Factors influencing COVID-19 vaccines hesitancy in rural and urban West Africa: Implications for vaccination strategies

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Abstract

Background: Raising immunization coverage against COVID-19, in particular in low- and middle-income countries (LMICs), is crucial in addressing the current pandemic. Additionally, in Africa reaching the necessary herd immunity threshold is jeopardized by factors, such as vaccine hesitancy. To build confidence in COVID-19 vaccines, it is important to understand and address the reasons for vaccine hesitancy. Yet, few studies for rural and urban Sub-Saharan Africa exist, which have analyzed these factors.

Methods: This study reports on a cross-sectional survey in five West African countries (Burkina Faso, Guinea, Mali, Senegal, and Sierra Leone) to identify and describe factors influencing COVID-19 vaccine hesitancy in rural and urban settings. The survey was conducted at a time when in these countries the roll-out of COVID-19 vaccines had not yet or only just begun. Data were analyzed using descriptive statistics and Poisson regression models, with robust standard errors. The general protocol is registered on clinicaltrial.gov (protocol number: NCT04912284)

Results: Findings show that in West Africa COVID-19 adult vaccine acceptance ranges from 60% in Guinea and 50% in Sierra Leone to 11% in Senegal. This is largely congruent with acceptance levels of COVID-19 vaccinations for children. Multivariable regression analysis shows that perceived effectiveness and safety of COVID-19 vaccines increased the willingness to get vaccinated, rather than socio-demographic factors, such as educational attainment and rural/urban residence. Primary sources of information about COVID-19 vaccines, include television, radio, and social media.

Conclusions: Communication strategies addressed at the adult population using mass and social media, which emphasize COVID-19 vaccine effectiveness and safety, could encourage greater acceptance also of COVID-19 child vaccinations in Sub-Saharan countries.

Contributions To The Literature

Identifying and addressing context-specific reasons for vaccine hesitancy is crucial for building COVID-19 vaccine confidence and uptake for both adults and children. Few studies have investigated these factors in rural and urban Sub-Saharan Africa. Our findings include that the low acceptance of COVID-19 vaccines for adults is congruent with that for children. Perceived vaccine effectiveness and safety explain vaccine hesitancy more strongly than factors, as educational attainment and rural/urban setting. Mass and social media-based communication strategies addressed at the adult population, which emphasize COVID-19 vaccine efficacy and safety, could also encourage greater COVID-19 child vaccine acceptance in this study's countries.

Introduction

Sufficient immunization coverage against COVID-19 in particular also in low- and middle-income countries (LMICs) is crucial in addressing the current pandemic (1). In Africa, as elsewhere, reaching the necessary herd immunity threshold is jeopardized by factors, such as the emergence of new SARS-CoV2 variants, the delayed arrival of COVID-19 vaccines for children, and vaccine hesitancy (2). Vaccine hesitancy can be defined as a 'delay in acceptance or refusal of vaccination despite availability of vaccination services', and can vary 'across time, setting, and vaccines' (3),(4). In Africa, a recent survey conducted among 15 countries indicates that COVID-19 vaccine acceptance varies from 94% and 93%, respectively, in Ethiopia and Niger to 65% and 59%, respectively, in Senegal and the Democratic Republic of Congo (2),(5),(6). While these are mostly high reported levels of willingness to get vaccinated compared with countries, such as the United States of America and Russia (7), there are concerns that

without appropriate interventions, those who are still hesitant may shift to completely refusing or maintain passive avoidance in seeking out immunization (8). High levels of COVID-19 vaccine hesitancy coupled with inequitable access to COVID-19 vaccines in LMICs, represent a major problem in the global efforts to control the current COVID-19 pandemic. Furthermore, vaccine hesitancy might also revert the tremendous successes LMICs have made in increasing overall immunization against other (childhood) infectious diseases (9). Therefore, to build confidence and trust in COVID-19 vaccines, it is important to understand and address the reasons for vaccine hesitancy and the motivations behind the decision-making of whether to get vaccinated or not. However, context-specific studies, which investigate factors influencing vaccine hesitancy in both rural and urban Sub-Saharan Africa are still far and few between (7). In this study, a community-based survey was carried out in five West African countries (Burkina Faso, Guinea, Mali, Senegal, Sierra Leone) with the objective of identifying similarities and differences in vaccine hesitancy and its determinants in a sub-region of Africa, which shares major cultural and geopolitical characteristics (10),(11).

Materials And Methods

Study area

The survey was conducted in the five West African countries Burkina Faso, Guinea, Mali, Senegal and Sierra Leone. In all study countries, study sites were selected in consultation with the local principal investigators from among urban and rural communities in and around the capital cities of the countries, namely Ouagadougou, Conakry, Bamako, Dakar and Freetown, respectively.

Sample size

The study size was calculated to estimate the proportion of the population willing to be vaccinated against COVID-19. Assuming a proportion of 0.5 (conservative estimate leading to the largest sampling size) 385 individuals had to be interviewed per study country to receive an estimate with 5% precision. These sample size considerations were met in all countries apart from Senegal where a considerable proportion of respondents had to be excluded from the analysis as they had reported to have never heard of any COVID-19 vaccines.

Sampling strategy

Participants were selected from among the general population within predefined rural and urban study areas. Similar proportions of interviewees were selected from among rural and urban areas. The number of interviews to be conducted was based on the overall sample size and was proportionally allocated according to the population size within the sampling clusters. A random sample was drawn using an adjusted random walk procedure, a procedure used in previous immunization coverage studies (26). Within each cluster between 8 and 12 random walks were conducted and an equal number of interviews were conducted per random walk. Each random walk started on a randomly assigned location mark. For this purpose, geographical maps of the selected clusters were drawn, for which random coordinates were marked using ascending numbers. Valid sampling points (e.g., coordinates pointing to a house or in the proximity of a house) on each map were identified by the field teams. Coordinates were selected in consecutive order from these valid location marks in order to start the random walks. The conventional random walk procedure was applied to select study participants as described in Lemeshow and Robinson (27). Once the sample was saturated per each starting point a new one was used until the defined sample size was reached.

Survey data were collected between May 5th and June 5th 2021. Respondents were invited to take part in face-to-face survey interviews using a 45-item questionnaire. The questionnaire uses measures as employed in other COVID-19 survey-based studies (e.g. COSMO - https://projekte.uni-erfurt.de/cosmo2020/web/) and were guided by the survey design recommendations by the WHO SAGE Working Group on Vaccine Hesitancy (28). Questions were discussed with all local PIs and adapted as appropriate to the countries' context. The questionnaires were administered by trained local fieldworkers using tablets and the Kobotoolbox software (version 2.0). The questionnaire asked about respondents' socio-demographic background characteristics, and their perceptions, experience, confidence, and decision-making in relation to COVID-19 and COVID-19 vaccines, as well as past acceptance and perceptions of other vaccines. Depending on the preference of the respondents, interviews were conducted in French, English, or one of the local languages. At the time of data collection, the COVID-19 vaccination roll-out was starting in the study countries and part of our study population had already been offered a vaccine. In Senegal this part of the population, upon specific request of the country's ethical commission, was excluded from the study analysis.

Analysis

The current study is a multi-country cross-sectional study. Graphical and statistical methods were used to describe study data. Continuous variables were described using the median and the interquartile rage (IQR) and categorical data were described using the frequency and percentages. Due to the exploratory nature of the study no significance testing was applied. Missing data were excluded from the respective analysis, thus the denominator in some calculations may differ. Poisson regression models, with robust standard errors, were calculated to analyze associations with vaccine hesitancy. For the model, vaccine hesitancy was dichotomized into *no* (definitely or probably do not want to be vaccinated) or *yes* (definitely or probably want to be vaccinated). Prevalence ratios (PR) and the 95% confidence interval (CI) were calculated. Categorical variables were dummy-coded to estimate PRs. This coding includes the categories *yes*, *no* and *don't know* (dk). Bivariable models (outcome and one predictor variable) and multivariable regression model (outcome with all predictor variables, without variable selection) were calculated. Multivariable regressions were calculated for each country. Multilevel models to calculate pooled effect estimates were not applied because of the small number of countries. All analyses were done in R (version 4.1.0) using the sandwich packages (3.0-1) to calculate robust standard errors.

Institutional review board and ethical considerations

Alongside a general study protocol, which defined the general rules for sampling strategy, sample size, selection of the recruitment areas, and the ethical principles on which the survey is based on, country specific protocols were developed. The general protocol was submitted and approved by the Hamburg Ethical Commission (protocol number: 2021-10550-BO-ff). The country specific protocols were submitted to the ethical commissions of Burkina Faso (protocol number: 2021-05-115), Guinea (protocol number: 97/CNERS/21), Mali (protocol number: 2021/118/CE/USTTB), Senegal (protocol number: 00000065/MSAS/CNERS/SP), and Sierra Leone (protocol number: SLERSC deliberated 11.05.21 -no official code). Data were collected according to a standard GCP procedure. The general protocol is registered on clinicaltrial.gov (protocol number: NCT04912284).

Results

Study population characteristics

Among the 4,198 study participants, 2,242 (53%) were aware of COVID-19 vaccines and data of these individuals were used for subsequent analyses. Figure 1A shows vaccine awareness across the study countries. In Senegal only 19% (n = 149) of the interviewees had heard about vaccines against COVID-19, however, in the other countries awareness ranged between 50% (n=428) in Sierra Leone and 70% (n=598) in Mali. Respondents' background characteristics stratified by country are described in Table 1A. In total, 1,240 (55%) interviews were conducted in urban areas. The median age of the interviewees was 36 years with an interquartile range (IQR) of 28–49 years and 42% (951) were female. The majority of study participants (1,832; 85%) lived together with children and 39% (n=840) lived together with people aged ≥65 years. In total, 22% (n=496) had not completed any formal education, 19% (n=417) had attended primary/middle school, and 59% (1,329) secondary school or higher. At the time of the survey (May 2021), COVID-19 vaccination had already been offered to 480 (21%) of the interviewees, the majority of whom were in the Guinean study group (n=312; 56%). Half of the respondents who had already been offered a COVID-19 vaccination (n=240; 50%) had subsequently been vaccinated, again, with the largest number in the Guinean study group (n = 181; (58%) (Fig. 2B). Study participants were asked about their main sources for information about COVID-19 vaccines (Fig. 1 SI). Among all participants, the most important sources mentioned were television (60%, n=1,345), radio (56%; n=1,258), social-media (34%; n=764) and family/friends/neighbors (28%; n=634). Governmental sources were only mentioned by 12% (n=262), however 40% (n=172) of interviewees from Sierra Leone ranked this as an important information source.

Perceptions of COVID-19 and COVID-19 vaccines

Respondents' perceptions of COVID-19 and COVID-19 vaccines are summarized in Table 1B. While more than half of all participants reported to be worried about the risk of getting infected with SARS-CoV-2 (n=1,303, 59%), there were variations between countries ranging from 71% (n=421) of respondents who reported to be concerned about getting infected in Mali to only 35% (n=177) and 36% (n=53), in Burkina Faso and Senegal, respectively. Almost half of the interviewees felt currently at risk of getting infected (n=1,051; 47%) with Sierra Leone having the highest number of respondents who reported to feel currently at risk of getting infected (n=260; 61%). While 69% (n=1,525) of the study participants believe that the vaccine protects against COVID-19, half of the interviewed individuals reported to be unsure whether the vaccine is safe. In fact, in Senegal, 41% of the respondents (n=61) said that they believe COVID-19 vaccines to be unsafe. A considerable proportion of all respondents (n=1,429; 65%) voiced concern about vaccine side effects, with the highest levels of concern reported in Senegal (n = 120; 81%) and Burkina Faso (n=395, 79%). About half of the participants (n=1,017; 46%) think COVID-19 vaccines carry more risk than routine vaccines. This perception varies from 62% in Burkina Faso (n=307) who believe this to be the case to 28% in Guinea (n=156).

Vaccine acceptance, hesitancy, and refusal in five West Africa countries

Overall, 39% (n=865) of the study population said they would definitely and 23% (n=514) would probably accept to get vaccinated against COVID-19, while 21% (n=465) of all participants would definitely and 13% (n=287) would probably refuse vaccination. COVID-19 vaccine acceptance ranged from 60% (n=330) in Guinea to 11% (n=16) in Senegal, whereas vaccine hesitancy ranged from 41% (n=58) in Senegal to 10% (n = 58) in Guinea (Fig. 2A). Similarly, when asked about their willingness to have their own children vaccinated against COVID-19 in case a vaccine would be licensed for that age group, 36% (n=765) responded that they would accept, 25% (n=532) that they would refuse, whereas the remainder reported either that they would probably vaccinate their children against COVID-19 (21%; n=448), or that they would probably not have their children vaccinated (11%; n=235). Again, COVID-19 vaccine acceptance for children was highest in Guinea (n=283; 53%) and Sierra Leone (n=179; 47%) and the

lowest in Senegal (n=9; 7%) (Fig. 2B). Fig. 2C shows the congruence of those who would accept, hesitate or refuse vaccination against COVID-19 for themselves, with those who would do so when it comes to their own children. Eighty percent (n=1,690) of the respondents show the same level of willingness in both cases.

<u>Factors influencing acceptance, hesitancy, and refusal</u>

Of all respondents 1,926 (86%) who were included in the Poisson regression models, 22% came from Burkina Faso (n=433), 25% from Guinea (n=484), 27% from Mali (n=524), 7% (n=132) from Senegal, and 18% (n=353) from Sierra Leone. Study participants with missing values in the independent variables had to be excluded from the regression analysis.

Results from the bi- and multivariable regression are summarized in Figure 3. The multivariable regression (Fig. 3B) showed that the perceived effectiveness of a vaccine to protect from COVID-19 and safety of COVID-19 vaccines increased the willingness to get vaccinated. Strongest associations with the perception of vaccine protection were observed for Burkina Faso (Prevalence Ratio = 6.1; 95%-CI: 2.6-14.4), Sierra Leone (PR = 4.3; 95%-CI: 1.5-12.2), and Senegal (PR = 4.2; 95%-CI: 1.0-18.0). Strongest association with vaccine safety was shown for Senegal (PR = 6.5; 95%-CI: 2.4-17.9), while for the other countries PRs about 2 or lower were observed. However, socio-demographic factors, such as sex, rural/urban residence, educational attainment and household composition (living with children and/or elderly), and the other perception parameters were not associated with the willingness to get vaccinated in the multivariable regression model. In the bivariable regression analysis (Fig. 3A) the belief that the vaccine has side effects or that the vaccine carries more risks compared to routine vaccines lowers the willingness to get vaccinated. However, this effect was no longer present in the multivariable regression, which could indicate that associations were confounded. Overall, the findings were fairly consistent across countries.

Discussion

This study presents findings from a multi-country survey on a thus far under-researched topic: factors influencing COVID-19 adult and child vaccine hesitancy in Sub-Saharan Africa. Main findings from the survey, which was conducted in five West African countries (Burkina Faso, Guinea, Mali, Senegal, and Sierra Leone) include, firstly, that levels of COVID-19 vaccine acceptance varied and ranged from 60% (n=330) in Guinea to 11% (n=16) in Senegal, conversely vaccine hesitancy ranged from 41% (n=58) in Senegal to 10% (n=58) in Guinea (Fig. 2A). One explanation for the lower levels of vaccine hesitancy in Guinea and Sierra Leone could be that these two countries have built on experiences from past epidemics, such as the devastating Ebola epidemic in 2014-2016 (12), and greater exposure to Ebola vaccinations and vaccination campaigns (13). It is possible that the major investments in community-based interventions (14) to increase the acceptability of a newly released vaccine, might have a role in the greater acceptance of vaccines against COVID-19.

Secondly, the willingness to get vaccinated was largely congruent with the intention to have own children vaccinated against COVID-19 in case that an appropriate vaccine becomes available/accessible (Fig. 2C). This may indicate that as COVID-19 vaccination strategies are moving towards child immunization (15), communication and awareness-raising approaches targeting adults, may also have a positive impact on COVID-19 vaccine coverage of children in our study region.

Thirdly, consistent with other studies, vaccine hesitancy among the study countries is primarily explained by concerns over the safety and effectiveness of COVID-19 vaccines (16),(17),(18), rather than age or educational

attainment (7). However, in contrast to other studies on vaccine hesitancy in LMIC, gender and rural versus urban setting did not explain the difference (19).

Further, it is noteworthy, that the most popular source of COVID-19 related information among the study population are television, radio, and social media, rather than for example, governmental sources and health care workers (Fig. 1 SI), which is in line with recent literature (20). Previous research has shown that individuals who inform themselves mostly relying on social media as primary source of information are more likely to be hesitant than those drawing more on professional sources of information (21). Thus, as shown by research concerned with other health topics, such as reproductive health, HIV and other sexually transmitted infections, social media needs to be used more effectively as a tool to communicate correct and appropriate information about COVID-19 vaccinations (22),(23).

Overall, only 39% of all participants included in the study reported that they would accept a vaccination against COVID-19, 21% in the group said they would refuse, and 36% said they were still hesitant. Strikingly, 55% of those who had previously been offered vaccination against COVID-19 declined it when the opportunity arose (Fig. 1B). Considerable levels of COVID-19 vaccine hesitancy and refusal coupled with inequitable access to vaccines and suboptimal vaccination coverage represent a complex challenge in these countries. Going forward, the possibility of a detrimental knock-on effect of lack of confidence in COVID-19 vaccines on the uptake of, for instance, childhood routine vaccinations, should be considered. There is evidence to suggest that this could revert the tremendous successes African countries have had in terms of increasing access to immunization and reducing child deaths (24).

Finally, while this study managed to conduct a baseline survey in a timely manner to capture the moment in time when COVID-19 vaccination campaigns – for both adults and children – had not yet or only just started to roll out in a region of Africa hat has a number of common historical, cultural, and geopolitical characteristics, it is not without limitations. Firstly, the study relied on self-reported perceptions and behavior, and responses are therefore susceptible to social desirability bias. However, trained local fieldworkers experienced in administering survey questionnaires and fluent in local languages and dialects helped to minimize this risk. Further, the survey included both urban and rural areas, however, the rural areas surrounding the capital cities may not be representative of more remote settings. The estimated target sample sizes were met in four out of the five study countries. However, in Senegal, there were particular ethical requirements that needed to be adhered to and there was a particularly high number of respondents who reported to not be aware of COVID-19 vaccines, which led to a limited number of observations and decreased the power of the data collected for this country. Finally, data are drawn from a cross-sectional survey, meaning that conclusions cannot be made regarding causality of relationships. Going forward, longitudinal research is needed to monitor vaccine hesitancy and its determinants in this region over time.

Conclusion

High vaccination coverage represents one of the most effective measures to mitigate the impact of the COVID-19 pandemic (25), but is jeopardized by vaccine hesitancy. Addressing vaccine hesitancy is particularly relevant in countries, where access to vaccines is limited. Communication strategies addressed at the adult population using mass and social media and emphasizing vaccine efficacy and safety, could encourage greater acceptance also towards COVID-19 child vaccinations in the countries included in the study.

List Of Abbreviations

CI: confidence interval

COSMO: COVID-19 snapshot monitoring

COVID-19: coronavirus diseases 2019

DK: don't know

HIV: human immunodeficiency virus

IQR: interquartile range

LMIC: low- and middle-income countries

PR: prevalence ratio

SAGE: strategic advisory group of experts on immunization

SI: supplementary information

WHO: world health organization

Declarations

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Tables

Due to technical limitations, Table 1 is only available as a download in the Supplemental Files section.
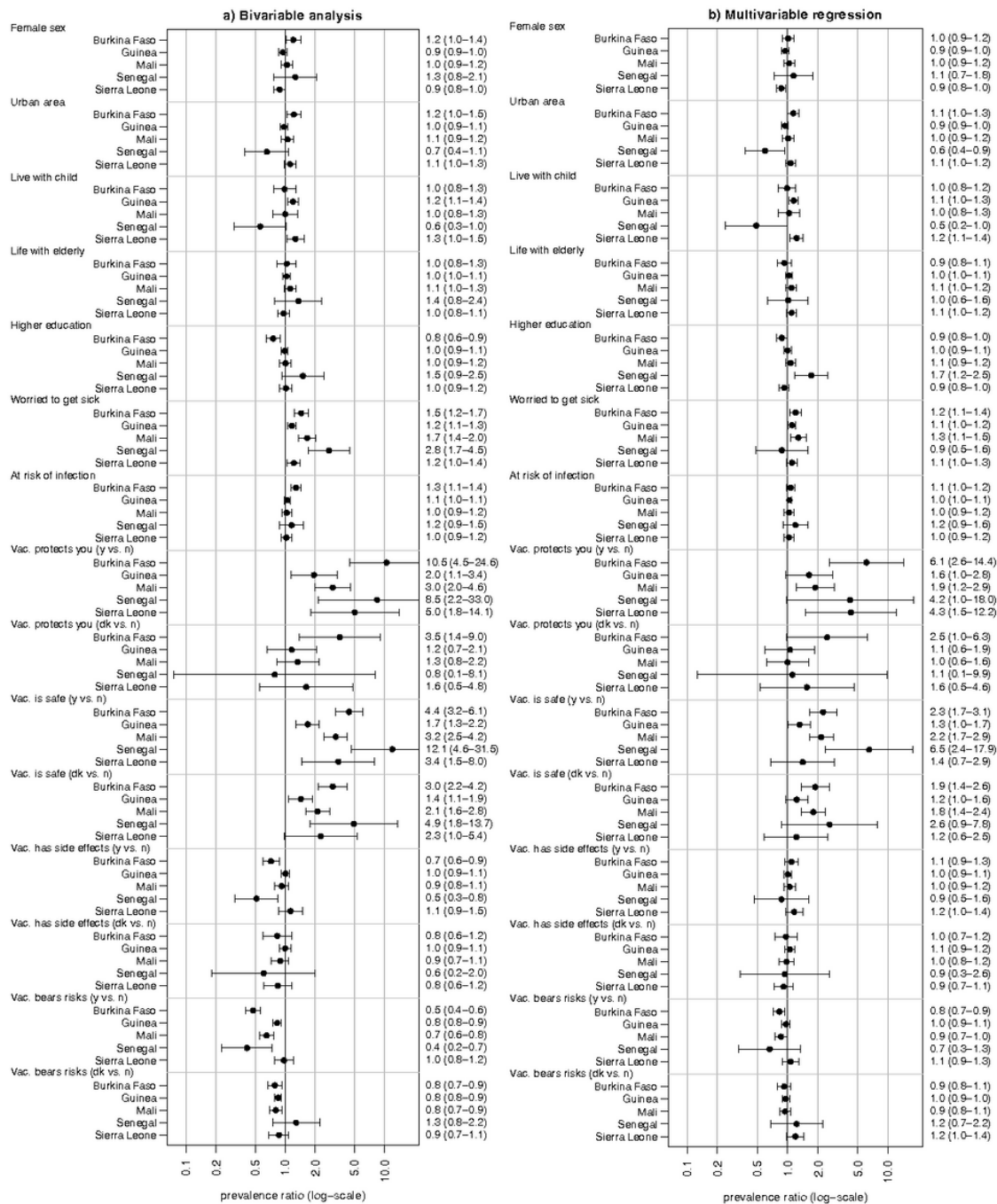
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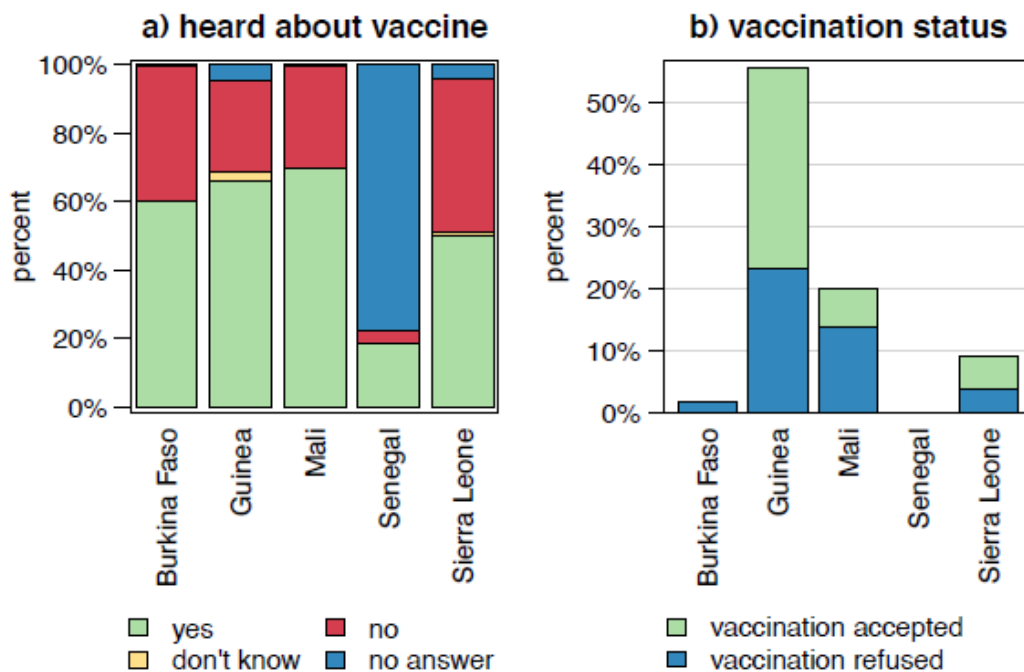
Figure 1

COVID-19 vaccine awareness (Fig. 1A) and COVID-19 vaccination status (Fig. 1B) among the study population stratified by country (n=4,198), 2021. Figure 1A depicts the proportion of respondents who have ever heard of COVID-19 vaccines stratified by country, and Figure 1B shows the proportion of those study participants who actually accepted the COVID-19 vaccination when offered. In alignment with the requirements of the Ethical Committee in Senegal, those participants in Senegal who had already been offered a COVID-19 vaccination had to be excluded from this study.
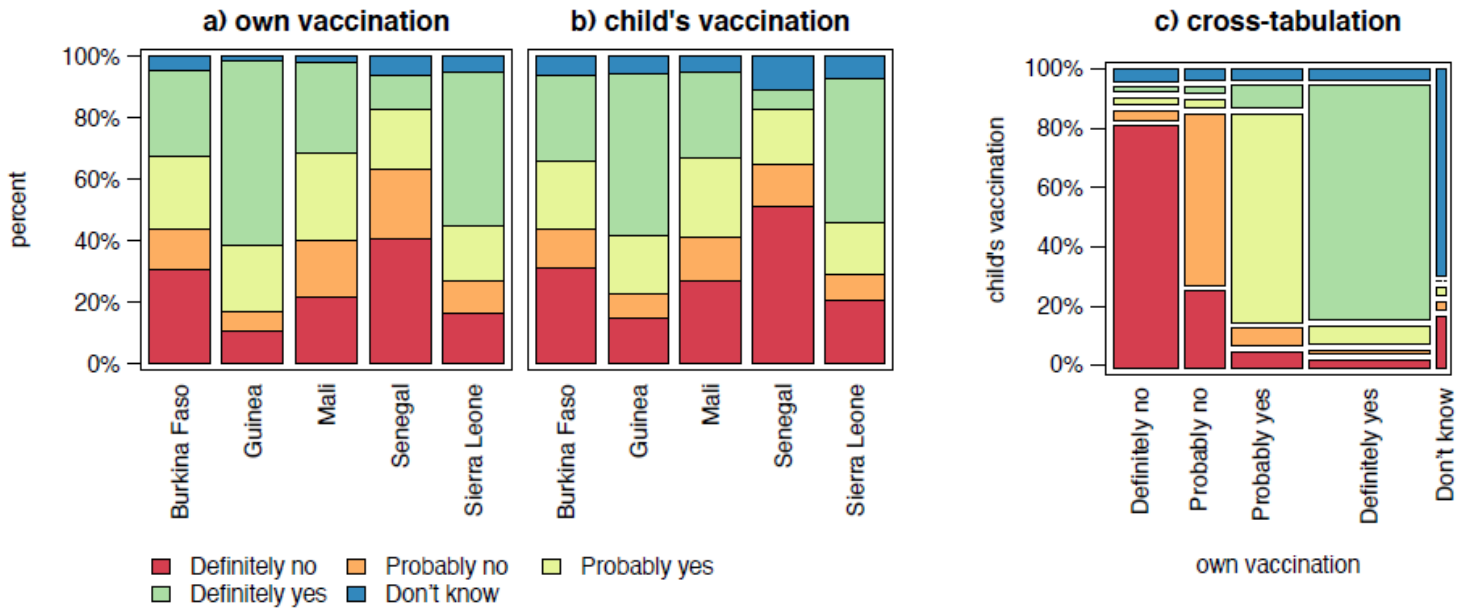
Figure 2

Respondents' willingness to get vaccinated and their willingness to have their children vaccinated against COVID-19 stratified by country, (n=2,242), 2021. Figure 2A shows respondents' COVID-19 vaccine acceptance, refusal and hesitancy for themselves (Fig. 2A), and for their children (Fig. 2B) respectively. Figure 2C shows a cross-tabulation of those who would accept, hesitate or refuse to get themselves vaccinated against COVID- 19, with those who would accept, hesitate or refuse to have their children vaccinated against COVID-19.

Figure 3

Bivariable (Fig. 3A) and multivariable prevalence ratios (PRs) (Fig. 3B) for willingness to get vaccinated against COVID-19 (n=1,926), 2021. Dots represent the estimated prevalence ratios and the whiskers the 95%-confidence intervals. Abbreviations: Vac., vaccine; y, yes; n, no; dk, don't know

Supplementary Files

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- STROBEchecklistcrosssectionalv0.2.pdf