Effects of a community-driven water, sanitation, and hygiene program on Covid-19 symptoms, vaccine acceptance, and non-Covid illnesses: a cluster-randomized controlled trial in rural Democratic Republic of Congo

Kevin Croke[1], Aidan Coville[2], Eric Mvukiyehe[3], Caleb Jeremie Dohou[2], Jean-Paul Zibika[2†], Luca Stanus Ghib[2], Michele Andreottola[2], Yannick Lokaya Bokasola[2], John Paul Quattrochi[4]

1 Department of Global Health & Population, Harvard TH Chan School of Public Health, Boston, USA

2. Development Impact Evaluation Unit, World Bank, Washington DC, USA

3 Department of Political Science, Duke University, Durham, USA

4 Department of Public Health, Simmons University, Boston, USA

Sustainable Development Goals: Good Health and Wellbeing, Clean Water and Sanitation, Sustainable Cities and Communities

Abstract

Objective: The government of the Democratic Republic of Congo responded to Covid-19 with policy measures such as business and school closures and distribution of vaccines, which rely on citizen compliance. In other settings, prior experience with effective government programs has increased compliance with public health measures. We study the effect of a national water, sanitation, and hygiene program on compliance with COVID-19 policies.

Methods: Prior to the COVID-19 pandemic, 332 communities were randomly assigned to the *Villages et Ecoles Assainis* program or control. After COVID-19 reached DRC, individuals who owned phones (590/1312; 45%) were surveyed by phone three times between May 2020-August 2021. Primary outcomes were COVID symptoms, non-COVID illness symptoms, child health, psychological well-being, and vaccine acceptance. Secondary outcomes included COVID-19 preventive behavior and knowledge, and perceptions of governmental performance, including COVID response. All outcomes were self-reported. Outcomes were compared between treatment and control villages using linear models.

Results: The VEA program did not affect respondents' COVID symptoms (-0.11, 95% CI -0.55, 0.33), non-COVID illnesses (-0.01, 95% CI -0.05, 0.03), child health (0.07, 95% CI -0.19, 0.33), psychological well-being (-0.05, 95% CI -0.35, 0.24), or vaccine acceptance (-0.04, 95% CI -0.19, 0.10). There was no effect on village-level COVID-19 preventive behavior (0.02, 95% CI -0.17, 0.22), COVID-19 knowledge (0.16, 95% CI -0.08, 0.39), or trust in institutions.

Conclusions: Although the VEA program increased access to improved water and sanitation, it did not increase trust in government. Accordingly, there was no evidence of increased compliance with COVID policies, and no reduction in illness.

Keywords: WASH; Covid-19; Democratic Republic of Congo; randomized controlled trial

Introduction

Governments around the world have implemented a wide range of public health measures to mitigate the COVID-19 pandemic. In many cases these restrictions have been costly to citizens. For example, in the earliest phase of the pandemic (March 2020), many countries implemented lockdowns and stay-at-home orders which restricted economic activity, limited access to public services, and constricted normal social interactions. In low income countries, where many citizens rely on informal labor for their livelihoods, and government programs to support unemployed workers are limited, these lockdowns were very costly (1). More recently, governments have also encouraged citizens to accept vaccination, while also continuing to promote selected non-pharmaceutical measures such as masking, and restrictions on mass gatherings and travel.

Citizen adherence to these measures has varied widely. Analyses of cell phone data from 21 low and middle income countries (LMICs) found that decreases in work-related mobility ranged from 40-80% in the first two months after the pandemic (2,3). A phone survey of adults in 18 African countries found that self-reported compliance with seven mitigation policies ranged from a low of 61% for reducing trips to the market to 85% for public masking (4). Many theories have been proposed to explain variation in citizen compliance with these policies. One group of explanations highlights the role of public trust in government (5). High trust in authorities is often understood to be the result of long-run historical and institutional processes (6). However, trust has also been shown to be influenced by more proximate community experiences with effective government programs (7). In this paper, we study the impact of a large-scale water and sanitation program in the Democratic Republic of the Congo, known as *Villages et Ecoles Assainis* (VEA), on adherence to COVID-19 preventive measures. This program was shown in a randomized controlled trial to generate large increases in access to improved water sources and sanitation services, and to increase citizen satisfaction with access to water (8). In other settings, similar programs have been shown to increase trust in governmental public health measures (7), and improve compliance with governmental COVID response (9). According to this logic, we examine whether the VEA program increased adherence to COVID-19 policies implemented by the DRC government over the first three waves of COVID-19 in the country, through 2020 and 2021. Furthermore, since increased adherence to social distancing, masking, and stay at home orders could lead to less transmission of illnesses (both COVID-19 and other infectious diseases), we also examine whether VEA villages have lower levels of reported illness.

Another element of the COVID-19 policy response, in DRC and globally, was a strong emphasis on handwashing to reduce transmission. This strongly overlapped with VEA program messages, which emphasized hygiene promotion activities, especially handwashing, as a preventive measure against diarrheal disease. Although global emphasis on handwashing to prevent COVID has decreased as the role of airborne transmission has become better understood, it was a central element of public health messages from the government in DRC and globally in the first phases of the pandemic. It is possible that VEA communities could have had greater receptivity to messages about the need for increased handwashing, and may have been better able to comply because of access to VEA-provided water supplies. Therefore, VEA could also have resulted in reduced transmission of COVID-19 through this handwashing channel. However, we see this as less likely, given the centrality of airborne transmission of COVID-19.

To test whether the VEA programs had any of these hypothesized positive effects, we conducted three rounds of mobile phone interviews with citizens and community leaders in a sample of communities which had been part of an earlier randomized evaluation of the VEA program. In these interviews, we asked participants about personal and household experience of illnesses, including both COVID-linked symptoms and non-COVID related illnesses. We also measured knowledge about COVID-19, personal adherence to COVID preventive behaviors, their community's adherence to COVID preventive policies, and their willingness to be vaccinated against COVID-19. To address the mechanisms discussed above, we also asked respondents about access to water and sanitation, and about WASH governance in their communities, to measure whether VEA's benefits persisted in treatment communities. Finally, we asked respondents about their trust in a range of government and non-governmental actors and institutions, to examine the hypothesis that improved services from VEA would engender greater trust in public authorities.

Methods

This analysis builds upon the randomized design of a trial focused on evaluating the impact of the VEA program on WASH outcomes. For this trial, we used statistical software (Stata V.16) to randomise the sample into 50 treatment clusters (containing 145 treatment villages) and 71 control clusters (183 control villages). Seven villages were randomly dropped to comply with UNICEF's operational targets, while maintaining treatment and control balance. Randomisation was stratified to ensure treatment and control balance with respect to (1) province (Kongo Central, Kasai, Kasai Central, and South Kivu (Figure A in S1)) and (2) the number of villages per cluster. Treatment clusters received the VEA intervention. Control clusters did not.

The first case of COVID-19 in the Democratic Republic of Congo (DRC) was identified on March 10, 2020 in Kinshasa. Given the urgency of pandemic response and social distancing guidelines, this COVID-19-related extension of the VEA study was implemented through mobile phone surveys. The sample for these COVID-focused surveys was drawn from households that had been interviewed as part of the existing impact evaluation: Out of the original 332 villages covered in the VEA evaluation, a subsample of 295 villages which had given some form of contact information from the evaluation's midline data collection was selected. 590 households were targeted (2 per village), comprising 45% of the households reached earlier. Figure 1 shows the composition of the original study sample and the construction of the mobile phone survey subsample.

The first round of data collection was completed between May and June 2020, the second round was conducted between November 2020 and January 2021, and the third was completed between June and August 2021. Details on the coverage rates, as well as the number of villages and households reached in each round (by treatment arm) are presented in Table 1. To maximize the probability of reaching each targeted respondent, several strategies were implemented. First, only villages for which the research team had the contact information of at least one respondent were targeted. In each village, respondents whose contact information was available were contacted directly. Those who were successfully reached were often asked to put us in contact with other respondents from the same or neighboring villages for whom we had no contact information. Finally, considering the poor mobile network coverage in some of the targeted regions, SMS were sent to those numbers that were not going through, so that respondents would eventually see the message when the mobile network was available again.

Variable definitions

Primary outcomes were COVID-linked symptoms, non-COVID illnesses, a child health index, and a mental health index. COVID symptoms were defined as the number of household members in the past week with fever, dry cough, difficulty breathing/shortness of breath, or fatigue, while non-COVID illness variable was defined as the number of sick household members in the last seven days (excluding those with Covid symptoms). The child health index was created using the proportion of children under five with fever/cough/diarrhea in the last two weeks. The mental health index is a summary index of scores from the following questions: Have you been a very nervous person over the past four weeks? Have you felt so down in the dumps that nothing could cheer you up over the past four weeks? Have you felt calm and peaceful over the past four weeks? (negatively coded). Have you felt downhearted and blue over the past four weeks? Have you been a happy person over the past four weeks? (negatively coded). (1=All of the time...6=None of the time). Finally the vaccine acceptance variable was coded as 1 based on answers to the following question: "If a vaccine for COVID-19 becomes available to you, would you take it?"

Estimation

We estimated the main impacts of VEA on the outcomes listed above, using the following basic specification:

$$y_{ihvc} = \alpha + \beta_1 T_c + \boldsymbol{\gamma X} + \varepsilon_i$$

where y is the outcome of interest for respondent *i* in household *h* in village *v* in cluster *c* at the follow-up survey, defined above. β is the treatment indicator that takes value 1 for clusters that were randomly assigned to participate in VEA ("treatment clusters") and 0 for otherwise ("control clusters"). $\boldsymbol{\gamma}$ represents a set of strata-specific dummies where strata are based on province and number of villages in the cluster, which equals 1 if the household falls in that stratum, and 0 otherwise. The main parameter of interest is β, the intention-to-treat effect (ITT). Standard errors are clustered at the randomization (cluster of villages) level.

Inverse probability weighting

To account for differential attrition by treatment status, we used inverse probability weighting. For household-level data, the following variables were used to generate attrition probability weights: age, religion, and education of respondent, household size, wall, floor, and roof material, and province-cluster stratum. For village leaders, age, education, and province-cluster stratum were used.

Power calculations

We performed power calculations for all outcomes by calculating ex post minimum detectable effects (Table B in Supplement S1).

A pre-analysis plan for this study was registered with the Pan African Clinical Trials Registry, protocol # 202102616421588 and updated to account for round 3 data. The pre-analysis plan was filed after round 1 data were collected, but before round 2 and 3 data were collected. Minor alterations to the plan were made prior to fielding the third survey, notably to add vaccine acceptance to the list of primary outcomes. Because the PAP was not filed before round 1 data were collected, all primary outcomes are limited to round 2 and round 3 data.

Ethics approval was received from the Harvard Longwood IRB protocol number IRB20-0984, Solutions IRB 2019/10/20, and I'Institut Supérieur des Techniques Médicales de Bukavu BKV/CRPS/CIE/NC/001/2019. Oral consent was obtained from study participants.

Results

Three rounds of data collection were completed in May to June 2020 (545 households), November 2020 to January 2021 (529 households), and June-August 2021 (519 households) (Figure 1).

First we analyzed balance in the sample between treatment (VEA) and control respondents, before reporting the effect on primary and secondary outcomes.

We did not observe significant differences between treatment and control respondents across a range of pre-specified covariates (Table 1). In bivariate tests, there is no association between treatment status and attrition. We did, however, observe significant correlations between treatment status and attrition in regressions which include treatment as well as the experimental stratification variables: in these models, treated respondents are approximately

5 percentage points less likely to respond to the mobile phone survey (Table C in Supplement 1).

Compared to study households that were not included in the phone surveys because they did not own phones at baseline, phone-owning households are more likely to live in improved housing, to have completed primary and secondary school, to be of Protestant religion, and to live in larger households. (Table D in Supplement 1)

Table 1. Balance

	(1)		(2)		t-test	t-test
	Control group		Intervention group		Difference	p-value
Variable	N/	Mean/	N/	Mean/	(1)-(2)	(1)-(2)
Household has improved roof	323	0.334	252	0.429	-0.094	0.846
	[65]	[0.068]	[45]	[0.078]		
Household has improved wall	323	0.012	252	0.012	0.000	0.585
	[65]	[0.006]	[45]	[0.006]		
Household has improved floor	323	0.062	252	0.067	-0.006	0.941
	[65]	[0.015]	[45]	[0.028]		
Household size	323	7.136	252	7.254	-0.118	0.635
	[65]	[0.249]	[45]	[0.207]		
Number of children the respondent had	323	5.687	252	5.806	-0.118	0.531
	[65]	[0.269]	[45]	[0.210]		
Respondent identifies as Catholic	323	0.207	252	0.230	-0.023	0.391
	[65]	[0.026]	[45]	[0.026]		
Respondent identifies as Protestant	323	0.384	252	0.409	-0.025*	0.070*
	[65]	[0.051]	[45]	[0.061]		
Respondent identifies with other religion	323	0.334	252	0.274	0.061	0.881
	[65]	[0.050]	[45]	[0.060]		
Respondent age	323	36.858	252	36.960	-0.103	0.925
	[65]	[0.703]	[45]	[0.911]		
Respondent has completed primary school	323	0.350	252	0.373	-0.023	0.879
	[65]	[0.037]	[45]	[0.053]		
Respondent has completed secondary school	323	0.080	252	0.071	0.009	0.551
	[65]	[0.015]	[45]	[0.021]		
Respondent is married or cohabitating	323	0.851	252	0.873	-0.022	0.551
	[65]	[0.019]	[45]	[0.022]		

Impact of VEA on primary outcomes

This study focused on the following primary outcomes: a child health index, a psychological well-being index, number of sick individuals with COVID-19-related symptoms, number of sick individuals without COVID-19-related symptoms, and vaccine acceptance.

The VEA program did not affect COVID symptoms (-0.11, 95% CI -0.55, 0.33), non-COVID illnesses (-0.01, 95% CI -

0.05, 0.03), the child health index (0.07, 95% CI -0.19, 0.33), the psychological well-being index (-0.05, 95% CI -0.35, 0.24), or vaccine acceptance (-0.04, 95% CI -0.19, 0.10) (Figure 2). These results account for differential attrition by treatment status through the use of inverse probability weights (IPW); however results are similar without IPW (Table S2 and Supplement 1 Figures B-D).

[INSERT FIGURE 2 HERE]

Figure 2. Effect of VEA on primary outcomes
Note: adjusted for loss to follow up using inverse probability weighting with weights a function of age, religion, and education of respondent, household size, wall, floor, and roof material, and province-cluster stratum. The unit of measure is household members (for sick individuals with and without Covid symptoms), standard deviation units (for the child health and psychological wellbeing indexes) and percentage points (for vaccine acceptance). COVID symptoms were defined as fever, dry cough, difficulty breathing/shortness of breath, or fatigue.
Impact of VEA on secondary outcomes

Among secondary outcomes, there was no effect on an employment/livelihoods index (0.14, 95% CI -0.10, 0.37), food insecurity (-0.30, 95% CI -0.74, 0.13), hospital visits (-0.16, 95% CI -0.49, 0.17), village-level COVID-19 preventive behavior (0.03, 95% CI -0.23, 0.29), individual-level COVID-19 preventive behavior (0.02, 95% CI -0.17, 0.22), COVID-19 knowledge (0.16, 95% CI -0.08, 0.39), number of sick household members (-0.27, 95% CI -0.62, 0.08) perceptions of COVID-19 prevention behavior by others in the community (-0.07, 95% CI -0.37, 0.23), foregone health care (0.00, 95% CI -0.12, 0.12), vaccine acceptance by village leaders (-0.03, 95% CI -0.13, 0.07), or leader's vaccine advice to villagers (-0.07, 95% CI -0.17, 0.03). Results are similar without IPW (Figure 3 and Table S2).

[INSERT FIGURE 3 HERE]

Figure 3. Effect of VEA on secondary outcomes

Note: adjusted for loss to follow up using inverse probability weighting with weights a function of age, religion, and education of respondent, household size, wall, floor, and roof material, and province-cluster stratum. The unit of measure is household members (for sick household members and hospital visits), standard deviation units (for the indexes, namely livelihoods, village/individual Covid prevention, Covid knowledge, perceived prevention by others in the community), percentage points (for skipped health visits and leaders' vaccine acceptance and vaccine advice to villagers).

There was also no significant effect on approval of ten local and international leaders and organizations (e.g. health zone officials, local chiefs, local NGOs, international NGOs, the Ministry of Health, the President), or on satisfaction with the government's response to COVID-19 (Figure 4 and Table S2).

[INSERT FIGURE 4 HERE]

Figure 4. Effect of VEA on secondary governance outcomes
Note: adjusted for loss to follow up using inverse probability weighting with weights a function of age, religion, and education of respondent, household size, wall, floor, and roof material, and province-cluster stratum.

Subgroup analysis

We conducted a subgroup analysis on our primary outcomes by province (Table S3) and found that in one of the four provinces (Kasai Central), VEA treatment village had 0.72 fewer household members with Covid symptoms (95%CI 0.46 to 0.98). VEA villages also had 17 percentage points higher Covid vaccine acceptance in Kasai Central (95%CI 4 to 29). In another province (Kasai), VEA villages experienced a 0.32 standard deviation increase in the child health index

(95% CI 0.01 to 0.63). This was driven by a 14 percentage-point reduction in children under 5 with diarrhea in the previous two weeks. We found no differences across provinces in the effect of VEA on non-Covid illnesses or psychological well-being.

Mechanisms

Next we explored possible mechanisms that may explain why we did not find any effects of VEA on the outcomes of interest. First, we tested whether the improvements to access to water and sanitation and WASH governance, which were documented in an earlier VEA evaluation, had persisted until the time of the COVID surveys. Second, we tested whether the program led to increased trust in authorities, which according to the theories discussed above, may be expected to increase public compliance with Covid-prevention behaviors advocated by those authorities.

Roughly two years after the VEA program, respondents in VEA treatment villages reported greater access to improved water sources (13 percentage points (pp)), improved sanitation facilities (23 pp), higher likelihood of having a water committee in their village (18 pp), and were more likely to be satisfied with their access to water (30 pp). This is consistent with VEA results measured at an earlier stage (five months after the program), and suggests that the VEA did deliver concrete benefits to treatment villages, and that these benefits persisted over time.

Table 2: Impact of VEA on WASH access and satisfaction (Round 3 survey)

	Control		Treatment				
Outcomes	**N**	**Mean**	**N**	**Mean**	**ITT**	**95% CI**	
Improved water source	295	0.63	224	0.81	0.13	0.00	0.26
Improved sanitation facility	295	0.19	224	0.40	0.23	0.11	0.34
Water satisfaction	295	0.00	224	0.28	0.30	0.08	0.52
Water Committee	295	0.55	224	0.79	0.18	0.08	0.29

Next we examined whether respondents report greater levels of approval of local and national officials and institutions in treatment communities. We found no difference in households' approval of any of ten authorities and institutions over the previous year, including Health Zone officials, Health Area officials, and village chief. (Figure 3 and Table S2). Evidently, despite programmatic improvements in access to water and sanitation, presence of a water committee, and satisfaction with water access, these improvements did not translate into greater trust in national or local leaders. Therefore the hypothesized pathway from successful programs to confidence in leaders to Covid policy compliance was unlikely to materialize, because the VEA program did not increase confidence in leaders or institutions.

Discussion

This cluster-level RCT of a national, community-led rural WASH program found no evidence that the program had any effect on COVID-like illness, non-COVID illnesses, child health, mental health, vaccine acceptance, knowledge of COVID-19, or adherence to COVID-19 prevention guidelines. Despite the large effects of VEA on a number of community water and sanitation access measures, on satisfaction with water services, and (in previous analyses) on self-reported health behaviors, this did not translate into changes in COVID-19 related outcomes.

The lack of impact on health outcomes should be considered in view of the various potential mechanisms of action. In the early phases of the COVID-19 pandemic, public messaging, both globally from WHO and other authorities, and in DRC from the Ministry of Public Health, heavily emphasized washing hands as a critical means of avoidance of transmission. The large increases in availability of improved water sources and reported increases in handwashing and other hygienic behavior due to the VEA program were initially seen as plausible channels to decreased incidence of COVID-19 or other similarly transmitted illnesses. However, as the pandemic progressed, greater emphasis was put on airborne transmission of COVID-19, and less on transmission via droplets or other routes addressable via handwashing and hygiene. With this improved understanding, the likelihood that the VEA's water availability and handwashing behavior change could reduce COVID transmission was understood to be limited. However, this focus on airborne transmission made compliance with non-pharmaceutical interventions (NPI) such as avoidance of mass gatherings, social distancing in public spaces, and mask wearing, a correspondingly more relevant mechanism through which VEA could affect COVID-19. Had the VEA program increased trust in government, NGO, and international health institutions, it could have increased compliance with their NPI recommendations and mandates.

In fact, this mechanism has been demonstrated in other recent studies on the COVID pandemic. A randomized public service delivery project in a conflict-affected region of the Philippines increased the cooperation of local leaders with COVID-19 government response (9). In the context of a different epidemic in Sierra Leone (Ebola viral disease), Christensen et al (7) showed that improved primary health care generated by a community mobilization and participation program increased testing and case finding for Ebola. Another area of overlap with previous health crises relates to the role of public trust in authorities. Recent research in DRC in the context of Ebola has shown that trust in government is highly correlated with adoption of preventive behaviors (including vaccine acceptance) against Ebola (10). And generalized social trust in other settings has been shown to be a robust predictor of adherence to COVID-19 restrictions, such as mobility limitations in the early phases of the pandemic (5). However, the VEA program was unable to engender such attitudinal or behavioral shifts in the sample that we studied.

This study has important advantages over previous examinations of the theory in question. Our setting provides an unusual opportunity to examine the effect of a large-scale, effective WASH and health mobilization program on COVID-related outcomes and behavior. While other related contributions have studied the impact of pre-existing development programs on community leader behavior, or have studied the impact of non-health programs (i.e. interventions on public safety and police-community relations (11), our study provides unique experimental evidence of a large scale health-related program, in a setting in which trust has also been shown to be highly correlated with preventive public health behaviors.

This study also has several limitations. With respect to sample generalizability, and loss-to-follow up, only households which owned mobile phones in previous survey rounds were included in these mobile phone surveys. These included households have marginally higher socioeconomic status than the households in our in-person survey who were not included in the phone survey. Thus the generalizability of these results is limited to the mobile phone-owning sample of the general population in study communities. We cannot rule out the possibility that the VEA program affected behavior among non-mobile phone owning households from the original full study sample. Furthermore, while our study was powered to detect substantively meaningful effects in key primary outcome domains, such as COVID symptoms and non-COVID illnesses, for other outcomes (such as psychological well-being), our study was only powered to detect substantial effects, on the order of 0.2 standard deviations or greater (Table B in Supplement S1).

Second, within this sample, the research team reached a large percentage of respondents (close to 90% across all three rounds) but did not reach everyone. Although results are adjusted using inverse probability weights to account for non-random attrition, residual confounding remains a possibility.

Another limitation is the reliance on self-reported measurements through mobile phone surveys. As three survey rounds largely coincided with the peaks of COVID-19 in DRC, the data collection team was not able to travel to the regions in question to measure health status directly such as by administering COVID antibody tests. As with all self-reported data, it may be subject to social desirability bias. In Kenya, for example, self-reports of mask use have been shown to be much higher than direct observations (12). As a test for social desirability bias, we randomly assigned respondents in the second round of data collection to questions about (i) their own prevention behaviors or (ii) the behaviors of others in their community. The results are nearly identical (S1 Figure E), suggesting that social desirability bias is not a major concern in this study. In any case, as long as inaccuracies in self-report are similar in our treatment and control groups, then treatment effect estimations will not be affected.

Conclusions

In rural Democratic Republic of Congo, a community-led WASH program that significantly increased access to improved water and sanitation sources, and improved village-level WASH governance, did not have any effect on health outcomes, adherence to COVID-19 preventive behavior and restrictions, or vaccine acceptance, in the immediate aftermath of three waves of Covid-19.

Nor did we find any evidence of an effect on employment/livelihoods, food insecurity, access to and utilization of health care, perceptions of governance and government COVID-response, or vaccine acceptance by village leaders. While strong associations between trust in government and preventive health attitudes and behaviors have been documented in DRC, even well-implemented large-scale programs do not appear to be sufficient, in absence of broader programs and reforms, to increase adherence to government health directives.

Acknowledgements

The authors thank the respondents, the data collection team from IHfRA, and their partners in the DRC Ministries of Public Health and of Primary, Secondary, and Professional Education, UNICEF, UK Foreign Commonwealth and Development Office, and at the World Bank.

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Corresponding author: John Paul Quattrochi, Department of Public Health, Simmons University, Boston, MA, USA. Email john.quattrochi@simmons.edu

Supplementary information

Supplement S1. Tables and Figures on outcome definitions, ex-post minimum detectable effects, attrition, and treatment effects with and without inverse probability weighting

Table S2. Effects of VEA all primary and secondary outcomes, and index components, with and without inverse probability weighting

Table S3. Subgroup analysis by province: Effects of VEA all primary and secondary outcomes, and index components, with and without inverse probability weighting

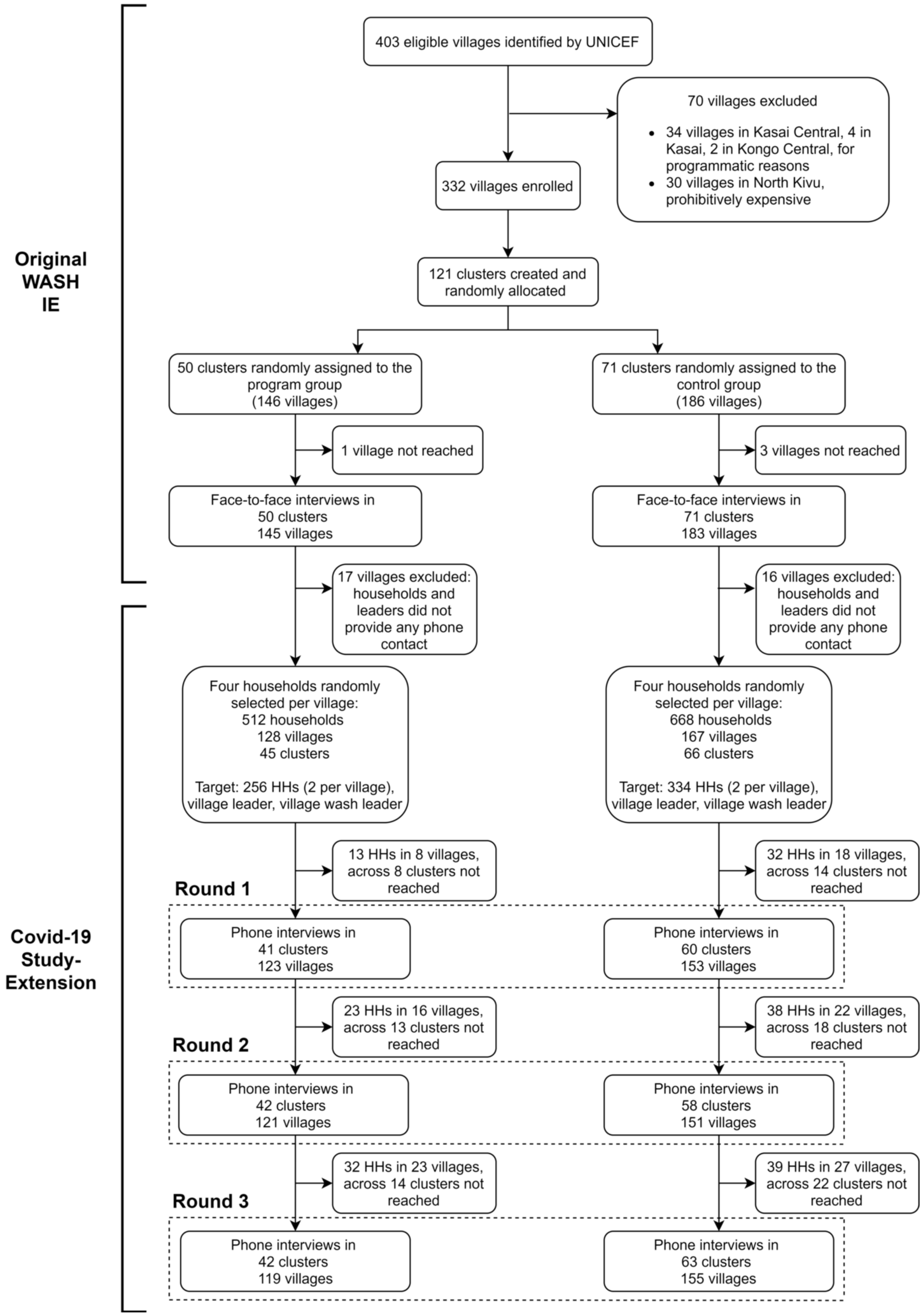
Original WASH IE
Covid-19 Study-Extension
403 eligible villages identified by UNICEF
70 villages excluded
34 villages in Kasai Central, 4 in Kasai, 2 in Kongo Central, for programmatic reasons
30 villages in North Kivu, prohibitively expensive
332 villages enrolled
121 clusters created and randomly allocated
50 clusters randomly assigned to the program group (146 villages)
71 clusters randomly assigned to the control group (186 villages)
1 village not reached
3 villages not reached
Face-to-face interviews in 50 clusters 145 villages
Face-to-face interviews in 71 clusters 183 villages
17 villages excluded: households and leaders did not provide any phone contact
16 villages excluded: households and leaders did not provide any phone contact
Four households randomly selected per village: 512 households 128 villages 45 clusters
Target: 256 HHs (2 per village), village leader, village wash leader
Four households randomly selected per village: 668 households 167 villages 66 clusters
Target: 334 HHs (2 per village), village leader, village wash leader
13 HHs in 8 villages, across 8 clusters not reached
32 HHs in 18 villages, across 14 clusters not reached
Round 1
Phone interviews in 41 clusters 123 villages
Phone interviews in 60 clusters 153 villages
23 HHs in 16 villages, across 13 clusters not reached
38 HHs in 22 villages, across 18 clusters not reached
Round 2
Phone interviews in 42 clusters 121 villages
Phone interviews in 58 clusters 151 villages
32 HHs in 23 villages, across 14 clusters not reached
39 HHs in 27 villages, across 22 clusters not reached
Round 3
Phone interviews in 42 clusters 119 villages
Phone interviews in 63 clusters 155 villages

Fig1.tiff

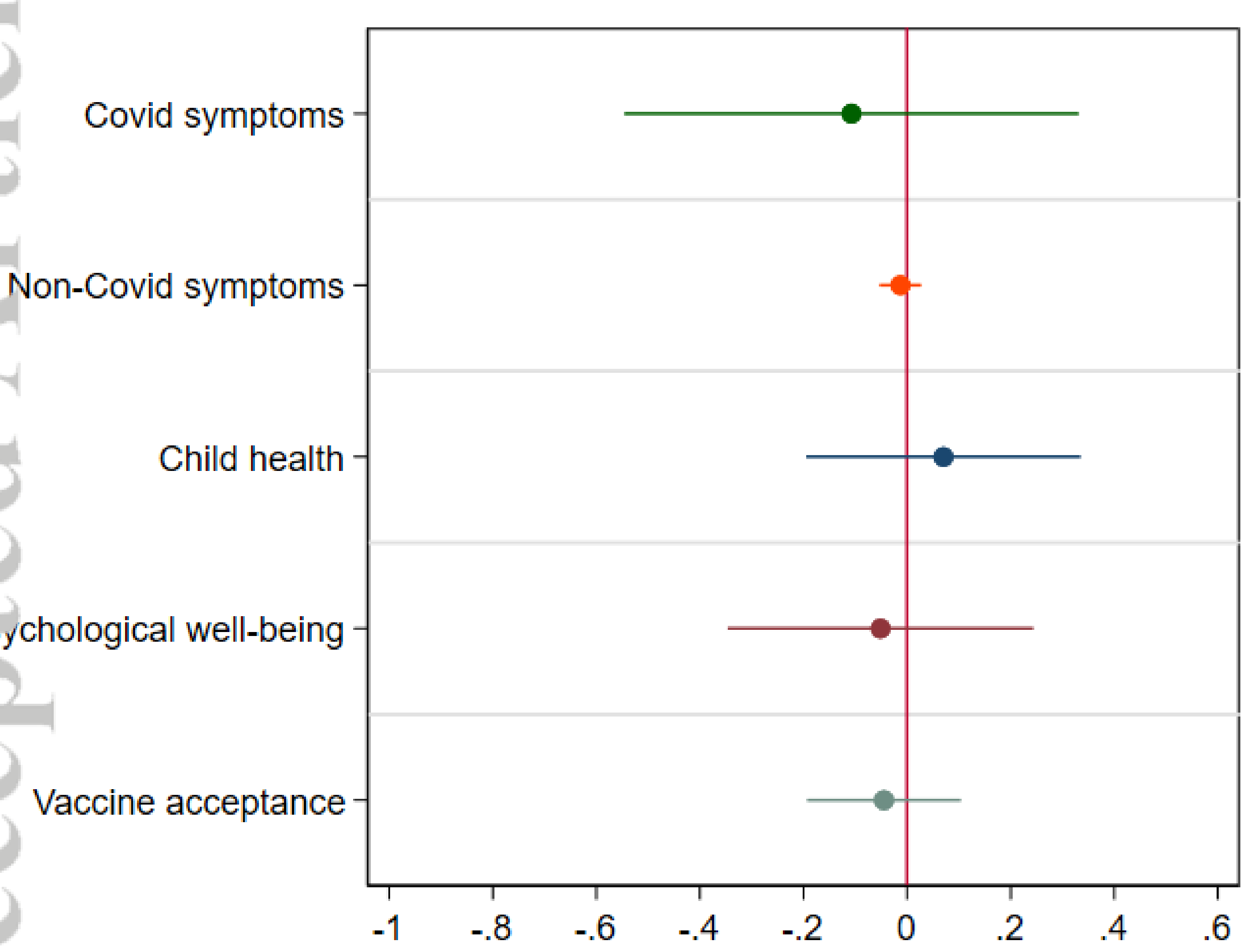
Covid symptoms
Non-Covid symptoms
Child health
Psychological well-being
Vaccine acceptance
-1
-.8
-.6
-.4
-.2
0
.2
.4
.6

Fig2.png

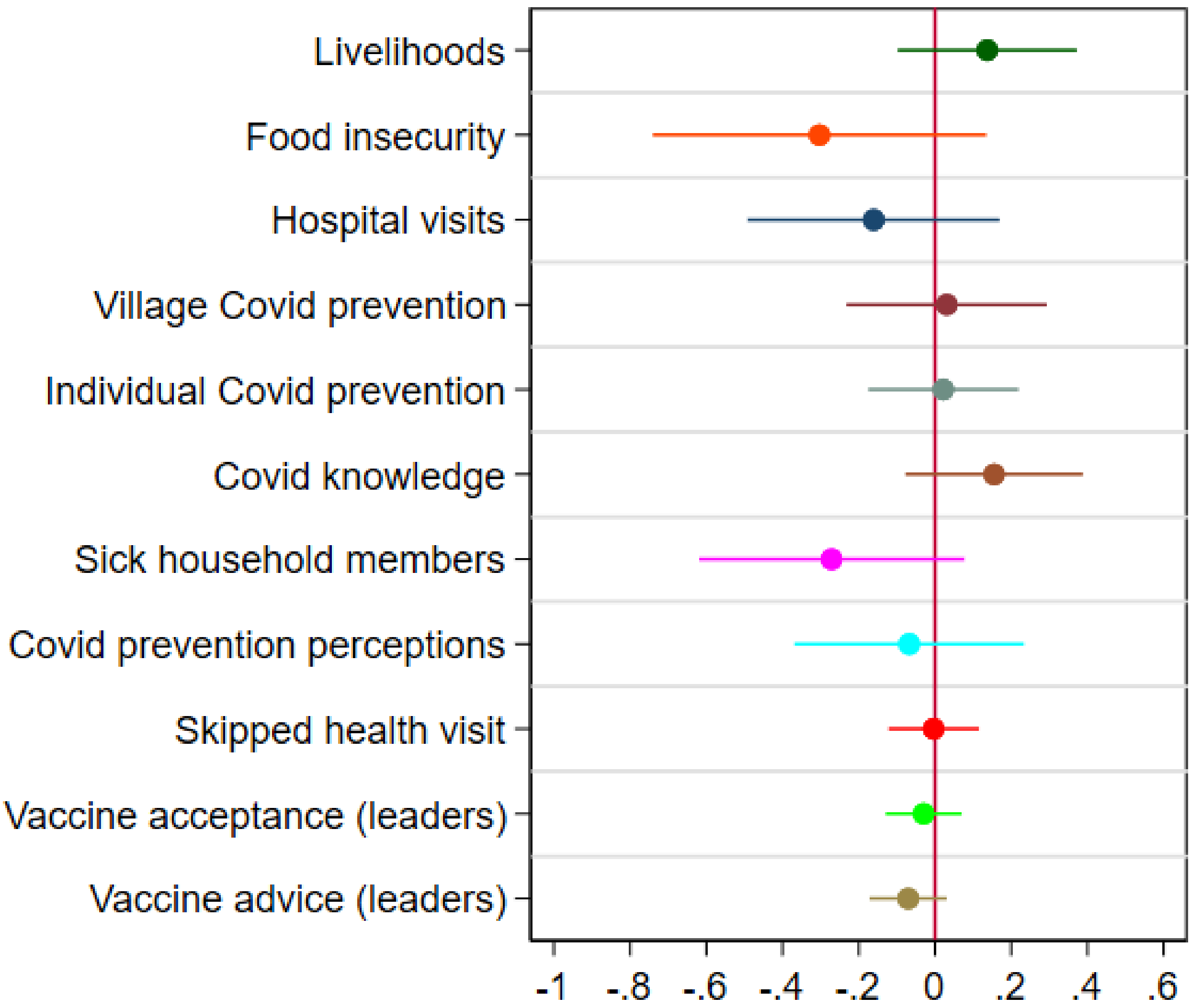
Livelihoods
Food insecurity
Hospital visits
Village Covid prevention
Individual Covid prevention
Covid knowledge
Sick household members
Community Covid prevention perceptions
Skipped health visit
Vaccine acceptance (leaders)
Vaccine advice (leaders)
-1
-.8
-.6
-.4
-.2
0
.2
.4
.6

Fig3.png

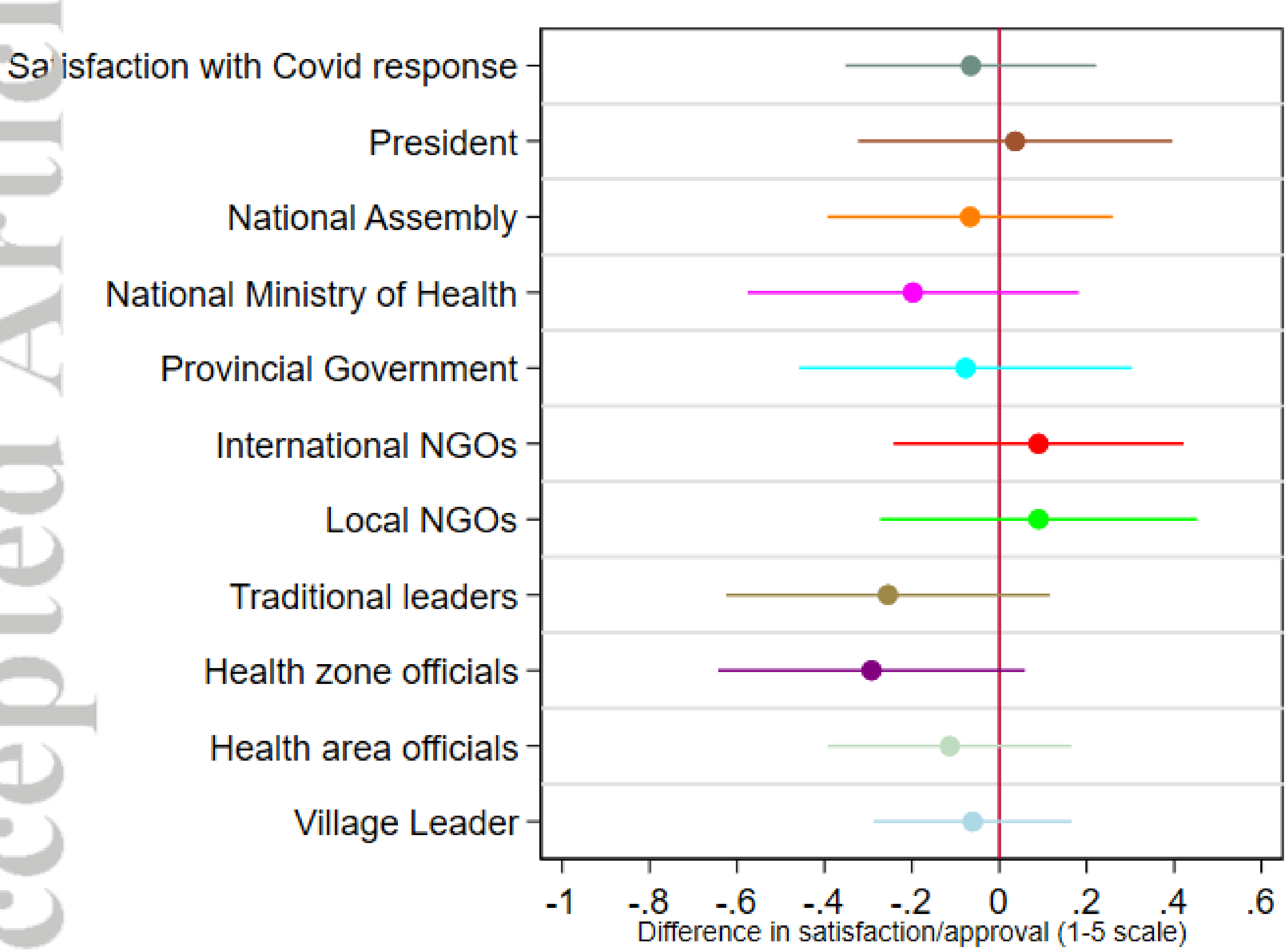
Satisfaction with Covid response
President
National Assembly
National Ministry of Health
Provincial Government
International NGOs
Local NGOs
Traditional leaders
Health zone officials
Health area officials
Village Leader
-1
-.8
-.6
-.4
-.2
0
.2
.4
.6
Difference in satisfaction/approval (1-5 scale)

Fig4.png