Assessing survey methods for measuring vaccine acceptance and uptake in 14 African countries

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October 17, 2024

Abstract

In the two years following the COVID-19 pandemic, extensive survey research was conducted globally to assess public attitudes toward COVID-19 vaccines, focusing on acceptance, intent, and eventually, uptake. These surveys used varied sampling methods and interview modes over similar time periods, raising important questions about whether policymakers and researchers received accurate insights from these surveys. To understand the role of survey methods, we compared rates of self-reported vaccination acceptance and uptake, measured 11 different ways across 14 countries, with each other and with administrative data on uptake. This analysis aimed to determine whether overlapping surveys produce consistent results and how closely they align with benchmark statistics from administrative data.

We find that survey results can vary depending on who is asking the questions and how they sampled and surveyed respondents. Survey-based vaccine acceptance can vary by 20 percentage points or more in the same country and time period. Also, rates of self-reported vaccine uptake are typically much higher than rates estimated from administrative vaccination records, suggesting considerable upward bias in survey data. We discuss the potential sources of this bias and conclude by suggesting strategies to enhance the accuracy of public health survey research.

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Introduction

In response to the COVID-19 pandemic, researchers and policy makers in low- and middle-income countries (LMICs) urgently sought national statistics regarding a wide variety of topics on an unprecedented scale and hurried timeline. Governments and funding agencies called for frequently updated quantitative data on health-related outcomes such as COVID-19 cases and hospitalizations, as well as socioeconomic trends in labor markets, household consumption, and education. A particularly important goal was to provide policymakers with accurate projections of demand for COVID-19 vaccines to support decision-making around production, distribution, and demand generation strategies. With these goals in mind, researchers fielded dozens of surveys which included questions designed to elicit willingness to receive a vaccine if available and recommended to them, referred to throughout this analysis as *vaccine acceptance*.[1] Estimating national and community-level vaccine acceptance is critical for designing and implementing demand promotion interventions and approaches to mass vaccination.

While the COVID-19 pandemic brought newfound interest in these challenges, measuring acceptance and intended uptake is important to the design and implementation of critical public health interventions. Large-scale vaccination in LMICs is a massive logistical undertaking. New vaccines being developed and brought to market today will require similar efforts in advance of distribution campaigns, and the advent of mRNA vaccines and related technologies may also increase the frequency with which new vaccines and treatments are deployed. Unfortunately, public controversies surrounding COVID-19 vaccines may well represent a paradigm shift in vaccine attitudes. A recent UNICEF report on vaccination has found that in 51 of 54 countries surveyed, the percentage of the national population who believed that vaccines were important for children fell during the COVID-19 pandemic (UNICEF 2023). It is unclear *ex ante* whether well-established vaccines like those for polio and measles, much less new antigens like those targeting HPV and malaria, will face acceptance rates as high as they would have before 2020.

In this study, we bring together national vaccine acceptance estimates obtained from 11 multi-national survey projects carried out between 2020 and 2023 across 14 African countries: Burkina Faso, Côte d'Ivoire, Ethiopia, Ghana, Kenya, Malawi, Mali, Morocco, Niger, Nigeria, Senegal, Sudan, Tunisia, and Uganda. Many were carried out simultaneously in the same country, providing a rare opportunity to examine "house effects," meaning the unique effect of each survey data collection organization (confounded with that organization's chosen methodology). First, we discuss the context and background of vaccine acceptance survey research. We then describe the data and statistical methods used in our analysis. We highlight two main findings. First, we find substantial disagreement among surveys that purport to measure the same attitudes (vaccine acceptance) for the same population at the same time. We offer several possible reasons for this, but the data cannot be distinguished. That would require a more systematic variation of survey methods, which is outside the scope of the current analysis. Second, we find that surveys measuring behavior (vaccine uptake), overstate such behaviors relative to administrative records on vaccine doses administered. We conclude by discussing possible explanations and implications of the findings.

1. We note that vaccine *acceptance* is not the inverse of vaccine *hesitancy*, which is a complex set of attitudes and norms that require measurement and interpretation across multiple questions (Bussink-Voorend et al. 2022)

Survey measurement of vaccine acceptance and uptake

Measuring attitudes - including acceptance, willingness or refusal - towards vaccines and subsequent uptake of those vaccines has long been a standard practice for informing public health practitioners and researchers. Understanding vaccine acceptance and uptake behavior is vital for public health planning and the strategic allocation of resources. This knowledge informs decisions on vaccine distribution, the design of public education campaigns, and the development of targeted interventions or policies that encourage vaccination. During a pandemic, when rapid and widespread vaccination is crucial to controlling disease spread, these insights become even more critical, allowing health authorities to respond swiftly and effectively to ensure high vaccination rates and protect public health.

Numerous studies have evaluated and defined attitudes toward routine childhood vaccinations to guide interventions aimed at increasing awareness, acceptance, and uptake (Cobos Muñoz, Monzón Llamas, and Bosch-Capblanch 2015; Dyda et al. 2020; Rainey et al. 2011; Khan et al. 2015; SteelFisher et al. 2015). Following the initial announcement of the malaria vaccine, several studies were conducted to explore acceptance rates and associated factors to assist public health experts and policymakers in developing and implementing appropriate malaria vaccination programs, which is ongoing (Sulaiman et al. 2022). Many studies have explored attitudes toward adult vaccines, including those for HPV, seasonal influenza, pandemic influenza, postpartum pertussis, smallpox, and anthrax, though a majority of these are from high-income countries (Larson et al. 2014; Larson et al. 2018; Schmid et al. 2017). In most cases, the reason for measuring vaccine acceptance - defined as a willingness to be vaccinated - is to predict or influence the final outcome of vaccine uptake. Unfortunately, many vaccine behavior studies are cross-sectional and do not assess acceptance and subsequent vaccination status. Studies that have assessed acceptance and subsequent behavior have found that intention does not always translate to action. During the 2009 influenza pandemic a longitudinal survey in Hong Kong found H1N1 vaccine acceptance did not predict uptake (Liao et al. 2011). While 7 percent of respondents reported intention to vaccinate, two months later less than one percent reported uptake of the vaccine. A study in the United States found that roughly half of respondents intending to get the seasonal influenza vaccine actually received it (Harris, Maurer, and Lurie 2009). A review of intention-behavior studies found that 47 percent of participants with positive intentions fail to follow through with preventative health behaviors (Sheeran 2002). Behavioral models such as the Theory of Planned Behavior (TPB) and the Behavioral and Social Drivers (BeSD) of Vaccination Framework specify that an individual's intention is the precursor to behavior, assuming practical issues such as availability, accessibility, cost and service quality are addressed. The intention-behavior gap may be the result of practical issues not captured in surveys or may be an issue related to the measurement of acceptance.

Empirical challenges in estimating COVID-19 vaccine attitudes

The accuracy and reliability of COVID-19 vaccine acceptance and uptake survey results may be impacted by several empirical challenges. The timing of data collection is crucial, as public sentiment toward vaccines can shift rapidly in response to new information, policy changes, or emerging variants. Mode effects may influence how questions are interpreted and answered. Additionally, recruitment methods may lead to sampling bias, skewing the findings and limiting the generalizability of the results. These factors collectively pose significant hurdles to obtaining a clear and accurate understanding of vaccine-related behaviors and attitudes.

The first and most obvious empirical challenge is that the underlying construct – vaccine acceptance – is itself subject to change in relatively short timeframes, particularly during a public health crisis that involved the development and introduction of a new vaccine. The volatile information (and misinformation) landscape during our reference period, from mid-2020 to mid-2022, could have changed attitudes towards vaccination. The severity of the disease burden in the area and shifting media coverage affected individuals' risk assessment. How seriously individuals considered getting vaccinated also naturally changed with the emergence of working and approved vaccines, followed by a rapidly shifting information landscape influenced by governments, news, and social media. As such, national surveys even just a few months apart could plausibly yield different results.

The second challenge stems from the mode of surveying. The COVID-19 pandemic forced a number of research projects that normally used face-to-face interviews to rely on remote methods. While some interviews were conducted in person, most used Computer-Assisted Telephone Interviewing [CATI] or were self-administered on the phone via Interactive Voice Response [IVR] or online via text message [SMS], WhatsApp, or other online platforms such as Qualtrics or SurveyMonkey. Estimates between surveys may differ as a result of *mode effects*, in which respondents reply differently to certain questions depending on the medium with which the questions were asked. For example, respondents may overreport their willingness to get vaccinated to avoid judgment from an in-person interviewer.

Another challenge stems from recruitment methods, as they directly influence the composition and representativeness of the survey sample. Different recruitment strategies—such as online advertisements, social media outreach, telephone surveys, or in-person interviews—tend to attract different segments of the population, each with unique characteristics and levels of vaccine acceptance. For example, online recruitment may disproportionately reach younger, more digitally savvy individuals, potentially skewing results if older adults or those with limited internet access are underrepresented. Two large multi-country studies found attitudes towards vaccination to be correlated with sampling bias (Solis Arce et al. 2021; Kanyanda et al. 2021).

Data and Methods

The data in this analysis is drawn from 11 multi-country survey projects, summarized by Recruitment and Survey Mode in Table 1. As Arab Barometer and Africa CDC CVP utilized more than one combination of sample recruitment and mode, each combination is counted as a distinct survey project. Four projects recruited from face-to-face samples, three projects recruited via RDD, two recruited using a call list, one project recruited online and another over social media. Across the multi-national survey projects, five were conducted over the phone via CATI, three face-to-face, one over the phone via IVR, and two using an online survey form. Researchers designed each survey project to produce estimates as close to nationally representative as feasible given budget and time constraints, through a combination of recruitment strategy, survey mode, and weighting. Each survey project included either individual, household sampling weighting variables[2].

Table 1: Survey Project Summary

Sampling	Survey Mode	Project Name	Countries
Household	Face-to-face	Africa CDC CVP[1]	BFA, CDI, MWI, NIG, NGA, SEN, SUD, UGA
		Afrobarometer	BFA, CDI, GHA, KEN, MWI, MLI, MOR, NIG, NGA, SEN, SUD, TUN, UGA
		Arab Barometer	MOR†, SUD, TUN†
Household	CATI[b]	World Bank HFPS[2]	BFA, ETH, KEN, MWI, MLI, NIG, UGA
Call list	CATI[b]	Africa CDC CVP[1]	ETH, KEN, MOR, TUN
		LMIC Panel[3]	BFA, KEN, NGA
RDD[a]	CATI[b]	Arab Barometer	MOR†, TUN†
		PERC[4]	CDI, ETH, GHA, KEN, MOR, NGA, SEN, SUD, TUN, UGA
RDD[a]	IVR[c]	UNICEF CRA[5]	ETH, KEN, RWA, UGA
Online	Internet	CVS[6]	GHA, KEN, NGA
Social media	Internet	Facebook CTIS[7]	BFA, CDI, ETH, GHA, KEN, MWI, MLI, MOR, NGA, RWA, SEN, SUD, TUN, UGA

Survey modes: [a] Random Digit Dial; [b] Computer Assisted Telephone Interview; [c] Interactive Voice Response. Survey Project names:[1] Africa CDC Vaccine Perceptions Survey; [2] World Bank High Frequency Phone Surveys; [3] Lower-Middle Income Panel Study; [4] Partnership for Evidence-Based Response to COVID-19; [5] UNICEF Community Rapid Assessment; [6] Coronavirus Vaccine Study; [7] COVID-19 Trends and Impact Survey. † The Arab Barometer collected data using phone surveys for the earlier part of the pandemic (2020), and transitioned to household face-to-face surveys for 2021-2022. Appendix Table 7 provides an expanded version of this table.

Differences in estimates of vaccine acceptance, and in later rounds, vaccine uptake, across survey projects could therefore be due to variations in recruitment mode, survey mode, weighting, or other key factors including question design, the timing of the survey project in relation to the ongoing pandemic, or a combination of these and other factors. We therefore make no claims about the relative quality of each survey. Rather, we focus on how these factors – largely recruitment mode and survey mode – may have played a role in responses to questions on COVID-19 vaccination.

2. In some instances, survey project data was unweighted. UNICEF Community Rapid Assessment (CRA) data did not include weights for the Kenya sample. Weights were available for other CRA sampled countries. The Africa CDC Coronavirus vaccine perceptions (CVP) project was only weighted in instances where the final sample differed notably from the available national data, in terms of key demographics such as age and gender.

Household sampling

Four survey projects in this paper utilized household sampling. The Afrobarometer survey project conducted in-person household surveys, and the World Bank High-Frequency Phone Survey (HPFS) used a call list created from a previous in-person household survey to conduct a panel survey via computer-assisted telephone interviews (CATI). Due to the COVID-19 pandemic, the Africa CDC CVP (Coronavirus vaccine perceptions) and Arab Barometer projects utilized both in-person recruitment and a second recruitment type to achieve their surveys. Africa CDC used call-list recruitment depending on the state of the pandemic within each country, while the Arab Barometer project used RDD (random digit dial) recruitment. Afrobarometer delayed its planned surveys until the organization was comfortable with in-person surveys.

The Afrobarometer, Africa CDC CVP, and Arab Barometer are cross-sectional surveys that have historically only used in-person sampling and interviews. Their in-person household surveys include content assessing public opinion and attitudes towards COVID-19 from 2020 - 2023. These surveys were designed to be representative of adults based on the most recent national census (Afrobarometer 2021 - 2022; CDC 2021; Barometer 2021 - 2022). All studies stratify each country sample by sub-national area and then randomly select primary sampling units (PSUs) within those areas. Afrobarometer additionally stratifies by urbanicity. All studies then implement household randomization within PSUs using a random-walk or skip pattern. In the case of Africa CDC CVP we used reported point estimates in the analysis.

The World Bank high-frequency phone survey (HFPS) draws on subsamples from nationally representative in-person household surveys conducted before the pandemic.[3] These panel surveys were conducted via telephone (CATI), and prioritized heads of household and targeted strata, such as rural households, to increase representativeness. We include data from seven countries from the World Bank HFPS survey project.

Call list sampling

We use the term ‘Call lists’ to refer to surveys that draw their samples from a list of active numbers. These lists may be procured through a mobile network operator, checked for activity and randomly sampled from the universe of telecom customers. In other cases, the list may be drawn from an existing database of previous survey respondents. The LMIC Panel survey projects utilized such call lists to recruit study samples and then conducted surveys over the phone (CATI). The LMIC Panel survey project conducted two rounds of telephone surveys targeting the adult population in Burkina Faso, Kenya, and Nigeria. The study sample was stratified by gender, age and region. The Africa CDC CVP sampled using a call list in four countries (Ethiopia, Kenya, Morocco and Tunisia), and conducted surveys over the phone (CATI). All other Africa CDC CVP country projects were recruited from household samples and interviewed in-person, as detailed in the previous section.

3. For details on the sampling strategy, see**gourlayetal2021**.

RDD sampling

Random digit dial (RDD) is a recruitment method in which telephone numbers are randomly generated in alignment with target countries' mobile number formations and subsequently contacted. RDD tends to be representative of those with working phones but inevitable generates a proportion of ineligible numbers such as non-connected and non-residential numbers (Henderson et al. 2020). RDD incorporates both landline and cell phones for telephone fieldwork, covering both urban and rural areas. Our study includes three survey projects that utilize RDD recruitment methods. Two of these projects use enumerators to conduct a CATI (computer-assisted telephone interviews), while one project employs an interactive voice response (IVR) survey method.

The Partnership for Evidence-Based Response to COVID-19 (PERC) survey project was a repeated cross-sectional study conducted in 19 countries. Respondents were recruited using RDD and surveyed via CATI. Samples were drawn to be nationally representative of all adults with access to a landline or cell phone. [4]

UNICEF's Community Rapid Assessment (CRA) survey project utilized RDD sampling to obtain a target sample in each study country and then conducted interviews via IVR. We applied weighting models to the Kenya's data, as weights were not included in the dataset.

The Arab Barometer temporarily pivoted to RDD sampling and phone interviews (CATI) for part of 2020 to collect data from Morocco, Sudan and Tunisia, and returned to in-person surveying in 2021. These surveys were intended to be nationally representative in contexts where over 90% of citizens in these countries own a mobile phone.

Online sampling

Two survey projects used the internet to survey respondents. The Coronavirus Vaccine Study (CVS) recruited respondents using online panel providers, including email, telephone, and direct email solicitation; the survey was implemented online (Lazarus et al. 2021).

The Facebook (University of Maryland 2020 - 2022) survey project collected thousands of daily observations globally on COVID-19 vaccination behaviors. Similar to CATI, the sample was limited to those with smartphone or computer access, as well as to those with a Facebook account (which also served as the recruitment mode). The Facebook survey (University of Maryland 2020 - 2022) recruited respondents from active Facebook users (the Facebook active user base, or FAUB) using daily unequal-probability stratified random sampling The Facebook app invited a daily random sample of adult users, stratified by sub-national administrative boundaries, to take the survey, creating repeated cross-sections with widespread geographic coverage. Sampled users received an invitation at the top of their Facebook News Feed to an optional, off-Facebook survey. Sampled users might be invited to take the survey again in either a few weeks or months, based on local population density. The survey was conducted continuously. We aggregate results over time by quarter (three-month periods) to allow for comparison with other point estimates.

4. We did not have microdata for the PERC study; therefore, we include only the reported point estimates in the analysis.

Survey data

Outcome measures

The two primary outcomes of interest in our analysis include an attitude and a behavior: vaccine acceptance and self-reported vaccine uptake. Vaccine acceptance is a binary measure derived from variations of the question: "If a COVID vaccine becomes available at no cost to you, would you accept it?" Response options typically included "Yes", "No", and a combination of "Do not know" and "Not sure". Respondents who reported already having received a vaccination are coded as "Yes". Variations in the wording and response options for this question across all surveys are detailed in Appendix Table 8. Note that the construct of interest here is vaccine *acceptance*, not vaccine *hesitancy*. Vaccine acceptance is coded 1 for "Yes" or "Yes Likely", and 0 otherwise. The residual category, labeled as "other" , includes refusals, "No", "Do not know", "Not sure", "Quite unlikely", "Mostly Disagree", "No, probably not", and other response options that were more similar to a response of "No" or "Unsure".

Once the vaccine became available or partially available, surveys included a question on vaccine uptake, such as "Have you been vaccinated for COVID-19?" Those who had reported receiving at least one dose of a vaccine were coded as 1 for vaccine uptake.[5] Similar to the vaccine uptake variable, he residual category for vaccine acceptance (coded as 0) includes those who responded "No", refused to respond, and a combination of "Do not know" and "Not sure". In some cases, survey respondents were screened out of being asked about vaccine uptake by earlier survey questions: the respondent had not heard of COVID-19, was unaware that a vaccine was available, or was unaware that they were eligible for the vaccine. These respondents were therefore not included in the binary vaccine uptake variable.

Administrative data

We relied on the Our World in Data (OWID) COVID-19 vaccination dataset for official vaccine uptake figures Mathieu et al. 2021. This dataset provides aggregated global data on administered COVID-19 vaccinations for 169 countries. The OWID vaccination dataset uses the most recent official numbers from governments and health ministries worldwide collected by the OWID team. We used the variable, 'people vaccinated', which includes the total number of people who received at least one vaccine dose. If a person receives the first dose of a 2-dose vaccine, this metric goes up by 1. If they receive the second dose, the metric stays the same. While the surveys analyzed in this paper inquired about vaccine behaviors among adults, the OWID data for people vaccinated is a sum total of people receiving at least one vaccine dose and may include children as young as five years old, depending on the country's vaccination policy. OWID could not verify from national data if 'people vaccinated' was restricted to adults and assumes the figures include all the population. This means the data for people vaccinated may include children as young as five years old, depending on the country's vaccination policy. We have included official estimates of uptake in the figures to be comparable to the surveys included in this analysis, which inquired about vaccine behaviors among

5. Individuals who had received only one dose of a two-dose vaccination series (such as with the Moderna vaccine) were treated equally as those being fully vaccinated.

adults only. These estimates were calculated using the OWID 'people vaccinated' variable divided by the adult population of the country (aged 18 and older). We use population estimates from the United Nations World Population Prospects (UNWPP) 2022 medium probabilistic projection scenarios United Nations and Social Affairs 2022. Given that the numerator - people vaccinated - may include children under the age of 18, these official estimates are to be considered an upper bound for comparison against survey estimates.

The figures also include lines to denote when vaccines were available and who was receiving them. Vaccine availability data is sourced from the Oxford Covid-19 Government Response Tracker (OxCGRT) (variable V2 - Vaccine eligibility/availability) and indicates which groups of people are receiving vaccines at that time, regardless of the country prioritization schedule. In the case of "vaccines partially available", only select groups such as frontline health workers, police, military and other first responders, and those deemed medically/clinically vulnerable were receiving vaccines. Vaccines are deemed fully available once anyone over the age of 16 is receiving the vaccine. In Côte d'Ivoire, Ethiopia, Ghana, Mali, Morocco, Rwanda, Tunisia and Uganda vaccines were available to anyone aged 5 years and up.

Empirical Strategy

The primary aim of the study is to understand the role of survey methods in measuring vaccination attitudes and behaviors during the COVID-19 pandemic. Our main outcomes of interest are self-reported vaccine uptake and a harmonized measure of vaccine acceptance. To achieve this, we calculate and compare rates of self-reported vaccination acceptance and uptake across 14 countries in Africa, using data from 9 different projects that employed 11 different combinations of survey modes and sampling methods. The unit of analysis is the weighted national estimate of vaccine acceptance or self-reported vaccine uptake for each survey project during the quarter in which the survey was implemented.

To ensure the comparability of our estimates, we restrict all samples to respondents over the age of 18. Timing is a key factor that may explain differences in vaccination estimates within countries, so we define our period of analysis as spanning from mid-2020 to the end of 2022. These dates are particularly significant due to the overlapping projects that conducted data collection during this time, as well as the fact that this period encompasses the dates in which vaccines began to be rolled out in the countries included. Nonetheless, to account for the dynamic nature of the COVID-19 pandemic and the varying timelines of vaccine roll-outs and data collection efforts, we break the reference period into quarters (12-week intervals). For data that was collected continuously across our period of analysis, quarters are defined based on the date respondents completed the survey. For data collected in waves, we use the dates when the surveys was conducted.

Researchers in each projects constructed sampling weights to adjust for sampling and non-response bias. Ex-post statistical adjustments were chosen by research teams based on specific sampling designs, which differ across samples. Therefore, we use the individual weights provided by each sample instead of attempting to harmonize them, as this could lead to misspecification of post-stratification adjustment methods across samples.

In the case of Kenya's data from UNICEF CRA, we could not access their original sample weights, so we constructed them using inverse probability weighting and raking adjustment, based on the latest nationally representative official survey from Kenya, the 2016 Integrated Household Budget Survey (KIHBS). Respondents were separated into bins based on age, gender and region. Weights were then calculated as the relative frequency of UNICEF CRA respondents in each bin over that of respondent households in the national samples. These were further adjusted using raking to ensure that the sample averages of the weighting variables matched the estimated population averages.

Estimating vaccine acceptance and uptake rates from surveys

To compare differences in estimated vaccine uptake rates, we report the weighted average proportion of respondents who answered "yes" to the vaccine uptake question by country and survey wave. By plotting these figures and their confidence intervals over time, we can visualize which samples were collected within the same time frame and, for multi-round samples, how vaccine uptake estimates vary over time while holding constant factors such as recruitment methods, interview modes, and question design. This same methodology was applied to report quarterly vaccine acceptance and confidence intervals by country and survey round. We also included vaccine availability and official vaccine uptake figures from administrative data to compare with the sample estimates. For the two samples where we did not have access to microdata (PERC and Africa CDC), we included reported weighted point estimates in the visualizations but not confidence intervals. Additionally, we incorporated identifiers in the visuals to denote quarters when vaccines were partially or fully available, to consider the variation in vaccine roll-out. Vaccine acceptance measures are reported in Panel A for each country in Figures 1 through 10.[6] Self-reported vaccine uptake measures are reported in Panel B.

Self-reported uptake versus official estimates

To analyze survey mode effects and sampling bias on our vaccine acceptance and uptake estimates, we calculate the difference between our self-reported uptake estimates at the country-sample-quarter level and the official uptake figures from administrative data and population estimates. These official estimates are set to zero for all the quarters prior to the start of vaccine roll out, allowing us to calculate differences across the entire period. Since official estimates represent an upper bound for comparison, the calculated differences correspond to the maximum possible deviation of the survey estimates from the official benchmark data.

Next, we compute the simple mean of the difference between the estimated and official uptake shares by sampling and survey mode. For each unique combination of survey and sampling modes, we calculate the mean of the differences between the uptake estimates and the official estimates across all samples that employed the same sampling and survey mode, pooling data from different quarters and countries. Given the diversity of samples included in the analysis, some reported means were calculated by pooling multiple samples, while others represent a unique sample. Additionally, multi-round samples provide more point estimates, as uptake rates can be estimated across different quarters, whereas single-round samples contribute

6. For brevity, some figures (Figures 11 through 14) have been moved to the Appendix.

only one estimate to the mean. The point estimates were not weighted, meaning that multi-round samples contributed more heavily to the overall mean. However, all surveys with more than two point estimates correspond to survey and sampling mode combinations that do not include shorter surveys. We also pooled all samples to calculate the mean difference across all sampling and survey modes.

The mean differences by survey and sampling modes, standard deviations and ranges are reported in Table 2. Additionally, we provide the number of country-sample-quarter estimates and the number of unique countries included in each of the mean calculations. A positive mean value indicates that, on average, the uptake estimates from samples using a specific sampling and survey mode are higher than the corresponding official estimates across time and countries.

We performed the same analysis at the country level, calculating the average difference between estimated self-reported vaccine uptake and official uptake shares for each country. This was done by pooling all quarters and samples from the same country, irrespective of sampling and survey modes. These results are reported in Table 3.

Unlike vaccine uptake, there is no official data on vaccine acceptance that we can use as benchmark to assess the effectiveness of our samples in estimating national-level vaccine acceptance. Therefore, no comparisons could be calculated for the vaccine acceptance variable.

Self-reported uptake and vaccine acceptance, differences between surveys

To quantify the observed differences in estimated vaccine acceptance and uptake rates between samples collected through varying modes and data collectors, we use Facebook CTIS as the reference category. This survey was conducted in most of the countries included in the analysis, with the exception of Malawi, Niger and Uganda, where the project was implemented but excluded from the analysis due to small sample sizes. Additionally, this survey was conducted continuously through our period of analysis and had both vaccine uptake and acceptance questions, providing estimates for both variables of interest over the entire time period, across the majority of countries. This decision allows us to compare all other surveys to the same reference category.

We follow the same methodology as before, calculating the difference between each country-sample-quarter estimate from studies other than Facebook (CTIS) and the corresponding quarter-country estimate for the Facebook CTIS study, for both acceptance and uptake estimates where available. We then calculate the mean of these differences for each unique combination of survey and sampling modes by pooling data from different quarters and countries across all samples using the same sampling and survey mode. This mean difference was calculated for both vaccine acceptance and self-reported vaccine uptake estimates, enabling comparisons across diverse sampling and survey modes. The results are presented in Tables 5 and 6.

Finally, we pooled data from all quarters and survey-sampling mode combinations to calculate the average difference between vaccine estimates derived from non-Facebook CTIS surveys and those obtained from Facebook CTIS, on a country-by-country basis. This analysis allows us to assess the consistency of the different survey methods by country. We report the calculated averages, standard deviations, and the range of differences in Table 4, providing a comprehensive view of how these estimates vary across different contexts.

Main Results

Vaccine acceptance: overlapping surveys disagree

We find that national estimates of prevailing attitudes about vaccines depend on who is asking the question and how they sampled and surveyed respondents. We show how, for the same country and time period, different surveys yield different estimates of survey respondents' willingness to accept the vaccine. In some cases, the differences are small, in many cases the estimates differ by 20 or more percentage points.

The findings by country are shown in Panel A of Figures 1 - 10. Each point represents the percentage of respondents who provided an affirmative answer to a vaccine acceptance question. The details of the questions and response options given in each survey are presented in Table 8. Error bars represent the 95 percent confidence interval. (We discuss Panel B of each figure in the next section, but they are shown together because vaccine acceptance attitudes and vaccine uptake behavior are logically related).

It helps to examine one of the countries. For example, Figure 1 shows that in Burkina Faso, about 47 percent of respondents to the Facebook survey were willing to accept the COVID-19 vaccine when the vaccines were first made available to a subset of the population (Quarter 2 of 2021), but estimates of the same attitudes from World Bank and LMIC Panel Call list phone surveys conducted in the same time period found the rate was 61 and 67 percent, respectively, more than 14 percentage points higher. Later that same year (Quarter 4), the Facebook and LMIC Panel phone survey also gave substantially different acceptance rates. This time the gap was 13 percentage points.

In Ethiopia, where vaccines were first made available to a subset of the population in Quarter 2 of 2021 as well, there were four different survey-based estimates of vaccine acceptance available, ranging from a low of 70 percent (Facebook sample) to a high of 96 percent (World Bank phone survey). PERC and UNICEF estimates fell in between.

Inspecting the figures for these ten countries, one can see more examples of overlapping surveys reaching different results. These differences far exceeded the reported margin of error for these surveys. Looking just at overlapping time periods, the discrepancies of similar size can be found for most other countries, although the acceptance rates in Kenya and Morocco (Figures 4 and 5) were much closer together, within 7 percentage points regardless of data source/methodology for a given quarter.

While not every survey was administered in every quarter, we can still exploit non-overlapping time periods by estimating time trends and looking for overlap using this interpolation between survey waves. This approach is reasonable as one can see for those surveys conducted at multiple intervals that time trends appear smooth.

Here we discuss 10 of the 14 countries we examined. The other four countries had more sparse data, making it more difficult to draw general conclusions, but their findings, largely consistent with the 10 we include here, are visualized in Figures 11-14 in the appendix.

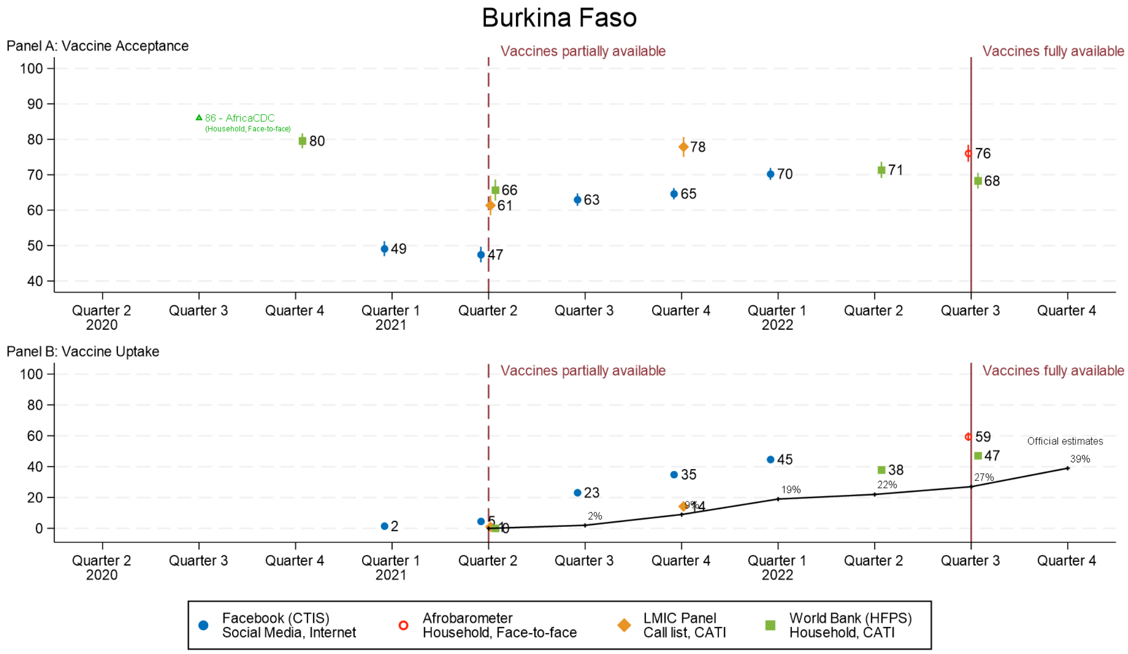


Figure 1: Vaccine Acceptance and Uptake Estimates by Quarter in Burkina Faso

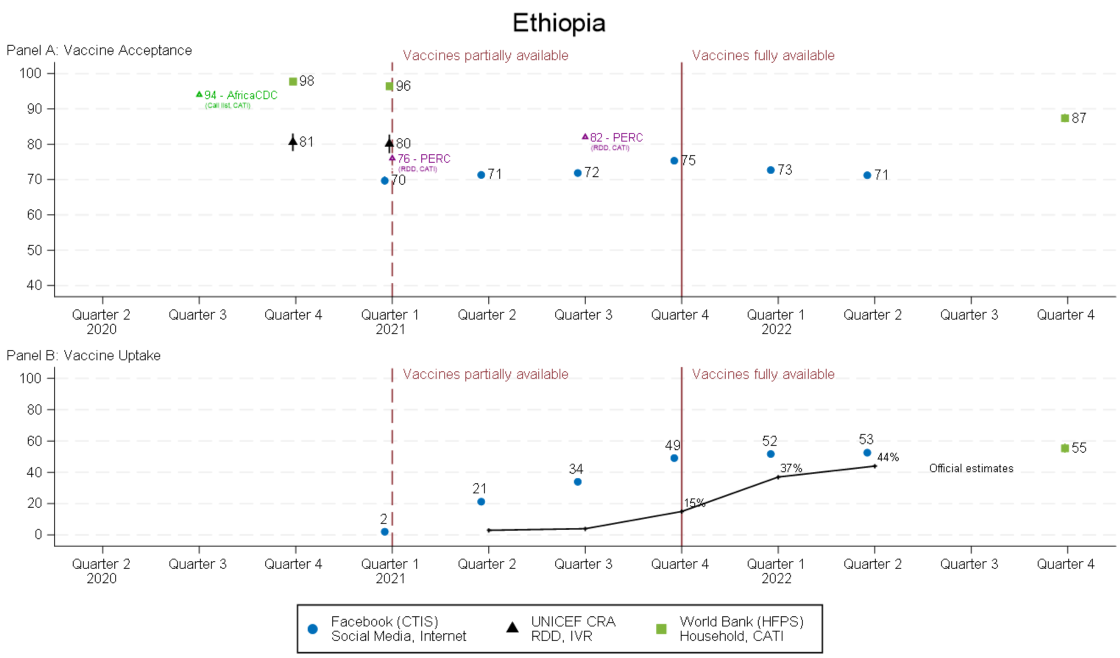


Figure 2: Vaccine Acceptance and Uptake Estimates by Quarter in Ethiopia

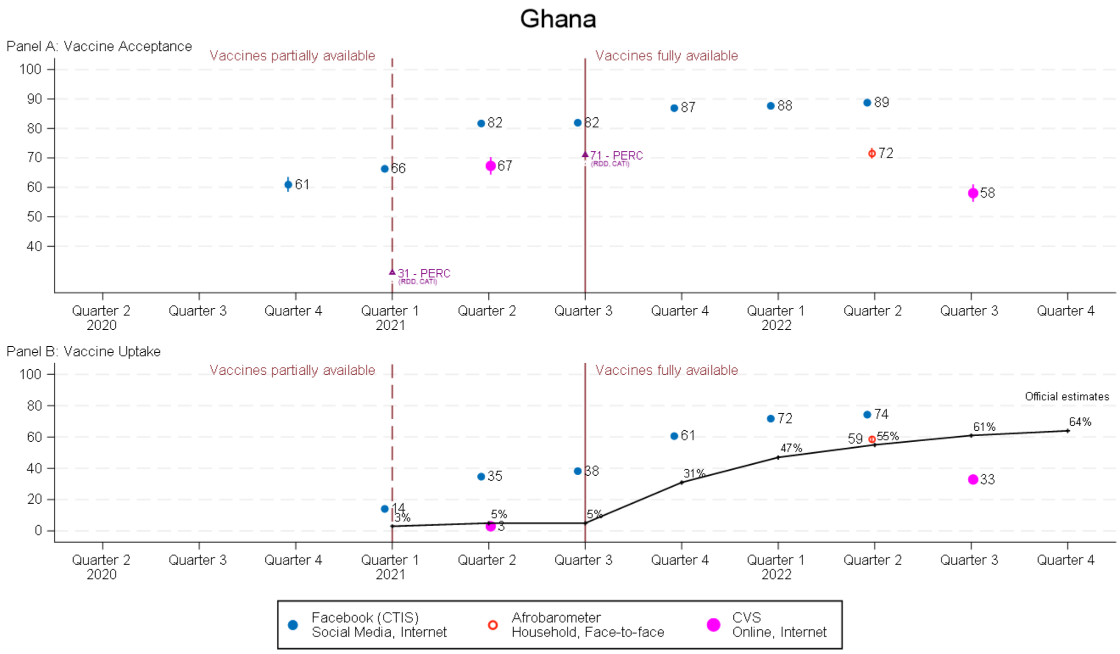


Figure 3: Vaccine Acceptance and Uptake Estimates by Quarter in Ghana

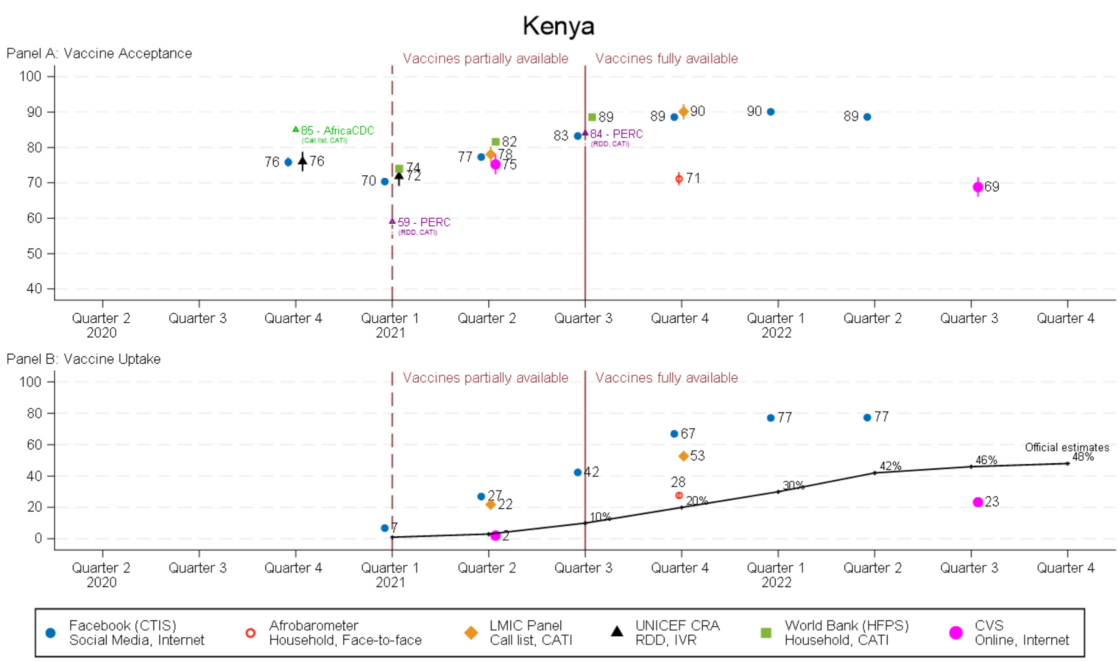
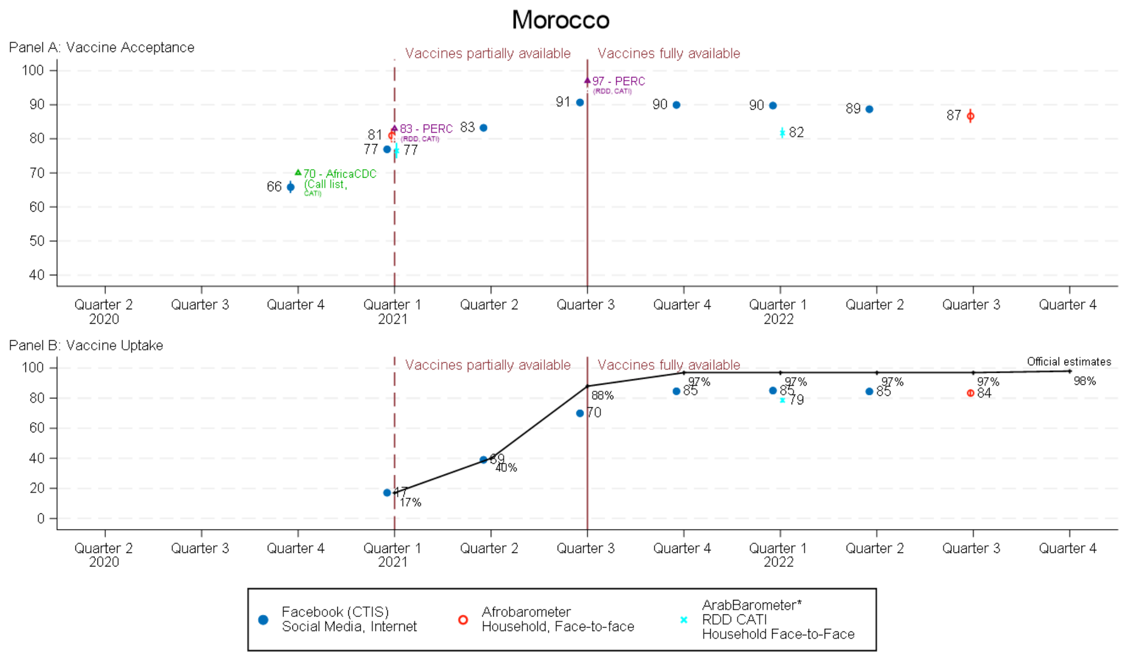


Figure 4: Vaccine Acceptance and Uptake Estimates by Quarter in Kenya



The Arab Barometer collected data using phone surveys for the earlier part of the COVID-19 pandemic (2020), and transitioned to household face-to-face surveys for 2021-2022.

Figure 5: Vaccine Acceptance and Uptake Estimates by Quarter in Morocco

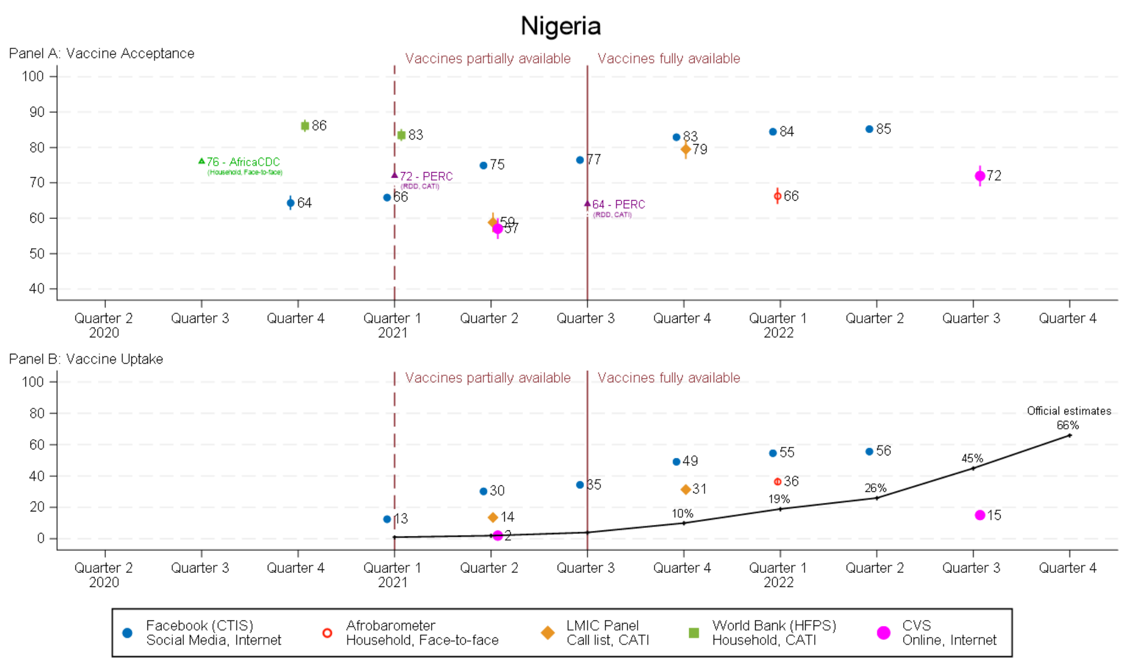


Figure 6: Vaccine Acceptance and Uptake Estimates by Quarter in Nigeria

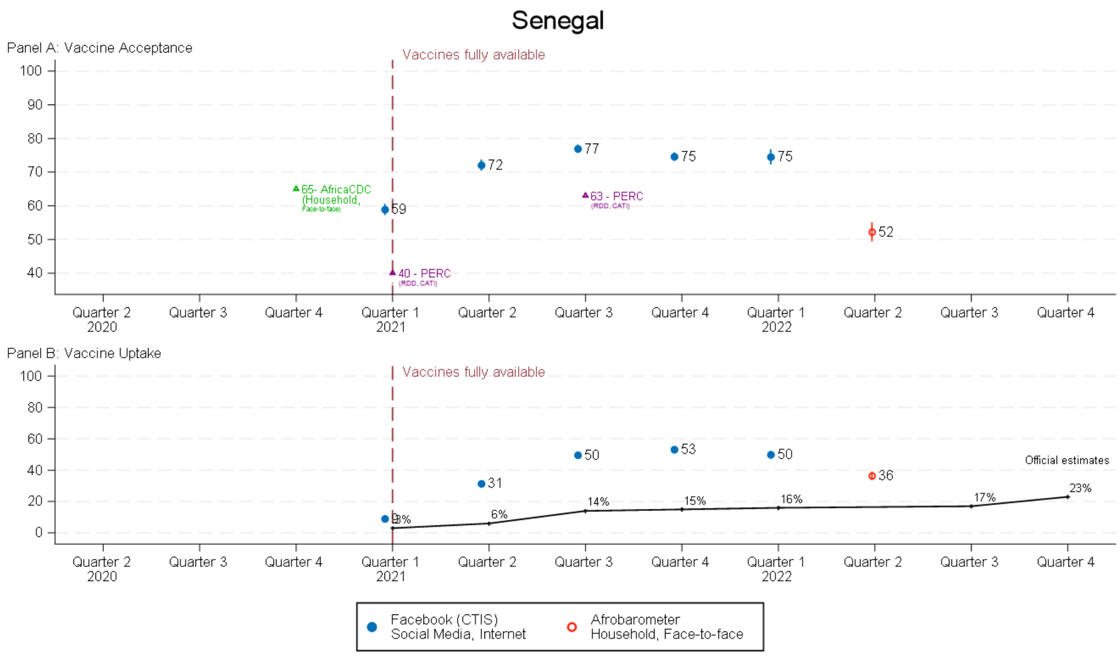
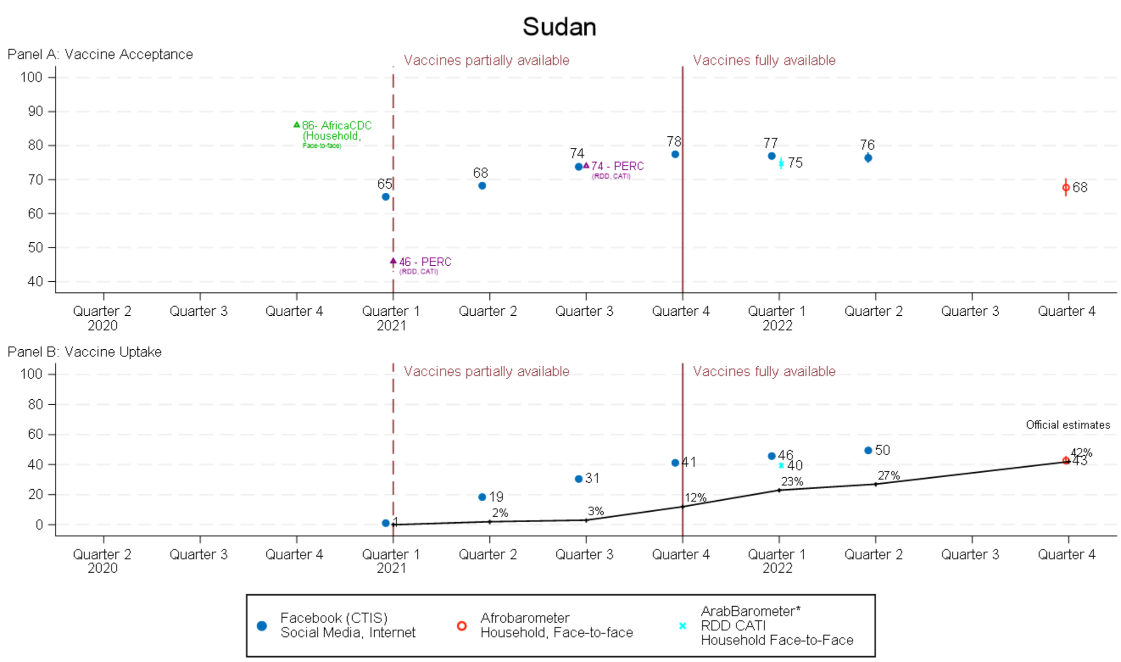
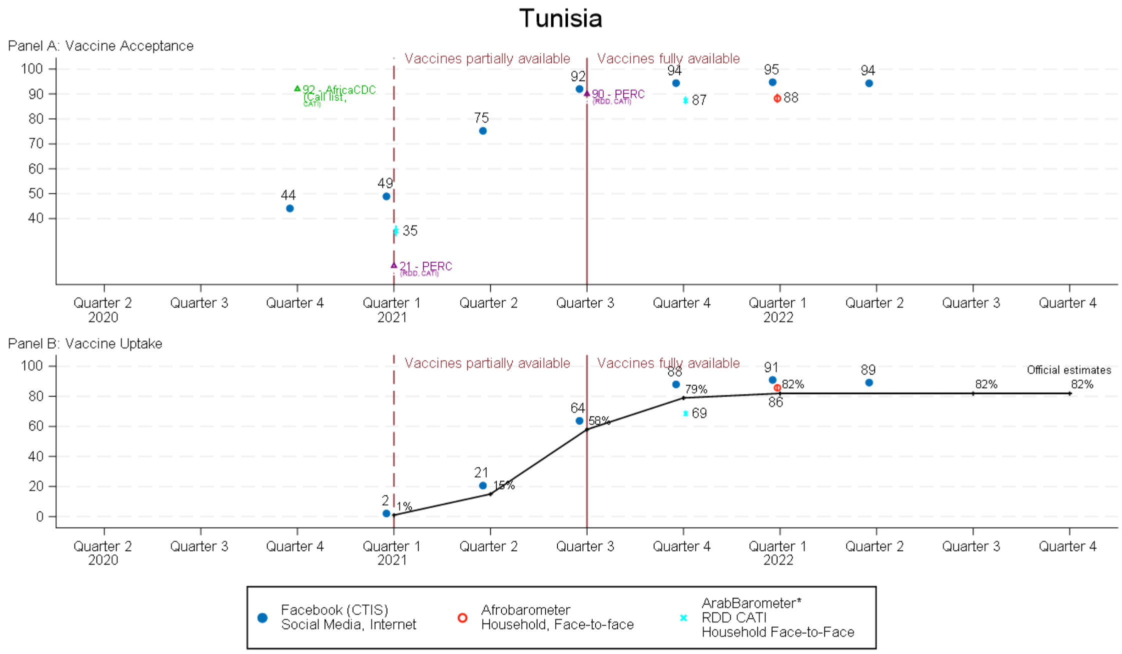


Figure 7: Vaccine Acceptance and Uptake Estimates by Quarter in Senegal



Note: The Arab Barometer collected data using phone surveys for the earlier part of the COVID-19 pandemic (2020), and transitioned to household face-to-face surveys for 2021-2022.

Figure 8: Vaccine Acceptance and Uptake Estimates by Quarter in Sudan



Note: The Arab Barometer collected data using phone surveys for the earlier part of the COVID-19 pandemic (2020), and transitioned to household face-to-face surveys for 2021-2022.

Figure 9: Vaccine Acceptance and Uptake Estimates by Quarter in Tunisia

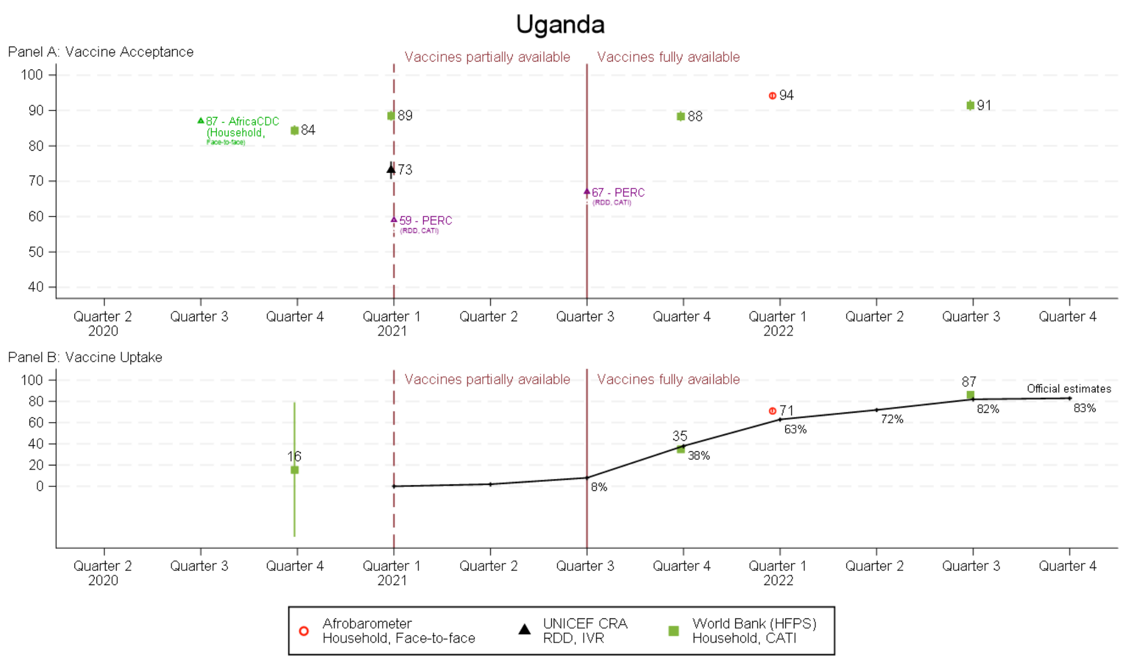


Figure 10: Vaccine Acceptance and Uptake Estimates by Quarter in Uganda

Vaccine uptake: surveys overstate rates from administrative data

We find that most of the survey modes and methodologies resulted in vaccine uptake estimates that were substantially higher than official estimates, which were based on government records of people who received at least one vaccine dose. This could either mean that governments under-report the number of vaccine doses administered, or perhaps more likely, survey samples only manage to include those respondents who have greater tendency to have gotten vaccinated, and therefore overstate the national uptake rates.

In each of the figures just presented, Panel B shows the self-reported vaccine uptake rates from different surveys marked by different colors and plot symbols, while the solid trend lines show the official estimates. For example, in Figure 1, Panel B, the solid line indicates that in Quarter 4 of 2021, 9 percent of Burkina Faso adults had received at least one vaccine dose, yet the survey estimates suggest that the rate was higher, 14 percent based on the LMIC Panel call list and 35 percent based on the Facebook CTIS survey. In each of the other quarters after vaccines were made fully available the self-reported uptake rates exceeded the official estimates by double digit percentage points. Even before any vaccines were supposed to have been available the self-reported estimates were 2 percent in Burkina Faso.

Similar size and direction discrepancies are evident in the other countries with some exceptions. The CVS online survey and the Afrobarometer survey reported vaccine uptake rates much more in line with official estimates. Across all surveys, self-reported uptake rates tended to match the official estimates more closely in three of the 10 countries: Morocco, Tunisia, and Uganda. See Table 3, which shows the mean, standard deviation, and range of differences between the survey-based uptake rates and the corresponding rate according to administrative data. Morocco, Tunisia, and Uganda stand out as having average discrepancies of 11 percentage points or less (-11 points in the case of Morocco), and a standard deviation of less than 10 points as well. Elsewhere the mean discrepancy is between 12 and 28 percentage points, always positive, consistent with upward biased survey estimates. The mean discrepancy across all countries is 14 percentage points.

Vaccine attitudes versus behavior

In most cases, the reason for measuring vaccine acceptance is to predict or influence the final outcome of vaccine uptake. In our analysis we see that reported acceptance does not adequately predict vaccine uptake, neither self-reported or official estimates of uptake. Comparison of Panels A and B in each figure highlights the stark contrast between the estimates of acceptance rate in this analysis and the official estimated vaccination rates in these countries as of mid-2022. In nearly all cases, the lowest point estimates for acceptance found among all samples in each country is still more than twice the actual vaccination rate. The same can be said of estimates for acceptance and reported uptake. In Kenya, 75 percent of CVS respondents expressed acceptance of the vaccine in early 2021, just a quarter before the vaccine was made fully available. In late 2022, only 23 percent of respondents reported being vaccinated despite the vaccine being fully available for roughly a year. This may suggest that while willing to be vaccinated, respondents encountered issues with actual uptake such as ease of access or stock outs. Or, after responding to the survey, respondents

Table 2: Differences in Uptake with Official estimates, by Sampling and Survey mode

Mode		Count		Official Uptake Estimates		
Sampling	Survey	Estimates	Countries	Mean	Std. Dev.	Range
Household	F2F[a]	15	12	.06	.13	(-.18 , .32)
Household	CATI[b]	6	2	.09	.10	(-.03 , .20)
Call list	CATI[b]	6	3	.15	.12	(.01 , .32)
Online	Internet	6	3	-.14	.14	(-.30 , 0)
Social media	Internet	60	11	.19	.15	(-.18 , .47)
All	All	93	14	.14	.17	(-.30 , .47)

[a] Face-to-face; [b] Computer Assisted Telephone Interview. **Estimates** represent the number of data points compared to official figures for each sampling and survey mode combination. A data point corresponds to the acceptance/uptake rate reported by a survey in a specific quarter. **Countries** denotes the number of distinct countries included in the comparison with official estimates for that particular sampling and survey mode combination. **Official Uptake Estimates**, refers to share of uptake from the population of individuals 18 years of age and older, according to the Oxford Covid-19 Government Response Tracker (OxCGRT).

de-prioritized vaccination based on new information (or misinformation) about effectiveness or based on periods of low COVID-19 cases.

As previously mentioned, acceptance does not always translate to action. It's unknown how survey methodology may have impacted reported acceptance but one plausible conclusion might be that regardless of the survey methods used in estimating acceptance, more attention needs to be paid to mediating psychological and practical factors, and in particular local and regional social norms.

Additional Analysis

There are many possible explanations for these findings. We explored whether the data could shed any light on *why* survey estimates of the same parameter (same country and time period) do not give the same answer and that surveys often overstate vaccine uptake relative to official estimates. Do some survey methods consistently produce outliers? Do some methods come closer to official uptake statistics than others? Are there clues in the observable characteristics of the survey members that suggest which surveys produce greater selection bias due to coverage errors or nonresponse errors?

Outliers

To address these questions, we note that one of the survey methods was a consistent outlier in the vaccine uptake analysis. The Facebook CTIS estimates vaccine uptake were consistently higher than estimates produce by any of the other survey projects. See Table 4 for differences of all the survey estimates with the

Table 3: Differences in Uptake with Official Estimates, by Country

	Count	Official Uptake Estimates		
Country	Estimates	Mean	Std. Dev.	Range
Burkina Faso	11	.14	.12	(0 , .32)
Côte d'Ivoire	6	.12	.09	(.01 , .23)
Ethiopia	5	.21	.11	(.08 , .35)
Ghana	9	.14	.20	(-.28 , .34)
Kenya	11	.20	.21	(-.22 , .47)
Malawi	1	.13		-
Mali	6	.22	.12	(.03 , .34)
Morocco	8	-.11	.07	(-.18 , 0)
Niger	1	.12		-
Nigeria	11	.18	.20	(-.30 , .40)
Senegal	5	.28	.13	(.06 , .38)
Sudan	8	.17	.11	(0 , .30)
Tunisia	7	.04	.07	(-.11 , .09)
Uganda	4	.06	.08	(-.03 , .16)
All	93	.14	.17	(-.30 , .47)

Estimates represent the number of data points compared to official figures for each country. A data point corresponds to the acceptance/uptake rate reported by a survey in a specific quarter. **Official Uptake Estimates**, refers to share of uptake from the population of individuals 18 years of age and older, according to the Oxford Covid-19 Government Response Tracker (OxCGRT).

Facebook estimates by country

For vaccine acceptance, the pattern was not as clear. The Africa CDC vaccine perceptions survey was administered just once, relatively early in the pandemic, but still appears to be an outlier on the high side in 5 of the 9 countries where it was administered.

Unfortunately, knowing that one survey project or another is an outlier does not answer the question fully. The reason could be method of recruiting sample members, question wording, mode effects, or a combination.

Sample composition

We can look at the sample demographics for each survey project and survey wave and compare them to the best available estimates of national populations by country, but this exercise, already conducted by Collins et al. 2024, is likely to be inconclusive. The very same conditions of pandemic that motivated the turn toward different survey modes also made it difficult or impossible for national statistical offices to conduct in-person census surveys, so there are not many reliable benchmarks. We did use sampling weights in our

Table 4: Differences in Vaccine Uptake and Acceptance with Facebook Estimates, by Country

	Vaccine Acceptance				Vaccine Uptake			
Country	Estimates	Mean	Std. Dev.	Range	Estimates	Mean	Std. Dev.	Range
Burkina Faso	3	.15	.03	(.13 , .18)	3	-.10	.10	(-.21 , -.04)
Côte d'Ivoire	3	-.14	.13	(-.24 , 0)	1	-.22	-	-
Ethiopia	4	.13	.09	(.06 , .27)	0	-	-	-
Ghana	4	-.20	.11	(-.35 , -.11)	2	-.24	.11	(-.32 , -.16)
Kenya	12	0	.07	(-.17 , .09)	4	-.21	.15	(-.39 , -.05)
Morocco	6	.02	.05	(-.08 , .06)	1	-.07		-
Nigeria	8	-.03	.16	(-.18 , .22)	4	-.20	.05	(-.28 , -.17)
Senegal	2	-.16	.04	(-.19 , -.14)	0	-	-	-
Sudan	3	-.07	.10	(-.19 , 0)	1	-.06	-	-
Tunisia	6	-.02	.26	(-.28 , .48)	2	-.12	.10	(-.19 , -.05)
All	51	-.02	.15	(-.35 , .48)	18	-.17	.1	(-.39 , -.04)

Estimates represent the number of data points compared to Facebook CTIS (Social media - Internet) figures for each country. A data point corresponds to the acceptance/uptake rate reported by a survey in a specific quarter.

analysis here to account for at least some of the sample composition differences between survey samples and national populations. Collins et al. demonstrated that poststratification weighting has limited ability to correct parameters for selection bias given that commonly available demographics such as gender, age, and education may explain little of the unobserved factors that determine who is eventually recruited into surveys and completes them. Thus, we conclude that selection is likely a factor, but cannot directly measure its influence.

Survey methodology

We also considered recruitment methods and survey modes. We collapsed the 11 survey projects into six categories of survey methodology: household CAPI, household CATI, Call list CATI, RDD CATI, RDD IVR, and Online/internet. Using Facebook as the reference category, because it was so widely available with the most countries and time periods and had the largest samples, we calculated differences in vaccine acceptance rates for each of these. Table 5 shows the average acceptance rates as the difference from the mean Facebook acceptance rates. The online/internet survey had the lowest estimated vaccine acceptance, 12 percentage points below the Facebook benchmark, while household CATI estimates were highest, 14 points higher than the Facebook benchmark, on average. Unfortunately, there is no way to know which of these is more accurate because prevailing attitudes cannot be benchmarked against an objective measure.

We repeated the analysis for vaccine uptake, which does have a benchmark in the administrative data, this time collapsing into just four categories because there were no RDD estimates of uptake. Again, the

Table 5: Differences in Acceptance with Facebook Estimates, by Sampling and Survey Mode

Mode		Count		Vaccine Acceptance		
Sampling	Survey	Estimates	Countries	Mean	Std. Dev.	Range
Household	F2F[a]	9	7	-.11	.09	(-.24 , .04)
Household	CATI[b]	7	4	.14	.09	(.04 , .27)
Call list	CATI[b]	9	5	.08	.18	(-.16 , .48)
RDD	CATI[b]	20	9	-.08	.13	(-.35 , .10)
RDD	IVR[c]	3	2	.04	.06	(0 , .10)
Online	Internet	3	3	-.12	.08	(-.18 , -.02)
All	All	51	10	-.02	.15	(-.35 , .48)

[a] Face-to-face; [b] Computer Assisted Telephone Interview; [c] Interactive Voice Response. **Estimates** represent the number of data points compared to Facebook CTIS (Social media - Internet) figures for each sampling and survey mode combination. A data point corresponds to the vaccine acceptance rate reported by a survey in a specific quarter. **Countries** denotes the number of distinct countries included in the comparison with Facebook CTIS estimates for that particular sampling and survey mode combination.

(non-Facebook) online survey produced the lowest estimates while the household CATI survey estimates were highest. Table6 shows that the average differences were all substantial and negative relative to Facebook, 17 points lower on average, with the other online/internet survey being the most different, 28 points lower, and the household CATI estimate being closest, just 4 percentage points lower than the Facebook survey estimates, on average. In this case, the lower estimates are probably most credible, so that favors the other internet survey, followed by the household face to face survey mode.

Table 6: Differences in Uptake with Facebook Estimates, by Sampling and Survey Mode

Mode		Count		Vaccine Uptake		
Sampling	Survey	Estimates	Countries	Mean	Std. Dev.	Range
Household	F2F[a]	8	7	-.17	.11	(-.39 , -.05)
Household	CATI[b]	1	1	-.04	-	-
Call list	CATI[b]	6	3	-.13	.07	(-.21 , -.04)
Online	Internet	3	3	-.28	.03	(-.32 , -.25)
All	All	18	8	-.17	.10	(-.39 , -.04)

[a] Face-to-face; [b] Computer Assisted Telephone Interview. **Estimates** represent the number of data points compared to Facebook CTIS (Social media - Internet) figures for each sampling and survey mode combination. A data point corresponds to the vaccine uptake rate reported by a survey in a specific quarter. **Countries** denotes the number of distinct countries included in the comparison with Facebook CTIS estimates for that particular sampling and survey mode combination.

Conclusion

The goal of this paper was to assess different survey methodologies for measuring vaccine attitudes (acceptance) and behaviors (uptake). We examined surveys across 14 African countries, where the survey researchers recruited samples from existing lists, from random digit dialing, and from internet recruitment such as on social media platforms (Facebook). The surveys varied in whether they were interviewer-administered or self-administered, in-person or over the phone, and in the precise wording used to ask about vaccine acceptance uptake.

The results suggest that all the survey methods implemented during the pandemic period should be considered with a degree of skepticism, both because they do not cluster tightly around common values for attitudes (vaccine acceptance rates), nor do they line up closely with administrative data.

With political polling, it is common to identify one or two outliers and remove them, and we did find that the Facebook-sourced survey sample was consistently different from the others, but it was also the largest and sample and was available for the most countries and time periods.

A key limitation of the present study is that it is observational. That is, we did not systematically vary the different factors that might affect survey accuracy, so many of the possible explanations for the findings are confounded or unmeasurable.

Nevertheless, it is possible to identify logical reasons and speculate on why some of the survey methods might yield the results that they did. For example, over-estimating actual vaccination rates could be the result of social desirability bias. Yet, we can likely discount this explanation because we also see upward bias in self-administered surveys, where social desirability should be lower than if the respondent were providing answers to a live interviewer.

This leaves sample selection, whether through voluntary (differential) nonresponse, or coverage bias as a likely explanation. In this case, self-administered surveys which require internet access, computers or smartphones, and for respondents to be literate, should have the largest bias due to coverage, excluding the poorest individuals. This in fact was the case for Facebook in most countries. Two of the countries where we did not see such a large discrepancies consistent with bias were Morocco and Tunisia, which were the higher income countries of those we studied. Those are also where we would expect less of this coverage bias. We do not have an explanation for why Uganda was one of these countries with better performance of the Facebook survey.

Another limitation is that, while we had data from 11 survey projects operating in multiple countries each, there was still a limited number of variations in survey methods. We found some evidence that household CATI surveys performed best by one measure compared to IVR, RDD, and even face to face surveys. However, this could have been a "house effect", related to the identity of the survey organization, or the quality of the sample frame, or some other factor. The data can only be suggestive.

In spite of these limitations, there is a lesson to be learned from the overlap of so many different surveys in so many countries. That is the idea that survey methods matter. This includes how questions and response options are worded, how sample members are recruited, and how questionnaires are administered. Wherever possible, triangulating with different methods for each of these could provide some insurance against the bias inherent in any one methodology, such as with mixed mode surveys. More research, including systematic studies like randomized experiments, can be used to drill down more specifically on individual factors like questionnaire design, sampling design, and mode effects. Ultimately, survey experiments using ground truth data will be most effective at empirically identifying the methodologies able to generate the most reliable data.

Acknowledgements

The authors thank the following research teams and researchers who contributed their data to this effort:

Facebook Covid Study: This research is based on survey results from University of Maryland. We thank the University of Maryland's Joint Program in Survey Methodology (JPSM), and their implementing partner, Facebook.

UNICEF Community Rapid Assessment (CRA) Studies: We thank the UNICEF Eastern and Southern Africa Region: Natalie Fol, Massimiliano Sani, Helena Ballester Bon, Urs Nagel, Carole Tronchet Pradhan; the UNICEF Country-level offices of Angola, Kenya, Ethiopia, Madagascar, Rwanda, South Africa, South Sudan, and Uganda: Vololomanitra Belalahy, Surangani Abeyesekera, Andinet Challa, Hoby Razakasoavina, Maksim Fazlitdinov, Janine Simon Meyer, Gopinath Durairajan, and Mandi Chikombero; UNICEF HQ: Uyen Kim Huynh, Vincent Petit, Rania Elessawi, Andrés Esteban Ochoa Toasa; the National Government of Ethiopia, and the National Government of Kenya.

Afrobarometer Survey: We thank the Afrobarometer, who generously provided microdata from Round 8 and Round 9 surveys that included COVID-19 vaccine attitude questions.

World Bank High Frequency Panel Survey (HFPS): We thank the World Bank for the Living Standards Measurement Survey (LSMS) Integrated Survey on Agriculture (ISA) in Nigeria and Ethiopia, the West Africa Economic Monetary Union (WAEMU) in Burkina Faso, and to the Kenya National Bureau of Statistics and the University of California, Berkeley for the COVID-19 Rapid Response Phone Survey (RRPS) in Kenya.

Arab Barometer Survey: We thank the Arab Barometer and local implementing partners: Sudan Polling and Survey Center and One to One for Research and Polling in Tunisia.

Lazarus Survey: We thank Jeffery V. Lazarus and their research team for the public availability of their data on COVID-19 vaccine acceptance.

We also include aggregate data from two studies drawn from public reports:

Partnership for Evidence-Based Response to COVID-19 (PERC): We thank the PERC consortium, which includes the Africa CDC, Resolve to Save Lives, the World Health Organization, the UK Public Health Rapid Support Team, the World Economic Forum, and their implementing partner, IPSOS.

COVID-19 Vaccine Perceptions: We thank the Africa CDC, the London School of Hygiene and Tropical Medicine, the Vaccine Confidence Project, and their implementing partner, ORB International.

This analysis was supported by a grant from the Bill & Melinda Gates Foundation. Any opinions contained herein are those of the authors and do not necessarily reflect the views of the funder.

We declare that we have no conflicts of interest.

Tables & Figures

Table 7: Survey Project Summary

Survey Project	Recruitment Mode	Survey Mode	Timeframe	Sample Size
Burkina Faso				
Africa CDC CVP	Household	Face-to-face	2020-Q4	1,037
Afrobarometer	Household	Face-to-face	2022-Q3	1,200
Facebook CTIS	Social media	Internet	2020-Q4 through 2022-Q2	13,139
LMIC Panel	Call list	CATI	2021-Q2, 2021-Q4	2,026
RECOVR	RDD	CATI	2020-Q2	977
WB HFPS	Call list	CATI	2020-Q4, 2021-Q2, 2022-Q2 & Q3	5,572
Côte d'Ivoire				
Africa CDC CVP	Call list	CATI	2020-Q4	1,039
Afrobarometer	Household	Face-to-face	2021-Q4	768
Facebook CTIS	Social media	Internet	2020-Q4 through 2022-Q2	30,283
PERC	RDD	CATI	2021-Q1 & Q3	2,723
Ethiopia				
Africa CDC CVP	Call list	CATI	2020-Q3	1,001
Facebook CTIS	Social media	Internet	2020-Q4 through 2022-Q2	58,012
PERC	RDD	CATI	2021-Q1 & Q3	3,134
UNICEF CRA	RDD	IVR	2020-Q4, 2021-Q1	1,866
WB HFPS	Call list	CATI	2020-Q4, 2021-Q1, 2022-Q4	5,854
Ghana				
Afrobarometer	Household	Face-to-face	2022-Q2	2,369
Facebook CTIS	Social media	Internet	2020-Q4 through 2022-Q2	79,239
Lazarus	Online	Internet	2021-Q2, 2022-Q3	2,028
PERC	RDD	CATI	2021-Q1 & Q3	2,578
Kenya				
Africa CDC CVP	Call list	CATI	2020-Q4	1,000
Afrobarometer	Household	Face-to-face	2021-Q4	2,400
Facebook CTIS	Social media	Internet	2020-Q4 through 2022-Q2	245,214
Lazarus	Online	Internet	2021-Q2, 2022-Q3	2,000
LMIC Panel	Call list	CATI	2021-Q2 & Q4	2,099
PERC	RDD	CATI	2021-Q1 & Q3	2,817
UNICEF CRA	RDD	IVR	2020-Q4, 2021-Q1	1,935
WB HFPS	Call list	CATI	2021-Q1 & Q2 & Q3	16,427
Mali				
Afrobarometer	Household	Face-to-face	2022-Q3	1,200
Facebook CTIS	Social media	Internet	2020-Q4 through 2022-Q2	15,079
Malawi				
Afrobarometer	Household	Face-to-face	2022-Q1	1,194
Morocco				
Africa CDC CVP	Call list	CATI	2020-Q4	1,000

Continued on next page

Table 7 – continued from previous page

Survey Project	Recruitment Mode	Survey Mode	Timeframe	Sample Size
Afrobarometer	Household	Face-to-face	2021-Q1, 2022-Q3	2,398
Arab Barometer	Household	Face-to-face	2021-Q1	1,201
Arab Barometer	RDD	CATI	2022-Q1	2,396
Facebook CTIS	Social media	Internet	2020-Q4 through 2022-Q2	151,138
PERC	RDD	CATI	2021-Q1 & Q3	2,482
Niger				
Afrobarometer	Household	Face-to-face	2020-Q4, 2022-Q2	2,397
Nigeria				
Africa CDC CVP	Household	Face-to-face	2020-Q3	1,172
Afrobarometer	Household	Face-to-face	2022-Q1	1,598
Facebook CTIS	Social media	Internet	2020-Q4 through 2022-Q2	270,628
Lazarus	Online	Internet	2021-Q2, 2022-Q3	2,000
LMIC Panel	Call list	CATI	2021-Q2 & Q4	2,004
PERC	RDD	CATI	2021-Q1 & Q3	2,575
WB HFPS	Call list	CATI	2020-Q4, 2021-Q1	3,451
Senegal				
Africa CDC CVP	Call list	CATI	2020-Q4	1,010
Afrobarometer	Household	Face-to-face	2022-Q2	1,200
Facebook CTIS	Social media	Internet	2021-Q1 through 2022-Q1	16,209
PERC	RDD	CATI	2021-Q1 & Q3	2,643
Sudan				
Africa CDC CVP	Call list	CATI	2020-Q4	1,075
Afrobarometer	Household	Face-to-face	2022-Q4	1,193
Arab Barometer	Household	Face-to-face	2022-Q1	2,347
Facebook CTIS	Social media	Internet	2021-Q1 through 2022-Q2	78,041
PERC	RDD	CATI	2021-Q1 & Q3	2,751
Tunisia				
Africa CDC CVP	Call list	CATI	2020-Q4	1,000
Afrobarometer	Household	Face-to-face	2022-Q1	1,199
Arab Barometer	Household	Face-to-face	2021-Q1	1,199
Arab Barometer	RDD	CATI	2021-Q4	2,396
Facebook CTIS	Social media	Internet	2020-Q4 through 2022-Q2	165,775
PERC	RDD	CATI	2021-Q1, Q3	2,416
Uganda				
Africa CDC CVP	Household	Face-to-face	2020-Q4	1,008
Afrobarometer	Household	Face-to-face	2022-Q1	2,400
PERC	RDD	CATI	2021-Q1, Q3	2,584
UNICEF CRA	RDD	IVR	2021-Q1	1,219
WB HFPS	Call list	CATI	2020-Q4, 2021-Q1 & Q4, 2022-Q3	7,617

Sample size indicates the usable sample size for analyzing vaccine hesitancy responses.

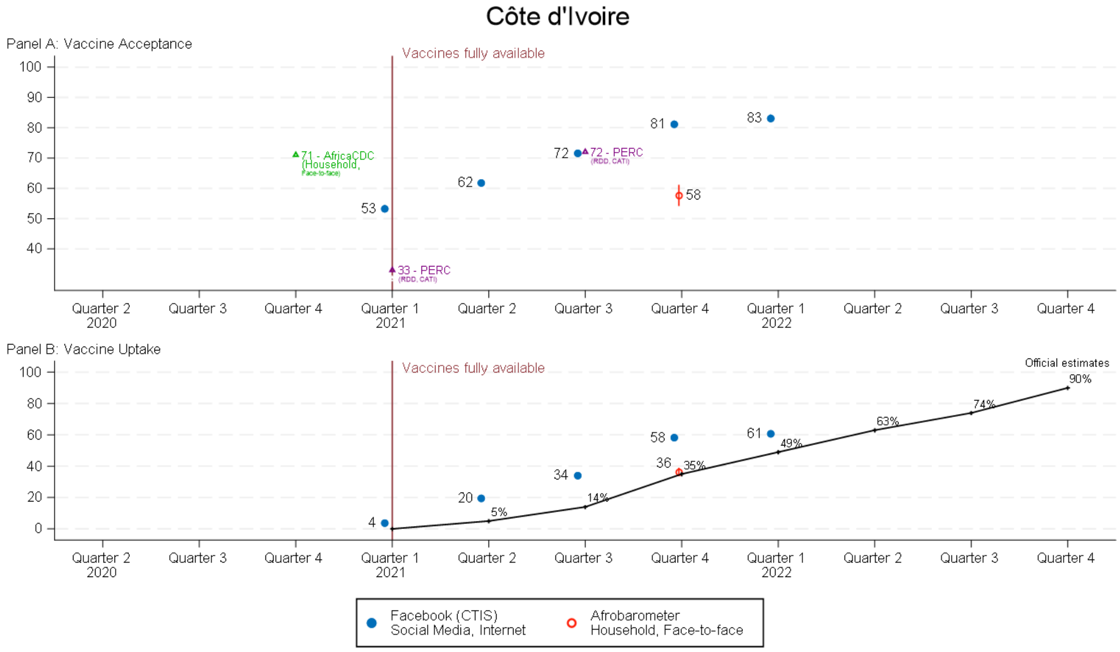


Figure 11: Vaccine Acceptance and Uptake Estimates by Quarter in Côte d'Ivoire

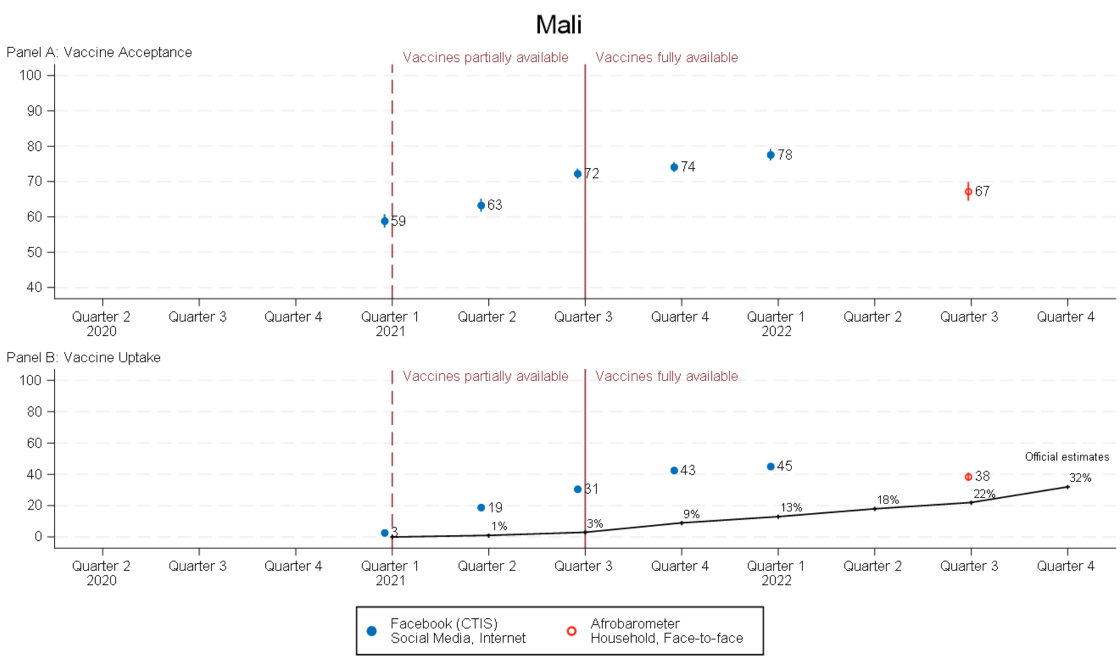


Figure 12: Vaccine Acceptance and Uptake Estimates by Quarter in Mali

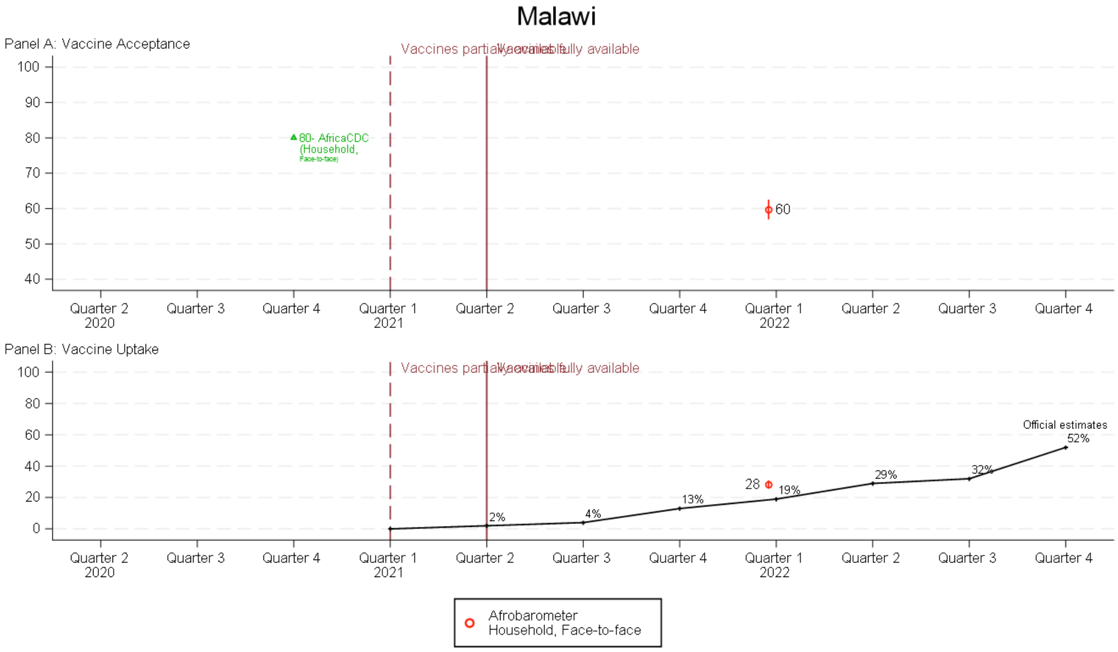


Figure 13: Vaccine Acceptance and Uptake Estimates by Quarter in Malawi

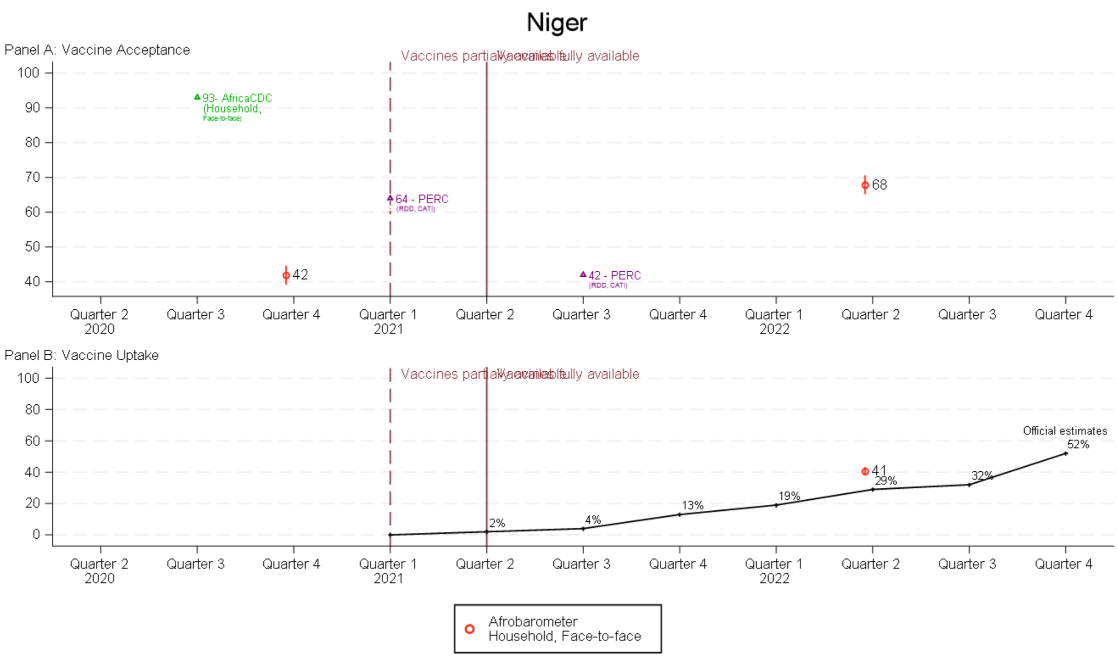


Figure 14: Vaccine Acceptance and Uptake Estimates by Quarter in Niger

Table 8: Survey questions and response options

Survey Project	Question	Response Set
Africa CDC CVP	If a new Coronavirus (COVID-19) vaccine became publicly available and was deemed safe and effective, do you think you would take it?	Yes; No; Don't know
Afrobarometer R7	If a vaccine for COVID-19 becomes available and the government says it is safe, how likely are you to try to get vaccinated?	Very unlikely; Somewhat unlikely; Somewhat likely; Very likely; Don't know
Afrobarometer R8	If a vaccine for COVID-19 is available , how likely are you to try to get vaccinated?	Very unlikely; Somewhat unlikely; Somewhat likely; Very likely
ArabBarometer R6	If it became available, how likely are you to get the vaccine if if was available for free?	Very likely, Somewhat likely, Somewhat unlikely, Very unlikely, Don't know
ArabBarometer R7	How likely are you to get the vaccine once it becomes available to you?	Very likely, Somewhat likely, Somewhat unlikely, Very unlikely, Don't know
Facebook CTIS R7	If a vaccine to prevent COVID-19 (coronavirus) were offered to you today, would you choose to get vaccinated?	Yes, I would definitely choose to get vaccinated; Yes, I would probably choose to get vaccinated; No, I would probably not choose to get vaccinated; No, I would definitely not choose to get vaccinated
Facebook CTIS R8-R13	If a vaccine to prevent COVID-19 were offered to you today, would you choose to get vaccinated?	Yes, definitely; Yes, probably; No, probably not; No, definitely not
Lazarus	I will take the COVID-19 vaccine when it becomes available to me.	Strongly agree, Somewhat agree, Unsure/No opinions, Somewhat disagree, Strongly disagree

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Survey Project	Question	Response Set
LMIC Panel R4	Please indicate whether you agree or disagree with the following statement. "I will get a COVID=19 vaccine when I can."	Strongly agree; Somewhat agree; Neither agree nor disagree; Somewhat disagree; Strongly disagree
LMIC Panel R5	As the new coronavirus (COVID-19) vaccines are offered in your country, how willing would you be to accept the vaccine?	Definitely yes; Unsure but leaning towards yes; Unsure but leaning towards no; Definitely no
PERC	If a safe and approved vaccine against COVID-19 were to become available, how likely would you be to get vaccinated? Please tell me if you would...	Definitely get vaccinated against COVID-19, probably get vaccinated, probably not get vaccinated or definitely note get vaccinated against COVID-19?
UNICEF CRA Ethiopia	If a COVID-19 vaccine becomes available at some point next year and it is recommended for you, would you get it?	Yes; No; Not sure
UNICEF CRA Kenya	If a COVID-19 vaccine becomes available at some point in the next year and is recommended for me, I would get it	Strongly agree; Agree; Not sure; Somewhat disagree / Mostly disagree; Strongly disagree
WB HFPS	If an approved vaccine to prevent coronavirus was available right now at no cost, would you agree to be vaccinated?	Yes; No; Not sure

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