresponding to a 5.5 percent increase relative to the control group mean. We also note that the difference in the test scores between the two treatment arms is not statistically significant. These differences are small and may reflect the fact that the knowledge quiz implemented as a part of the survey was relatively easy for the relatively well-educated urban study participants. However, finding this difference motivates us to assess whether the video treatments led to increases in the amounts of fruits and vegetables consumed by the households.

**Table 2. Estimates of intention-to-treat effects on nutrition knowledge score**

	(1)	(2)
Video	0.218*** (0.074)	0.241*** (0.070)
Video+	0.146* (0.080)	0.172** (0.076)
Household level controls?	No	Yes
Sub-city fixed effects?	No	Yes
F-test (1, 39) for Video=Video+	0.92	0.84
--- p-value	0.34	0.37
Observations	890	890
Untreated group mean of the dependent variable	3.66	3.66

Note: Unit of observation is a household at the endline. Outcome variable is nutrition knowledge score (see Table B1 in Appendix B). Household level controls are household size, male-headed household, head's education in years, and age of the household head. Standard errors are clustered at the enumeration areas and reported in parentheses. Statistical significance denoted with \*  $p < 0.10$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$ .

Source: Authors calculation based on the February 2020 Addis Ababa food consumption survey data.

### III. ESTIMATION STRATEGY

We quantify the differences in household per capita fruit and vegetable consumption using a difference-in-differences estimation. We use the following unconditional specification to model the fruit and vegetable consumption of a household  $i$  observed in survey round  $t$  ( $Y_{it}$ ):

$$(1) \quad Y_{it} = \gamma_1 D_i^1 + \beta_1 (T_t * D_i^1) + \gamma_2 D_i^2 + \beta_2 (T_t * D_i^2) + \delta_1 T_t + \varepsilon_{it},$$

where  $D_i^1$  and  $D_i^2$  are time-invariant binary variables capturing a value of 1 if the household is randomly selected to receive the *Video* or *Video+* treatment, respectively.  $T_t$  is a time-varying binary variable obtaining a value of 0 if the household is observed in October 2019 and 1 if in February 2020. The effects of the video treatments on household fruit and vegetable consumption relative to the control group are measured by  $\beta_1$  and  $\beta_2$ , or the coefficients on the interaction between  $D_i$  and  $T_t$  variables. Our treatment variables are defined on the basis of the randomization, and not on the basis of actual compliance. As a result, our impact estimates represent intention-to-treat effects (ITT). ITT estimates are a good proxy for impacts that can be expected beyond experimental settings, and thus are more policy relevant, given that 100 percent compliance is rarely possible in a real-world setting.

To assess whether our estimates are sensitive to the inclusion of basic household-level controls (household size, male-headed household, household head's education in years, and age of the household head) and sub-city fixed effects, we append Equation (1) with these control variables. We use an OLS to estimate the coefficients in Equation (1). Standard errors in all regressions are clustered at the enumeration area (*ketena*) level.<sup>5</sup>

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<sup>5</sup> Our household sample groups into 6 sub-cities and 40 *ketenas*.

## IV. RESULTS

### 4.1. Main results

Table 3 shows the difference-in-differences estimates of the impact of the video treatments on daily household per capita calorie consumption of fruits and vegetables. Column 1 shows the unconditional estimates based on Equation 1, and column 2, the corresponding estimates conditional on differences in basic household characteristics and household location (i.e., sub-city fixed effects). To preserve space, only  $\beta_1$  and  $\beta_2$  coefficients are reported in the table. As the differences between the unadjusted and adjusted regressions are small, we focus our discussion on the adjusted regression results.

The basic *Video* treatment increased fruit and vegetable consumption by 15.2 kcal on average (95 CI: 0.23 kcal-30.2 kcal), or 10.1 percent if benchmarked against mean fruit and vegetable consumption in the control group at the baseline. The estimated average effect of the *Video+* treatment is similar in magnitude (12.7 kcal) but it is not statistically different from zero. However, an F-test cannot reject the null hypothesis that the difference in the two treatment effects is statistically not different. Therefore, in subsequent analyses, we pool the two treatment arms into one treatment.

**Table 3. Estimates of intention-to-treat effects on daily household per capita calorie consumption from fruits and vegetables**

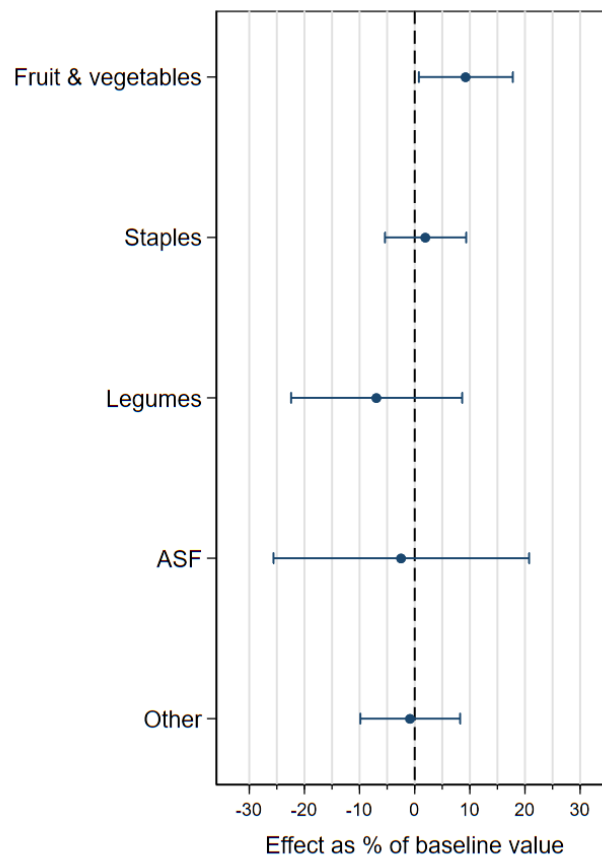
	(1)	(2)
Video	16.39** (7.87)	15.24** (7.42)
Video+	11.35 (8.25)	12.73 (8.00)
Household level controls?	No	Yes
Sub-city fixed effects?	No	Yes
F-test (1, 39) for Video=Video+	0.31	0.08
--- p-value	0.58	0.78
Observations	1,782	1,782
Untreated group mean of the dependent variable at the baseline	150.84	150.84

Note: Difference in differences estimator. Unit of observation is a household observed in two survey rounds. Outcome variable is daily household per capita calorie consumption from fruits and vegetables, measured in kcal. Household level controls are household size, male-headed household, head's education in years, and age of the household head. Standard errors are clustered at the enumeration areas and reported in parentheses. Statistical significance denoted with \*  $p < 0.10$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$ .

Source: Authors calculation based on the February 2020 Addis Ababa food consumption survey data.

The first capped line in Figure 3 reports the conditional estimate along with the estimated confidence interval for the pooled treatment, with the estimate reported as a percentage of the baseline consumption value among the untreated group. We see that the video treatment increased per capita fruit and vegetable consumption by 9.3 percent. The remaining capped lines in Figure 2 show the corresponding estimates for other food groups – those that were not targeted by the video treatment. The impact estimates for the other food groups are close to zero and not statistically significant. While we do not see sizable differences in knowledge between the control and treatment groups (Section 3), the fact that we see statistically significant impacts in fruit and vegetable consumption, but not in the consumption of other food groups, suggests that the intervention (that targeted fruit and vegetable consumption) worked as intended.

**Figure 3. Estimates of intention-to-treat effects on household per-capita calorie consumption, by food group**



*Source:* Authors calculation based on the February 2020 Addis Ababa food consumption survey data.

## 4.2. Heterogeneity

Considering the high relative prices of fruits and vegetables (Headey and Alderman, 2019), we next explore whether the effectiveness of these BCC interventions varied by household well-being. To explore heterogeneity along this dimension, we interacted the terms in the difference-in-differences equation with a binary indicator variable,  $P_i$ , that obtains value 1 if the household is poor (and zero otherwise):

$$(2) \quad Y_{it} = \gamma D_i + \beta(T_t * D_i) + \delta T_t + \zeta(D_i * P_i) + \vartheta(T_t * D_i * P_i) + \theta(T_t * P_i) + \varepsilon_{it},$$

where  $\beta$  quantifies the effect of any video intervention on household fruit and vegetable consumption among non-poor households and  $\beta + \vartheta$  among poor households. As a proxy for household income levels, we used household per capita food consumption levels measured at the baseline. We used three different food consumption thresholds to crudely define households as “poor”: the 10<sup>th</sup> percentile of the distribution, the 20<sup>th</sup> percentile, and the 30<sup>th</sup> percentile.

Table 4 shows the results of this triple difference estimation based on Equation 2. The coefficient on the interaction term ( $\vartheta$ ) is negative across all poverty definitions, suggesting that, relative to other treated households, the video interventions led to smaller changes in fruit and vegetable consumption among the treated households that were poor. However, the coefficient is only statistically different from zero when we define households as poor if their baseline food consumption level is below the 10<sup>th</sup> percentile of the full distribution. The sum of the two coefficients ( $\beta + \vartheta$ ) gives us the total impact on fruit and vegetable consumption among the poorest households. Based on F-tests, we cannot reject the null that the video interventions do not affect fruit and vegetable consumption among the poorest households, irrespective of the consumption threshold we use to define poor households. Therefore, the effects of the intervention are concentrated among the relatively well-off, or those who would be more likely to be able to afford additional fruits and vegetables.

**Table 4. Heterogeneity by baseline household per capita consumption levels**

	(1)	(2)	(3)
<i>Definition of Poor:</i>	<i>Poorest 10 percent</i>	<i>Poorest 20 percent</i>	<i>Poorest 30 percent</i>
Any video intervention	17.65** (6.75)	16.62** (7.52)	16.63* (8.26)
Any video intervention x Poor	-40.39*** (13.97)	-18.47 (14.37)	-10.55 (13.49)
Control variables?	Yes	Yes	Yes
Sub-city fixed effects?	Yes	Yes	Yes
F-test (1, 39) for 'Any video intervention' + 'Any video intervention x Poor' = 0	2.48	0.02	0.34
--- p-value	0.123	0.879	0.562
Observations	1,782	1,782	1,782

Note: Poverty status defined based on baseline household per capita consumption levels. Triple difference estimator. Unit of observation is a household observed in two survey rounds. Outcome variable is daily household per capita calorie consumption from fruits and vegetables, measured in kcal. Household level controls are household size, male-headed household, head's education in years, and age of the household head. Standard errors are clustered at the enumeration areas and reported in parentheses. Statistical significance denoted with \*  $p < 0.10$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$ .

Source: Authors calculation based on the September 2019 and February 2020 Addis Ababa food consumption survey data.

### 4.3. Robustness

Our results are robust to defining consumption in monetary terms instead of per capita calorie terms (Appendix C). We checked the robustness by converting the consumed amounts to Ethiopian birr using monthly retail price data collected in Addis Ababa at the time of the baseline (September 2019) by the Central Statistical Agency of Ethiopia. Table C1 in Appendix C replicates Table 3, using per capita fruit and vegetable consumption measured in Ethiopian birr as the outcome variable. The (adjusted) estimated impact of the basic *Video* treatment is a daily increase of 1.1 birr per capita ( $p < 0.05$ ), or 10 percent, and the impact of the *Video+* treatment is a daily increase of 1.2 birr per capita ( $p < 0.05$ ), or 11 percent, when benchmarked against the mean baseline fruit and vegetable consumption in the control group. The difference in impact estimates between the two treatment effects is not statistically different from zero. Figure C1 repeats Figure 3 using consumption defined in Ethiopian birr. The pooled impact of the two video treatments on daily per capita fruit and vegetable consumption is 10.8 percent higher than the corresponding consumption in the control group at baseline. As before, the impact estimates for the other food groups are smaller in magnitude and not statistically different from zero.

We also checked whether our findings could be explained by a type of response bias which leads respondents to report higher fruit and vegetable consumption just to please the enumerator who earlier showed them a video about fruit and vegetable health benefits. This bias is known as social desirability bias, and psychologists have developed questionnaire modules to measure the degree to which individuals are concerned with social approval (Crowne and Marlowe, 1960; Reynolds, 1982). We followed Menon et al. (2016a) to measure respondents' social desirability bias using a reduced version of the original Marlowe–Crowne social desirability scale. While our respondents do display a relatively high level of social desirability, the differences in the social desirability scale across study arms are not statistically significant (Table D2). More importantly, the degree of social desirability is not correlated with reported fruit and vegetable consumption levels at the endline within any study arm (Table D3), suggesting that the results reported here are not explained by social desirability bias.

In sum, we find that most household respondents in the treatment groups recall seeing the video shown at the end of the baseline interview. Four months after viewing the video, the average household in the two treatment groups has increased their consumption of fruits and vegetables by about 10 percent. The treatment does not appear to affect any other type of food consumption. Given that they saw the video, the apparent mechanism is through an increase in nutritional knowledge catalyzed by the video, though our measures of nutritional knowledge are somewhat imprecise. The videos may also help households pay more attention to their consumption of fruits and vegetables.

## V. CONCLUSIONS

We conducted a randomized control trial to test whether messages related to improving nutrition, delivered through video, can affect consumption of fruits and vegetables. The trial took place among a representative sample of households in Addis Ababa, and we find that even four months after watching a 36-minute video, households who saw the videos have higher nutritional knowledge than control group households, and report about 10 percent higher consumption of fruits and vegetables than control group households, related to the control mean at baseline. The overall spending changes are not large (on average, a daily increase by 1.2 birr per capita over the control mean) but represent a potentially promising way to deliver messages through televising the videos.

As with most trials, even if the evidence is promising, it is somewhat limited. We are not fully able to pin down the impact pathway; the gains in nutritional knowledge could be thought of as small, and the knowledge as measured was relatively high even among the control group; yet we do not have a large enough sample to do, for example, causal mediation analysis (though it also requires additional assumptions). Further, we cannot say much about cost effectiveness. Assuming that the videos can be screened on TV channels, the cost effectiveness could be quite good, but it would fully depend upon the number of people watching and paying attention to them; in the trial, we had something of a captive audience, though as noted in the Appendix, the videos were well liked. The approach could be also cost effective if used by existing health extension workers in tandem with their household visits and community outreach activities, since the costs associated with the video medium (i.e., video production and screening device) are fixed in nature and the cost effectiveness increases with the number of viewers.

A further interesting result is that we find no differences between the two treatments. There are some hints as to why this finding might have occurred in Appendix A, though there is nothing definitive. First, we find an almost identical distribution between the two treatment groups for the impression of the households in the videos. Second, for a number of other indicators about the videos, particularly related to the salience of messages, the average responses were somewhat lower for the “how” and “why” video

than the basic one. It could be that respondents found the messages simpler in the more basic video, which could have led to more or equal understanding. However, the differences in most measures are small, and as such we are certainly speculating.

Still, we believe these results can potentially play an important role in helping to fill potential gaps in the current public health extension system in Ethiopia. There are concerns that the health extension workers' scope of work is too diverse, and consequently too little time is allocated to nutrition-related interventions (Baye and Hirvonen, 2020; Mangham-Jefferies et al., 2014). As a result, nutrition related BCC exposure rates remain low in many areas (Abate et al., 2020b; Berhane et al., 2020). Videos like the ones produced in this project clearly can play a role in reaching more households in a consistent fashion to increase demand for fruits and vegetables. Government policies that could help broadcast videos like these on television or potentially on popular websites could help stimulate fruit and vegetable consumption on a larger scale.

However, it is important to note that light-touch videos are not enough to fill the consumption gap. The average impact of the videos was relatively small, and they appear to have been ineffective in changing consumption behavior among the poorest households in our sample. For larger improvements in consumption, it is important to find ways to lower the relative cost of fruits and vegetables, since they are consistently relatively expensive worldwide (Headey and Alderman, 2019; Hirvonen et al., 2020). In Ethiopia, fruit and vegetable prices have been rising rapidly in recent decades (Bachewe et al., 2017). Production and value chain interventions to reduce inflationary pressures, combined with innovative communication plans to increase demand, could help reduce the observed consumption gap.

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## APPENDIX A. RESPONDENTS' VIEWS ABOUT THE INTERVENTIONS

The endline questionnaire had a series of questions about the respondents' perceptions about the videos that were shown to them. Tables A1 to A8 summarize these responses, separately for each study arm.

Tables A9 to A11 report the responses regarding the poster that was given to some respondents.

**Table A1. What was your first impression of the families featured in the video?**

Response	Control (N=23)	Video (N=243)	Video+ (N=227)
Very similar to my family	4.3	4.5	3.5
Somewhat similar to my family	30.4	18.5	16.7
Somewhat different to my family	17.4	15.6	14.5
Very different to my family	13	53.9	55.5
I don't remember	34.8	7.4	9.7
<b>Total</b>	<b>100</b>	<b>100</b>	<b>100</b>

*Source:* Authors calculation based on the February 2020 Addis Ababa food consumption survey data.

**Table A2. Was the language used by the featured families similar to the language you are more comfortable speaking?**

Response	Control (N=23)	Video (N=243)	Video+ (N=227)
Yes	65.2	90.1	84.1
No	34.8	9.9	15.9
<b>Total</b>	<b>100</b>	<b>100</b>	<b>100</b>

*Source:* Authors calculation based on the February 2020 Addis Ababa food consumption survey data.

**Table A3. What was your impression of the content provided by the video or featured families?**

Response	Control (N=23)	Video (N=243)	Video+ (N=227)
Very easy to understand	34.8	77	70.5
Somewhat easy to understand	39.1	14.8	16.7
Somewhat difficult to understand	0.0	0.8	3.5
Very difficult to understand	0.0	1.2	2.6
I don't remember	26.1	6.2	6.6
<b>Total</b>	<b>100</b>	<b>100</b>	<b>100</b>

*Source:* Authors calculation based on the February 2020 Addis Ababa food consumption survey data.

**Table A4. What was the quality (picture, sound) of the video?**

Response	Control (N=23)	Video (N=243)	Video+ (N=227)
High	52.2	72.8	74.4
Medium	26.1	21	17.6
Low	0.0	1.6	1.3
I don't remember	21.7	4.5	6.6
<b>Total</b>	<b>100</b>	<b>100</b>	<b>100</b>

Source: Authors calculation based on the February 2020 Addis Ababa food consumption survey data.

**Table A5. What was your impression regarding the usefulness of the information in the video?**

Response	Control (N=23)	Video (N=243)	Video+ (N=227)
Very useful	52.2	84	80.2
Somewhat useful	39.1	13.2	16.7
Not useful	8.7	2.9	3.1
<b>Total</b>	<b>100</b>	<b>100</b>	<b>100</b>

Source: Authors calculation based on the February 2020 Addis Ababa food consumption survey data.

**Table A6. Can the respondent remember any specific scenes of the video?**

Response	Control (N=23)	Video (N=243)	Video+ (N=227)
Yes	56.5	84.8	79.3
No	43.5	15.2	20.7
<b>Total</b>	<b>100</b>	<b>100</b>	<b>100</b>

Source: Authors calculation based on the February 2020 Addis Ababa food consumption survey data.

**Table A7. Have your household practiced the instructions in the video?**

Response	Control (N=23)	Video (N=243)	Video+ (N=227)
Yes, all of them	34.8	25.9	25.6
Yes, some of them	47.8	57.6	55.1
No	17.4	16.5	19.4
<b>Total</b>	<b>100</b>	<b>100</b>	<b>100</b>

Source: Authors calculation based on the February 2020 Addis Ababa food consumption survey data.

**Table A8. Do you recommend or see a value for screening the video in national TV?**

Response	Control (N=23)	Video (N=243)	Video+ (N=227)
Yes	69.6	90.1	85.5
No	4.3	4.9	5.7
I don't know	26.1	4.9	8.8
<b>Total</b>	<b>100</b>	<b>100</b>	<b>100</b>

Source: Authors calculation based on the February 2020 Addis Ababa food consumption survey data.

**Table A9. What was your impression regarding the usefulness of the information on the poster?**

<b>Response</b>	<b>Control (N=4)</b>	<b>Video (N=8)</b>	<b>Video+ (N=250)</b>
Very useful	75	87.5	84
Somewhat useful	25	0.0	13.2
Not useful	0.0	12.5	2.8
<b>Total</b>	<b>100</b>	<b>100</b>	<b>100</b>

*Source:* Authors calculation based on the February 2020 Addis Ababa food consumption survey data.

**Table A10. What was your impression of the information on the poster?**

<b>Response</b>	<b>Control (N=4)</b>	<b>Video (N=8)</b>	<b>Video+ (N=250)</b>
Very easy to understand	75	75	76
Somewhat easy to understand	25	12.5	19.2
Somewhat difficult to understand	0	0	2.4
Very difficult to understand	0	12.5	2.4
<b>Total</b>	<b>100</b>	<b>100</b>	<b>100</b>

*Source:* Authors calculation based on the February 2020 Addis Ababa food consumption survey data.

**Table A11. Do you still have the poster?**

<b>Response</b>	<b>Control (N=4)</b>	<b>Video (N=8)</b>	<b>Video+ (N=250)</b>
Yes	25	0	68
No	75	100	32
<b>Total</b>	<b>100</b>	<b>100</b>	<b>100</b>

*Source:* Authors calculation based on the February 2020 Addis Ababa food consumption survey data.

## APPENDIX B. NUTRITION KNOWLEDGE QUIZ

**Table B1. Nutrition knowledge quiz**

Question and marking criteria	mean points [max points]
<p><b>Which foods should be consumed daily as part of a healthy diet?</b>                      1 point if either fruit or vegetables are mentioned, but not both                      2 points if both fruit and vegetables are mentioned</p>	<p>1.54 [2]</p>
<p><b>What are some of the benefits of consuming fruits and vegetables?</b>                      1 point if 'immunity boost' or 'good source of vitamins and minerals' is mentioned, but not both                      2 points if both are mentioned</p>	<p>0.69 [2]</p>
<p><b>How do you ensure you get most of the health benefits of vegetables?</b>                      1 point if 'by incorporating seasonally available vegetables in daily diet' or 'by not overcooking fruits and vegetables' is mentioned                      2 points if both are mentioned</p>	<p>1.55 [2]</p>
<b>Total</b>	<b>3.78 [6]</b>

N=895 households

*Source:* Authors calculation based on the February 2020 Addis Ababa food consumption survey data.

## APPENDIX C. REPLICATING MAIN RESULTS BY DEFINING CONSUMPTION IN MONETARY TERMS

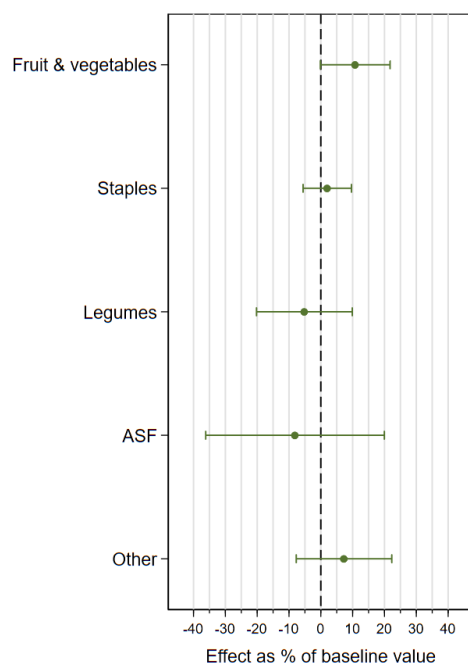
**Table C1. Estimates of intention-to-treat effects on daily household per capita fruit and vegetable consumption (measured in Ethiopian birr)**

	(1)	(2)
Video	1.23*	1.14*
	(0.68)	(0.65)
Video+	1.10	1.21*
	(0.72)	(0.70)
Household level controls?	No	Yes
Sub-city fixed effects?	No	Yes
F-test (1, 39) for Video=Video+	0.04	0.01
--- p-value	0.85	0.93
Observations	1,782	1,782
Untreated group mean of the dependent variable at the baseline	10.88	10.88

Note: Difference in differences estimator. Unit of observation is a household observed in two survey rounds. Outcome variable is daily household per capita calorie consumption from fruits and vegetables, measured in kcal. Household level controls are household size, male-headed household, head's education in years, and age of the household head. Standard errors are clustered at the enumeration areas and reported in parentheses. Statistical significance denoted with \*  $p < 0.10$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$ .

Source: Authors calculation based on the February 2020 Addis Ababa food consumption survey data.

**Figure C1. Estimates of intention-to-treat effects on household per-capita consumption-expenditure, by food group**



Note: Difference in differences estimator, separately for each food group. Dots quantify the increase in household per capita consumption-expenditure (in birr), measured as a percent of the baseline household per capita consumption-expenditure value. Capped bars are 95-% confidence intervals, calculated from standard errors clustered at the enumeration area level. N=1,782 households.

Source: Authors calculation based on the February 2020 Addis Ababa food consumption survey data.

## APPENDIX D. SOCIAL DESIRABILITY BIAS

Social desirability bias refers to the tendency of respondents to give responses that are socially desirable instead of responding accurately about their actual behavior (Nederhof, 1985). In our case, the worry is that respondents who were exposed to the video treatments about the health benefits of fruit and vegetable consumption report consuming fruit and vegetables, even though they did not. Psychologists have developed survey tools to measure social desirability bias. The Marlowe–Crowne Social Desirability Scale (Crowne and Marlowe, 1960) is arguably the most used questionnaire to assess the degree to which respondents are concerned with social approval. With 33 items, this questionnaire is lengthy and therefore, in subsequent work, Reynolds (1982) validated a shorter version of the original Marlowe–Crowne social desirability scale. More recently, nutritionists have adopted a five-item version of the Reynolds’ scale questionnaire and used this to assess the role of social desirability bias in the context of impact evaluations of the effectiveness of social behavioral change communication campaigns on child feeding practices in low- and middle-income countries, including in Ethiopia (Kim et al., 2019; Menon et al., 2016a). We administered this five-item version as a part of our baseline survey. Table D1 shows the questions with expected responses for respondents concerned with social approval. Each socially desirable response was assigned value 1 (zero otherwise) and the total social desirability score was constructed by summing the scores across the responses to the 5 questions. Consequently, the minimum score in this scale is 0 and maximum is 5.

Figure D1 shows the distribution of the social desirability bias scale. Menon et al., 2016 categorize social desirability scale of 0-2 being as a low score, 3 as medium score, 4 as high, and 5 as very high. Nearly 20 percent of the respondents in our sample have a social desirability scale as very high. The sample mean (median) scale is 3.5 (4).

In Table D2, we assess the correlation between the social desirability scale and the (random) assignment to the study arms by regressing the social desirability scale on the binary treatment variables with and without controls. The coefficients are small in magnitude and not statistically significant,

implying that the households across the study arms are similar with respect to their social desirability bias.

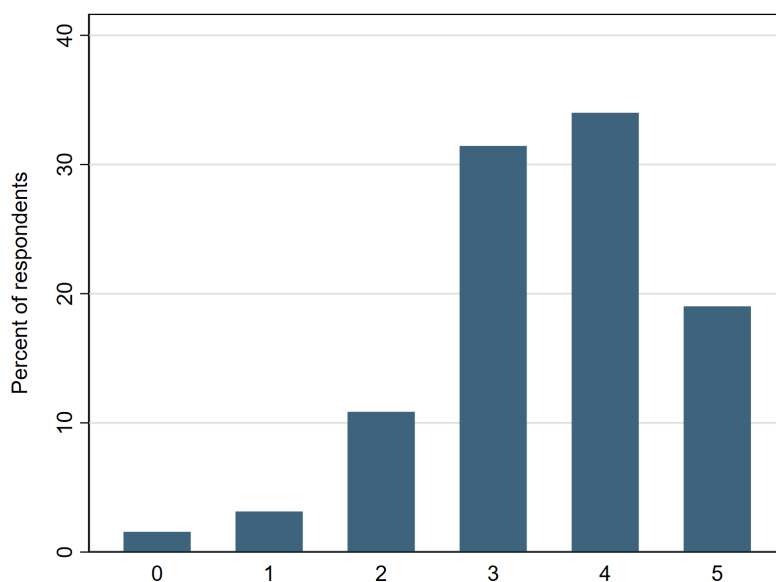
In Table D3, we test whether social desirability is associated with higher reported fruit and vegetable consumption at the endline. We do so by regressing household fruit and vegetable consumption (measured in kcal) on their social desirability scale value, separately for each study arm. A positive coefficient on the social desirability scale variable would indicate that households with higher tendency to please others are reporting higher fruit and vegetable consumption values. As before, the regression coefficients are not statistically different from zero, suggesting that social desirability bias is not driving the results reported in the main text.

**Table D1. Social desirability module in the endline**

Question	Socially desirable response
Do you occasionally give up doing something because you don't think you have the ability?	No
Do you occasionally feel like not listening to people even if you know they are right?	No
Do you sometimes get annoyed (translate so understandable) by people who ask you to do something for them?	No
Are you always courteous, even to people who are disagreeable/not pleasant?	Yes
When you make a mistake, are you always willing to admit it?	Yes

*Source:* Authors calculation based on the February 2020 Addis Ababa food consumption survey data.

**Figure D1. Distribution of the social desirability bias index**



N= 894 households

Source: Authors calculation based on the September 2019 Addis Ababa food consumption survey data.

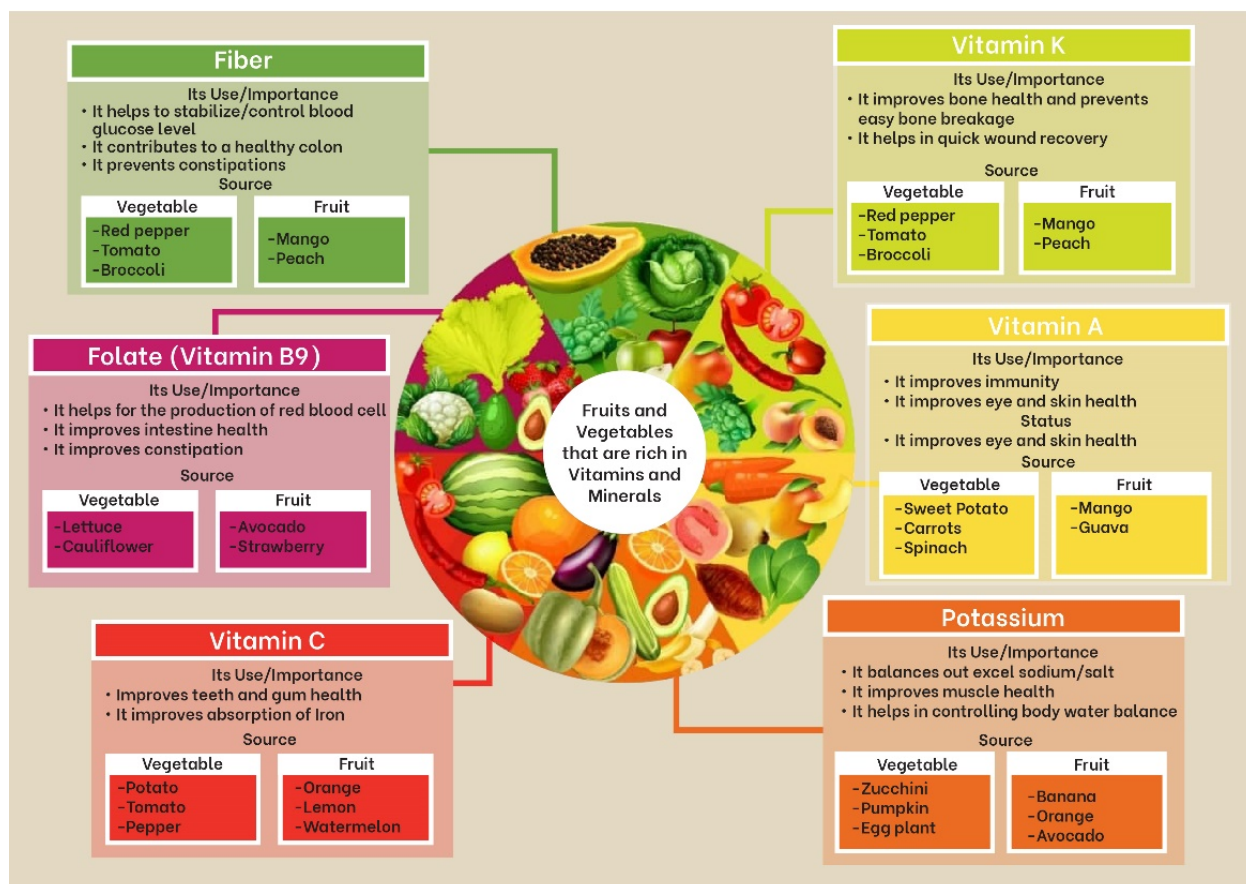
**Table D2. Correlation between social desirability and random assignment into study arms**

	(1)	(2)
Video	0.034 (0.083)	0.032 (0.082)
Video+	0.051 (0.077)	0.047 (0.078)
Household level controls?	No	Yes
Sub-city fixed effects?	No	Yes
Observations	889	889
Sample mean of the outcome variable	3.47	3.47

Note: Cross-sectional OLS estimator. Unit of observation is a household. Outcome variable is social desirability score measured at baseline. Household level controls are household size, male-headed household, head's education in years, and age of the household head. Standard errors are clustered at the enumeration areas and reported in parentheses. Statistical significance denoted with \*  $p < 0.10$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$ .

Source: Authors calculation based on the September 2019 and February 2020 Addis Ababa food consumption survey data.

## APPENDIX E. POSTER ON THE HEALTH AND NUTRITION BENEFITS OF FRUITS AND VEGETABLES (TRANSLATED)



Note: The original poster was in Amharic.

Source: designed by Authors in collaboration with NEED.

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