Intra-household dynamics and attitudes towards vaccines: Experimental and survey evidence from Zambia[1]

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Abstract. This paper explores how intra-household dynamics relate to attitudes towards vaccines in low and lower-middle income countries by drawing on two novel data sources from Zambia. The first is a nationally representative, in-person survey of over 10,000 households where all household members were individually asked about their willingness to get a COVID-19 vaccine. The second is a randomized survey experiment with almost 3,000 social media users that tested how the impact of information about the benefits from receiving a COVID-19 vaccine on people's willingness to get vaccinated varied based on intra-household dynamics. Both data sources showed that people's willingness (unwillingness) to get a COVID-19 vaccine was very strongly associated with whether other household members were also willing (unwilling). The experiment found that respondents who received information emphasizing either individual or household benefits from getting a COVID-19 vaccine were around 20 percent more willing to get vaccinated than those in the control group. This information was more potent among respondents who believed other members of their household would not get vaccinated but did not have a larger impact on respondents that were involved in household decision making. There was also evidence of positive "second-round" effects whereby respondents who received the information treatments were more likely to encourage other household members to get a COVID-19 vaccine. An important implication that flows from this analysis is that even though household members tend to have similar attitudes towards vaccines, communicating accurate information about the benefits of getting vaccinated can counter intra-household dynamics that undermine acceptance.

JEL-Classification: I12, I15, I18, D90, D91.

Keywords: COVID-19, Vaccines, Survey experiment, Low and Middle-income countries.

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1 Introduction

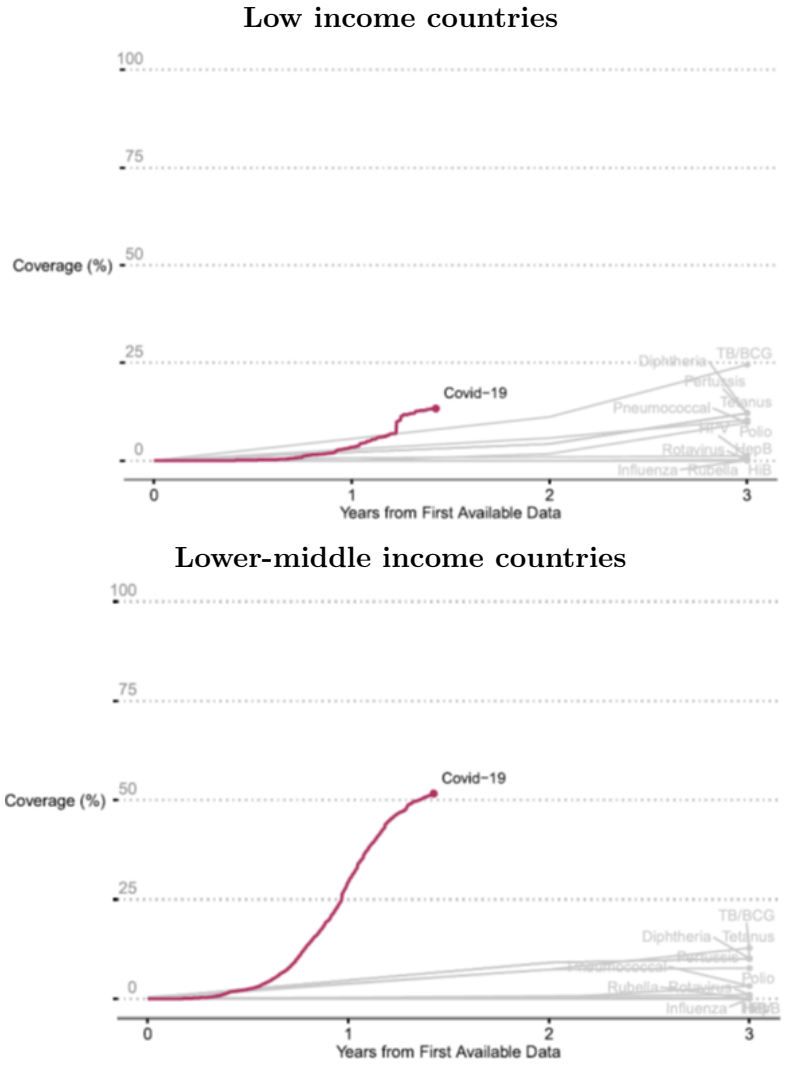
The global rollout of COVID-19 vaccines has been substantially faster than any other vaccine rollout in history, however progress has been very uneven (Figure 1). During the first half of 2022, low and lower-middle income countries (LICs and LMICs) still had relatively limited coverage of their populations and the take up of COVID-19 vaccines had begun to slow down considerably. These trends are alarming as the possibility of many of these countries reaching herd immunity for COVID-19 seems far beyond reach (Kwok et al, 2020). This is at a time when many supply constraints for COVID-19 vaccines have been eased, which suggests limited demand is likely contributing to slower progress towards reaching the rest of the population. The drivers of people's demand for COVID-19 vaccines have received relatively little attention in LICs and LMICs as policy makers have tended to focus on procuring vaccines and making them as widely available as possible. There is a knowledge gap about the role intra-household dynamics may play in shaping people's attitudes towards COVID-19 vaccines. This issue warrants close consideration as the rapid rollout of COVID-19 vaccines and near universal eligibility means that all adults and teenagers in the same household can get vaccinated at the same time, which is truly distinct from what has occurred with any other vaccine rollout in LICs and LMICs[1].

We examine this issue of intra-household dynamics and attitudes towards vaccines by conducting a novel randomized survey experiment and drawing on a unique nationally representative survey in Zambia. Specifically, we use individual level surveys for all household members in a nationally representative sample of over 10,000 households that were conducted in-person immediately prior to the rollout of COVID-19 vaccines. Building on this initial survey, we conducted a randomized survey experiment through social media involving almost 3,000 participants in March and April 2022. This online experiment tested how people's self-reported willingness to receive the COVID-19 vaccine was impacted by information about the benefits of the vaccine to either the individual or the household. In addition, in

[1]For instance, in most high-income countries (and some upper middle-income countries), influenza vaccines are readily available for all household members, but this is not the case in LICs and LMICs.

line with our pre-registration, we examined how the efficacy of these treatments varied based on people's beliefs about the attitudes of other household members towards COVID-19 vaccines and their role in household decision making. These two distinct surveys, which were conducted at different times, using different sampling techniques, and with different focuses, provide rich insights about how intra-household dynamics relate to people's willingness to get vaccinated against COVID-19.

Figure 1: The share of the population reached during the first three years of vaccine rollouts



Note: These charts show how vaccine rollouts (highlighting COVID-19 vaccines rollouts in red) have varied across countries at different income levels. The analysis was conducted by Glassman, Kenny and Yang (2022) and we received their permission to include these charts in our paper.

We show that intra-household dynamics are very closely related to people's attitudes towards vaccines. The in-person survey revealed that by far the strongest covariate of whether an individual is willing (unwilling) to get vaccinated is whether other members of their household are willing (unwilling). A related pattern also existed at the household level, whereby the share of household members that were willing to get vaccinated was closely correlated with whether the head of the household was willing to get the vaccine. The online experiment shows respondents in the treatment groups were more likely to be willing to get vaccinated, regardless of whether they received information emphasizing the individual or household benefits of getting a COVID-19 vaccine. Both treatments were more potent among respondents who believed other household members would not get vaccinated, while the treatments did not have a larger impact on respondents with a role in household decision making. There was also evidence that there could be positive "second-round" treatment effects whereby treated respondents were also more likely to encourage other household members to get a COVID-19 vaccine.

A key implication that flows from this analysis is that household members tend to share similar attitudes towards vaccines, however communicating accurate information about the benefits of getting vaccinated can counter intra-household dynamics that undermine acceptance. At first glance, the strong correlation between household members' willingness to get vaccinated suggests there may be a need to reconsider efforts that are primarily targeted towards individuals getting vaccinated for COVID-19, such as providing vaccines at workplaces. Rather, it may be more appropriate to approach household members as a collective unit and undertake vaccination activities at the household level, such as door-to-door campaigns. However, the experimental results illustrate that there is still value in communicating the benefits of COVID-19 vaccinations to individuals in households that are not accepting of vaccines. In fact, this can lead both to the individual recipients of the information being more willing to get vaccinated and may create a virtuous cycle with others in the previously "hostile" household becoming more willing to get vaccinated. Collectively, the descriptive and causal findings show that there is considerable value in taking a multi-pronged approach

(i.e., at both the individual and household level) to vaccine outreach. If one person in a household is provided timely and relevant information to ease their concerns about vaccination, they may be able to encourage their household members to get vaccinated and if a household is approached together, any concerns can be addressed in one interaction with the family unit.

This study makes two notable contributions to the existing literature. Firstly, to the best of our knowledge this is the first study that closely examines how intra-household dynamics relate to attitudes towards COVID-19 vaccines. On topics other than vaccines there has been extensive work showing that intra-household dynamics shape attitudes (a notable example is pioneering work on social contagion theory (Christakis and Fowler, 2013)). There has also been some work on vaccines, prior to COVID-19, showing the existence of peer effects (e.g., see a review by Kontantinou et al., 2021). Previous studies that have focused on levels of acceptance of COVID-19 vaccines have relied on surveys with only one respondent per household, which limits the authors' ability to dive deeply into intra-household dynamics. We overcome this hurdle by drawing on an in-person dataset with individual level surveys covering all household members (aged 10 years and older) from a nationally representative sample of households in Zambia. The findings from the in-person survey informed the design of the online experiment that explicitly tested whether emphasizing benefits for individuals or their household had a greater impact on people's willingness to get vaccinated. In addition, we examine heterogenous treatment effects based on people's beliefs about the attitudes of other household members towards vaccines and their role in household decision making. The small amount of prior experimental work has almost exclusively focused on individual benefits from vaccination and had not examined heterogenous treatment effects along these dimensions.

Secondly, we contribute to the sparse literature that generates causal evidence about what underpins the acceptance of vaccines in LICs and LMICs, being among one of the first experiments to explicitly focus on COVID-19 vaccines. Seminal studies prior to the COVID-19 pandemic have tended to focus on how mistrust towards vaccines was influenced by

questionable activities being brought to light (Archibong and Annan, 2021; Martinez-Bravo and Stegmann, 2022). Since the outset of the pandemic there has been some experimental work in high-income countries about ways to boost COVID-19 vaccine acceptance (e.g., Kaplan and Milstein, 2021), but in LICs and LMICs existing publicly available studies have been almost exclusively descriptive (e.g., Kanyanda et al., 2021). An exception is a study by Hoy et al. (2021) in Papua New Guinea (PNG) that also uses social media to conduct an online experiment. Our study extends beyond this previous paper in three ways. Firstly, our study is arguably far more generalizable to other LICs and LMICs, as rates of COVID-19 vaccine acceptance in Zambia are similar to the average for Sub-Saharan Africa (PNG has among the lowest COVID-19 vaccine take-up and highest levels of hesitancy in the world), and this experiment was conducted when vaccines were widely available (the PNG study took place before vaccines were widely available). Secondly, there are several design features of our experiment that allow for more credible heterogenous treatment effect analysis, such as having a larger sample size, a reduced number of treatment groups, and pre-registering the hypotheses. Finally, the treatments we provided were more targeted towards specific research questions, whereas the previous experiment was part of a "first generation" of surveys examining what type of information, if any, could boost the acceptance of COVID-19 vaccines. A limitation of this type of research (including our study) is that respondents were asked to self-report their willingness to be vaccinated. While intention to vaccinate is an important issue to consider, it does not necessarily guarantee vaccine uptake as other barriers may block an individual from turning their intent into action.

The rest of the paper is structured as follows. Section 2 provides background about the related literature and the hypotheses that emerge from them, as well as details about the setting of the study. Section 3 outlines the methodology behind the in-person survey and shows the main results. Section 4 describes the methodology behind the online experiment and presents the key findings. Section 5 discusses the findings across the two data sources and outlines the implications of this research.

2 Background

2.1 Related Literature

Our study is part of a growing literature that examines the drivers of people's willingness to get a COVID-19 vaccine. This subsection provides a review of existing literature in two parts. Firstly, we discuss related research about attitudes towards vaccines in LICs and LMICs and is followed by an overview of studies related to intra-household dynamics and the acceptance of vaccines.

2.1.1 Attitudes towards vaccines in low and middle-income countries

Vaccination decisions are influenced by several factors, one of which is people's beliefs and attitudes. The "increasing vaccination model" suggests that vaccine uptake is determined by three broad factors: individual cognitions, social processes, and practice issues (Brewer et al, 2017; MacDonald, 2015). Individual cognitions can range from individuals' beliefs or attitudes towards vaccination, perceived efficacy, or safety concerns, to perceptions on types of vaccines. Factors of social processes can be interpersonal interactions with either friends or family about attitudes and perceptions of vaccination. Practice issues include behavior affecting vaccine accessibility, vaccination cost, and availability.

Studies prior to the COVID-19 pandemic suggest that vaccines in general are accepted by most people in LICs and LMICs. A 2018 Wellcome Global Monitor survey of 140,000 individuals in 140 countries regarding public attitudes to health and science showed that over 90 percent of respondents in South Asia and East Africa described vaccines as safe. This is in contrast with results from Western Europe, where only 59 percent of the respondents believed vaccines to be safe. This is in line with another global study (Larson et al, 2016) on vaccine confidence conducted in 67 countries. The European region tended to be more negative when it comes to vaccine safety sentiment with France being least confident (41 percent) in vaccine safety globally. The study also showed that LICs and LMICs, such as

Bangladesh, Ecuador, and Iran, reported very high agreement that vaccines are important.

Despite this very positive outlook towards vaccines in general, existing cross-country research suggests slightly less accepting views towards COVID-19 vaccines. A multi-country study of 20 LICs and LMICs (sample of 10,477 participants) examining perceptions of COVID-19 vaccine effectiveness showed moderate to high levels of acceptance ranging from 69 percent in Indonesia to 94 percent in Bangladesh (Marzo et al., 2022). This between-country variation in attitudes to COVID-19 vaccines is similar to a large-scale study focusing on 15 countries in Africa (Africa CDC, 2021) where the variation ranged from 59 percent in the Democratic Republic of Congo to 94 percent in Ethiopia. Results from a World Bank study on COVID-19 vaccines in six Sub-Saharan African countries by Kanyanda et al (2021) conducted between December 2020 and June 2021 showed acceptance rates ranging from 64.5 percent in Mali to 97.9 percent in Ethiopia. These studies also showed that trust in the effectiveness and safety of the vaccine was the most common reasons for acceptance (Marzo et al., 2022; Arce et al., 2021).

Existing publicly available research on ways communication campaigns[2] can increase COVID-19 vaccine acceptance comes almost exclusively from high-income countries and has returned mixed results. Some experiments have successfully changed views, while others have not, or have only found certain treatments to be effective (Ashworth et al., 2021; Chang et al., 2021; Pink et al., 2021; Kaplan and Milstein, 2021; Loomba et al., 2021). One of the few published experimental papers on attitudes about COVID-19 vaccines in the United States found that norm-based appeals emphasizing vaccination uptake among others increase people's propensity to state they will be vaccinated (Palm et al., 2021). To the best of our knowledge, the only publicly available experimental research on this in a low or middle-income country comes from Papua New Guinea. This online experiment demonstrated that a message emphasizing the safety of the vaccine relative to getting COVID-19 increased willingness to get vaccinated by around 50 percent (Hoy et al, 2021).

[2]Other approaches that have been shown to increase vaccine uptake, such as mandates and incentive schemes (Dubé et al., 2015; Eskola et al., 2014) are beyond the scope of this research.

2.1.2 Intra-household dynamics and the acceptance of vaccines

Clustering of opinions and exchange of information is a common phenomenon in social networks, particularly households (Christakis and Fowler, 2013). The sources of such information can be external agents, such as health or government authorities, or internal agents, such as people in one's social circle ranging from friends or co-workers to people living in the same household. The conditions under which intra-household decisions are made, such as gender roles in the household, status within the household and cultural norms, impact household outcomes (Ashraf, 2009). For example, studies on food security have shown that gendered aspects of intra-household decision making impact production diversity and dietary quality in Ethiopia (Sariyev et al., 2020) and Malawi (Jones et al., 2014).

Social networks and intra-household dynamics can play an essential role in influencing attitudes in vaccination uptake. A review of eleven studies on vaccine uptake and social networks found that individuals held more positive attitudes and had a higher probability to get vaccinated if their network consists of people, especially family and friends, with positive attitudes towards vaccines (Kontantinou et al., 2021). In a similar way, negative attitudes and lower acceptance were transmitted within households (ibid). A cross-cultural study by Taylor et al (2016) on household influence on flu vaccine decisions found that household members recommend one another to vaccinate, albeit at different levels, and that advice is congruous with an increased vaccination uptake.

Recent studies related to COVID-19 have also emphasized the role of social networks and households in impacting behavior. There is evidence that closely knit communities have reported relatively fewer COVID-19 cases and deaths because of the spread of information about preventive measures (Fraser et al., 2021; Makridis and Freeman, 2021; Pitas and Ehmer, 2020). In a study on COVID-19 vaccine uptake among Americans, Hao and Shao (2022) found that people are more likely to get vaccinated if a higher proportion of their family or close friends had already been vaccinated. An IMF study by Khan et al. (2021), that used individual-level data from the COVID-19 Behavior Tracker, found that peers

help in driving (and undermining) vaccine acceptance. They argue that people who receive warnings against the vaccine from family and friends are less willing to take it, and more likely to share negative information about vaccines with others.

2.2 Hypotheses

Several hypotheses emerge from the existing literature about how intra-household dynamics are likely to relate to attitudes towards COVID-19 vaccines.

The first hypothesis that emerges from the existing literature that can be explored with descriptive data is as follows:

Hypothesis 1 – People's willingness to get vaccinated for COVID-19 will be closely correlated with whether other household members are willing to get vaccinated for COVID-19

This hypothesis is a natural extension of the widely accepted phenomenon whereby people's decisions are influenced by the behavior of others around them, particularly in the same household. There is good reason to believe this is likely to apply to COVID-19 vaccines. Especially as information about the availability and reported benefits (or lack thereof) from COVID-19 vaccines is likely to be shared within households and, in some instances, access to vaccines may be provided to household members collectively (e.g., through door-to-door vaccination campaigns).

The second hypothesis that emerges from the very limited prior experimental work on boosting people's willingness to get a COVID-19 vaccine is as follows:

Hypothesis 2 - Respondents who receive information about the benefits of being vaccinated will be more (less) likely to state they are willing (unwilling) to get vaccinated

This hypothesis is underpinned by descriptive surveys in low and middle-income countries that show people are more likely to be accepting of COVID-19 vaccines if they trust it has benefits. In addition, the nascent experimental literature on this topic (almost exclusively in high-income countries) suggests that in some instances information treatments can lead to people being more accepting of COVID-19 vaccines. Prior to field work commencing, when this hypothesis was pre-registered, we were agnostic on which specific types of information about the benefits from COVID-19 vaccines would lead to greater willingness to get vaccinated.

The third and fourth hypotheses build on the previous two hypotheses by inferring how the impact of information about the benefits of COVID-19 vaccines on people's willingness to get vaccinated is likely to vary based on intra-household dynamics. These hypotheses are as follows:

Hypothesis 3 - Respondents who receive an information treatment and have household members who are willing to be or have been vaccinated will be more (less) likely to state they are willing (unwilling) to get vaccinated

Hypothesis 4 - Respondents who receive an information treatment and have a role in making household decisions will be more (less) likely to state they are willing (unwilling) to get vaccinated

Both hypotheses are founded on the premise that the elasticity of people's willingness to get a COVID-19 vaccine is influenced by the attitude and behavior of others in their household. In the case of the third hypothesis, we suggest that the treatment will have a relatively smaller impact on people in households where others are unwilling to get vaccinated because their attitudes will be less malleable to outside sources of information that are contrary to the prevailing view in the household. In the case of the fourth hypothesis, we

postulate that people who have a role in decision making within the household will be more likely to respond to the treatment as they have greater autonomy over their own choices. Due to the novelty of this research, these hypotheses extend well beyond clear guidance that is available from prior research. As such they were somewhat speculative when these hypotheses were pre-registered prior to the online survey experiment commencing.

2.3 Setting

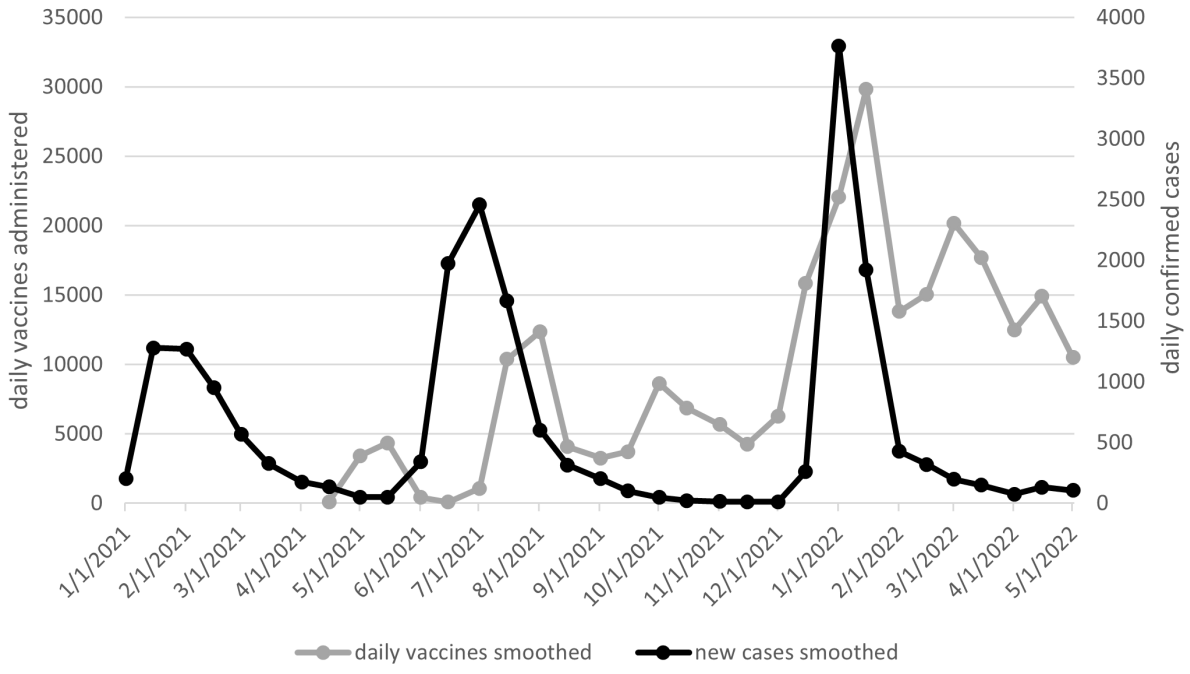
Zambia is a large, landlocked, resource-rich country with sparsely populated land in the center of Southern Africa. More than 58% (2015) of Zambia's 16.6 million people live on less than the international poverty line of USD1.90 per day (compared to 41% across Sub-Saharan Africa) and three quarters of the poor live in rural areas (World Bank 2022). The Zambian Ministry of Health has implemented successful mass vaccination campaigns targeted at children (Carcelen et al, 2021). In 2019, 93 percent coverage was reported for the first dose of measles-rubella vaccine (MR). Despite this progress with MR vaccines, coverage of other vaccines, such as hepatitis B, are far more limited (ibid).

The first COVID-19 cases in Zambia were reported in the capital city of Lusaka in March 2020 when most countries started grappling with the virus. There have been 319,755 (as of 1 May 2022) cumulative confirmed cases of COVID-19 in Zambia in the past two years, since the beginning of the pandemic (WHO, 2022). In 2021, the total number of confirmed cases and deaths increased almost tenfold from 20,997 cases and 390 deaths in January 2021 to 305,047 cases and 3,734 deaths by the end of December 2021 (Johns Hopkins University, 2022) (see Figure 2).

The Government of Zambia launched the national COVID-19 vaccination program in April 2021. Zambia received its vaccines mostly through vaccine initiatives such as the African Vaccine Acquisition Trust (AVAT) and COVID-19 Vaccine Global Access (COVAX), a partnership between CEPI, Gavi, UNICEF, and WHO. In June 2021, amidst a third wave of infections and deaths, Zambia received its second shipment of 228,000 COVID-19 vaccine

doses through COVAX (UNICEF, 2021). However, there was a decline in the number of vaccines administered in the months following August 2021. To address this a joint campaign between the Zambian Ministry of Health and USAID was launched in December 2021 and this helped to speed up the vaccination rate. As new infections peaked early in 2022, there was a tremendous increase in the number of doses administered in January leading to around 10 percent of the population being fully vaccinated in February 2022 (Mathieu et al, 2021). By the end of April 2022, Zambia averaged 11,001 doses administered each day (Reuters, 2022). By 1 May 2022, 13 percent of the national population had been vaccinated with a total of 3,750,417 vaccine doses administered.

Figure 2: COVID-19 cases and vaccines administered in Zambia from 1 Jan 2021 to 1 May 2022



Note: This chart shows how new COVID-19 cases and vaccines administered in Zambia varied from 1 January 2021 to 1 May 2022. The data used to produce this chart was sourced from Johns Hopkins University (2022).

3 In-person survey methodology and results

3.1 Methodology

The in-person survey was conducted by the Zambia Statistical Agency from February 2021 to April 2021 in collaboration with the World Bank and several UN agencies. Data was collected from over 10,000 households with respondents answering questions on household welfare and COVID-19 socio-economic impact at the individual and household level. The household level questionnaire was answered primarily by the household head, whereas the individual survey consisted of all people 10 years of age or older in households available at the time of the interview. The average proportion of eligible members in a household who participated in the survey (excluding children under 10 years of age) was 71.5 percent. Similar to what takes place for Demographic and Health Surveys, the individual survey modules were conducted in a way that meant people did not have to provide their answers in front of other household members. The in-person survey employed a two-stage stratified cluster sample design. Firstly, 419 Enumeration Areas (EAs) were selected with Probability Proportional to Size (PPS) of the stratum. Secondly, systematic sampling was employed to select 25 households from each EA (ZamStats, 2021). The sampling frame was based on the 2010 Census of Population and Housing. The sampling frame covered 10,490 households and produced results that were representative at the national, provincial, and urban/rural levels. The survey yielded a high response rate as 97 percent (10,213 households) of the planned households were reached.

Sample weights in the survey were constructed using the 2015 LCMS (CSO, 2016) methodology. To construct weights, the inverse of the probability of an EA being selected was multiplied by the inverse of the probability of a particular household in an EA being selected by 1 (i.e., the probability that an individual in that household is selected). These weights were then post-stratified to match population projections based on the 2010 Zambian census.

3.2 Findings

3.2.1 Acceptance of COVID-19 vaccines

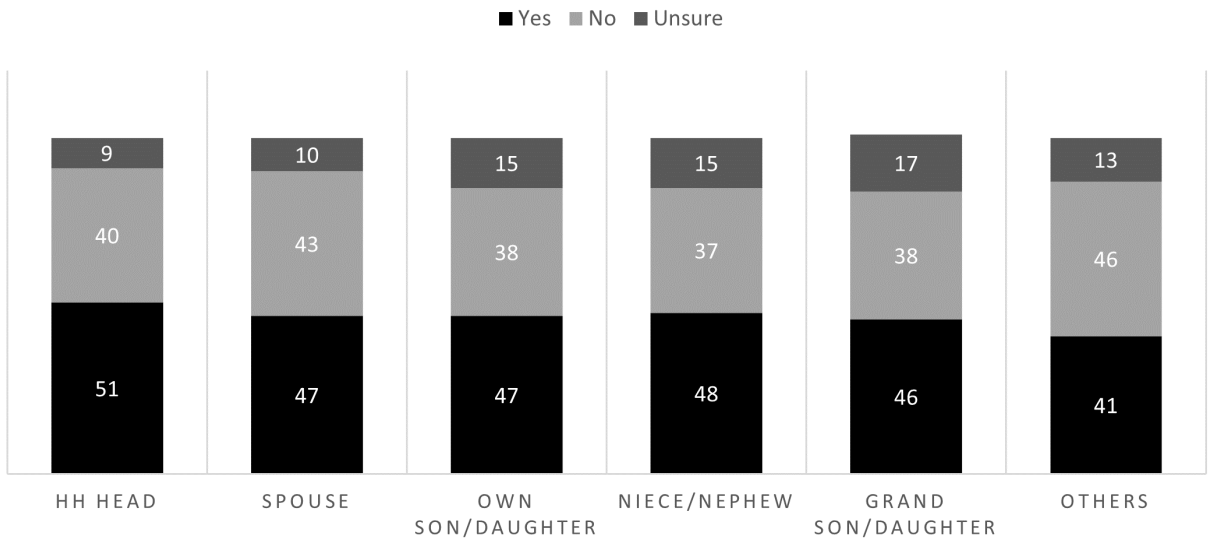
In early 2021, around 95 percent of Zambians reported that they are aware of COVID-19. Nearly half of the survey respondents were also aware of the existence of a COVID-19 vaccine. Men tended to be slightly more aware than women (52 percent vs. 48 percent). Awareness of the COVID-19 vaccine was much higher among respondents in Lusaka (70 percent) compared to respondents living in urban areas excluding Lusaka (54 percent) and those in rural areas (30 percent). Nearly half of Zambians (48 percent) reported being willing to take a COVID-19 vaccine if it became available . The remainder of the population were unsure whether they would get vaccinated (12 percent) or were not willing to get vaccinated (40 percent). Men tended to be slightly more willing to get vaccinated (50 percent vs 46 percent). Willingness to take the COVID-19 vaccine was higher among people in the rural areas (52 percent), compared to people living in urban regions (43 percent). There is no notable difference in acceptance of COVID-19 vaccines among people with different employment types or by age group.

Household heads were slightly more willing to get vaccinated compared to other members of the household. As seen in Figure 3, more than half of the household heads (51 percent) intended to get COVID-19 vaccine, 40 percent did not intend to get vaccinated, and 9 percent were unsure. Spouses were the most likely to state they don't intend to get vaccinated (43 percent) and people with other positions in the household were more likely to say they were unsure (around 15 percent). These trends did not vary greatly based on the gender of the household head. In total, of the 10,213 households, 65.2 percent of the households had at least one member who is willing to get vaccinated against COVID-19.

The most common reasons for vaccine hesitancy were a lack of trust in the vaccine (40 percent) and fear of side effects (32 percent) . Around 10 percent of those who are unwilling to get COVID-19 vaccine claimed COVID-19 vaccines to be experimental and 10 percent cited vaccines to be ineffective. There is no clear variation in reasons for hesitancy across different

individual characteristics. Additional findings from the in-person survey are presented in Appendix A1.

Figure 3. Willingness to get vaccinated by position in the household



Note: This chart shows how willingness to get vaccinated varies by people's position in the household.

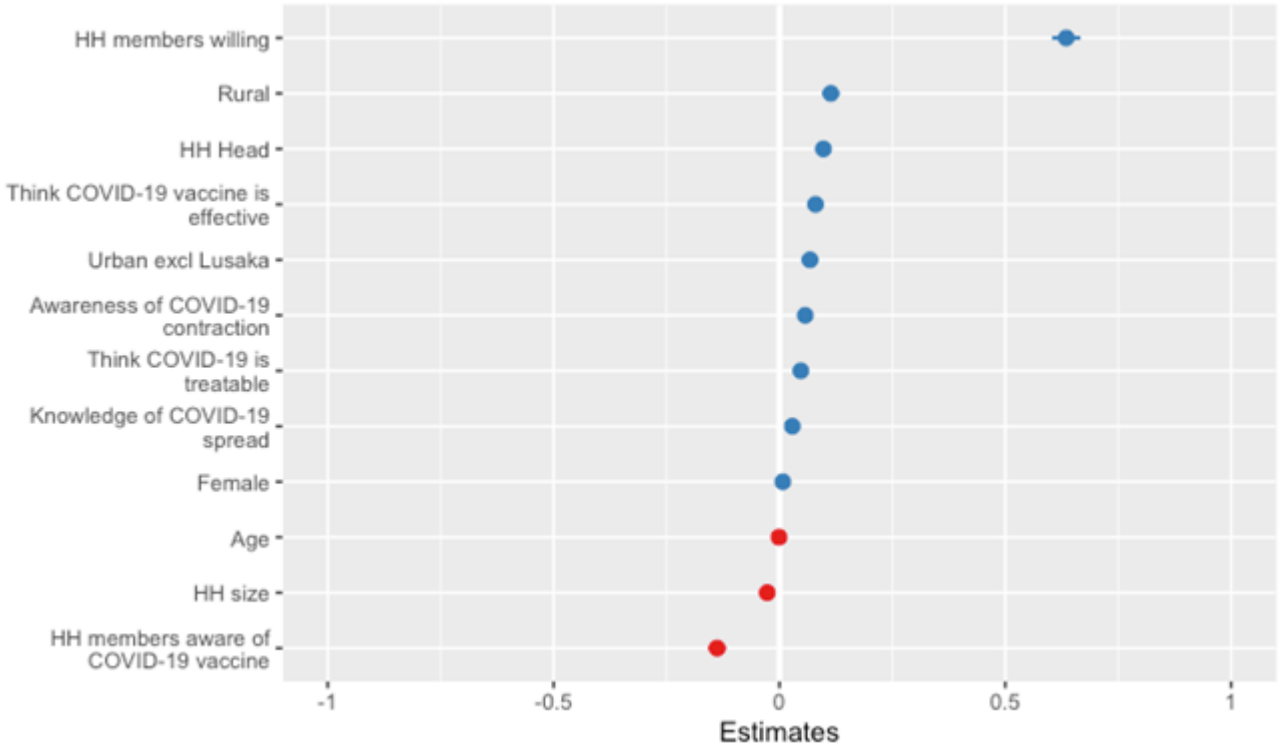
3.2.2 Factors associated with willingness to get a COVID-19 vaccine

Drawing on the in-person survey data, the relationship between an individual's willingness to get vaccinated and the willingness of other household members to get vaccinated, particularly the household head, are discussed at the individual and household levels below.

Individual level

Whether other household members were willing to get vaccinated was closely associated with whether an individual was also willing. After controlling for background characteristics, the likelihood an individual would state they were willing to get vaccinated was around 62 percentage points higher when other household members were also willing to get vaccinated (see Figure 4 and see Table A2.1 in the Appendix). No other characteristics had such a clear association with whether an individual would say they are willing to get vaccinated.

Figure 4: Factors influencing individual COVID-19 vaccine intentions



Note: This chart shows the extent to which different factors are associated with an individual's intention to get vaccinated. See the full regression analysis in Table A2.1 in Appendix for details. Age: Defined as the age of the individual in years. Female: Dummy variable for whether an individual is female. Urban excl Lusaka: Dummy variable for whether a household is in urban regions excluding Lusaka with Lusaka as baseline category. Rural: Dummy variable for whether a household is in a rural region with Lusaka as baseline category. HH size: Defined as the number of members in the household. HH Head: Dummy variable for whether an individual is a household head. HH members willing: Defined as the proportion of other household members who are willing to get a COVID-19 vaccine. HH members aware of COVID vaccine: Defined as the proportion of household members who are aware of COVID-19 vaccine. Think COVID-19 is effective: Dummy variable for whether the individual thinks COVID-19 vaccine is effective. Think COVID-19 is treatable: Dummy variable for whether the individual thinks COVID-19 is treatable. Knowledge of COVID-19 spread: Dummy variable for whether the individual has the knowledge of COVID-19 spread. Awareness of COVID-19 contraction: Dummy variable for whether the individual is aware of COVID-19 contraction in the community.

Household level

The proportion of household members who were willing to get vaccinated was closely associated with whether the household head was also willing. This can be seen most simply by comparing the share of household members who were willing to get a COVID-19 vaccine

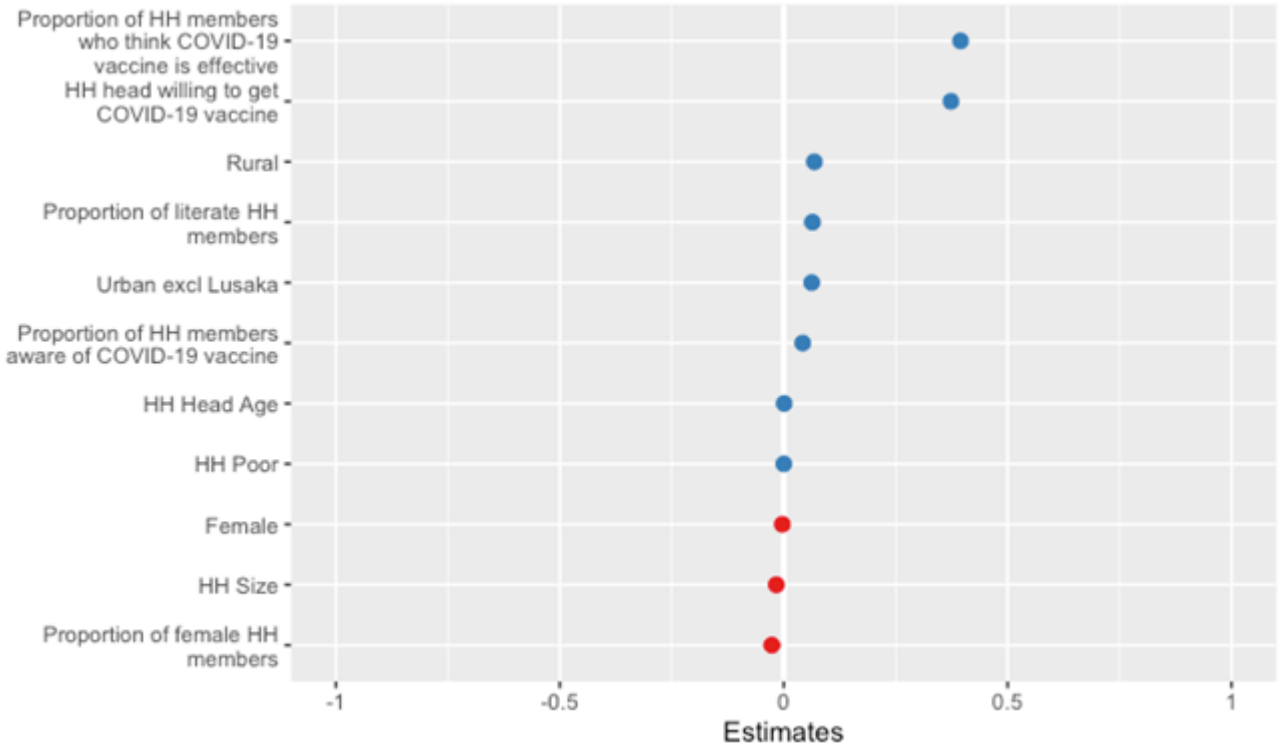
between households where the head was willing or not willing. The difference is almost 50 percentage points (61.4 percent of household members were willing when the household head was, while 13.6 percent were willing when the household head was not). This pattern is explored more rigorously in the following regression analysis whereby other background characteristics are also controlled for.

The regression analysis also shows that willingness of a household head to get vaccinated had a very strong association with the proportion of household members who would be willing to get a vaccine. After controlling for background characteristics, the proportion of household members who were willing to get vaccinated was around 35 percentage points higher when the household head was also willing to get vaccinated (see Figure 5 and Table A2.2 in the Appendix). The only other characteristic that had a very strong association was the proportion of household members who think that a COVID-19 vaccine would be effective (around 39 percentage points). All other factors had a negligible correlation.

3.3 Summary of findings from in-person survey

Three key findings about intra-household dynamics and attitudes towards COVID-19 vaccines emerge from this nationally representative, in-person survey that was conducted in Zambia prior to widespread access to COVID-19 vaccines. Firstly, there is considerable variation across households in terms of willingness to get vaccinated against COVID-19, with around half of individuals being willing. Secondly, the main reasons people were unwilling to get vaccinated seemed to somewhat stem from a lack of understanding about the benefits from getting a COVID-19 vaccine. Thirdly, consistent with Hypothesis 1, we illustrate that there is a strong correlation between the attitudes of individuals within households towards COVID-19 vaccines. Collectively, these results suggest that intra-household dynamics may play an important role in shaping people's attitudes towards COVID-19 vaccines and that there could be greater acceptance of vaccines if people were made aware of the benefits.

Figure 5: Factors influencing the share of household members that would be willing to get a COVID-19 vaccine



Note: This chart shows the extent to which different factors are associated with the share of household members that intend to get vaccinated. See the full regression analysis in Table A2.2 in Appendix for details. HH size: Defined as the number of members in the household. HH poor: Dummy variable for whether a household is poor . HH head age: Defined as the age of the household head in years. Female: Dummy variable for whether a household has a female household head. Urban excl. Lusaka: Dummy variable for whether a household is in urban regions excluding Lusaka. Rural: Dummy variable for whether a household is in a rural region. Proportion of female HH members: Defined as the proportion of female household members. Proportion of literate HH members: Defined as the proportion of literate household members (completed primary or secondary education). Proportion of HH members aware of COVID vaccine: Defined as the proportion of household members who are aware of COVID-19 vaccine. Proportion of HH members who think COVID vaccine is effective: Defined as the proportion of household members who think COVID-19 vaccine is effective. Willingness of HH head to get COVID vaccine: Dummy variable for whether a household head is willing to get vaccinated.

4 Online experiment methodology and results

4.1 Methodology

The design of the online experiment was based on prior surveys about COVID-19 vaccine acceptance conducted by the World Bank in 2021 (Kovacevic et al., 2022; Bidani et al., 2022). It took place via Facebook from March 4 to April 6, 2022. Participants were recruited using Facebook advertisements (see example in Appendix A3) and were taken to a chatbot in Facebook messenger to complete the survey (see example of how the questions appeared in Appendix A3). Advertisements to recruit people to this study reached approximately 825,000 Facebook users and 10,837 people clicked on an advertisement to begin the survey. The sample was drawn from all Facebook accounts in Zambia over the age of 18 and quotas were applied based on demographic characteristics (age, gender, and region) to ensure adequate representation in the sample. At the time of the online survey, it was estimated that almost one-third of adults in Zambia have a Facebook account (Napoleon Cat, 2022), but these individuals were more likely to be younger, male and in urban areas compared to the general population. To address this issue, survey data was weighted using inverse probability weights based on age, gender, and region calculated using the most recent Zambian census from 2010 (see Appendix A3 for details).

The treatments in the online experiment were informed by the findings of the in-person survey, existing studies on vaccine acceptance, and were also tailored to suit the Zambian context based on consultation with local stakeholders. Two similar, but distinct treatments were included to explore whether any differences existed between messages emphasizing benefits at an individual versus household level from getting a vaccine. Efforts were made to ensure that the treatments were as comparable as possible and potential differences between treatment groups would be attributable to the content, as opposed to the format. The resulting two treatments (individual benefit and household benefit) are in Table 1.

Table 1: Design of randomized survey experiment

Group	Question
Control	Are you willing to get a COVID-19 vaccine?
Individual Benefit	The best choice you can make to protect yourself from COVID-19 is to get fully vaccinated. This greatly reduces the risk of severe illness, hospitalisation and dying from COVID-19. Are you willing to get a COVID-19 vaccine?
Household Benefit	The best choice you can make to protect your household and family from COVID-19 is to get fully vaccinated. This will help to keep the people you love healthy, safe and strong. Are you willing to get a COVID-19 vaccine?

In total, 10,169 people completed the online survey, of which 2,937 people took part in the online experiment. As the experiment focused on ways to increase willingness to get vaccinated, only people who had not received a COVID-19 vaccine were eligible (i.e., all respondents to the Facebook advertisement who stated they were already vaccinated for COVID-19 did not participate in the experiment). Survey experiment participants were randomly allocated into three groups (the two treatment groups and the control group). Forty percent of participants were allocated to the control group and the remaining 60 percent were split between the two treatment groups. The sample sizes for the treatment and control groups were informed by best practice in the literature (Haaland et al., 2022). Randomization ensured there were very few statistically significant differences between treatment and control groups across demographic characteristics (see Table A4.1 in Appendix). As such, we present graphs showing treatment effects by comparing means across groups (with survey weights) in the body of this paper. In Appendix A4, we present tables showing the regression analysis of the treatment effects with controls added. Results from both methods are effectively the same.

4.2 Findings

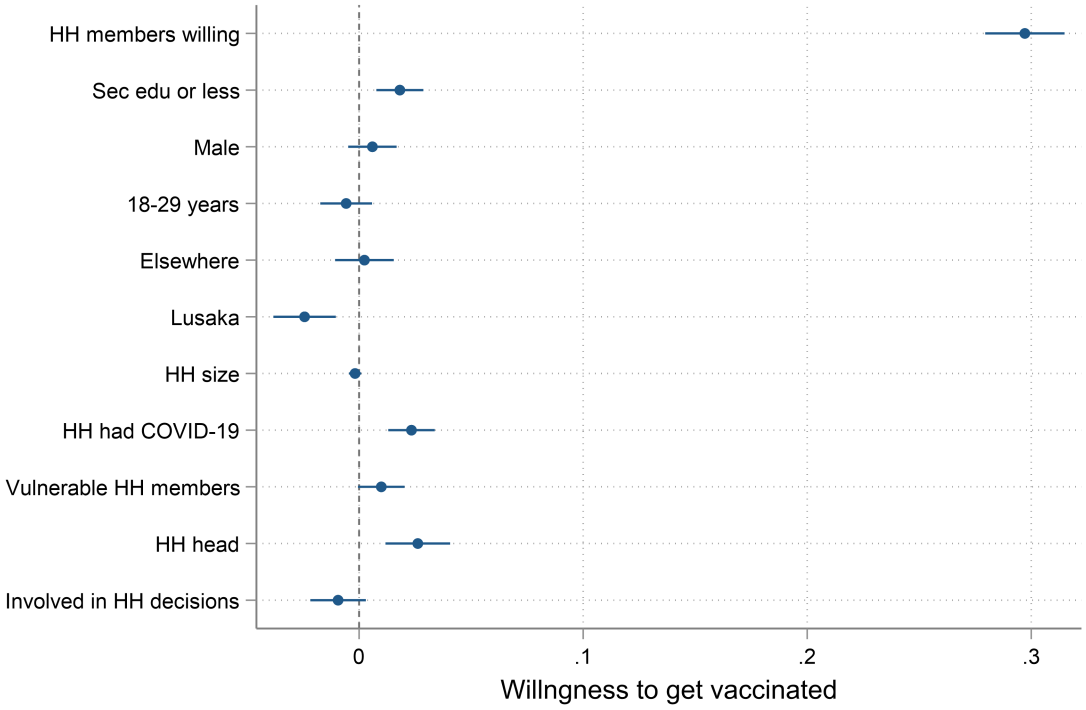
4.2.1 Descriptive results

Similar to the in-person survey, the descriptive findings of the online survey also reflect the prominent role the attitude of other household members has on an individual's willingness to get vaccinated. Figure 6 shows the results of the equivalent regression analysis described in relation to the in-person survey in Section 3 (equivalent of Figure 4) but using data from respondents to the Facebook advertisements in the control group, who were not randomly allocated to receive a treatment (see Table A4.2 in Appendix for details). An individual was around 30 percentage points more willing to be vaccinated if others in their household were also willing. This factor has by far the strongest association with whether a respondent is willing to get a COVID-19 vaccine. All other factors had a negligible correlation. It is important to note this means that being involved in household decisions was not clearly associated with willingness to get a COVID-19 vaccine.

4.2.2 Main findings from online experiment

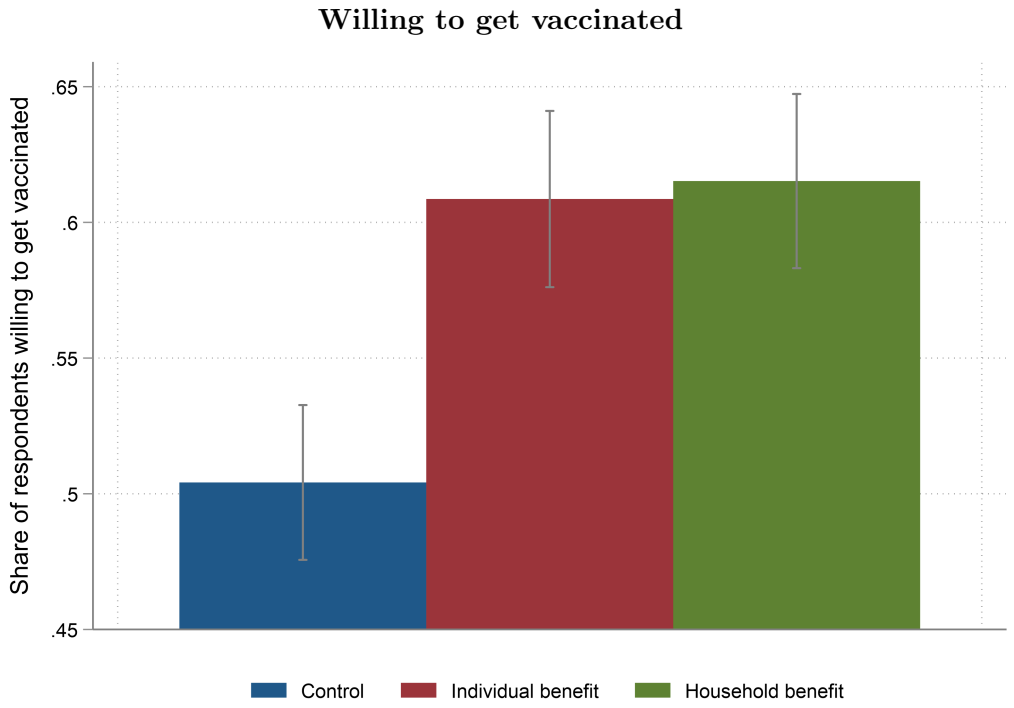
The overall results of the experiment illustrate that a message about the benefits of COVID-19 vaccines can substantially increase willingness to get vaccinated and decrease unwillingness. Figure 7 shows that both treatments increased the share of respondents who were willing to get vaccinated by around 10 to 11 percentage points and decreased the share who were unwilling to get vaccinated by around 7 and 5 percentage points (individual benefit and household benefit respectively). Both of the treatment effects are statistically significant at conventional levels. After controlling for the characteristics of respondents, the treatment effects were still large and significant (see Table A4.3 in Appendix).

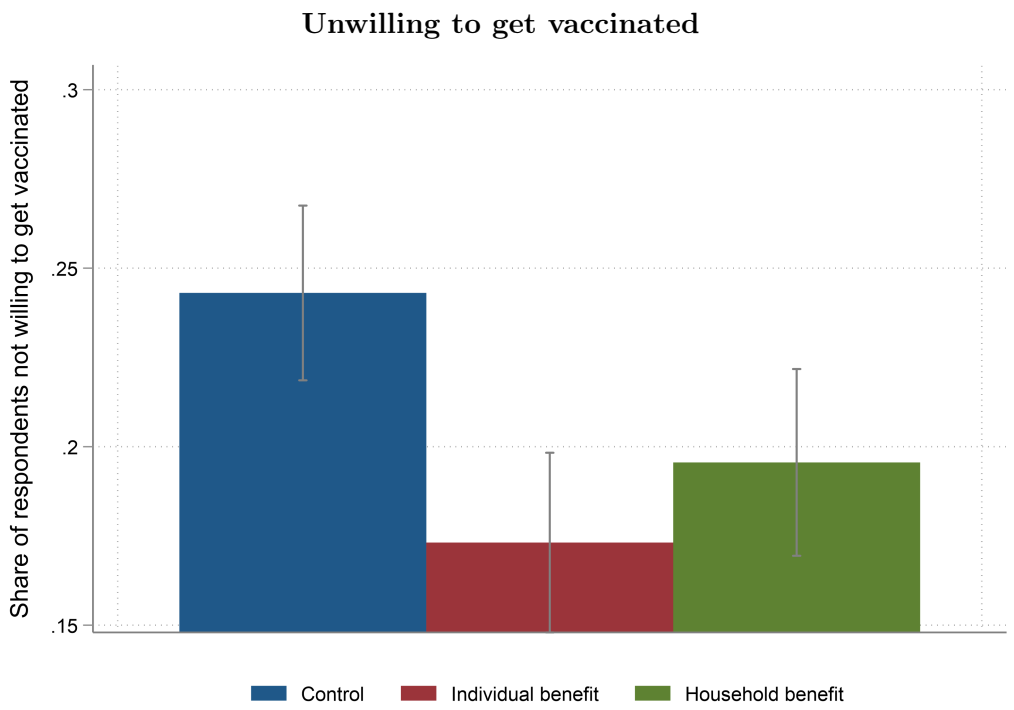
Figure 6: Factors influencing individual COVID-19 vaccine intentions



Note: This chart shows the extent to which different factors are associated with an individual's intention to get vaccinated. See the full regression analysis in Table A4.2 in Appendix for details. HH members willing: Dummy variable for whether respondents believe other household members would be willing to get a COVID-19 vaccine. HH size: Defined as the number of members in the household. Sec edu or less: Dummy variable for whether an individual has completed secondary education or less. Male: Dummy variable for whether an individual is male. 18-29 years: Dummy variable for whether an individual is between 18-29 years. Elsewhere: Dummy variable for whether an individual is living outside Lusaka and the Copperbelt regions. Lusaka: Dummy variable for whether an individual is living in Lusaka. HH had COVID-19: Dummy variable for whether an individual lives in a household where someone has contracted COVID-19. Vulnerable HH members: Dummy variable for whether an individual lives in a household with vulnerable household members (e.g., those aged 65 years and older). HH head: Dummy variable for whether an individual is the head of the household. Involved in HH decisions: Dummy variable for whether an individual is involved in household decision making.

Figure 7: Main treatment effects





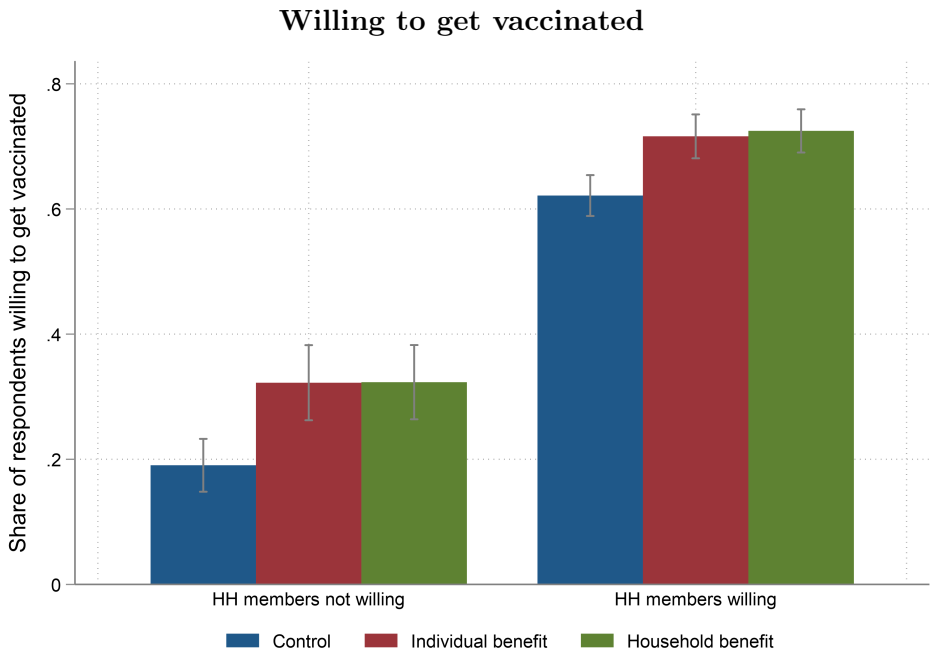
Note: These charts show the share of respondents in each treatment group and the control group that was willing (or unwilling) to get vaccinated. The confidence intervals are set at the 95 percent level. See the full regression analysis in Table A4.3 in Appendix for details.

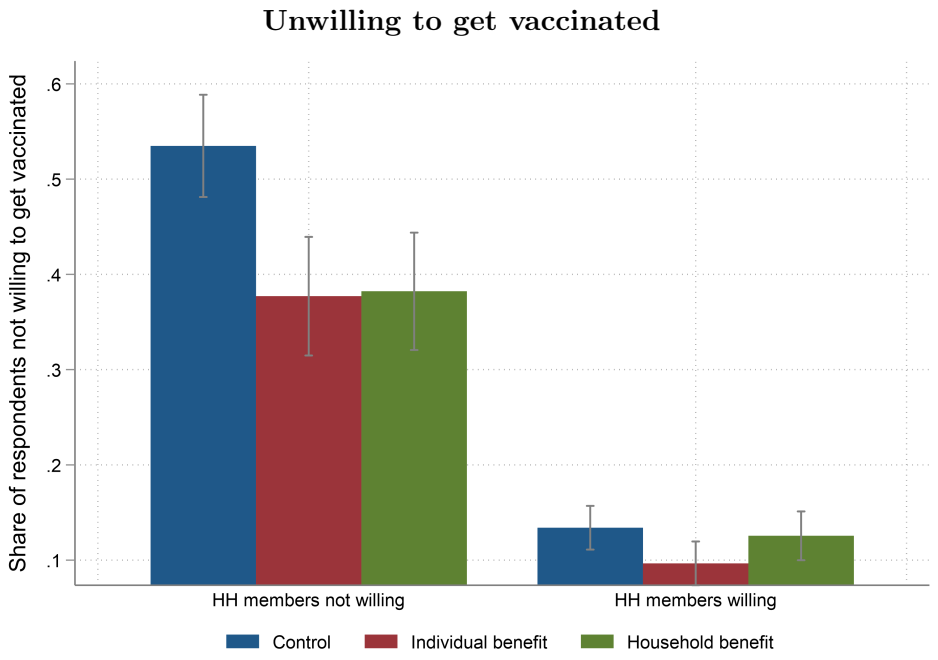
4.2.3 Heterogenous treatment effects

The heterogenous treatment effects along the dimensions that were included in the pre-registered hypotheses (discussed in Section 2) reveal important information about intra-household dynamics and attitudes towards vaccines (see regression results including interaction terms in Table A4.3 in Appendix). Firstly, Figure 8a shows that both treatments increased the share of respondents willing to get a COVID-19 vaccine regardless of whether other household members were willing. The order of magnitude of the treatment effects (in terms of percentage points) between these sub-groups were similar, but there were large differences in levels in the control group. Among respondents whose household members were willing to get vaccinated, over 70 percent of respondents in both treatment groups were willing, compared to just over 60 percent in the control group. This represents a treatment effect of more than 10 percentage points (i.e., more than 17 percent higher than the control group). Among respondents whose household members were unwilling to get vaccinated, over 30 percent of respondents in both treatment groups were willing, compared to less than 20 percent in the control group. This represents a treatment effect of more than 10 percentage points (i.e., more than 50 percent higher than the control group).

Secondly, Figure 8b shows that there were sizable differences in treatment effects, in terms of reducing unwillingness to get a vaccine between respondents based on whether other household members would be willing to get vaccinated. Both treatments dramatically reduced the share of respondents that were unwilling to get vaccinated among respondents whose other household members were not willing to get vaccinated. Less than 40 percent of respondents in both treatment groups were unwilling, compared to over 50 percent in the control group. This represents a treatment effect of around 15 percentage points (i.e., over 25 percent lower than the control group). Among respondents whose household members were willing to get vaccinated, there were negligible effects from the treatments.

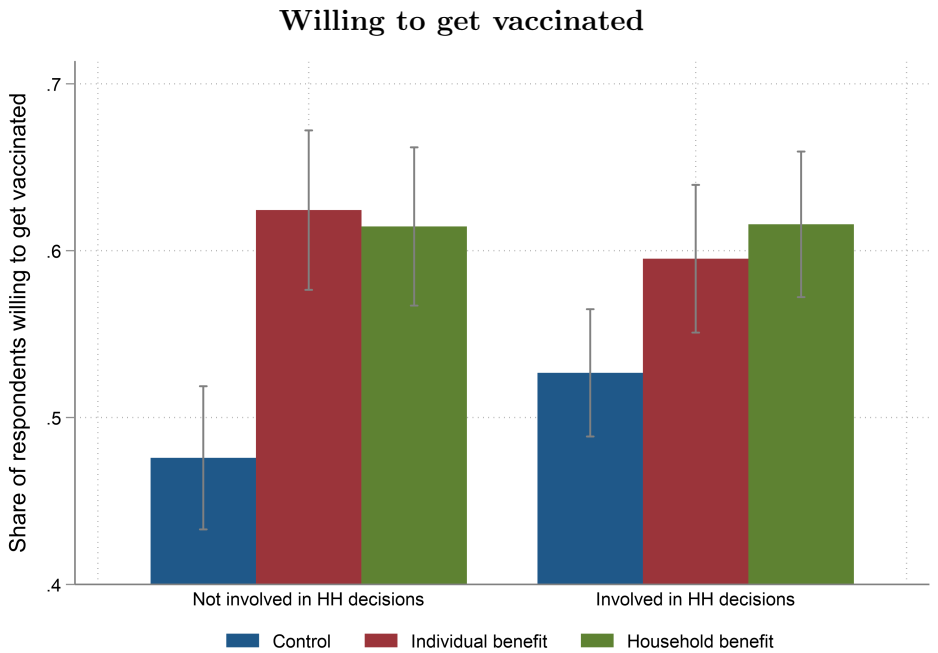
Figure 8: Heterogenous treatment effects based on the willingness of other household members

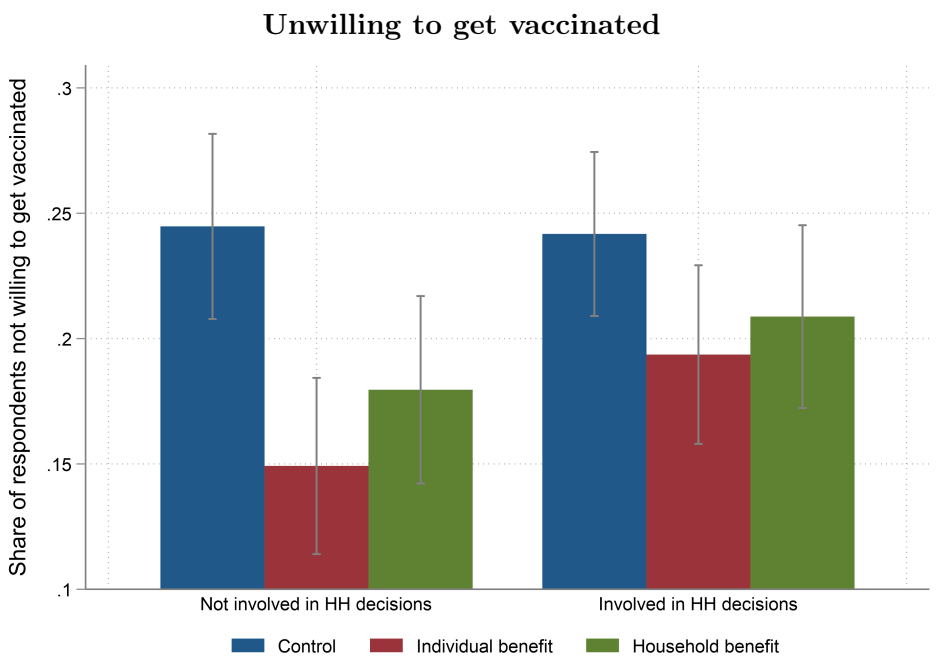




Note: These charts show the share of respondents in each treatment group and the control group that was willing (or unwilling) to get vaccinated. The confidence intervals are set at the 95 percent level. See the full regression analysis in See Table A4.3 in Appendix for details. HH members willing: Dummy variable for whether respondents believe other household members would be willing to get a COVID-19 vaccine. HH members not willing: Dummy variable for whether respondents believe other household members would not be willing to get a COVID-19 vaccine.

Figure 9: Heterogenous treatment effects based on respondents' involvement in decision making





Note: These charts show the share of respondents in each treatment group and the control group that was willing (or unwilling) to get vaccinated. The confidence intervals are set at the 95 percent level. See the full regression analysis in Table A4.3 in Appendix for details. Involved in HH decisions: Dummy variable for whether an individual is involved in household decision making. Not involved in HH decisions: Dummy variable for whether an individual is not involved in household decision making.

Thirdly, Figure 9 show that both treatments had similar effects on improving respondents' willingness to get the COVID-19 vaccines regardless of their degree of involvement in household decision making. For example, among respondents who are involved in decision making, there was an almost 10 percentage point impact on people's willingness to get vaccinated, while among respondents not involved in household decision making, there was a slightly larger than 10 percentage point impact on people's willingness to get vaccinated. As such, the results from the online survey show that not only is involvement in decision making uncorrelated with willingness to get a vaccine, but there is also an absence of a notable difference in elasticity of preferences based on this dimension. In fact, there are only minor differences between the overall share of respondents willing to get vaccinated across this dimension.

4.2.4 Second round impact from treatments

We illustrate that there were potentially "second round" effects from accurate information about the benefits of COVID-19 vaccines as treated respondents were more likely to encourage other household members to get vaccinated. As this is a "downstream" measure of the impact of information we combine treatments to maximize statistical power. We show that the treatments had a non-trivial impact on the likelihood respondents would encourage a household member to get vaccinated.

The overall effect was driven entirely by respondents who were in households where other members were unwilling to get vaccinated (see Figure 10a). Specifically, the share of respondents in the treatment groups that would encourage others to get vaccinated in their households was around 63 percent, while it was 55 percent in the control group (representing a treatment effect of 8 percentage points). The descriptive results of the online survey illustrate that respondents encouraging others in their household to get vaccinated would likely have additional benefits by creating a pro-vaccination social norm in the household. Among the unvaccinated in the control group, around one-third reported that a family member was the most likely person who could change their mind about getting the COVID-19 vaccine. As

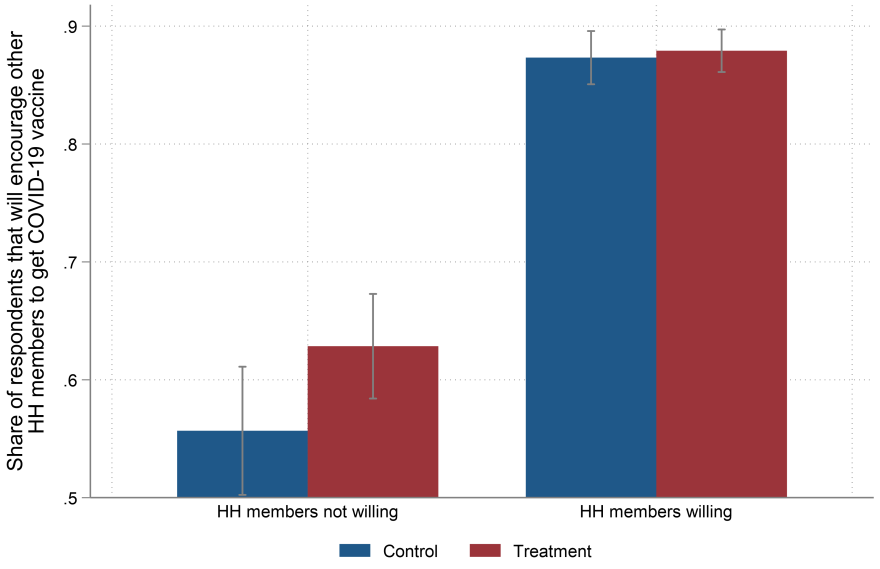
was the case for the main outcome of interest, the treatments had similar effects on whether respondents would encourage others to get a COVID-19 vaccine regardless of their degree of involvement in household decision making (see Figure 10b).

4.3 Summary of findings from online experiment

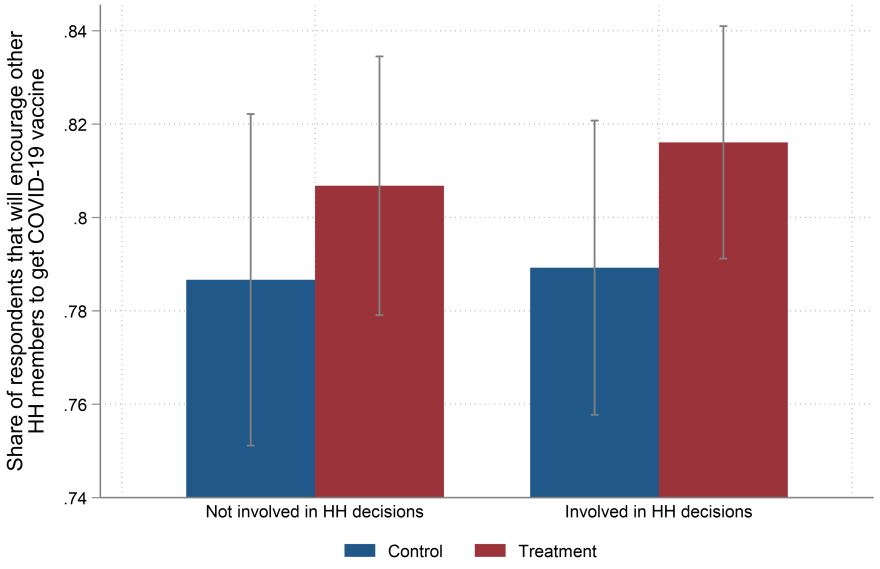
The online experiment provides several important findings about intra-household dynamics and people's willingness to get vaccinated. Firstly, consistent with Hypothesis 1 and the results of the in-person survey, there is a strong association between the attitudes towards COVID-19 vaccines among members of the same household. Secondly, consistent with Hypothesis 2, accurate information about the benefits of getting vaccinated improved attitudes towards vaccines and this did not vary based on whether individual or household level benefits were emphasized. Thirdly, counter to Hypothesis 3, accurate information was far more effective at decreasing unwillingness to get vaccinated among those without other household members who were willing to get the COVID-19 vaccine. Fourthly, counter to Hypothesis 4, the treatments were not more effective at increasing willingness to get vaccinated among those who stated they were involved in household decisions. Finally, we present suggestive evidence that there may be second round effects from accurate information, whereby respondents who received a treatment were more likely to encourage their household members to get vaccinated (this was entirely driven by those without other household members who were already willing).

Figure 10: Treatment effects on whether a respondent would encourage other household members to get a COVID-19 vaccine

Heterogenous treatment effects based on the willingness of other household members



Heterogenous treatment effects based on respondents' involvement in decision making



Note: These charts show the share of respondents in both treatment groups and the control group that would encourage other household members to get vaccinated. The confidence intervals are set at the 95 percent level. See the full regression analysis in Table A4.4 in Appendix for details. Involved in HH decisions: Dummy variable for whether an individual is involved in household decision making. Not involved in HH decisions: Dummy variable for whether an individual is not involved in household decision making. HH members willing: Dummy variable for whether respondents believe other household members would be willing to get a COVID-19 vaccine. HH members not willing: Dummy variable for whether respondents believe other household members would not be willing to get a COVID-19 vaccine.

5 Discussion and conclusion

Three key insights emerge from this study that have important implications for policy makers and future research. Firstly, there is clearly a strong correlation between people's willingness (or lack thereof) to get vaccinated within the same household. This pattern is evident in both the in-person and online surveys. As such, in many instances it would seem to be appropriate to consider the attitudes towards vaccines of household members as a collective unit as opposed to a group of individuals. Similar points have been made about other topics, such as political preferences whereby the correlation of attitudes within households tends to be extremely high (e.g., see Zuckerman and Kotler-Berkowitz, 1998).

Secondly, even though household members tend to share similar attitudes towards vaccines, communicating accurate information about the benefits of getting vaccinated can counter intra-household dynamics that undermine acceptance. The strong correlation about attitudes within households may at face value be a cause of concern for policy makers because household members that are unwilling to get vaccinated may not change their minds regardless of the content of communication campaigns. This partly underpinned our third hypothesis that suggested the elasticity of attitudes towards COVID-19 vaccines from the treatments would be lower among respondents in these "hostile" households. However, the opposite was the case. The experimental results show there is great value in communicating the benefits of COVID-19 vaccinations to members of households that were not accepting of vaccines. Respondents in these households were more likely to respond positively to the treatments than those in households who were more supportive of vaccination in the first place. In fact, the treatments led to not only the respondents being more willing to get vaccinated, but there is some evidence of a second-round effect whereby they were more likely to encourage others in their household to get vaccinated. In other words, communicating accurate information may create a virtuous cycle whereby both recipients of the information as well as others in previously "hostile" households become more willing to get vaccinated.

Collectively, these first two insights suggest that there would be considerable value in

policy makers taking a multi-pronged approach (i.e., at both the individual and household level) to vaccine outreach. If one person in a household is provided timely and relevant information to ease their concerns about vaccination, they may be able to encourage their household members to get vaccinated. If a household is approached together, any concerns can be addressed in one interaction with the family unit.

The third insight from the study is that the strong correlation among household members' attitudes towards vaccination does not appear to solely be a consequence of head of households having a large degree of control over the attitudes of others in their household. If this was the case, then a way to increase willingness of the population at large to get vaccinated would be to exclusively focus on influencing the head of the household. Our fourth hypothesis was partly informed by this line of thinking as we speculated that respondents who have a role in household decisions would have greater autonomy over their vaccination choices and consequently more likely to be influenced by the treatment. However, the online experiment shows there is a lack of substantial differences between people's acceptance of vaccines based on their role in household decision making. As such, there is clearly greater nuance in terms of how intra-household dynamics influence people's attitudes towards vaccines. Based on the evidence presented in this study, there would appear to be value in policy makers ensuring that communication campaigns reach a broad segment of society and are not too narrowly focused on household members that are thought to have the greatest influence.

Future research on this topic could take a few directions. Firstly, the quantitative evidence presented in this paper would be nicely complemented by qualitative interviews exploring further how intra-household dynamics relate to people attitudes towards vaccines. Secondly, there is considerable scope to conduct similar research to this study but in different locations, examining alternative types of vaccines and/or providing different treatments. Finally, as there are significant limitations to relying on in-person (they are particularly expensive) and online surveys (can only reach population with internet access), future studies could use alternative sampling methodologies, such as phone surveys, that are less resource

intensive and more representative of the general population. Furthermore, the outcome measure was an individual's self-reported willingness to get vaccinated, which may or may not translate to COVID-19 vaccine uptake. More research is needed to understand how intra-household norms influence the physical act of going to get vaccinated.

References

Africa CDC. (2021). COVID 19 Vaccine Perceptions: A 15 country study. https://africacdc.org/download/covid-19-vaccine-perceptions-a-15-country-study/

Acosta, M., van Bommel, S., van Wessel, M., Ampaire, E. L., Jassogne, L., and Feindt, P. H. (2019, May). Discursive translations of gender mainstreaming norms: The case of agricultural and climate change policies in Uganda. In Women's Studies International Forum (Vol. 74, pp. 9-19). Pergamon.

Archibong, B., and Annan, F. (2021). 'We Are Not Guinea Pigs': The Effects of Negative News on Vaccine Compliance. Available at SSRN 3765793.

Ashraf, N. (2009). Spousal control and intra-household decision making: An experimental study in the Philippines. American Economic Review, 99(4), 1245-77.

Ashworth, M., Thunstrom, L., Cherry, T., Newbold, S., and Finnoff, D. (2021) Messaging to boost COVID-19 vaccinations: emphasize personal health benefits. Ann Arbor, MI: Inter-university Consortium for Political and Social Research. https://doi.org/10.3886/E139461V7

Bidani, B. Menon, R., Nguyen, S. Vakis, R. and Afif, Z. (2022) Vaccine Hesitancy: 10 lessons from chatbotting about COVID-19 in 17 countries. https://blogs.worldbank.org/health/vaccine-hesitancy-10-lessons-chatbotting-about-covid-19-17-countries

Brewer, N. T., Chapman, G. B., Rothman, A. J., Leask, J., and Kempe, A. (2017). Increasing vaccination: putting psychological science into action. Psychological Science in the Public Interest, 18(3), 149–207.

Brown, C. and Dominique van de Walle, 2020. "Headship and Poverty in Africa," Working Papers 531, Center for Global Development.

Carcelen, A. C., Mutembo, S., Matakala, K. H., Chilumba, I., Mulundu, G., Monze, M., Mwansa, F.D.,Moss W.J., and Hayford, K. (2021). Impact of a Measles and Rubella Vaccination Campaign on Seroprevalence in Southern Province, Zambia. The American Journal of Tropical Medicine and Hygiene, 104(6), 2229.

Carey, J. M., Guess, A. M., Loewen, P. J., Merkley, E., Nyhan, B., Phillips, J. B., and Reifler, J. (2022). The ephemeral effects of fact-checks on COVID-19 misperceptions in the United States, Great Britain and Canada. Nature Human Behaviour. doi:10.1038/s41562-021-01278-3

Central Statistical Office (CSO), (2016). Government of the Republic of Zambia. Living Conditions Monitoring Survey Report: 2015. Living Conditions Monitoring Branch, Lusaka, CSO

Chang, J, M Shah, R Pramanik and S Shah (2021) Financial Incentives and Other Nudges Do Not Increase COVID-19 Vaccinations among the Vaccine Hesitant. NBER Working Paper 29403.

Christakis N.A., and Fowler J.H (2013) Social contagion theory: examining dynamic social networks and human behavior. Stat Med;32(4):556-77. doi: 10.1002/sim.5408. Epub 2012 Jun 18. PMID: 22711416; PMCID: PMC3830455.

Desai, S., and Kiersten, J. (2005). Women's decision making and child health: Familal and social hierachies.

Eve Dubé, E., Dominique, G., and MacDonald NE (2015) Strategies intended to address vaccine hesitancy: Review of published reviews, Vaccine, 33 (34), 4191-4203, ISSN 0264-410X, https://doi.org/10.1016/j.vaccine.2015.04.041.

Fraser T., Aldrich D.P., and Page-Tan C. Bowling alone or distancing together? The role of social capital in excess death rates from COVID19. Soc Sci Med. 2021;284:114241.

Glassman, A., Kenny, C. and Yang, G. (2022). COVID-19 Vaccine Development and Rollout in Historical Perspective. CGD Working Paper 607. Washington, DC: Center for Global Development. https://www.cgdev.org/publication/ covid-19-vaccine-development-and-rollout-historical-perspective

Haaland, I., C. Roth and J. Wohlfart. (forthcoming) 'Designing Information Provision Experiments', Journal of Economic Literature.

Hao F, and Shao W. (2022) Understanding the influence of political orientation, social network, and economic recovery on COVID-19 vaccine uptake among Americans. Vaccine. 2022 Mar 25;40(14):2191-2201. doi: 10.1016/j.vaccine.2022.02.066. Epub 2022 Feb 22. PMID: 35227522; PMCID: PMC8860708.

Hoy, C., Wood, T., and Moscoe, E. (2021). Addressing Vaccine Hesitancy : Survey and Experimental Evidence from Papua New Guinea. Policy Research Working Paper;No. 9837. World Bank, Washington, DC. https://openknowledge.worldbank.org/handle/10986/36549 License: CC BY 3.0 IGO.

James, J (2021) COVAX Local Press Statement on arrival of 228,000 vaccines in Zambia https://www.unicef.org/zambia/press-releases/covid-19-vaccines-shipped-covax-arrive-zambia-

donation-france

Johns Hopkins University (2022) Novel Coronavirus COVID-19 (2019-nCoV) Data Repository by Johns Hopkins CSSE. Baltimore, Maryland: Johns Hopkins University.

Jones, A. D., Shrinivas, A., and Bezner-Kerr, R. (2014). Farm production diversity is associated with greater household dietary diversity in Malawi: findings from nationally representative data. Food Policy, 46, 1–12. https://doi.org/10.1016/j.foodpol.2014.02.001

Kanyanda, S., Markhof, Y., Wollburg, P., and Zezza, A. (2021) Acceptance of COVID-19 vaccines in sub-Saharan Africa: evidence from six national phone surveys BMJ Open 2021;11:e055159. doi: 10.1136/bmjopen-2021-055159

Kaplan, R.M, and Milstein, A. Influence of a COVID-19 vaccine's effectiveness and safety profile on vaccination acceptance (2021)Proc Natl Acad Sci U S A. 2021 Mar 9;118(10): e2021726118. doi: 10.1073/pnas.2021726118. PMID: 33619178; PMCID: PMC7958192.

Karlsson, L.C., Soveri A, Lewandowsky, S., Karlsson, L., Karlsson, H., Nolvi, S., Karukivi, M., Lindfelt, M., and Antfolk J. (2021) Fearing the disease or the vaccine: The case of COVID-19. Pers Individ Dif. 2021 Apr;172:110590. doi: 10.1016/j.paid.2020.110590. Epub 2020 Dec 14. PMID: 33518869; PMCID: PMC7832025.

Khan, H., Dabla-Norris, M. E., Lima, F., and Sollaci, A. (2021). Who Doesn't Want to be Vaccinated? Determinants of Vaccine Hesitancy During COVID-19. International Monetary Fund.

Konstantinou, P., Georgiou, K., Kumar, N., Kyprianidou, M., Nicolaides, C., Karekla, M., and Kassianos, A. P. (2021). Transmission of Vaccination Attitudes and Uptake Based on

Social Contagion Theory: A Scoping Review. Vaccines, 9(6), 607. https://doi.org/10.3390/vaccines9060607

Kovacevic, R., Cameron, C., and Vakis, R. (2022) Being behaviorally savvy vaccine communication. https://blogs.worldbank.org/health/being-behaviorally-savvy-vaccine-communication

Kwok, K. O., Lai, F., Wei, W. I., Wong, S., and Tang, J. (2020). Herd immunity - estimating the level required to halt the COVID-19 epidemics in affected countries. The Journal of infection, 80(6), e32–e33. https://doi.org/10.1016/j.jinf.2020.03.027

Lazarus, J.V., Ratzan, S.C., Palayew, A.,Gostin L.O.,Larson, H.J.,Rabin, K., Kimball, S., and Mohandes, A. (2021). A global survey of potential acceptance of a COVID-19 vaccine. Nat Med 27, 225–228. https://doi.org/10.1038/s41591-020-1124-9

Loomba, S., de Figueiredo, A., Piatek, S.J., de Graaf, K., and Larson, H.J. Measuring the impact of COVID-19 vaccine misinformation on vaccination intent in the UK and USA. Nat Hum Behav. 2021 Mar;5(3):337-348. doi: 10.1038/s41562-021-01056-1. Epub 2021 Feb 5. Erratum in: Nat Hum Behav. 2021 Mar 8;: Erratum in: Nat Hum Behav. 2021 Jul;5(7):960. PMID: 33547453.

MacDonald, N. E. (2015). Vaccine hesitancy: Definition, scope and determinants. Vaccine, 33(34), 4161–4164.

Makridis C.A., Wu C., and Freeman J. How social capital helps communities weather the COVID-19 pandemic. PLoS ONE. 2021;16(1):e0245135. doi: 10.1371/journal.pone.0245135.

Marzo, R.R., Sami, W., and Alam, M.Z. (2022) Hesitancy in COVID-19 vaccine uptake and its associated factors among the general adult population: a cross-sectional study in

six Southeast Asian countries. Trop Med Health 50, 4. https://doi.org/10.1186/s41182-021-00393-1

Martinez-Bravo, M., and Stegmann, A. (2022) In Vaccines We Trust? The Effects of the CIA's Vaccine Ruse on Immunization in Pakistan, Journal of the European Economic Association, Volume 20, Issue 1, February 2022, Pages 150–186, https://doi.org/10.1093/jeea/jvab018

Mathieu, E., Ritchie, H., and Ortiz-Ospina, E. (2021) A global database of COVID-19 vaccinations. Nat Hum Behav 5, 947–953.

McAbee L, Tapera O, and Kanyangarara M. Factors Associated with COVID-19 Vaccine Intentions in Eastern Zimbabwe: A Cross-Sectional Study. Vaccines (Basel). 2021 Sep 29;9(10):1109. doi: 10.3390/vaccines9101109. PMID: 34696215; PMCID: PMC8538260.

NapoleanCat (2022) Social Media Users in Zambia https://napoleoncat.com/stats/facebook-users-in-zambia/2022/03/

Oraro T, Ngube N, Atohmbom GY, Srivastava S, and Wyss K. The influence of gender and household headship on voluntary health insurance: the case of North-West Cameroon. Health Policy Plan. 2018 Mar 1;33(2):163-170. doi: 10.1093/heapol/czx152. PMID: 29145600.

Reuters (2022) COVID-19 Tracker https://graphics.reuters.com/world-coronavirus-tracker-and-maps/countries-and-territories/zambia/

Palm, R., Bolsen, T., and Kingsland J.T. (2021) The Effect of Frames on COVID-19 Vaccine Resistance. Frontiers in Political Science, 3. doi: 10.3389/fpos.2021.661257

Pink, S. L., Chu, J., and Willer, R. (2021). Religious Identity Cues Increase Vaccination Intentions and Trust in Medical Experts among American Christians. Retrieved from osf.io/2uk5d

Pitas N., and Ehmer C. Social capital in the response to COVID-19. Am J Health Promot. 2020;34(8):942–944. doi: 10.1177/0890117120924531

Rao, N., Mobius, M. M., and Rosenblat, T. (2007). Social networks and vaccination decisions. Working Papers, No. 07-12, Federal Reserve Bank of Boston, Boston, MA.

Sariyev O, Loos, TK, and Zeller M (2020). Women's participation in decision-making and its implications for human capital investment. European Review of Agricultural Economics, Article jbaa008. Advance online publication. https://doi.org/10.1093/erae

Solís Arce, J. S., Warren, S. S., Meriggi, N. F., Scacco, A., McMurry, N., Voors, M., and Omer, S. B. (2021). COVID-19 vaccine acceptance and hesitancy in low- and middle-income countries. Nature Medicine, 27(8), 1385-1394. doi:10.1038/s41591-021-01454-y

Taylor E, Atkins KE, Medlock J, Li M, Chapman GB, and Galvani AP (2016). Cross-Cultural Household Influence on Vaccination Decisions. Med Decis Making. 2016 Oct; 36(7):844-53. doi: 10.1177/0272989X15591007. Epub 2015 Jun 17. PMID: 26085600; PMCID: PMC4683113.

Wellcome Global Monitor 2018, 'How does the world feel about science and health?' https://wellcome.ac.uk/reports/wellcome-global-monitor/2018

WHO COVID-19 Dashboard. Geneva: World Health Organization, 2020. https://covid19.who.int/ (last cited: May 2022)

World Bank (2022). "World Development Indicators." https://datatopics.worldbank.org/world-development-indicators/

Zambia Statistics Agency (ZamStats), (2021). Socio-economic Impact Assessment of COVID-19 on household Survey.

Zintel, S., Flock, C., Arbogast, A.L., Forster, A., Wagner, C.V., and Sieverding, M. (2022). Gender differences in the intention to get vaccinated against COVID-19: a systematic review and meta-analysis. J Public Health (Berl.). https://doi.org/10.1007/s10389-021-01677-w

Zuckerman, A. S., and Kotler-Berkowitz, L. A. (1998). Politics and Society: Political Diversity and Uniformity in Households as a Theoretical Puzzle. Comparative Political Studies, 31(4), 464-497.https://journals.sagepub.com/doi/abs/10.1177/0010414098031004004

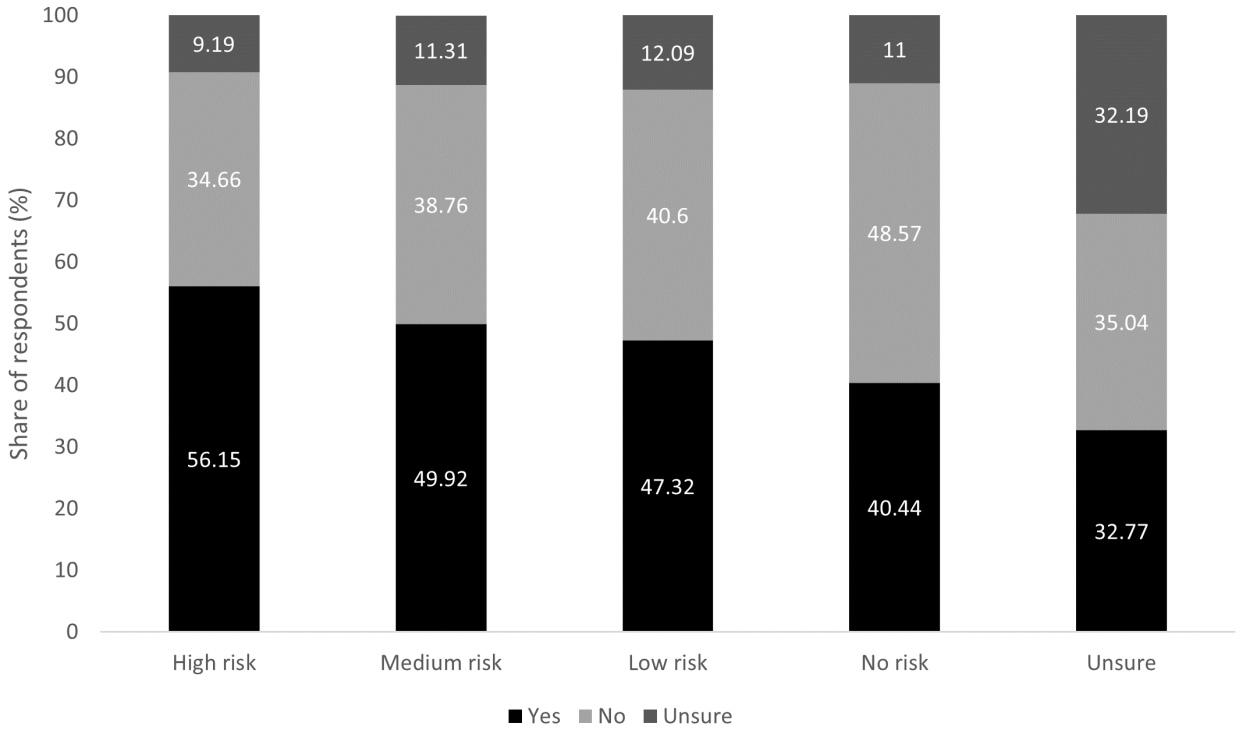
Appendix

A1 – Further descriptive statistics from the in-person survey

A1.1 Concern about contracting COVID-19

Concern about contracting COVID-19 was related to whether people were willing to get vaccinated. Around one-third of respondents believed that they were at low risk of contracting COVID-19, whereas 14 percent thought there was no risk at all. Only 17 percent of respondents believed there is a high risk in being affected by the virus. Those who believed they were at a higher risk reported being more willingness to get the vaccine (56.15 percent) compared to respondents who believed there was no risk (40.44 percent) or respondents who were unsure whether they are at risk (32.77 percent) (Figure A1).

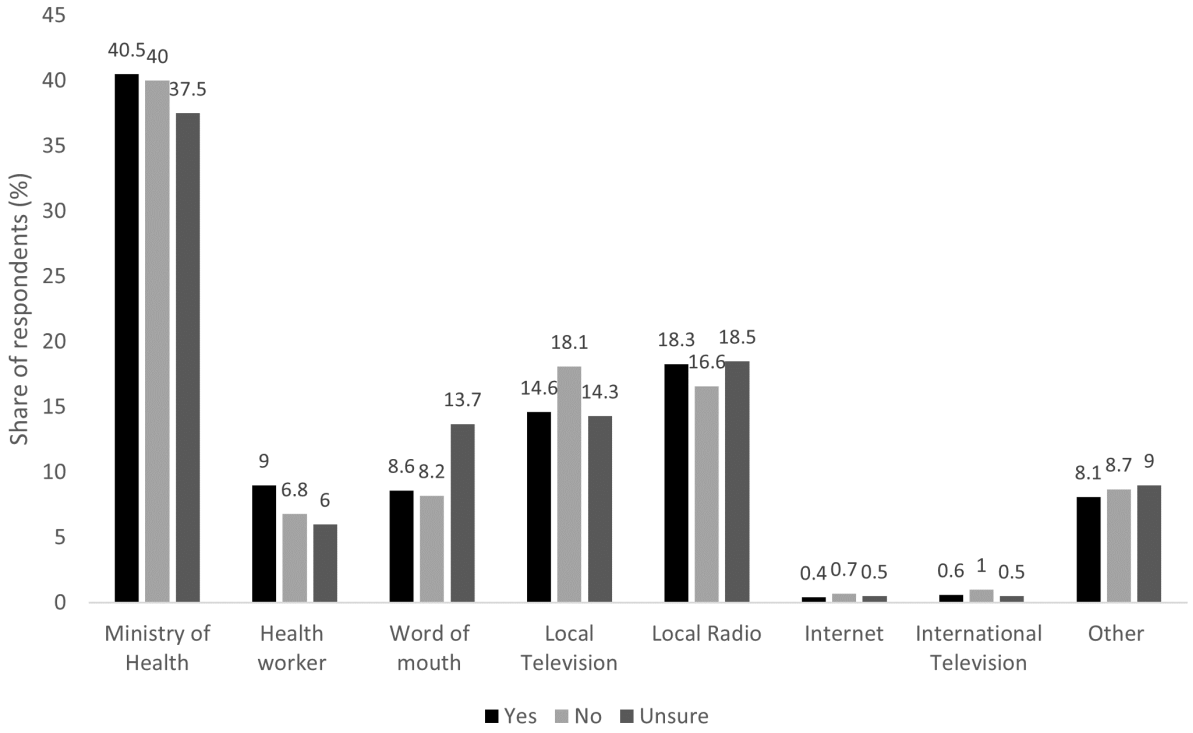
Figure A1: Perceived risk of COVID-19 vs. willingness to get vaccinated



A1.2 Sources of information about COVID-19

The sources of information about COVID-19 that people trust the most are unrelated to the levels of acceptance and hesitancy of COVID-19 vaccine. The three most trusted sources of information about COVID-19 were: the Ministry of Health (40.0 percent), local television (15.9 percent) and radio (17.4 percent). As seen in Figure A2, there was no variation in the willingness of people to get vaccinated depending on the source of information they trusted. For example, 40.5 percent of respondents not planning on get COVID-19 vaccine mentioned that the Ministry of Health was their most trusted source of information about the virus and around 40.0 percent of respondents that did plan on getting vaccinated selected the same answer.

Figure A2: Source of information vs. willingness to get vaccinated



A1.3 Responsibility for providing protection against COVID-19

Around 4 in 5 respondents (79 percent) claimed that protection against COVID-19 was their personal responsibility, whereas 1 in 10 respondents cited that their household head was responsible for providing protection. Of those respondents who take personal responsibility, nearly 47.8 percent were willing to take a COVID-19 vaccine. At the same time, 47.7 percent of respondents who claim that their household head was responsible for preventing COVID-19 were willing to get vaccinated. This shows that willingness to get vaccinated was unrelated to who respondents believed was responsible for preventing them getting COVID-19.

A2 – Regression tables based on the in-person survey data

Table A2.1: Linear regression model of willingness to get vaccinated at the individual level

	Model 1		Model 2		Model 3		Model 4	
Predictors	*Estimates*	*CI*	*Estimates*	*CI*	*Estimates*	*CI*	*Estimates*	*CI*
Intercept	1.42 ***	1.40 – 1.45	1.25 ***	1.22 – 1.28	1.30 ***	1.27 – 1.33	1.24 ***	1.21 – 1.27
Age	0.00 *	0.00 – 0.00	-0.00 ***	-0.00 – -0.00	-0.00 ***	-0.00 – -0.00	-0.00 ***	-0.00 – -0.00
Female	-0.03 ***	-0.05 – -0.02	0.01	-0.00 – 0.02	0.01	-0.00 – 0.02	0.01	-0.00 – 0.02
Region: Urban excl Lusaka	0.05 ***	0.03 – 0.07	0.03 **	0.01 – 0.05	0.06 ***	0.04 – 0.08	0.07 ***	0.05 – 0.09
Region: Rural	0.08 ***	0.06 – 0.11	0.06 ***	0.04 – 0.08	0.09 ***	0.07 – 0.11	0.11 ***	0.09 – 0.13
HH members willing to get COVID-19 vaccine			1.04 ***	1.02 – 1.06	0.63 ***	0.60 – 0.66	0.63 ***	0.60 – 0.67
HH Size			-0.01 ***	-0.01 – -0.01	-0.03 ***	-0.03 – -0.02	-0.03 ***	-0.03 – -0.02
HH Head			0.12 ***	0.10 – 0.13	0.10 ***	0.09 – 0.12	0.10 ***	0.08 – 0.11
HH members aware of COVID-19 vaccine			-0.05 ***	-0.07 – -0.03	-0.10 ***	-0.12 – -0.08	-0.14 ***	-0.16 – -0.12
Think COVID-19 vaccine is effective					0.08 ***	0.08 – 0.09	0.08 ***	0.08 – 0.08
Think COVID-19 is treatable							0.05 ***	0.04 – 0.06
Knowledge of COVID-19 spread							0.03 ***	0.02 – 0.04
Aware of COVID-19 contraction							0.06 ***	0.05 – 0.07
Observations	28133		25936		25936		25936	
R^2 / R^2 adjusted	0.004 / 0.004		0.220 / 0.220		0.263 / 0.263		0.270 / 0.269	

** p<0.05 ** p<0.01 *** p<0.001*

*Note: ***, **, and * indicate significance at the 1, 5, and 10 percent critical level. Age: Defined as the age of the individual in years. Female: Dummy variable for whether an individual is female. Urban excl. Lusaka: Dummy variable for whether a household is in urban regions excluding Lusaka. Rural: Dummy variable for whether a household is in a rural region. HH size: Defined as the number of members in the household. HH Head: Dummy variable for whether an individual is a household head. HH members willing: Defined as the proportion of other household members who are willing to get a COVID-19 vaccine.*

Table A2.2: Linear regression model of share of household members that are willing to get vaccinated

	Model 1		Model 2		Model 3		Model 4	
Predictors	*Estimates*	*CI*	*Estimates*	*CI*	*Estimates*	*CI*	*Estimates*	*CI*
Intercept	0.27 ***	0.22 – 0.31	0.02	-0.01 – 0.05	-0.02	-0.05 – 0.01	-0.05 ***	-0.08 – -0.02
HH size	-0.02 ***	-0.02 – -0.02	-0.02 ***	-0.03 – -0.02	-0.02 ***	-0.02 – -0.02	-0.02 ***	-0.02 – -0.01
Proportion of female HH members	-0.05 ***	-0.08 – -0.02	-0.04 ***	-0.07 – -0.02	-0.04 **	-0.06 – -0.01	-0.03 **	-0.05 – -0.01
Proportion of literate HH members	0.17 ***	0.14 – 0.20	0.15 ***	0.13 – 0.17	0.12 ***	0.10 – 0.14	0.06 ***	0.05 – 0.08
Region: Urban excl Lusaka	0.05 ***	0.02 – 0.08	0.03 **	0.01 – 0.04	0.04 ***	0.02 – 0.05	0.06 ***	0.05 – 0.08
Region: Rural	0.05 **	0.02 – 0.08	0.02	-0.00 – 0.04	0.04 ***	0.02 – 0.06	0.07 ***	0.05 – 0.09
HH Poor	0.02 *	0.00 – 0.04	-0.00	-0.02 – 0.01	0.01	-0.00 – 0.02	0.00	-0.01 – 0.01
HH Head Gender			-0.01	-0.02 – 0.01	-0.01	-0.02 – 0.01	-0.00	-0.01 – 0.01
HH Head Age			0.00 ***	0.00 – 0.00	0.00 ***	0.00 – 0.00	0.00 ***	0.00 – 0.00
HH head willing to get COVID-19 vaccine			0.51 ***	0.50 – 0.52	0.50 ***	0.49 – 0.51	0.37 ***	0.36 – 0.38
Proportion of HH members aware of COVID-19 vaccine					0.12 ***	0.10 – 0.13	0.04 ***	0.03 – 0.06
Proportion of HH members who think COVID-19 vaccine is effective							0.39 ***	0.38 – 0.41
Observations	7161		6790		6790		6790	
R^2 / R^2 adjusted	0.040 / 0.040		0.598 / 0.598		0.609 / 0.609		0.713 / 0.712	

** p<0.05 ** p<0.01 *** p<0.001*

*Note: ***, **, and * indicate significance at the 1, 5, and 10 percent critical level. HH size: Defined as the number of members in the household. HH poor: Dummy variable for whether a household is poor. HH head age: Defined as the age of the household head in years. Female: Dummy variable for whether a household has a female household head. Urban excl. Lusaka: Dummy variable for whether a household is in urban regions excluding Lusaka. Rural: Dummy variable for whether a household is in a rural region. Proportion of female HH members: Defined as the proportion of female household members. Proportion of literate HH members: Defined as the proportion of literate household members (completed primary or secondary education). Proportion of HH members aware of COVID-19 vaccine: Defined as the proportion of household members who are aware of COVID-19 vaccine. Proportion of HH members who think COVID-19 vaccine is effective: Defined as the proportion of household members who think COVID-19 vaccine is effective. Willingness of HH head to get COVID-19 vaccine: Dummy variable for whether a household head is willing to get vaccinated.*

A3 – Background information about the online experiment

Figure A3.1: Example of Facebook advertisements

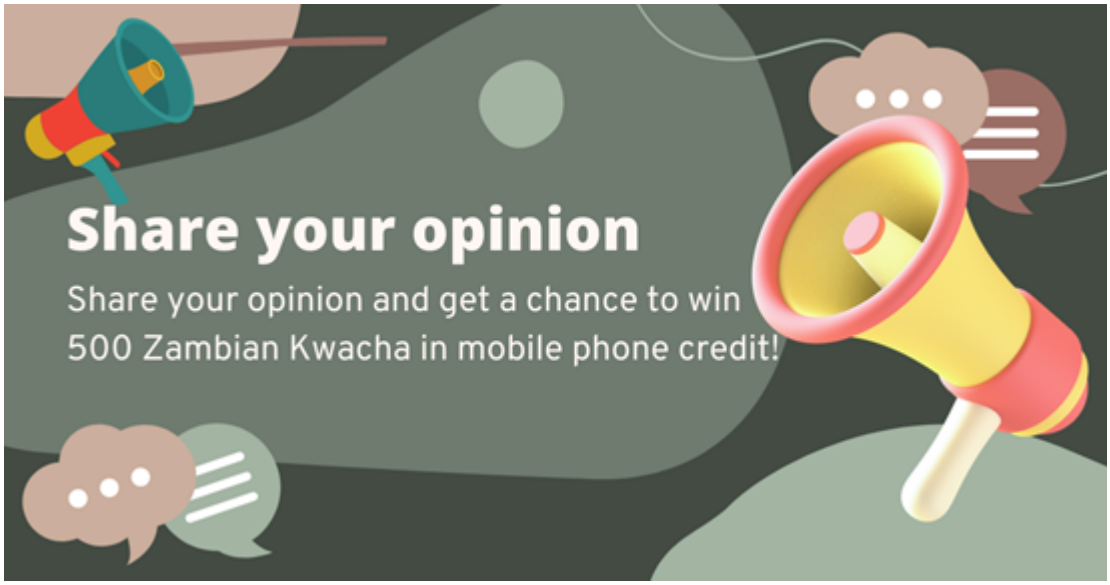
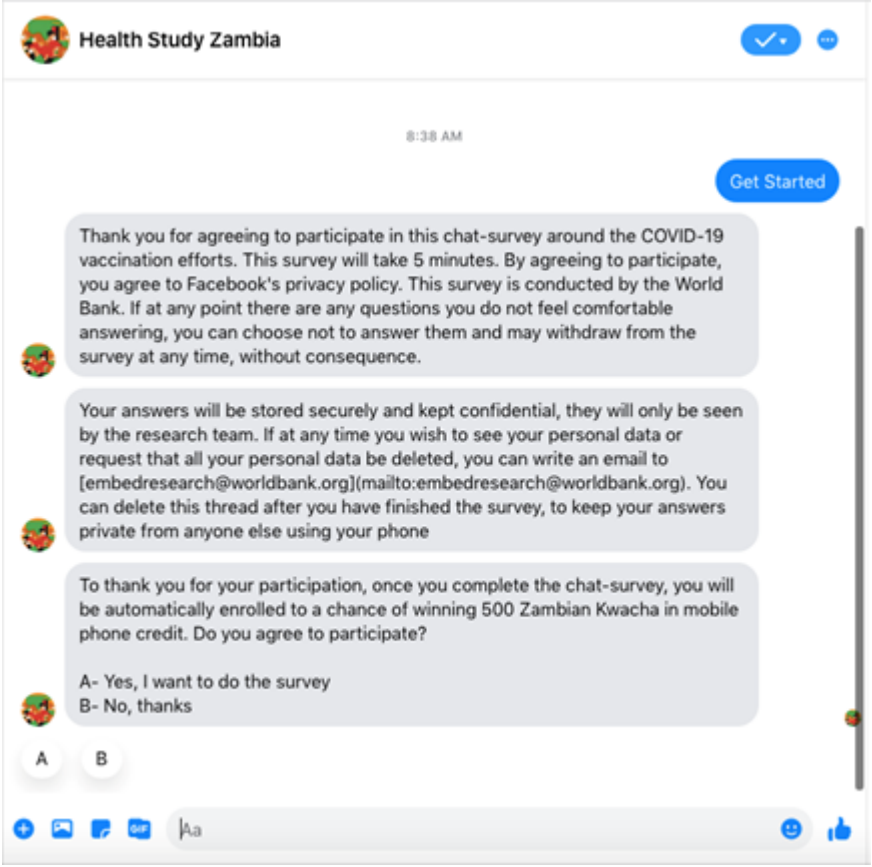


Figure A3.2: Example of how chatbot in Facebook messenger was used for survey



The online experiment collected samples of respondents that were broadly representative of the population that had access to their respective communication channels. Consequently, there were differences in the demographic characteristics (in terms of age, sex and location) between the survey sample and the general population as per the most recent census (see Table A3.1 below). Respondents to both surveys were more likely to be male and younger than the general population and their geographic concentration also differed.

Table A3.1 Characteristics of respondents in online experiment and general population

	Online experiment (%)	**National population (%)**
Male	60.1	49.0
Aged 40 years or older	14.4	29.5
Lusaka	33.6	18.5
Copperbelt Region	22.1	16.3
Rest of Zambia	44.4	65.3

To address concerns about this issue, we calculated inverse probability weights at the individual level and applied these weights to adjust for these differences between the survey sample and the general population. This involved determining the frequency of demographic characteristics (in terms of age, sex and location) in the survey and in the general population from the census. The survey weights reflected these differences. The calculated survey weights used are shown in Table A3.2 below.

Table A3.2 Inverse probability weights used in online experiment

	Male			**Female**		
	18-29	30-39	40+	18-29	30-39	40+
Lusaka	0.4	0.6	0.8	0.5	0.7	1.4
Copperbelt	0.5	0.6	1.1	0.7	0.8	1.9
Rest of Zambia	0.9	1.1	2.0	1.6	1.8	4.6

A4 – Regression tables drawing on the online survey data

Table A4.1: Balance table showing differences between respondent characteristics across groups

Variable	N	(1) Control Mean/SE	N	(2) Individual benefit Mean/SE	N	(3) Household benefit Mean/SE	t-test Diff (1)-(2)	t-test Diff (1)-(3)	t-test Diff (2)-(3)
HH members willing	1182	0.718	870	0.731	884	0.729	-0.013	-0.01	0.003
		[0.013]		[0.015]		[0.015]			
Sec edu or less	1182	0.587	870	0.64	885	0.624	-0.053**	-0.037*	0.017
		[0.014]		[0.016]		[0.016]			
Male	1182	0.606	870	0.631	885	0.606	-0.025	0	0.025
		[0.014]		[0.016]		[0.016]			
18-29 years	1182	0.636	870	0.633	885	0.636	0.003	0	-0.003
		[0.014]		[0.016]		[0.016]			
Lusaka	1182	0.411	870	0.401	885	0.415	0.01	-0.004	-0.014
		[0.014]		[0.017]		[0.017]			
HH size	1181	5.052	870	5.106	884	5.109	-0.054	-0.057	-0.003
		[0.056]		[0.064]		[0.064]			
HH had COVID-19	1181	0.317	869	0.311	885	0.293	0.006	0.024	0.018
		[0.014]		[0.016]		[0.015]			
Vulnerable HH members	1181	0.368	869	0.371	884	0.357	-0.002	0.011	0.013
		[0.014]		[0.016]		[0.016]			

*Note: The value displayed for t-tests are the differences in the means across the groups. Standard arrors are in brackets. ***, **, and * indicate significance at the 1, 5, and 10 percent critical level. HH members willing: Dummy variable for whether respondents believe other household members would be willing to get a COVID-19 vaccine. HH size: Defined as the number of members in the household. Sec edu or less: Dummy variable for whether an individual has completed secondary education or less. Male: Dummy variable for whether an individual is male. 18-29 years: Dummy variable for whether an individual is between 18-29 years. Lusaka: Dummy variable for whether an individual is living in Lusaka. HH had COVID-19: Dummy variable for whether an individual lives in a household where someone has contracted COVID-19. Vulnerable HH members: Dummy variable for whether an individual lives in a household with vulnerable household members (e.g., those aged 65 years and older).*

Table A4.2: Linear regression model showing characteristics associated with willingness to get vaccinated based on online survey data

	(1) Willing to get vaccinated	(2) Unwilling to get vaccinated
HH members willing	0.297***	
	(0.00903)	
HH members unwilling		0.294***
		(0.00839)
Sec edu or less	0.0182***	-0.0107**
	(0.00535)	(0.00372)
Male	0.00593	0.00459
	(0.00552)	(0.00384)
18-29 years	-0.00578	-0.000184
	(0.0059)	(0.0041)
Elsewhere	0.00237	-0.000278
	(0.00668)	(0.00464)
Lusaka	-0.0244***	0.00819
	(0.00711)	(0.00494)
HH size	-0.00181	0.000538
	(0.00141)	(0.000979)
HH had COVID-19	0.0234***	-0.0144***
	(0.00529)	(0.00368)
Vulnerable HH members	0.0099	-0.00281
	(0.00531)	(0.00369)
HH head	0.0262***	-0.0103*
	(0.00737)	(0.00512)
Involved in HH decisions	-0.00939	0.00097
	(0.00632)	(0.0044)
Constant	0.646***	0.0276***
	(0.0139)	(0.00808)
Observations	8721	8721

*Note: This table shows the extent to which different factors are associated with an individual's intention to get vaccinated and it is based on all respondents to the Facebook advertisement who were not allocated to a treatment group. As such it includes both people who have already been vaccinated and those that have not been vaccinated and were allocated to the control group. ***, **, and * indicate significance at the 1, 5, and 10 percent critical level. HH members willing: Dummy variable for whether respondents believe other household members would be willing to get a COVID-19 vaccine. HH members unwilling: Dummy variable for whether respondents believe other household members would not be willing to get a COVID-19 vaccine. HH size: Defined as the number of members in the household. Sec edu or less: Dummy variable for whether an individual has completed secondary education or less. Male: Dummy variable for whether an individual is male. 18-29 years: Dummy variable for whether an individual is between 18-29 years. Elsewhere: Dummy variable for whether an individual is living outside Lusaka and the Copperbelt regions. Lusaka: Dummy variable for whether an individual is living in Lusaka. HH had COVID-19: Dummy variable for whether an individual lives in a household where someone has contracted COVID-19. Vulnerable HH members: Dummy variable for whether an individual lives in a household with vulnerable household members (e.g., those aged 65 years and older). HH head: Dummy variable for whether an individual is the head of the household. Involved in HH decisions: Dummy variable for whether an individual is involved in household decision making.*

Table A4.3: Linear regression model showing the main results of the online experiment

	Willing to be vaccinated			Unwilling to be vaccinated		
	(1)	(2)	(3)	(4)	(5)	(6)
Individual benefit treatment	0.0962***	0.116**	0.135***	-0.0662***	-0.152***	-0.0885***
	(0.0217)	(0.0387)	(0.0322)	(0.0181)	(0.0325)	(0.0268)
Household benefit treatment	0.112***	0.135***	0.141***	-0.0462*	-0.153***	-0.0629*
	(0.0216)	(0.0383)	(0.0322)	(0.018)	(0.0322)	(0.0268)
Household members willing		0.429***			-0.394***	
		(0.0295)			(0.0247)	
Individual benefit × Household members willing		-0.0257			0.116**	
		(0.0453)			(0.038)	
Household benefit × Household members willing		-0.0312			0.147***	
		(0.045)			(0.037)8	
Involved in Household decisions			0.0279			-0.0229
			(0.0307)			(0.0255)
Individual benefit × Involved in Household decisions			-0.0712			0.0406
			(0.0436)			(0.0363)
Household benefit × Involved in Household decisions			-0.0523			0.0303
			(0.0434)			(0.0361)
Observations	2931	2930	2931	2931	2930	2931

*Note: This table presents the OLS regression analysis behind the main results of the online experiment. Standard errors are in parentheses. ***, **, and * indicate significance at the 1, 5, and 10 percent critical level. The outcome variable is dummy that takes on the value of 1 if the respondent states they are willingness to get vaccinated in columns (1)-(3) and 0 otherwise. The outcome variable is dummy that takes on the value of 1 if the respondent states they are unwillingness to get vaccinated in columns (4)-(6) and 0 otherwise. The regressions in columns (1) and (4) can be expressed formally as* $Y_i = \beta_0 + \beta_1 T_{IND} + \beta_2 T_{HH} + \gamma X_i + \epsilon_i$*, where* T_{IND} *is a dummy variable for the individual treatment,* T_{HH} *is a dummy variable for the household treatment and* X_i *is a vector of control variables (age, sex, location, education, household size, exposure of household to COVID-19 and vulnerability of household members to COVID-19). The regressions in columns (2) and (5) can be expressed formally as* $Y_i = \beta_0 + \beta_1 T_{IND} + \beta_2 T_{HH} + \beta_3 HHwill + \beta_4 T_{HH} \times HHwill + \beta_5 T_{IND} \times HHwill + \gamma X_i + \epsilon_i$*, where* T_{IND} *is a dummy variable for the individual treatment,* T_{HH} *is a dummy variable for the household treatment,* $HHwill$ *is a dummy variable for whether respondents believed other household members would be willing to get a COVID-19 vaccine and* X_i *is a vector of control variables (age, sex, location, education, household size, exposure of household to COVID-19 and vulnerability of household members to COVID-19). The regressions in columns (3) and (6) can be expressed formally as* $Y_i = \beta_0 + \beta_1 T_{IND} + \beta_2 T_{HH} + \beta_3 Inv + \beta_4 T_{HH} \times Inv + \beta_5 T_{IND} \times Inv + \gamma X_i + \epsilon_i$*, where* T_{IND} *is a dummy variable for the individual treatment,* T_{HH} *is a dummy variable for the household treatment,* Inv *is a dummy variable for whether respondents were involved in household decision making and* X_i *is a vector of control variables (age, sex, location, education, household size, exposure of household to COVID-19 and vulnerability of household members to COVID-19).*

Table A4.4: Linear regression model showing the "second round" results of the online experiment

	(1)	(2)	(3)
Any treatment	0.0213	0.0682*	0.0152
	(0.015)	(0.0275)	(0.0223)
Household members willing		0.307***	
		(0.0248)	
Treatment × Household members willing		-0.0637*	
		(0.0322)	
Involved in Household decisions			0.0159
			(0.0251)
Treatment × Involved in Household decisions			0.0108
			(0.03)
Observations	2866	2865	2866

*Note: This table presents the OLS regression analysis behind the "second round" results of the online experiment. Standard errors are in parentheses. ***, **, and * indicate significance at the 1, 5, and 10 percent critical level. The outcome variable is dummy that takes on the value of 1 if the respondent states they would encourage other household members to get vaccinated. The regression in column (1) can be expressed formally as* $Y_i = \beta_0 + \beta_1 T + \gamma X_i + \epsilon_i$*, where* T *is a dummy variable for receiving either treatment and* X_i *is a vector of control variables (age, sex, location, education, household size, exposure of household to COVID-19 and vulnerability of household members to COVID-19). The regression in column (2) can be expressed formally as* $Y_i = \beta_0 + \beta_1 T + \beta_2 HHwill + \beta_3 T \times HHwill + \gamma X_i + \epsilon_i$*, where* T *is a dummy variable for receiving either treatment,* $HHwill$ *is a dummy variable for whether respondents believed other household members would be willing to get a COVID-19 vaccine and* X_i *is a vector of control variables (age, sex, location, education, household size, exposure of household to COVID-19 and vulnerability of household members to COVID-19). The regression in column (3) can be expressed formally as* $Y_i = \beta_0 + \beta_1 T + \beta_2 Inv + \beta_3 T \times Inv + \gamma X_i + \epsilon_i$*, where* T *is a dummy variable for receiving either treatment,* Inv *is a dummy variable for whether respondents were involved in household decision making and* X_i *is a vector of control variables (age, sex, location, education, household size, exposure of household to COVID-19 and vulnerability of household members to COVID-19).*