Facilitators and barriers to COVID-19 vaccination among healthcare workers and the general population in Guinea

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Abstract

Introduction

The advent of the effective COVID-19 vaccine was the most eagerly expected worldwide. However, this hope quickly became hesitation and denial in many countries, including Guinea. Understanding the reasons for low vaccine coverage is essential to achieving herd immunity that will lead to disease control.

Methods

We conducted a mixed cross-sectional survey focused on healthcare workers and the general population in 4 natural regions in Guinea. The study was conducted from 23 March 2021 to 25 August 2021. We used univariate and multivariate logistic regression to identify vaccination-associated factors against COVID-19, backed by classification and regression tree (CART) and thematic content analysis for the qualitative component.

Results

We surveyed 3547 healthcare workers and 3663 general population members. The proportion of people vaccinated was 65% among healthcare workers and 31% among the general population. For health care workers: the main factors associated with vaccination against COVID-19 were as follows: absence of pregnancy AOR = 4.65 [3.23–6.78], being supportive of vaccination AOR = 1.94 [1.66–2.27] and being an adult AOR = 1.64 [1.26–2.16]. Regarding the general population, the following factors increased the odds of vaccination: absence of pregnancy AOR = 1.93 [CI: 1.01–3.91], being favourable for vaccination AOR = 3.48 [CI: 2.91–4.17], being an adult AOR = 1.72 [CI: 1.38–2.14] and being able to get the vaccine AOR = 4.67 [CI: 3.76–5.84]. Semi-interviews revealed fear, lack of trust, and hesitant perception of the government as potential barriers to vaccination.

Conclusion

This study suggests that beliefs and negative perceptions are potential barriers to vaccination against COVID-19 among healthcare workers and the general population. Policies should emphasise practical strategies to mitigate these barriers among young people and pregnant women. Lastly, there is a need to improve access to vaccines in the general population.

Introduction

In March 2020, Guinea reported its first case of COVID-19. As a result, on 13 April 2022, 6540 cases, with 441 deaths and 36054 recoveries, were recorded [1]. In the wake of COVID-19, Government undertook many actions to limit the spread of the epidemic. One crucial step was to reassure the population that restrictive measures were required. The Guinean population, firmly devoted to religions, could never believe that disease could lead to the closure of places of worship (mosques and churches). The

psychosis induced by that environment, especially the fact that the world was unarmed as to a specific therapy, is the bottom-line that fuelled fear and stress among the population.

Therefore, the hope depends on making effective vaccines to stop the spread of the disease. Vaccine development in trials usually takes a long time, from 10 to 15 years[2, 3]. However, a global mobilisation supported this expectation to make that dream possible. Hence, the context of the COVID-19 pandemic shortened this process to less than 24 months [2, 3]. However, the population's beliefs towards vaccination took the opposite side. Indeed, misinformation through the media has taken hold in many parts of the world, including Africa. Yet, a few months earlier, a study had predicted a favourable opinion of vaccination in sub-Saharan Africa[4]. Indeed more than 70% of the participants in this survey were willing to be vaccinated when the vaccine became available, and 60% of them had confidence in developing the vaccine [4].

As misinformation, fear of backlash and uncertainty spread to large numbers of people in many countries, the concept of hesitancy has increasingly found its way into the literature [5, 6], which highlights the reluctance to be vaccinated against COVID vaccination19. Those attitudes varied from one region to another, some being favourable (high proportion to be vaccinated) and others unfavourable (low vaccination rates) [7]. Against this backdrop of shared opinion, Guinea initiated its first vaccination in March 2021. The beginning of this campaign coincided with the sudden recurrence of the Ebola virus disease, which had negatively affected the country a few years ago. Therefore, Guinea's health authorities implemented double vaccination for healthcare workers (one against the Ebola virus and the other against COVID-19). Healthcare workers deserve special attention in the battle against epidemics because some studies have shown significant hesitation among healthcare workers to get vaccinated [8–10].

In the context of vaccination, achieving herd immunity is imperative to reduce transmission and, consequently, the disease's impact. Studies show that a minimum of 67% is required to achieve this goal[11, 12]. However, Guinea struggles to reach 30% of the people vaccinated like other African countries. Since vaccination is free, it is essential to understand the reasons for this low commitment. Previous studies have focused on a particular target to explain the causes of non-vaccination[5, 6, 8, 9, 13, 14].

Additionally, almost all of those studies have looked at the intention to vaccinate. Yet, changes in opinion can occur from one period to another, as Wang et al. showed in a survey of differences in willingness to vaccinate [15]. Given the interaction between the population and healthcare workers and the possibility that the healthcare workers could mobilise the general population, studying these two targets is crucial to define the best strategies to increase the proportion of people vaccinated.

Methodology

Study setting

The study took place in the four natural regions of Guinea (Lower Guinea, Middle Guinea, Upper Guinea and Forest Guinea). Latitude North 7°30’ and 12°30’ Longitude West: 8° and 15°, with an area of 245,857 km² and 12,907,395 inhabitants [16]Guinea-Bissau, Senegal, Mali, Ivory Coast, Sierra Leone, and Liberia [16].

Study type and period

We conducted a mixed cross-sectional study. The quantitative survey laid on knowledge and attitudes about COVID-19, and the qualitative part was on the perception of COVID-19. The study occurred from 23 to 25 August 2021.

Study population

For the diversity of opinion, our target population will consist of the general population on the one hand and health care staff on the other hand.

Selection criteria

Inclusion criteria

- Free and informed consent;

- At least 18 years old at the time of inclusion;

- Available and able to express themselves.

Exclusion criteria

- Refusal to participate in the survey;

Sampling

a) Selection method

The selection was made at two different levels.

- H**ealth care staff**: First, we randomly selected health facilities in the natural regions of Guinea based on the list of operational health facilities provided by the Ministry of Health and then chose the health personnel who met the criteria.

- The general population. We randomly selected the workplaces and then randomly recruited the participants.

Sample size

Quantitative component

Health care workers. We hypothesised that 70% of health care workers favour vaccination. With the desired precision of 5%, the sample size was calculated using the formula.

$$N = \frac{Z^2(P*Q)}{i^2}$$

The minimum expected size is 322; considering the 10% of non-response rates, this size was increased to 370 per health district in the region.

General population. We hypothesised that 50% of the population favour vaccination. The formula calculates the sample size with the desired precision of 5%.

$$N = \frac{Z^2(P*Q)}{i^2}.$$

The expected minimum size is 384; considering the 10% of non-response rates, this size will be increased to 420 per prefecture in the natural region.

Qualitative component

Participants from the health care staff, considering the socio-professional categories, and participants from the general population were interviewed in each area of the natural region selected. We interviewed 20 participants among the health care personnel for the four natural sites and 50 participants among the general population, i.e. 70 participants per region.

Data collection

1. Training of the data collectors

The interviewers were trained in the survey's methodology, the collection tools and the collection technique. A pre-test of the tools was organised to assess the feasibility of the field survey. This pre-test focused on areas unselected for the study.

2. Data collection

Investigators used Android phones to administer the questionnaires to patients at the workplace or by appointment at the nearest or most convenient location. The data was recorded through an Android application (ODK) downloaded and connected to the ONA server (https://ona.io/home/). For the qualitative part, we used a semi-structured interview, and the participants' permission was obtained for the recording of the interview. The participants for the qualitative survey were from the respondents to the quantitative part; if necessary, other participants were selected from the same sites.

Theoretical framework and variables. The theoretical framework is based on the Fishbein integration model [17]. The elicitation or preliminary analysis consisted of a literature review. Our model was adapted from existing work [18–20]. The model presented in Figure 1 incorporates socio-demographic characteristics, disease history, vaccination information, disease perception and apprehension, and barriers. These different elements influence the individual's attitude. Finally, norms and the ability to be vaccinated potentiate the previous factors to predict vaccination against COVID-19.

1. **Study variables**

A- Dependent variable: this is the participant's vaccination status. The participants were asked about their vaccination status.

B- Independent variables

1. **Socio-demographic variables**
2. Age: in completed years; sex represented by male and female, marital status (single, married); residence; the level of education; occupation (job held by the participant), the number of persons in the household, number of persons with age ≥ to 18 years, the duration of stay in the place of residence (less than six months, more than six months), monthly income and current pregnancy.
3. **Variables on medical history.** The participant's existing medical history: asthma, hypertension, diabetes, obesity or overweight, allergic diseases (sinusitis, rhinitis, allergies, vaccinations), and other chronic diseases.

Variables for COVID-19 and vaccination. This section consists of three parts:

- Existing knowledge about vaccination: this item asked whether the participant had any prior knowledge about vaccination in general; the items were based on the definition of vaccination, types of vaccine, post-injection adverse effects, and individual and herd immunity. It was simply a question of whether they knew the general principle of vaccination for the general population.
- **Sources of information:** these are the primary sources of news used by the participants to discover the disease. Have you sought news about COVID-19 recently?
- **Perception/fear of COVID-19:** for this section, we have three items on a scale of 1 to 5 (strongly disagree, disagree, neutral, agree, strongly agree).

- **Perceived Susceptibility of the disease.** I am likely to get COVID-19, I am at risk of COVID-19, I may get COVID-19.
- **Perceived seriousness of the disease.** I think that COVID-19 is a severe health problem. I believe that COVID-19 has negative consequences. I think that COVID-19 is highly harmful.
- **Fear of COVID.** We used the French version of the COVID-19 fear scale (I am terrified of COVID-19. Thinking about COVID-19 makes me feel uncomfortable; my palms get sweaty when I think about COVID-19. I am afraid of dying of COVID-19. Watching the news about COVID-19 on social networks makes me nervous or anxious. I cannot sleep because I am fearful of catching COVID-19. My heart rate increases, or I have palpitations when I think about COVID-19).

Attitudes and beliefs are composed of three elements, similar to perception. The rating is on a scale of 1 to 5 (strongly disagree, disagree, neutral, agree, strongly agree).

Perceived benefits of COVID-19 vaccination: taking COVID-19 vaccination will help prevent coronavirus, and taking COVID-19 vaccine will help strengthen the body's immunity in fighting viruses.

Perceived barriers to COVID-19 vaccination. The vaccine is reserved for a group of people, and the vaccine is too expensive for me; the procedure to get the vaccine is laborious.

Perceived threats to COVID-19 vaccination. I am afraid of the side effects of the vaccine. I have learnt that the vaccine induces the disease; the vaccine is made to prevent reproduction. I don't trust vaccines.

- **Ability.** Rating on five points**.** I will be able to get the vaccine to avoid getting COVID-19. It will be easy for me to get a vaccine to protect me from COVID-19.
- **Intention to receive COVID-19 vaccine.** I am seeking the COVID-19 vaccine. I will vaccinate myself if my family or friends ask me to do so.

Quality control and assurance: A system was put in place that included strict monitoring of the fieldwork progress, including the geolocation of interviewers. Data were regularly checked and corrected as they were collected. A data manager checked the internal consistency and validity of the data. Any inconsistencies were reported and dealt. Finally, integrity constraints will limit the occurrence of missing data.

Statistical analysis. We recoded some variables before data analysis. Age into two classes (under 40 considered young, over 40 adults). For the following variables: perception/fear, attitudes/beliefs, subjective norms, ability and intention to receive the vaccine, we classified them according to the average of the scale scores. Thus, for perception, participants with a score above or equal to the mean were considered to have a positive perception. Otherwise, the perception was negative. For attitude and belief, we divided into two parts: items related to negative attitude (when the score is lower than the mean, the attitude is less negative; otherwise, the attitude is more negative) and those related to positive attitude (when the score is lower than average, the attitude is less positive; otherwise, the attitude is more positive). For norms, when the score of the scales was below average, the norms are considered

favourable; otherwise, the norms are unfavourable). When the score was below average for ability, the participants are deemed unable; otherwise, they are able.) Finally, when the score was below the mean of income for the intention, the participants had less intention to be vaccinated; otherwise, they had more intention to be vaccinated. Quantitative variables were analysed using the median and interquartile range, and qualitative variables using the percentage. We considered households with high income when the mean income is ≥2000000GNF, and the number of people in the household is ≤10. For low-income households, when the mean income is <2000000GNF and the number of people in the household is >10, all other cases were considered middle income. The Chi-square or Fisher test and the Student or Wilcoxon test were used for the descriptive analysis. We used multivariate logistic regression between the participants' vaccination status and the independent variables to identify facilitators and barriers. Then, we put in the classification and regression tree (CART) the significant variables of the previous regression models for the health care staff and the general population while keeping the dependent variable. The last analysis was backed by qualitative research with the thematic content method. The statistical tests were considered significant at the risk α = 0.005. The software R version 4.1.2 and Stata 15 were used.

Results

Figure 2 shows the flow of inclusion among health care staff and the general population with 7210 participants.

Descriptive analysis

Table 1 shows the description of the study sample. We surveyed 3547 healthcare workers and 3663 of the general population. The general knowledge of healthcare workers about vaccination was 45%, while that of the general population was 48%. For healthcare workers and the general population, the overall perception of good intention was 49% and 48%, respectively. The positive attitude was 73% for healthcare workers and only 16% for the general population.

Furthermore, the proportion of people vaccinated was 65% among healthcare workers and 31% among the general population (Figures 3 and 4). Figure 5 shows the evolution of vaccination with COVID-19 cases. We noticed that from April to August, the number of people vaccinated increased, and the cases of COVID-19 decreased.

The three sources of information used by healthcare workers concerning COVID19 were social networks, private radio and national television (figure 6). The three most used sources simultaneously were social networks, private radio and private television (figure 6). The three primary sources of information used for the general population were social networks, private radio, and national television (Figure 7). The three main sources of information used simultaneously were social media, public television, and private television (Figure 7).

Univariate analysis

Table 2 shows the factors associated with vaccination among healthcare workers, which were as follows: gender, marital status, education level, occupation, pregnancy, being hypertensive, knowledge of the vaccine, seeking information about COVID-19 in the last three days of the survey, positive perception of the COVID-19 vaccine, positive and negative attitude, norms, household income, intention to vaccinate and age. The same factors were found in the general population besides perception and the factors listed, such as the length of stay in the residential setting, history of diabetes and obesity, and ability to have the COVID-19 vaccine.

Multivariate analysis

Table 3 shows the factors associated with vaccination against COVID-19 in multivariate analysis. **For healthcare workers**. Single people were 30% less likely to get vaccinated than married people, AOR = 0.70 [CI: 0.60–0.82]; those with high school levels were 75% more likely to get vaccinated than those with secondary school, AOR=1.75 [CI:1. 13–2.70]; medical support staff were 52% less likely to get vaccinated compared to nurses, AOR=0.48 [CI:0.29–0.78], while midwives were 32% likelier to get vaccinated compared to nurses, AOR=1.32 [CI:1.04:1.67]. Non-pregnant women had 4.65 odds of being vaccinated than pregnant women AOR=4.65 [CI:3.23–6.78]. Those with higher vaccine knowledge were 38% less likely to get vaccinated than those with lower vaccine knowledge AOR=0.62 [CI:0.53–0.72]. Those with a more negative attitude were 36% less likely to get vaccinated, AO =0.64 [CI:0.55–0.75], than those with less. Those favourable to vaccination were 94% more likely to get vaccinated than those less, AOR=1.94 [CI: 1.66–2.27]. Participants who had not looked for information on COVID-19 for three days were 16% less likely to get vaccinated than those who had looked for information, AOR = 0.84 [CI:0.71–0.98]. Participants with more intention to get vaccinated were 50% less likely to vaccinate than those with less intention AOR=0.50 [CI: 0.42–0.59]. Those with a middle household income were 38% less likely to get vaccinated than those with high income, AOR=0.62 [CI: 0.44–0.86]. Finally, adults were 64% more likely to get vaccinated than young people AOR=1.64 [CI:1.26–2.16].

As for the general population, non-pregnant women were 93% more likely to get vaccinated than pregnant women, AOR=1.93 [CI: 1.01–3.91]. Those with insufficient knowledge about vaccines were 34% less likely to vaccinate than those with more knowledge AOR = 0.66 [CI: 0.55–0.78]. Those with more negative attitudes were 27% less likely to vaccinate than those with less negative attitudes AOR= 0.73 [CI: 0.61–0.86]. Participants with more positive attitudes were 16% less likely to vaccinate than those with less positive attitudes AOR=1.77 [CI: 1.36–2.31]. Those favourable to vaccination were 3.48 times more likely to get vaccinated than those less favourable, AOR=3.48 [CI: 2.91–4.17]. Participants with more intention to get vaccinated were 56% less likely than those with less intention, AOR=0.44 [CI:0.37–0.52]. Adults were 72% more likely to be vaccinated than young people AOR=1.72 [CI:1.38–2.14]. Those without hypertension were 41% less likely to get vaccinated than those with hypertension, AOR=0.59 [CI: 0.43–0.82]. Similarly, those who were not obese were 19% less likely to get vaccinated than those who were obese. Participants with other chronic diseases were 36% more likely to get vaccinated than those

without; AOR=1.36 [CI: 1.03–1.81]. Those with a negative perception were 19% less likely to get vaccinated than those with a positive perception AOR=0.81 [CI: 0.68, 0.96]. Finally, those who could get the vaccine were 4.67 times more likely to get vaccinated than those unable AOR = 4.67 [CI: 3.76–5.84].

Classification and regression tree (CART)

The regression tree in Figures 8 and 9 for the healthcare workers and the general population, respectively, shows the association of the dependent variable with the significant variables in the multivariate logistic regression models. Overall, the general knowledge of the vaccine discriminates against COVID-19 vaccination among healthcare workers. According to this variable, two categories can be specified then into seven classes:

Four classes stand out in the first category (low knowledge about vaccines): pregnant and non-pregnant women. It can be seen that whatever the attitude, the proportion of people vaccinated is higher for non-pregnant women than for pregnant women.

The norms are divided into three groups in the 2nd category (good knowledge of vaccination). We found that the most favourable participants for vaccination had higher proportions than those who were less favourable.

General population. The ability to obtain the vaccine is the main factor determining vaccination against COVID19. Three main segments stand out. According to the norms in the first segment from left to right, those with favourable norms for vaccination were more likely to get vaccinated against COVID-19. The middle segment tells us that adults were more likely to vaccinate if they were less favourable. In the third segment, where the models are favourable for vaccination, young people were less likely to get vaccinated than others.

Discussion

The COVID-19 pandemic has left hundreds of families in Guinea in mourning, so the advent of an effective vaccine was eagerly awaited. The burden of this disease has plunged populations worldwide into an unprecedented psychosis. Preventive measures such as vaccination should be seen as beneficial. However, we found that the proportion of people vaccinated is lower than expected.

More than half of the healthcare were vaccinated, with only a small proportion of the general population. Yet, a herd immunity of over 67% would favour a reduction in infection [12] Despite the previous findings reflecting the proportion of people vaccinated. Our results are similar to some studies about the intention to get vaccinated [7, 8, 21, 22] This low proportion of people vaccinated contrasts with the reality that indicates that vaccination works in our context. Indeed, by looking at the evolution of the vaccination status with the number of COVID-19 cases during the study period, we can see the effect of the vaccination (Fig. 5). We found that single people were less likely to be vaccinated than married people for healthcare workers. In a society that emphasises wedding and family responsibility, single people tend to

be young and less likely to take responsibility. The above observation corroborates the finding that adults were more likely to get vaccinated in our study. Most healthcare workers in our setting are professional students who often provide direct patient care and are therefore at greater risk of exposure. The medical support staff are generally administrators, pharmacists, and other support staff who do not involve in the care. They may therefore be prone to delay their vaccination. Pregnant healthcare workers were less likely to be vaccinated than non-pregnant healthcare workers. The initial policy to countries clearly stated that pregnant women should not be vaccinated, regardless of their level of exposure. However, the vaccines used at the time, such as SINOVAC (inactivated vaccine), were recommended during pregnancy. Moreover, recent studies indicate the tolerance of the vaccine in pregnant women with mRNA vaccines[23, 24].

We also identify that increased knowledge of vaccines or vaccination resulted in a high probability of healthcare workers not being vaccinated. This is a contrast but not surprising as the qualitative analysis reveals that some health workers are vaccinated only by conviction, as indicated by the following statement: "*No, I took it, but I don't trust it, I took it in my conviction as a doctor, but I don't trust it*" [Male, 25 years old, physician]. In addition to this, there is the fact that healthcare personnel had to take the vaccine or would be subject to sanctions or refusal to practise in certain places. Moreover, it noted that knowledge is not enough to determine vaccination uptake. After all, negative beliefs can influence. The following quotation, *"The first thing was the origin of the vaccine, as the government benefited from one type of vaccine (Russian) and we from another type (Chinese), so, that was already a fear at my level because we know that Chinese products are not of good quality. I was afraid of reacting to the vaccine or developing other pathologies. I am in a neurology department. We have seen reactions from people who developed secondary myelitis to the vaccines. They take the vaccine, and shortly afterwards, there is a paralysis that sets in; it's rare, but it's something that can't be ruled out".*

"Similarly, there have been reports that some people have developed other pathologies secondary to vaccination"—[Male, 25 years old, physician]. Trust in authority is essential for encouraging adherence to vaccination [14, 25].

Alternatively, a favourable opinion increases the probability of vaccination. A healthcare staff attests to this: *"I think this disease is real, and it is not only in Guinea that it is rampant... Of course, some people don't believe it, but I think ignorance does it. And I hope that taking the vaccines will lead to a decrease in the disease. Otherwise, a disease that affects almost every country in the world deserves to be believed..."* [Male 30 years old, physician].

We noted in this study that healthcare knowledge was not sufficient to predict an increase in the proportion of people vaccinated. The study shows that those who had not looked for updated information for more than three days were less likely to vaccinate. We noted that those who had a good intention towards vaccination were less likely to get vaccinated; the reason is trivial, as seen in the previous study [15] It is possible to have goodwill to get vaccinated initially and later on not to vaccinate for various reasons that we have just mentioned.

As for the general population, the factors associated with vaccination against COVID-19 were diverse. As with the healthcare workers, non-pregnant women were more likely to be vaccinated than pregnant women, and the same reason for the healthcare workers remains valid here. We found that, similar to healthcare workers, negative beliefs reduced the likelihood of being vaccinated. According to them, the absence of the authorities at the vaccination centres means discrimination against the community. Hence, the choice of the vaccine type and where the product comes from are the precursors of the vaccine's acceptability. The following statements illustrate people's attitudes: "*Try breaking this discrimination. Let the top people in this country come to the same health centres as the community to be vaccinated. Let them be seen by everybody and take the same kind of vaccine as us, the rest of the population. It's more than enough to say that we see a minister coming here to be vaccinated; it is not us ordinary citizens who will doubt that now. It is said that even the minister came to take his vaccine in this health centre, which alone encourages the population and gives the vaccinator more credibility. It is a first-class act of bravery to encourage people not to doubt. It's the trigger, so to speak"*. [physician, female 30]. A second added, "*Well, I'm not unafraid to take the vaccine. Still, I have to see that those in front of the 'authorities and the government' get vaccinated and all their families, so that the others can join in*" [Man, 26, general population]. Later another shows us his perception "…, *as they have already shown on TV and we see it in social networks when you take the Astra Zenica vaccine, it can cause allergic reactions. The other time there, they said that it has side effects that can lead to blood clotting, so people can be afraid that the same thing will manifest itself on my person, that is too because of that otherwise…*" [general population 35]. The other element that reinforces the negative belief is trust in the government. According to them, this lack of trust lies in choosing the type of vaccine, the Russian vaccine for the government and ministry officials and the Chinese vaccine for the community. As shown in the following declaration: *"The only reason I can say is that people don't trust the government; in fact, the politics have mixed everything up, and that's the main reason because when you tell people to go and get vaccinated, they tell you that it's not good, and they are still saying that the vaccine the government has taken is not the same vaccine that the population is taking, you see!"* [30-year-old man, general population]. Another added, *"The only particularity of what is happening in Guinea is that we had two types of vaccine, one produced by the Russians, and the other produced by China. Currently, rumours are circulating that the population benefited from one type of vaccine. The government from another, i.e., the Russian vaccine, was given to government personnel. We, the lowly people, were given the Chinese vaccine, so this alone gives us ideas in our heads: is the vaccine we received the right one?". Why give a lambda population one type of vaccine and benefit from another type of vaccine when we are all in the same country? it's a bit like that, there's a polemic at this level, and I have doubts even if I had to be vaccinated.* [Male, 40, general population].

Some question the vaccine's efficacy; "*This vaccine is not effective; otherwise, how can you be vaccinated, and when you do the test again, you are still told that you have COVID? I don't believe it*". [Male 30, general population]. Contrary to previous realities, favourable opinion increases the probability of vaccination in the population. Other important elements are identified at the level of the general population, i.e. the history of illnesses that increase the probability of vaccination. This attitude would be

part of a preventive action among these people to avoid complications of their health condition with COVID-19. Finally, the population that could not get the vaccine or have easy access to it was less likely to be vaccinated. We can understand this because vaccination points were limited initially and stood for great challenges for those who had to travel, particularly financial ones.

Our study is one of the first to combine healthcare workers and the general population. It also incorporates a mixed methodology that better understands the barriers and facilitators to COVID-19 vaccination in Guinea. Our study is representative of the natural regions of Guinea, whose socio-cultural characteristics remain diverse. This representativeness is limited to only active people in the workplace, not household members. We considered that working people accounted for an active part of the population and were most at risk as it interacts with the others. It would have been even more interesting in this study if we had studied the factors associated with a vaccination before and during vaccination. The two targets are not comparable but offer the possibility of extracting hypotheses about the variability of specific characteristics that may be of standard or opposite interest—for example, the ability to have a significant portion of the population vaccinated through healthcare workers. Finally, in any cross-sectional study, we cannot prove causality.

CONCLUSION

The simultaneous study of healthcare workers and the general population shows us that belief and perception play a key role in vaccination against COVID-19. Attitudes and negative perceptions are potential barriers. Other characteristics related to age and pregnancy status should be evaluated when planning activities. Capacity-building strategies for healthcare workers and their training on vaccines' scientific and ethical value should be reviewed and regularly updated. This action should lead healthcare staff to reach as many people as possible in their immediate environment and patients. Vaccine access must be expedited for the population, especially the young people. The current strategies to target educational institutions and large gathering places should be evaluated to establish their effectiveness. Finally, we must identify effective communication strategies to reduce barriers and reinforce the facilitator's factors.

Abbreviations

AOR	Adjusted Odds Ratio
CART	Classification and Regression Trees
WHO	World Health Organization
CI	Confidence Interval
CNFRSR	Centre National de Formation et de Recherce en Santé Rurale de Mafèrinyah.

Declarations

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Author's contributions

AAT, FAT, and GC conceptualised the study idea. AAT, ASM and IB drafted the manuscript. AAT, MLK, YS, NYC and DD analysed the data. ND, AHB, SS and AD critically revised the manuscript. All the authors approved the final version of the manuscript.

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Availability of data and materials

The dataset supporting the conclusions of this article is included within the article (and its additional file(s))

Ethics approval and consent to participate

The Kofi Annan University Institutional Reviewed Board in Guinea (020 / UKAG / P9 / 2021) approved the study. The heads of the health centres also gave their consent before starting the survey. Data were collected anonymously after obtaining informed consent from all participants. All methods were performed in accordance with the Guinea's guidelines and regulations.

Consent for publication

Not applicable.

Competing interests

The authors have no competing interests to declare.

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Tables

Table 1

Description of the study sample.

Characteristic	N = 3,547[1]	N = 3,663[1]
Socio-demographic factors		
Age		
Young	3,115 (88%)	2,902 (79%)
Adult	432 (12%)	761 (21%)
Gender		
Men	1,339 (38%)	2,542 (69%)
Women	2,208 (62%)	1,121 (31%)
Matrimonial status		
Married	1,935 (55%)	1,711 (47%)
Single	1,612 (45%)	1,952 (53%)
Education		
Second	102 (2.9%)	1,724 (47%)
University	1,114 (31%)	1,716 (47%)
High school	2,331 (66%)	223 (6.1%)
Occupation		
Nurse assistant	1,876 (53%)	
Laboratory technician	165 (4.7%)	
Physician	794 (22%)	
Medical support	95 (2.7%)	
Midwife	470 (13%)	
Internship	147 (4.1%)	
Private-employee		260 (7.1%)
Student		896 (24%)
Civil-servant		833 (23%)
Freelance		1,434 (39%)
Unemployed		240 (6.6%)

Characteristic	N = 3,547[1]	N = 3,663[1]
Household size		
[1,5]	1,562 (44%)	1,753 (48%)
(5,10]	1,428 (40%)	1,362 (37%)
(10,30]	557 (16%)	548 (15%)
≥ 18 years old	3 (2, 5)	3 (2, 5)
Length-stay		
<6months	362 (10%)	404 (11%)
>=6months	3,185 (90%)	3,259 (89%)
Pregnancy		
Yes	152 (4.3%)	77 (2.1%)
No	2,054 (58%)	1,040 (28%)
Not appliccable	1,341 (38%)	2,546 (70%)
Household Income		
High income	266 (7.5%)	442 (12%)
Low income	512 (14%)	475 (13%)
Middle income	2,769 (78%)	2,746 (75%)

Medical history		
Diabetes		
Yes	83 (2.3%)	114 (3.1%)
No	3464 (97.7%)	3549 (96.9%)
Hypertension		
Yes	154 (4.3%)	249 (6.8%)
No	3393 (95.7%)	3414 (93.2%)

Characteristic	N = 3,547[1]	N = 3,663[1]
Obesity		
Yes	613 (17%)	897 (24%)
No	2934 (83%)	2766 (86%)
Asthma		
Yes	123 (3.5%)	103 (2.8%)
No	3424 (96.5%)	3560 (97.2%)
Other allergic conditions		
Yes	664 (19%)	649 (18%)
No	2883 (81%)	3014 (82%)
Other chronic diseases		
Yes	336 (9.5%)	342 (9.3%)
No	3211 (80.5%)	3021(80.7%)
Factors related to the COVID-19 and Vaccine		
Vaccine knowledge		
Yes	1,609 (45%)	1,769 (48%)
No	1938 (55%)	1894 (52%)
Seeking COVID vaccine news in the last three days		
Yes	2,254 (64%)	2,025 (55%)
No	1293 (36%)	1638 (45%)
Perception		
Positive	1,746 (49%)	1,774 (48%)
Negative	1,801 (51%)	1,889 (52%)
Negative attitude		
Less negative	1,891 (53%)	1,961 (54%)
Much negative	1,656 (47%)	1,702 (46%)
Positive attitude		
Less positive	2,603 (73%)	597 (16%)
Much positive	944 (27%)	3,066 (84%)

Characteristic	N = 3,547[1]	N = 3,663[1]
Norms		
Less favourable	1,692 (48%)	1,927 (53%)
Favourable	1,855 (52%)	1,736 (47%)
Ability to get the vaccine		
Not able	3,081 (87%)	1,340 (37%)
Able	466 (13%)	2,323 (63%)
Intend to get vaccinated		
Less intend	2,401 (68%)	2,039 (56%)
More intend	1,146 (32%)	1,624 (44%)

[1] Median (IQR); n (%)

Table 2

Univariate analysis.Factors associated with COVID-19 vaccination.

	Health Care workers			General population		
	Already get vaccinated			Already get vaccinated		
	No N = 1,231[1]	Yes N = 2,316[1]	p-value[2]	No N = 2,542[1]	Yes N = 1,121[1]	p-value[2]
Socio-demographic factors						
Age			<0.001			<0.001
Young	1,145 (93%)	1,970 (85%)		2,148 (85%)	754 (67%)	
Adult	86 (7.0%)	346 (15%)		394 (15%)	367 (33%)	
Gender			<0.001			0.008
Men	407 (33%)	932 (40%)		1,730 (68%)	812 (72%)	
Women	824 (67%)	1,384 (60%)		812 (32%)	309 (28%)	
Matrimonial status			<0.001			<0.001
Married	615 (50%)	1,320 (57%)		1,065 (42%)	646 (58%)	
Single	616 (50%)	996 (43%)		1,477 (58%)	475 (42%)	
Éducation			<0.001			0.003
Secondary	52 (4.2%)	50 (2.2%)		1,243 (49%)	481 (43%)	
University	333 (27%)	781 (34%)		1,155 (45%)	561 (50%)	
High school	846 (69%)	1,485 (64%)		144 (5.7%)	79 (7.0%)	
Occupation			<0.001			<0.001
Nurse assistant	706 (57%)	1,170 (51%)				

	Health Care workers			General population		
	Already get vaccinated			Already get vaccinated		
	No N = 1,231[1]	Yes N = 2,316[1]	p-value[2]	No N = 2,542[1]	Yes N = 1,121[1]	p-value[2]
Laboratory technician	51 (4.1%)	114 (4.9%)				
Physician	222 (18%)	572 (25%)				
Medical support	49 (4.0%)	46 (2.0%)				
Midwife	153 (12%)	317 (14%)				
Internship	50 (4.1%)	97 (4.2%)				
Private-employee				156 (6.1%)	104 (9.3%)	
Student				723 (28%)	173 (15%)	
Civil-servant				446 (18%)	387 (35%)	
Freelance				1,053 (41%)	381 (34%)	
Unemployed				164 (6.5%)	76 (6.8%)	
Household size			0.4			0.7
[1,5]	561 (46%)	1,001 (43%)		1,227 (48%)	526 (47%)	
(5,10]	483 (39%)	945 (41%)		934 (37%)	428 (38%)	
(10,30]	187 (15%)	370 (16%)		381 (15%)	167 (15%)	
≥ to 18 years old	3 (2, 5)	3 (2, 5)	0.11	3 (2, 5)	3 (2, 5)	0.6
Length-stay			0.057			<0.001

	Health Care workers			General population		
	Already get vaccinated			Already get vaccinated		
	No N = 1,231[1]	Yes N = 2,316[1]	p-value[2]	No N = 2,542[1]	Yes N = 1,121[1]	p-value[2]
<6months	142 (12%)	220 (9.5%)		314 (12%)	90 (8.0%)	
>=6months	1,089 (88%)	2,096 (91%)		2,228 (88%)	1,031 (92%)	
Pregnancy			<0.001			0.006
Yes	102 (8.3%)	50 (2.2%)		63 (2.5%)	14 (1.2%)	
No	721 (59%)	1,333 (58%)		746 (29%)	294 (26%)	
Not applicable	408 (33%)	933 (40%)		1,733 (68%)	813 (73%)	
Household income			<0.001			0.020
High income	53 (4.3%)	213 (9.2%)		282 (11%)	160 (14%)	
Low income	172 (14%)	340 (15%)		339 (13%)	136 (12%)	
Middle income	1,006 (82%)	1,763 (76%)		1,921 (76%)	825 (74%)	
Medical history						
Diabetes						
Yes	25 (2.0%)	58 (2.5%)	0.4	59 (2.3%)	55 (4.9%)	<0.001
No	1206 (98%)	2258 (97.5)		2483 (97.7)	1066 (95.1)	
Hypertension						
Yes	38 (3.1%)	116 (5.0%)	0.008	120 (4.7%)	129 (12%)	<0.001
No	1193 (96.9%)	2200 (95%)		2422 (96.3%)	992 (88%)	

	Health Care workers			General population		
	Already get vaccinated			Already get vaccinated		
	No N = 1,231[1]	Yes N = 2,316[1]	p-value[2]	No N = 2,542[1]	Yes N = 1,121[1]	p-value[2]
Obesity						
Yes	202 (16%)	411 (18%)	0.3	582 (23%)	315 (28%)	<0.001
No	1029 (84%)	820 (82%)		1960 (77%)	806 (82%)	
Asthma						
Yes	43 (3.5%)	80 (3.5%)	>0.9	72 (2.8%)	31 (2.8%)	>0.9
No	1180 (96.5%)	2236 (96.5%)		2470 (97.2%)	1090 (97.2%)	
Other allergic conditions						
Yes	231 (19%)	433 (19%)	>0.9	449 (18%)	200 (18%)	0.9
No	1000 (81%)	1883 (81%)		2093 (82%)	921 (82%)	
Other chronic diseases						
Yes	105 (8.5%)	231 (10.0%)	0.2	239 (9.4%)	103 (9.2%)	0.8
No	1126 (91.5%)	2085 (90%)		2303 (81.6%)	1018 (81.8%)	
COVID-19 factors related						
Vaccine knowledge						
Yes	692 (56%)	917 (40%)	<0.001	1,083 (43%)	686 (61%)	<0.001

	Health Care workers			General population		
	Already get vaccinated			Already get vaccinated		
	No N = 1,231[1]	Yes N = 2,316[1]	p-value[2]	No N = 2,542[1]	Yes N = 1,121[1]	p-value[2]
No	539 (44%)	1399 (60%)		1459 (57%)	435 (39%)	
Seeking COVID vaccine news in the last three days						
Yes	734 (60%)	1,520 (66%)	<0.001	1,288 (51%)	737 (66%)	<0.001
No	497 (40%)	796 (44%)		1254 (49%)	384 (44%)	
			0.002			0.4
Perception						
Positive	562 (46%)	1,184 (51%)		1,243 (49%)	531 (47%)	
Negative	669 (54%)	1,132 (49%)		1,299 (51%)	590 (53%)	
Negative			<0.001			<0.001
Less negative	563 (46%)	1,328 (57%)		1,286 (51%)	675 (60%)	
More negative	668 (54%)	988 (43%)		1,256 (49%)	446 (40%)	
Positive attitude			0.024			<0.001
Less positive	875 (71%)	1,728 (75%)		498 (20%)	99 (8.8%)	
More positive	356 (29%)	588 (25%)		2,044 (80%)	1,022 (91%)	
Norm			<0.001			<0.001
Less favourable	676 (55%)	1,016 (44%)		1,616 (64%)	311 (28%)	

	Health Care workers			General population		
	Already get vaccinated			Already get vaccinated		
	No N = 1,231[1]	Yes N = 2,316[1]	p-value[2]	No N = 2,542[1]	Yes N = 1,121[1]	p-value[2]
More favourable	555 (45%)	1,300 (56%)		926 (36%)	810 (72%)	
Ability to get the vaccine			0.9			<0.001
Not able	1,071 (87%)	2,010 (87%)		1,213 (48%)	127 (11%)	
Able	160 (13%)	306 (13%)		1,329 (52%)	994 (89%)	
Intend to get vaccinated			<0.001			0.2
Less intend	732 (59%)	1,669 (72%)		1,398 (55%)	641 (57%)	
More intend	499 (41%)	647 (28%)		1,144 (45%)	480 (43%)	

Table 3

Multivariate analysis. Factors associated with vaccination against COVID-19.

	Health Care workers			General population		
Characteristic	**OR[1]**	**95% CI[1]**	**p-value**	**OR[1]**	**95% CI[1]**	**p-value**
Age						
Young	—	—		—	—	
Adult	1.64	1.26, 2.16	<0.001	1.72	1.38, 2.14	<0.001
Matrimonial status						
Married	—	—				
Single	0.70	0.60, 0.82	<0.001			
Education						
Secondary	—	—		—	—	
University	1.56	0.95, 2.57	0.078	1.48	1.22, 1.80	<0.001
High school	1.75	1.13, 2.70	0.012	1.33	0.95, 1.87	0.10
Occupation						
Nurse assistant	—	—				
Laboratory technician	1.05	0.68, 1.64	0.8			
Physician	0.99	0.69, 1.42	>0.9			
Medical support	0.48	0.29, 0.78	0.003			
Midwife	1.32	1.04, 1.67	0.022			
Internship	1.00	0.69, 1.47	>0.9			
Private -employee				—	—	
Student				0.47	0.33, 0.68	<0.001
Civil-servant				1.32	0.95, 1.83	0.10

	Health Care workers			General population		
Characteristic	**OR[1]**	**95% CI[1]**	**p-value**	**OR[1]**	**95% CI[1]**	**p-value**
Freelance				0.81	0.59, 1.12	0.2
Unemployed				0.78	0.51, 1.18	0.2
Pregnancy						
Yes	—	—		—	—	
No	4.65	3.23, 6.78	<0.001	1.93	1.01, 3.91	0.055
Vaccine knowledge						
No	—	—		0.66	0.55, 0.78	<0.001
Yes	0.62	0.53, 0.72	<0.001	—	—	
Seeking COVID vaccine news in last three days						
Yes	—	—				
No	0.84	0.71, 0.98	0.027			
Negative attitute						
Less negative	—	—		—	—	
Much negative	0.64	0.55, 0.75	<0.001	0.73	0.61, 0.86	<0.001
Positive attitude						
Less positive	—	—		—	—	
Much positive	0.84	0.71, 1.00	0.050	1.77	1.36, 2.31	<0.001
Norms						
Less favourable	—	—		—	—	
Favourable	1.94	1.66, 2.27	<0.001	3.48	2.91, 4.17	<0.001
Intend to get vaccinated						

	Health Care workers			General population		
Characteristic	**OR[1]**	**95% CI[1]**	**p-value**	**OR[1]**	**95% CI[1]**	**p-value**
Less intend	—	—		—	—	
More intend	0.50	0.42, 0.59	<0.001	0.44	0.37, 0.52	<0.001
Household income						
High income	—	—				
Low income	0.74	0.51, 1.08	0.12			
Middle income	0.62	0.44, 0.86	0.006			
≥ to 18 years old				0.98	0.95, 1.01	0.13
Length-stay						
<6months				—	—	
>=6months				1.31	0.99, 1.74	0.063
Hypertension						
Yes				—	—	
No				0.59	0.43, 0.82	0.002
Obesity						
Yes				—	—	
No				0.81	0.67, 0.98	0.032
Other chronic disease						
Yes				—	—	
No				1.36	1.03, 1.81	0.034
Perception						
Positive				—	—	
Negative				0.81	0.68, 0.96	0.014

	Health Care workers			General population		
Characteristic	OR[1]	95% CI[1]	p-value	OR[1]	95% CI[1]	p-value
Ability to get vaccine						
Not able				—	—	
Able				4.67	3.76, 5.84	<0.001
[1] OR=Odds Ratio, CI=Confidence Interval						

Figures

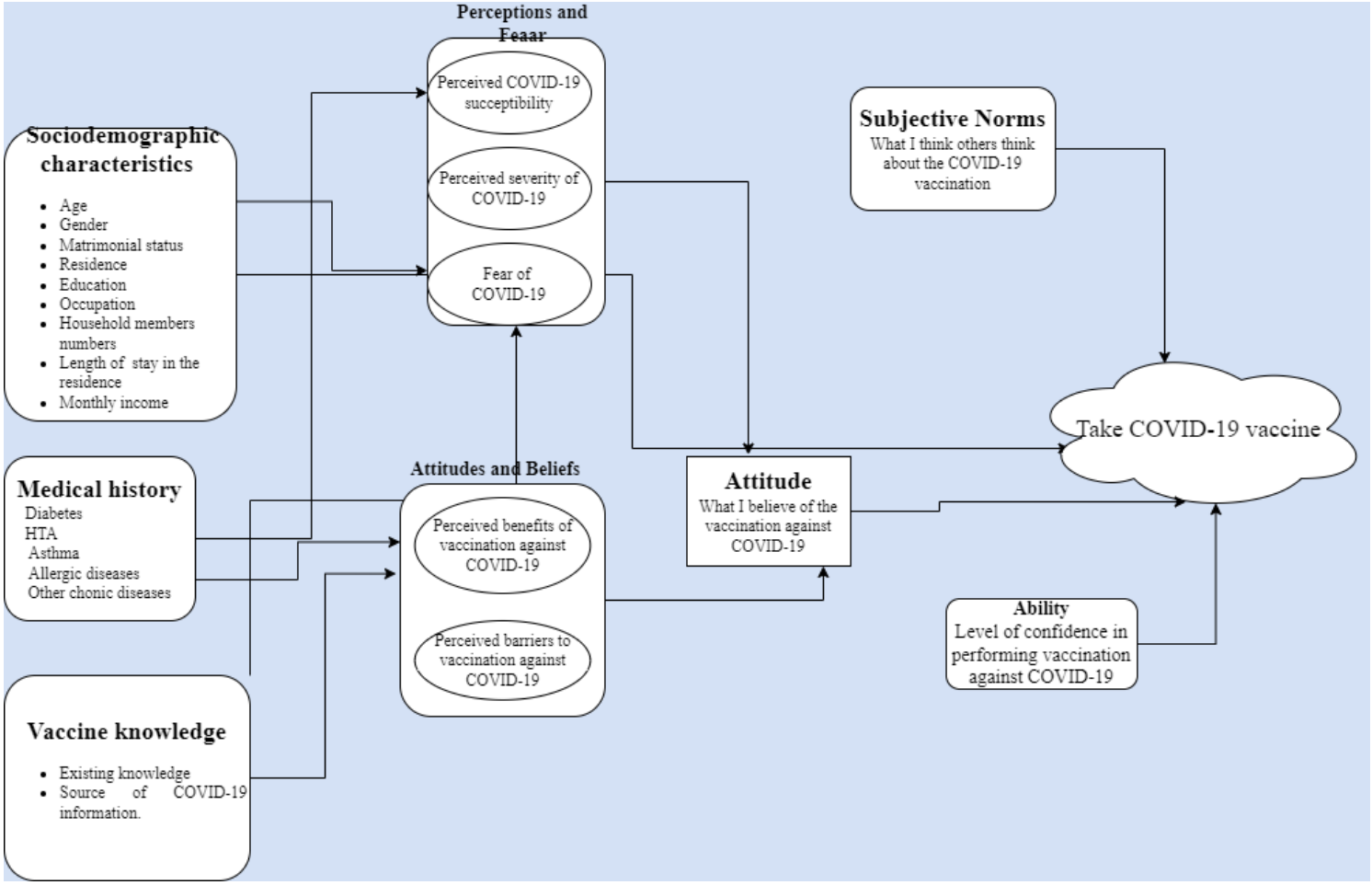

Figure 1

Theoretical framework of the study

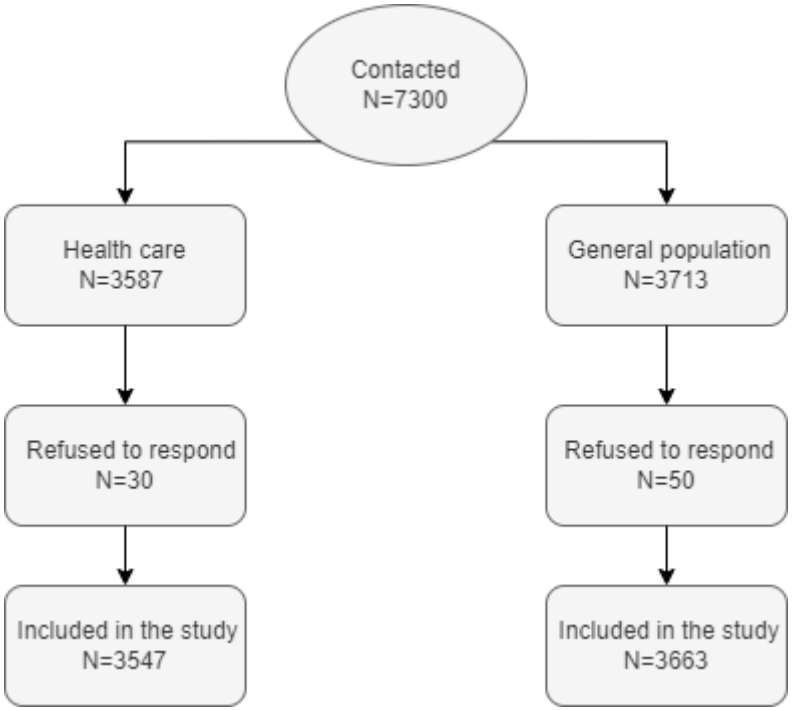

Figure 2

Inclusion flow diagram

Figure 3

The healthcare workers who get vaccinated from March to August 2021. N = 3547.

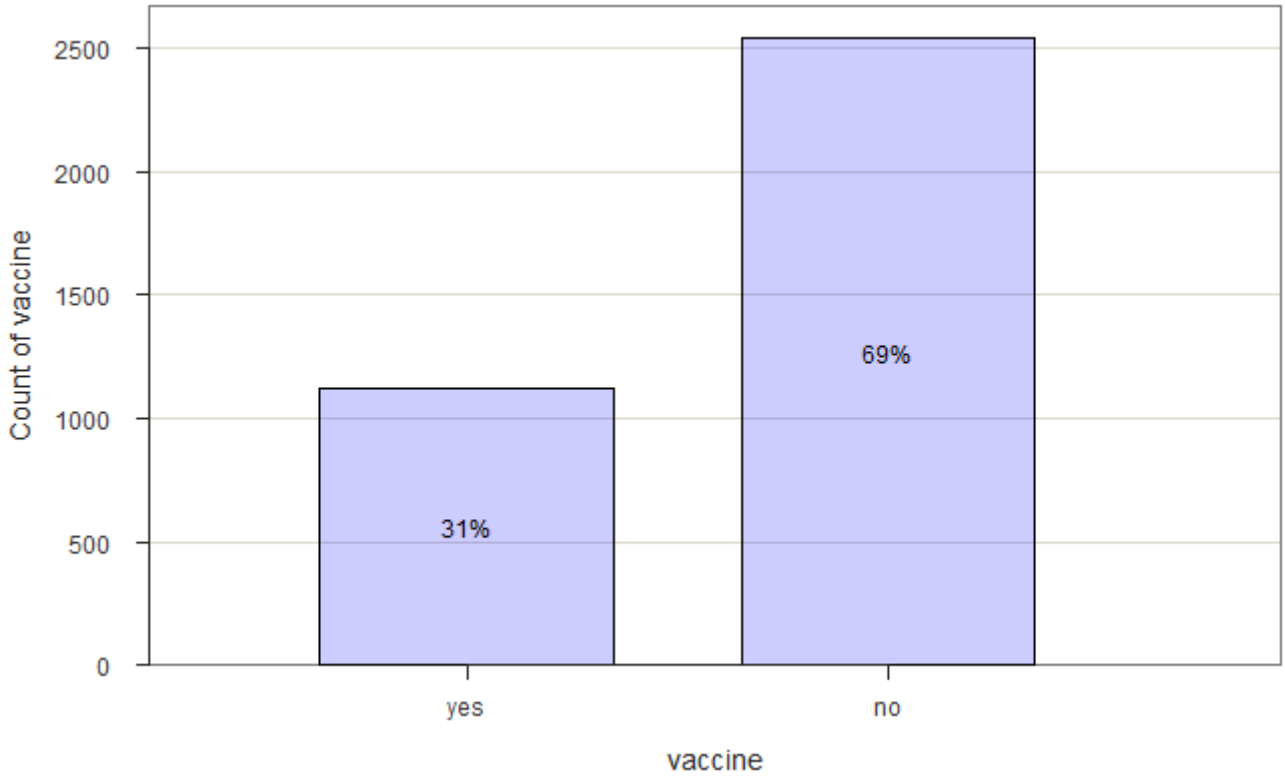

Figure 4

The general population who get vaccinated from March to August 2021. N = 3663.

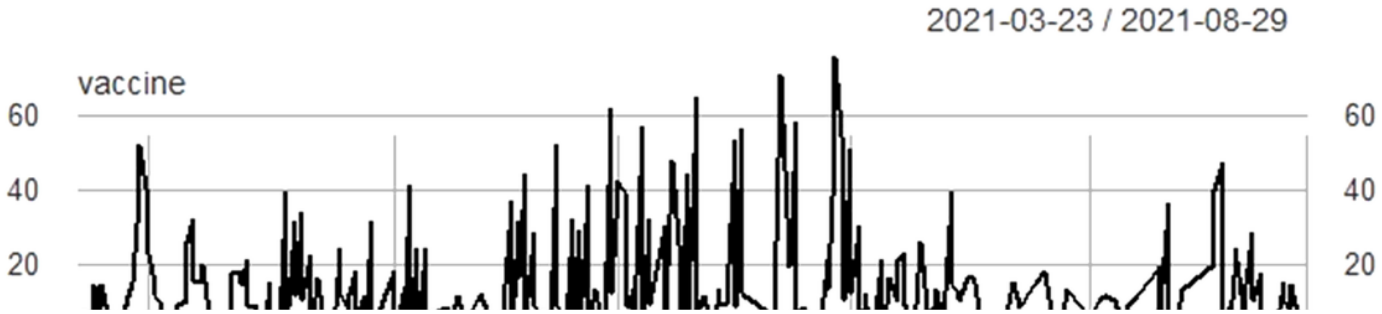

Figure 5

Evolution of vaccination against COVID-19 and COVID-19 cases.

Figure 6

COVID-19 Source of News for the healthcare workers.

Figure 7

COVID-19 Source of News for the general population.

Figure 8

CART. Factors associated with vaccination against COVID-19 among healthcare workers.

Figure 9

CART.Factors associated with vaccination against COVID-19 in the general population.

Supplementary Files

This is a list of supplementary files associated with this preprint. Click to download.

- StudyRscript.pdf
- additionalFile1Healthcareworkers.xlsx
- additionnalFile2Healthcareworkers.xlsx
- additionalFile3GeneralPopulation.xlsx
- additionnalFile4GeneralPopulation.xlsx