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# Covid-19 in Africa: Exploring the Factors that Predict Public Acceptance & Intended Use of the Covid-19 Vaccine in Sub-Saharan Africa

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**ABSTRACT** The Covid-19 pandemic has resulted in many unprecedented mortality and fatalities globally. To address the negative effects of the pandemic on the general public and nations, the Covid-19 vaccine was developed and rolled out around the world. However, historical evidence suggests that Africans initially struggle to accept and use vaccines because of misconceptions and unfamiliarity about vaccine safety and administration. The Covid-19 vaccine might not be an exception. This study identifies the various factors that correlate with the intention of citizens to acceptance and use of the Covid-19 vaccine in Sub-Saharan Africa, using a chi-square analysis of 3000 respondents from six countries in the region. Results from our analysis suggest that vaccine-specific issues such as safety, effectiveness, availability, delivery methods, and other factors strongly correlate with acceptance and intended use of the Covid-19 vaccine in Sub-Saharan Africa. The findings of this study have serious implications for both theory and practice vaccine administration in Africa and globally.

**KEY WORDS** Covid-19, Sub-Saharan Africa, vaccination & African

## INTRODUCTION

Globally, the Covid-19 virus that started in Wuhan, China in 2019 has been devastating for many individuals and nations. Among the notable effects of the virus are the collapse of world economies and businesses, the pressure on healthcare systems and professionals, a decline in the emotional and physical wellbeing of individuals, unemployment, and the death of hundreds of thousands of people (Nkengasong et al., 2020; Afolabi & Ilesanmi, 2021). In Africa, especially Sub-Saharan Africa, the impact of Covid-19 on the lives of the citizens has been more devastating for several reasons, such as poor healthcare systems, the lack of health professionals, etcetera. (Hotez & Bottazzi, 2020; Dinga, Sinda & Titanji, 2021). Efforts to find a vaccine has yielded results, however, there are questions regarding the safety and public perception of the vaccine (Dinga, Sinda & Titanji, 2021). Few studies currently attempt to examine the factors that correlate or influence Covid-


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19 vaccine us (Lancet, 2020; Singh, 2020; Murphy et al., 2021). The present study augments the existing literature and also address the gap in the literature pertaining to Africa.

## LITERATURE REVIEW

The importance of vaccines in global health promotion is well documented in the literature. In Africa, vaccine programs have been highly effective in reducing illness such as smallpox, measles, diphtheria tetanus, poliomyelitis, and death, especially among children (Dubé et al., 2016; Cooper et al., 2018; Olson, Berry & Kumar, 2020; Afolabi & Ilesanmi, 2021). Another important effect of vaccine programs in Africa is the reduction in hospital cost incurred by families to treat several illnesses (Cooper et al., 2018). The success of vaccine programs in Africa has led to calls for the creation of a malaria vaccine to help curtail the disease, which is endemic to the continent (Ojakaa et al., 2011; Dzordzormenyoh, Asafo, & Domeh, 2020). Beside the malaria vaccine, there are currently trials in some parts of Africa with the Ebola virus vaccine with hopes of reducing Ebola outbreaks (Huo et al., 2016). Nevertheless, there are still challenges with vaccine programs on the continent and even across the world. Empirical evidence from previous studies and the World Health Organization (WHO) suggest that the administration of vaccines in Africa is usually delayed because of public misconception and unfamiliarity (Fine, Eames & Heymann, 2011; Febir et al., 2013; Marti et al., 2017; Patel et. al., 2019). It has been observed that misconceptions and unfamiliarity about the polio vaccine in Africa led to delays in acceptance and intended use of the vaccine. These delays led to an increase in polio infection across the continent. Additionally, religious beliefs have been attributed to the high levels of misconceptions and unfamiliarity surrounding vaccines in Africa (Jegede, 2007; Afolabi & Ilesanmi, 2021). In essence, vaccine rejection by the public in Africa is rooted in fear, unfamiliarity, misconceptions, and religious beliefs.

In regard to the challenges of acceptance and intended use of the Covid-19 vaccine in Africa, government mistrust has also been proposed as an explanatory factor (Amadasun, 2020; Afolabi & Ilesanmi, 2021). The inadequate response by African governments has weakened citizens' trust in their leaders and governments, reducing citizens' willingness to accept the Covid-19 vaccine (Afolabi & Ilesanmi, 2021). Most African countries and governments adopted an authoritarian approach, using security agencies instead of healthcare professionals to implement and monitor several Covid-19 control measures like the use of face masks, social distancing, hand hygiene, and stay-at-home orders (Amadasun, 2020; Bowman, 2020). This led to the abuse of citizens by security agencies and further weakening of public trust in their governments on the continent (Bowman, 2020). In addition to these challenges faced in Africa that can hinder acceptance and intended use of the vaccine, other studies have also identified specific concerns the general public have about the Covid-19 vaccine. Among these concerns are safety of the vaccine (Makoni, 2020; Singh, 2020), effectiveness of the vaccine (Madhi et. al., 2021; Wiysonge et al., 2021), availability of the vaccine, and delivery method (Nachega et al., 2021) of the vaccine to all citizens.

## METHOD

### Data source

The data for this study was obtained from the Inter-university Consortium for Political and Social Research (ICPSR) at the University of Michigan, Ann Arbor. The data was initially collected by the research firm GeoPoll from six African countries – Côte D'Ivoire, the Democratic Republic of Congo, Kenya, Mozambique, Nigeria, and South Africa. The survey was conducted via SMS from November 10th to 24th, 2020, and it contains data on the impact of Covid-19 on citizens' daily routines, finances, and consumer spending. Additional questions were asked about vaccine safety and effectiveness and the public's willingness to take a Covid-19 vaccine if available. The sample size for this data was 3000 respondents. GeoPoll used a simple random sampling technique from GeoPoll's respondent database. While SMS surveys are criticized for over sampling the rich and more educated, the sample used by GeoPoll was nationally representative. [1]

## MEASURES

### Outcome variable

The dependent variable for this study is *Covid-19 vaccine acceptance and intended use*. Respondents were asked if they would get the vaccine if it was free and available at the time of the interview. Respondents were given five

[1] Geopoll. 2020 Year End Report. https://f.hubspotusercontent30.net/hubfs/325431/GeoPoll%20Year%20End%20Report%202020.pdf?__hstc=242131037.14a7e8d5d637d04133d74d047bb72384.1637611423169.1637611423169.1637611423169.1&__hssc=242131037.1.1637611423169&__hsfp=999455785&hsCtaTracking=3867c49b-55bc-4e71-a9a4-5d1e0aeffec6%7Cb471350b-9319-4ed7-9891-3993ac319d8c. Accessed: November 22, 2021.

options – 1 as definitely yes, 2 as probably yes, 3 as probably not, 4 as definitely not and 5 as unsure.

### Predictor variables

Since this study adopted a bivariate and exploratory approach in understanding the factors that correlate with Covid-19 vaccine acceptance and intended use, all the variables were treated as predictors. Over 20 variables were used as predictors of the outcome variable and they are: *the country of respondents* coded as 1 = Côte D'Ivoire, 2 = the Democratic Republic of Congo, 3 = Kenya, Mozambique, 4 = Nigeria, and 5 = South Africa. The *gender* of respondents was coded as male and female, and the *age* of respondents measured in actual years was coded as 1 = 15 – 25 years, 2 = 26 – 35 years, and 3 = 36+ years. Respondents were also asked *how covid affected their daily routines* and if the respondent's *life had returned to normal at the time of the interview*. For both questions respondents had five options: 1 = not at all, 2 = very little, 3 = somewhat, 4 = quite a bit and 5 = a great deal. Respondents were also asked *when Covid would end* and had the choices: 1 = already, 2 = first half of 2021, 3 = second half of 2021, 4 = 2020 or later and 5 = never. Also, respondents were asked about *the impact of Covid on their physical and emotional health* with the options: 1 = much worse, 2 = a little worse, 3 = about the same, 4 = a little better and 5 = much better. Respondents were also asked about *the biggest challenge they experienced because of Covid* and had the following options: 1 = finances, 2 = staying at home, 3 = emotional wellbeing, 4 = physical health, 5 = illness of loved ones and 6 = others. Respondents were asked if they *trust the information on Covid from their government* with options: 1 = strongly disagree and 5 = strongly agree.

Furthermore, *the impact of Covid on the income of respondents* was assessed with 1 = decreased a lot, 2 = decreased a little, 3 = no change, 4 = increased a little and 5 = increased a lot. Respondents were asked about *the concerns they have had in paying their monthly bills since Covid started* and the options were 1 = more concerned, 2 = less concerned, and 3 = no change. Respondents were also surveyed about *their spending habits on essential and non-essential items during the pandemic* and both questions had these options: 1 = more, 2 = less and 3 = about the same. *Shopping online and using mobile money instead of physical cash* was another question the respondent had to answer with the options 1 = more frequently, 2 = less frequently and 3 = about the same.

The survey also had questions directly related to the vaccine. Respondents were asked if they think the *vaccine is safe to use* and had these options: 1 = strongly agree, 2 = somewhat agree, 3 = neither agree or disagree, 4 = somewhat disagree and 5 =strongly disagree. For *the effectiveness of the vaccine*, respondents had these options: 1 = strongly agree, 2 = somewhat agree, 3 = neither agree or disagree, 4 = somewhat disagree and 5 = strongly disagree. Respondents were also asked about the *concerns they have about the vaccine* with the options, 1 = vaccine safety, 2 = ability to get the vaccine myself, 3 = ability for everyone to get the vaccine, 4 = cost, 5 = no concern/nothing and 6 = others. Respondents' views regarding *when the vaccine would be available were also collected,* and the answer choices were 1 = Nov. – Dec. 2020, 2 = Jan. – Jun. 2021, 3 = July – Dec. 2021, 4 = 2022 or later and 5 = unsure. Respondents were also asked *who should get the vaccine* and the options were: 1 = everybody at once, 2 = vulnerable/poor people, 3 = healthcare workers, 4 = those who can pay for the vaccine, 5 = poorest populations and 6 = others.

## ANALYTICAL STRATEGY

To achieve the primary objective of this study – what are the factors that correlate with Covid-19 vaccine acceptance and intended use in Sub-Saharan Africa? We assessed how each of the predictor variables separately correlates with the outcome variable – acceptance and intended use of the vaccine. Furthermore, we calculated descriptive statistics and conducted chi-square analysis. The descriptive statistics were used to show the distribution of scores across various variables used in the present study (see Table 1 below). In addition to the descriptive statistics, chi-square analysis was conducted between each predictor variable and the outcome variable to determine the correlation between both variables. The chi-square results are presented in Table 2 below.

## RESULTS

### Descriptive statistics

Table 1 below shows the distribution of scores for the variables included in this study. Overall, a total of 3000 respondents were interviewed from six African countries – Cote D'Ivoire (16.7%), Democratic Republic of Congo (16.7%), Kenya (16.7%), Mozambique (16.7%), Nigeria (16.7%) and South Africa (16.7%). Women were slightly oversampled (50.4%) compared to men at 49.6%. The age distribution of respondents was 38.4% for respondents aged 15 – 25 years, 28.3% for respondents aged 26 – 35 years, and finally 33.4% for respondents aged 36 years and above. Regarding respondents' acceptance and intended use of the Covid-19

vaccine, the answers were as follows: definitely yes (41.9%), probably yes (19.8%), definitely not (9.5%), probably not (9.9%), and unsure (18.9%). Again, most of the respondents (87.1%) suggest Covid has changed their daily routine compared to 12.9% who experienced no change. Similarly, most of the respondents (84.7%) suggest their lives have returned to normal since Covid started compared to 15.3% whose lives have not returned to normal. Finally, most of the respondents (40.1%) believed that Covid would end the first half of 2021 compared to 23.7% that believed Covid had already ended.

**TABLE 1.** SUMMARY STATISTICS FOR THE VARIABLES USED IN THIS STUDY (N = 3000)

| Variables | N | Valid % |
|---|---|---|
| Get the Covid vaccine | | |
| Definitely | 1,256 | 41.9 |
| Definitely not | 286 | 9.5 |
| Probably | 594 | 19.8 |
| Probably not | 296 | 9.9 |
| Unsure | 568 | 18.9 |
| Country | | |
| Cote D'Ivoire | 500 | 16.7 |
| DRC | 500 | 16.7 |
| Kenya | 500 | 16.7 |
| Mozambique | 500 | 16.7 |
| Nigeria | 500 | 16.7 |
| South Africa | 500 | 16.7 |
| Age | | |
| 15 – 25 | 1,151 | 38.4 |
| 26 – 35 | 848 | 28.3 |
| 36+ | 1,001 | 33.4 |
| Gender | | |
| Female | 1,512 | 50.4 |
| Male | 1,488 | 49.6 |
| Covid changed my daily routine | | |
| A lot | 846 | 28.2 |
| Somewhat | 382 | 12.7 |
| Quite a bit | 651 | 21.7 |
| Very little | 734 | 24.5 |
| Not at all | 387 | 12.9 |
| Life return to normal since Covid | | |
| A lot | 273 | 9.1 |
| Somewhat | 480 | 16.0 |
| Quite a bit | 511 | 17.0 |
| Very little | 1,277 | 42.6 |
| Not at all | 459 | 15.3 |
| When will Covid end | | |
| Already | 710 | 23.7 |
| First half of 2021 | 1,225 | 40.8 |
| Second half of 2021 | 516 | 17.2 |
| 2022 or later | 284 | 9.5 |
| Never | 265 | 8.8 |
| Impact of Covid on physical health | | |
| A little better | 673 | 22.4 |
| Much better | 487 | 16.2 |
| About the same | 1,079 | 35.9 |
| A little worse | 495 | 16.5 |
| Much worse | 266 | 8.9 |
| Impact of Covid on emotional health | | |
| A little better | 604 | 20.1 |
| Much better | 344 | 11.5 |
| About the same | 759 | 25.3 |

| | | |
|---|---|---|
| A little worse | 787 | 26.2 |
| Much worse | 506 | 16.9 |
| Biggest challenge because of Covid | | |
| Emotional wellbeing | 229 | 7.6 |
| Finances | 1,658 | 55.3 |
| Illness of loved one | 191 | 6.37 |
| Other | 82 | 2.7 |
| Physical health | 148 | 4.9 |
| Staying home | 692 | 23.1 |
| Trust Covid information from government | | |
| Strongly agree | 735 | 24.5 |
| Agree | 151 | 5.0 |
| Undecided | 225 | 7.5 |
| Disagree | 176 | 5.9 |
| Strongly disagree | 1,713 | 57.1 |
| Changes in income due to Covid | | |
| Decreased a little | 796 | 26.5 |
| Decreased a lot | 1,566 | 52.2 |
| No change | 371 | 12.4 |
| Increased a little | 167 | 5.6 |
| Increased a lot | 100 | 3.3 |
| Concerned about paying expense due to Covid | | |
| Less concerned | 662 | 22.1 |
| No change | 389 | 12.9 |
| More concerned | 1,949 | 64.9 |
| Spending on essential items | | |
| Less | 702 | 23.4 |
| About the same | 484 | 16.1 |
| More | 1,814 | 60.5 |
| Spending on non-essential items | | |
| Less | 1,702 | 56.7 |
| About the same | 546 | 18.2 |
| More | 752 | 25.1 |
| Use of online shopping | | |
| Less | 1,756 | 58.5 |
| About the same | 688 | 22.9 |
| More | 556 | 18.5 |
| Use of mobile money | | |
| Less | 1,340 | 44.7 |
| About the same | 615 | 20.5 |
| More | 1,045 | 34.8 |
| Covid Vaccine is safe | | |
| Strongly agree | 986 | 32.9 |
| Agree | 642 | 21.4 |
| Undecided | 867 | 28.9 |
| Disagree | 243 | 8.1 |
| Strongly disagree | 262 | 8.7 |
| Covid vaccine effectiveness | | |
| Strongly agree | 983 | 32.8 |
| Agree | 720 | 24.0 |
| Undecided | 828 | 27.6 |
| Disagree | 221 | 7.4 |
| Strongly disagree | 248 | 8.3 |
| Concerns about the Covid vaccine | | |
| Everyone can get the vaccine | 814 | 27.1 |
| Ability to get the vaccine myself | 306 | 10.2 |
| Cost | 359 | 11.9 |

| | | |
|---|---|---|
| Nothing | 331 | 11.0 |
| Vaccine safety | 1,061 | 35.4 |
| Other | 129 | 4.3 |
| When will the vaccine be available | | |
| November - December 2020 | 441 | 14.7 |
| January-June 2021 | 942 | 31.4 |
| July-December 2021 | 313 | 10.4 |
| 2022 or later | 147 | 4.9 |
| Unsure | 1,157 | 38.6 |
| How should be vaccine be delivered | | |
| Everybody at once | 562 | 18.7 |
| Healthcare workers | 858 | 28.6 |
| Poorest populations | 180 | 6.0 |
| Those who can pay | 700 | 23.3 |
| Vulnerable people | 551 | 18.4 |
| Other | 149 | 4.9 |

**N** represents number of respondents & **Valid %** represents percentage of respondents based on the number of respondents for each question.

Furthermore, the responses regarding the impact of Covid on the physical health of respondents were: the same (35.9%), either better or much better (38.6%), worse or much worse (25.4%). The impact of Covid on the emotional health of respondents, the responses were: better (31.6%), the same (25.3%), and worse (43.1%). Respondents suggested that finance (55.3%) and staying at home (23.1%) are the two major challenges that came with Covid. Additionally, with the quality of Covid-19 information most respondents (63%) either agree or strongly disagree with the quality of information on Covid compared to 29.5% who agree with the quality of Covid-19 information they receive. This shows support to public mistrust towards African governments by the citizens discussed in the literature review. Regarding the impact of Covid on income, responses include decreased income (78.7%), and unchanged/same income (12.4%).

Moreover, most of the respondents (64.9%) are more concerned about paying for expenses during Covid, compared to 22.1% who are less concerned and 12.9% who argue there is no change.

Again, about 61% of the respondents spend on essential items compared to 23% that do not spend on essential items during the pandemic. In contrast to essential items, 67% of respondents spend less on non-essential items compared to 25% that spend more on non-essential items during the pandemic. The use of online shopping among respondents was less at about 59% compared to 19% that used online shopping during the pandemic. With the use of non-physical cash (mobile money) during the pandemic, 45% of the respondents used it less compared to 35% that used it more.

Finally, with specific questions related to the vaccine the distributions were as follows. With regards to the safety of the vaccine, about 54% of the respondents believe the vaccine is safe. However, about 29% of the respondents were undecided. Regarding the effectiveness of the vaccine, 57% of the respondents believe the vaccine is effective against the virus but 28% of the respondents were undecided. With concerns that people have about the vaccine, 11% of the respondents had no concern about the vaccine, 23% were concerned if the vaccine will be made available for everyone, 35% were concerned about the safety of the vaccine and about 12% were concerned about the cost of the vaccine. With questions regarding vaccine availability, 39% of the respondents were unsure; however, 31% of respondents believe the vaccine will be available in the first half of 2021. About 29% of respondents believe healthcare workers should be the first to have the vaccine, followed by 23% of respondents who believe individuals who can pay for the vaccine should have it. Access to the vaccine by everybody and vulnerable people was about 19% and 18% respectively.

## Correlates of acceptance & intended use of Covid-19 vaccine

Table 2 below shows the estimates for the association of several variables with the acceptance and intended use of Covid-19 vaccine. From the results presented in Table 2, several interesting and intriguing revelations about the factors that correlate with intended Covid-19 vaccine use, can be observed. Overall, three variables were found not to correlate with the public's acceptance and intended use of Covid-19 vaccine in Sub-Saharan Africa. First, the age of respondents was not significant, with the estimate ($X^2 = 10.54$) and a p-value of 0.229.

Second, gender was not significant, with the estimate ($X^2$ = 9.05) and a p-value of 0.060. Finally, the biggest challenge that respondents experienced because of Covid-19 was also not significant with the estimate ($X^2$ = 27.38) and a p-value of 0.125. These results are consistent with empirical studies from some previous studies examining the factors that correlates with vaccine acceptance and intended use (El-Gendy et. al., 2020; Freeman et. al., 2020).

**TABLE 2.** PREDICTORS OF ACCEPTANCE AND USE OF VACCINE (N=300)

| Variables | Definitely | Definitely Not | Probably | Probably Not | Unsure | Chi-square Test (p-value) |
|---|---|---|---|---|---|---|
| Age | | | | | | |
| 15 – 25 | 451(35.9) | 116(40.6) | 227(38.2) | 128(43.2) | 229(40.3) | $X^2(8)$ =10.54 |
| 26 – 35 | 370(29.5) | 85(29.7) | 172(28.9) | 69(23.3) | 152(26.8) | (0.222) |
| 36+ | 435(34.6) | 85(29.7) | 195(32.8) | 99(33.5) | 187(32.9) | |
| Gender | | | | | | |
| Female | 611(48.6) | 150(52.5) | 286(48.2) | 150(50.7) | 315(55.5) | $X^2(4)$ = 9.05 |
| Male | 645(51.4) | 136(47.5) | 308(51.9) | 146(49.3) | 253(44.5) | (0.060) |
| Country | | | | | | |
| Cote D'Ivoire | 149(11.9) | 41(14.3) | 105(17.7) | 50(16.9) | 155(27.3) | $X^2(20)$ = 196.44 |
| DRC | 132(10.5) | 78(27.2) | 98(16.5) | 67(22.6) | 125(22.0) | (0.000***) |
| Kenya | 237(18.9) | 35(12.2) | 103(17.3) | 60(20.2) | 65(11.4) | |
| Mozambique | 244(19.4) | 31(10.8) | 97(16.3) | 35(11.8) | 65(16.4 | |
| Nigeria | 234(18.6) | 57(19.9) | 106(17.9) | 40(13.5) | 63(11.1) | |
| South Africa | 260(20.7) | 44(15.4) | 85(14.3) | 44(14.9) | 67(11.8) | |
| Change daily routine | | | | | | |
| A lot | 345(27.5) | 83(29.0) | 154(25.9) | 86(29.1) | 178(31.3) | $X^2(16)$ = 47.76 |
| Somewhat | 130(10.4) | 33(11.5) | 95(15.9) | 47(15.9) | 77(13.6) | (0.000***) |
| Quite a bit | 302(24.0) | 51(17.8) | 136(22.9) | 62(20.9) | 100(17.6) | |
| Very little | 322(25.6) | 68(23.8) | 153(25.8) | 70(23.7) | 121(21.3) | |
| Not at all | 157(12.5) | 51(17.8) | 56(9.4) | 31(10.5) | 92(16.0) | |
| Life return to normal | | | | | | |
| A lot | 125(9.9) | 26(9.1) | 39(6.6) | 27(9.1) | 56(9.9) | $X^2(16)$ = 68.13 |
| Somewhat | 152(12.1) | 38(13.3) | 134(22.6) | 64(21.6) | 92(16.2) | (0.000***) |
| Quite a bit | 209(16.6) | 48(16.8) | 103(17.3) | 53(17.9) | 98(17.3) | |
| Very little | 569(45.3) | 121(42.3) | 260(43.8) | 113(38.2) | 214(37.7) | |
| Not at all | 201(26.0) | 53(18.5) | 58(9.8) | 39(13.2) | 108(19.0) | |
| When will Covid end | | | | | | |
| Already | 300(23.9) | 73(25.5) | 133(22.4) | 65(21.9) | 139(24.5) | $X^2(16)$ = 27.17 |
| First half of 2021 | 515(41.0) | 112(39.2) | 272(45.8) | 118(39.9) | 208(36.6) | (0.040*) |
| Second half of 2021 | 217(17.3) | 51(17.8) | 103(17.3) | 59(19.9) | 86(15.1) | |
| 2022 or later | 123(9.8) | 22(7.7) | 45(7.6) | 26(8.8) | 68(11.9) | |
| Never | 28(9.8) | 101(8.0) | 41(6.9) | 28(9.5) | 67(11.8) | |
| Impact of Covid on physical health | | | | | | |
| A little better | 298(23.7) | 64(22.4) | 129(21.7) | 56(18.9) | 126(22.2) | $X^2(16)$ = 46.08 |
| Much better | 225(17.9) | 56(19.6) | 74(12.5) | 36(12.2) | 96(16.9) | (0.000***) |
| About the same | 389(30.9) | 110(38.5) | 243(40.9) | 124(41.9) | 213(37.5) | |
| A little worse | 215(17.1) | 32(11.2) | 106(17.9) | 58(19.6) | 84(14.8) | |
| Much worse | 129(10.3) | 24(8.4) | 42(7.1) | 22(7.4) | 49(8.6) | |
| Impact of Covid on emotional health | | | | | | |
| A little better | 275(21.9) | 55(19.2) | 116(19.5) | 44(14.9) | 114(20.1) | $X^2(16)$ = 62.76 |
| Much better | 164(13.1) | 48(16.8) | 45(7.6) | 23(7.7) | 64(11.3) | (0.000***) |
| About the same | 277(22.1) | 69(24.1) | 156(26.3) | 88(29.7) | 169(29.8) | |
| A little worse | 294(23.4) | 72(25.2) | 185(31.1) | 90(30.4) | 146(25.7) | |
| Much worse | 246(19.6) | 42(14.7) | 92(15.5) | 51(17.2) | 75(13.2) | |
| Covid challenges | | | | | | |
| Emotional wellbeing | 93(7.4) | 20(6.9) | 49(8.3) | 29(9.8) | 38(6.7) | $X^2(20)$ = 27.38 |

| | | | | | | |
|---|---|---|---|---|---|---|
| Finances | 697(55.5) | 161(56.3) | 341(57.4) | 157(53.0) | 302(53.2) | (0.125) |
| Illness of loved one | 81(6.5) | 12(4.2) | 37(6.2) | 18(6.1) | 43(7.6) | |
| Other | 24(1.9) | 14(4.9) | 12(2.0) | 7(2.4) | 25(4.4) | |
| Physical health | 72(5.7) | 10(3.5) | 28(4.7) | 13(4.4) | 25(4.4) | |
| Staying home | 289(23.1) | 69(24.1) | 127(21.4) | 72(24.3) | 135(23.8) | |
| Trust information on covid | | | | | | |
| Strongly agree | 252(20.1) | 101(35.3) | 140(23.6) | 101(34.1) | 141(24.8) | $X^2(16) = 126.64$ |
| Agree | 48(3.8) | 22(7.7) | 40(6.7) | 21(7.1) | 20(3.5) | (0.000***) |
| Undecided | 67(5.3) | 26(9.1) | 64(10.8) | 34(11.5) | 34(5.9) | |
| Disagree | 66(5.3) | 19(6.6) | 42(7.1) | 20(6.8) | 29(5.1) | |
| Strongly disagree | 823(65.5) | 118(41.3) | 308(51.9) | 120(40.5) | 344(60.6) | |
| Changes in income | | | | | | |
| Decreased a little | 306(24.4) | 76(26.6) | 206(34.7) | 61(20.6) | 147(25.9) | $X^2(16) = 46.90$ |
| Decreased a lot | 688(54.8) | 145(50.7) | 266(44.8) | 160(54.1) | 307(54.1) | (0.000***) |
| No change | 140(11.2) | 41(14.3) | 79(13.3) | 38(12.8) | 73(12.9) | |
| Increased a little | 76(6.1) | 13(4.6) | 31(5.2) | 19(6.4) | 28(4.9) | |
| Increased a lot | 46(3.7) | 11(3.9) | 12(2.0) | 18(6.1) | 13(2.3) | |
| Concerned expenses | | | | | | |
| Less concerned | 272(26.7) | 67(23.4) | 137(23.1) | 63(21.3) | 123(21.7) | $X^2(8) = 20.76$ |
| No change | 140(11.2) | 42(14.7) | 65(10.9) | 40(13.5) | 102(17.9) | (0.008**) |
| More concerned | 844(67.2) | 177(61.9) | 392(65.9) | 193(65.2) | 343(60.4) | |
| Spending on essential items | | | | | | |
| Less | 279(22.2) | 79(27.6) | 144(24.2) | 79(26.7) | 121(21.3) | $X^2(8) = 30.49$ |
| About the same | 165(13.1) | 48(16.8) | 97(16.3) | 51(17.2) | 123(21.7) | (0.000***) |
| More | 812(64.7) | 159(55.6) | 353(59.4) | 166(56.1) | 324(57.0) | |
| Spending on non-essential items | | | | | | |
| Less | 701(55.8) | 160(55.9) | 341(57.4) | 50(16.9) | 317(55.8) | $X^2(8) = 24.42$ |
| About the same | 200(15.9) | 51(17.8) | 114(19.2) | 183(61.8) | 131(23.1) | (0.002**) |
| More | 355(28.3) | 75(26.2) | 139(23.4) | 63(21.3) | 120(21.1) | |
| Use of online shopping | | | | | | |
| Less | 734(58.4) | 175(61.2) | 358(60.3) | 171(57.8) | 318(55.9) | $X^2(8) = 32.65$ |
| About the same | 251(19.9) | 67(23.4) | 132(22.2) | 68(22.9) | 170(29.9) | (0.000***) |
| More | 271(21.6) | 44(15.4) | 104(17.5) | 57(19.3) | 80(14.1) | |
| Use of mobile money | | | | | | |
| Less | 569(45.3) | 127(44.4) | 260(43.8) | 132(44.6) | 252(44.4) | $X^2(8) = 36.57$ |
| About the same | 213(16.9) | 69(24.1) | 115(19.4) | 61(20.6) | 157(27.6) | (0.000***) |
| More | 474(37.7) | 90(31.5) | 219(36.9) | 103(34.8) | 159(27.9) | |
| Covid vaccine is safe | | | | | | |
| Strongly agree | 697(55.5) | 37(12.9) | 123(20.7) | 43(14.5) | 86(15.1) | $X^2(16) = 936.02$ |
| Agree | 255(20.3) | 21(7.3) | 217(36.5) | 60(20.3) | 89(15.7) | (0.000***) |
| Undecided | 219(17.4) | 80(27.9) | 197(33.2) | 106(35.8) | 265(46.7) | |
| Disagree | 48(3.8) | 57(19.9) | 34(5.7) | 50(16.9) | 54(9.5) | |
| Strongly disagree | 37(2.9) | 91(31.8) | 23(3.9) | 37(12.5) | 74(13.0) | |
| Covid Vaccine effectiveness | | | | | | |
| Strongly agree | 672(53.5) | 39(13.6) | 128(21.6) | 39(13.2) | 105(18.5) | $X^2(16) = 774.33$ |
| Agree | 279(22.2) | 36(12.6) | 238(40.1) | 73(24.7) | 94(16.6) | (0.000***) |
| Undecided | 208(16.6) | 83(29.0) | 175(29.5) | 106(35.8) | 256(45.1) | |
| Disagree | 48(3.8) | 50(17.5) | 33(5.6) | 39(13.2) | 51(8.9) | |
| Strongly disagree | 49(3.9) | 78(27.3) | 20(3.4) | 39(13.2) | 62(10.9) | |
| Vaccine concerns | | | | | | |
| Everyone can get the Vaccine | 518(41.2) | 26(9.1) | 151(25.4) | 42(14.2) | 77(13.6) | $X^2(20) = 556.47$ |
| Ability to get the vaccine Myself | 149(11.9) | 17(5.9) | 63(10.6) | 39(13.2) | 38(6.7) | (0.000***) |
| Cost | 183(14.6) | 14(4.9) | 70(11.8) | 26(8.8) | 66(11.6) | |
| Nothing | 53(4.2) | 63(22.0) | 38(6.4) | 43(14.5) | 134(23.6) | |
| Vaccine safety | 334(26.6) | 129(45.1) | 260(43.8) | 131(44.3) | 207(36.4) | |
| Other | 19(1.5) | 37(12.9) | 12(2.0) | 15(5.1) | 46(8.1) | |

| | | | | | | |
|---|---|---|---|---|---|---|
| Availability of vaccine | | | | | | |
| Nov - Dec 2020 | 281(22.4) | 20(6.9) | 69(11.6) | 25(8.5) | 46(8.1) | $X^2(16) = 344.54$ |
| Jan - June 2021 | 471(37.5) | 54(18.9) | 228(38.4) | 85(28.7) | 104(18.3) | (0.000***) |
| July-Dec 2021 | 116(9.2) | 25(8.7) | 77(12.9) | 46(15.5) | 49(8.6) | |
| 2022 or later | 53(4.2) | 21(7.3) | 28(4.7) | 24(8.1) | 21(3.7) | |
| Unsure | 335(26.7) | 166(58.0) | 192(32.3) | 116(39.2) | 348(61.3) | |
| Vaccine delivery | | | | | | |
| Everybody at once | 280(22.3) | 30(10.5) | 106(17.9) | 33(11.2) | 113(19.9) | $X^2(20) = 143.86$ |
| Healthcare workers | 405(32.3) | 78(27.3) | 160(26.9) | 84(28.4) | 131(23.1) | (0.000***) |
| Poorest populations | 65(5.2) | 27(9.4) | 33(5.6) | 28(9.5) | 27(4.8) | |
| Those who can pay | 265(21.1) | 62(21.7) | 148(24.9) | 85(28.7) | 140(24.7) | |
| Vulnerable people | 217(17.3) | 55(19.2) | 125(21.0) | 51(17.2) | 103(18.1) | |
| Other | 24(1.9) | 34(11.9) | 22(3.70) | 15(5.1) | 54(9.5) | |

Column percentages in parenthesis beside number of respondents; chi-square degree of freedom in parenthesis followed by chi-square statistic number.
* p<0.05, ** p<0.01, *** p<0.001

In contrast to these variables that had no correlation with public acceptance and intended use of the Covid-19 vaccine, several other variables were observed to be significant. First, the country of respondents was significant with the estimate ($X^2 = 196.44$; $p<0.001$). Country variations in vaccine acceptance and intended use in Africa is well documented in the literature and further supports this result (Afolabi, & Ilesanmi, 2021). For example, Seychelles, Mauritius, Morocco, Tunisia, Brazzaville, Comoros, and Cape Verde have vaccines between 20% to 60% of their population with the Covid-19 vaccine compared to the other countries on the continent yet to reach the 10% global Covid-19 vaccination goal (WHO, 2021). Second, the effect of Covid on the daily routine of respondents was significant with the estimate ($X^2 = 47.76$; $p<0.001$). Covid-19 preventive measures such as stay-at-home orders, the use of security agencies to enforce these measures etcetera created new daily challenges for citizens in Africa to overcome. Third, respondents' view of their life returning to normal since the start of Covid was highly significant with the estimate ($X^2 = 68.13$; $p<0.001$). Fourth, respondents' view of when Covid will end was very significant with the estimate ($X^2 = 27.17$; $p< 0.05$). Fifth, the impact of Covid on the physical and emotional health of respondents was highly significant with the estimates ($X^2 = 46.08$; $p< 0.001$) and ($X^2 = 62.76$; $p<0.001$) respectively. These results are consistent with empirical evidence from previous studies (Oliver et. al., 2020; Mellet & Pepper, 2021).

Furthermore, the trust respondents had in the quality of information about Covid from their government was also significant with the estimate ($X^2 = 126.64$; $p<0.001$). Again, change in income due to Covid was significant with the estimate ($X^2 = 46.90$; $p<0.001$). Also, respondents' concern about paying for their expenses during Covid was significant with the estimate ($X^2 = 20.76$; $p<0.01$). Respondents spending on essential and non-essential items during Covid was significant at ($X^2 = 30.49$; $p<0.001$) and ($X^2 = 24.42$; $p<0.01$) respectively. Also, respondents' use of online shopping instead of face-to-face shopping was significant at ($X^2 = 32.65$; $p<0.001$). Finally, the use of mobile money instead of physical exchange of cash during Covid was also significant ($X^2 = 36.57$; $p<0.001$). The literature on vaccine acceptance and intended use is replete with similar empirical evidence (Matrajt et. al., 2020; Mellet & Pepper, 2021).

Moreover, the correlation of specific Covid-19 vaccine questions such as safety of the vaccine, effectiveness of the vaccine, availability, delivery, and concerns about the vaccine with Covid-19 vaccine acceptance and intended use were examined. The results reveal the following – the safety of Covid vaccine use was significant with the estimate ($X^2 = 936.02$; $p<0.001$); effectiveness of the Covid vaccine was significant with the estimate ($X^2 = 774.33$; $p < 0.001$); other concerns and questions about the vaccine was significant with the estimate ($X^2 = 556.47$; $p<0.001$), and finally, the availability and delivery method of the vaccine was significant with the estimate ($X^2 = 344.54$; $p<0.001$) and ($X^2 = 143.86$; $p<0.001$) respectively. The current findings are consistent with some most recent findings about predictors of Covid-19 vaccine acceptance and intended use (Oliver et. al., 2020; Mellet & Pepper, 2021).

## DISCUSSION & CONCLUSION

The Covid-19 pandemic has challenged many aspects of human life, especially regarding healthcare and vaccine delivery across the globe. The race to find a vaccine has not been void of public concerns about vaccine safety and effectiveness (Mellet & Pepper, 2021; Afolabi & Ilesanmi, 2021). Some scholars argue that public misconceptions, fear, and unfamiliarity about the Covid-19 vaccine can negatively affect the public's acceptance

and intended use, especially in Africa (Grech, Gauci, & Agius, 2020; Afolabi & Ilesanmi, 2021). Although few seminal studies have been done regarding vaccine use in Africa, there are still some gaps in the literature worth investigating (Grech, Gauci, & Agius, 2020; Mellet & Pepper, 2021; Afolabi & Ilesanmi, 2021). The present study seeks to address this gap in the literature by examining the factors that correlates with public acceptance and intended use of the Covid-19 vaccine in Africa, specifically Sub-Saharan Africa.

Several important revelations and observations made from the results of this current study are discussed below. One interesting revelation worth discussing is the correlation between perceive vaccine safety and effectiveness with public acceptance and intended use of the Covid-19 vaccine. Globally, various stakeholders and the general public continue to express concerns about the safety and effectiveness of Covid-19 vaccine (Singh, 2020; Madhi et. al., 2021). Concerns about whether enough clinical testing has been done to ensure the safety and effectiveness of the vaccine continues to make headlines in major media outlets globally (Makoni, 2020; Wiysonge et al., 2021). It was therefore unsurprising to observe that Covid-19 vaccine safety and effectiveness strongly correlates with public acceptance and intended use of the vaccine. Additionally, it was also revealed that availability and delivery of the vaccine correlates with public acceptance and intended use of the vaccine. Debates about whether the vaccine would be free for all citizens and who should be vaccinated first were contentious among various stakeholders (Makoni, 2020; Nachega et al., 2021). The current study suggests that vaccine availability and delivery strongly correlate with public acceptance and intended use of the Covid-19 vaccine.

Another important observation worth discussing is the association between factors such as country of respondents, effect of Covid on the physical and emotional health of respondents and public acceptance and intended use of the Covid-19 vaccine. The literature review above suggested the existence of different rate of vaccination among countries in Africa because of fear of vaccines, misinformation, religious beliefs etcetera (Nkengasong et al., 2020; Mbow et al., 2020). The present study shows a strong correlation between country (varying geographic, sociocultural, and economic beliefs) and vaccine administration in Africa. This further supports existing empirical evidence in the literature. Future study can further investigate the country specific variables that accounts for the different rate of vaccination in Africa.

Moreover, like most empirical studies, the current study is not without limitations. First, we acknowledge the possibility of desirability bias that is likely to influence the results. Since we utilized survey data collected from the public, there is the likelihood that respondents may alter their answers to appear good and credible during the interviewing process. This limitation can be addressed by using systematic social observations in future studies to further examine this issue. Furthermore, we acknowledge that this study is an exploratory study that serves as the foundation of future studies seeking to understand the factors that predict public acceptance and intended use of the Covid-19 vaccine in Africa, specifically sub-Saharan Africa. Therefore, the methodology utilized in this study only measures the association of each predictor variable separately with the outcome variable without controlling for other variables. In essence, this study shows a correlation but not causation. Future studies can focus on developing a more robust analysis that accounts for the effect of all the variables simultaneously instead of separately. In essence, the present study provides a correlation between the outcome variable and the predictors and not a causal effect. Finally, using SMS surveys in Africa can lead to the oversampling of wealthier and educated respondents. Therefore, we caution readers against further interpretation of the present results based on this factor. Despite these limitations, we argue the revelations from this study are important for theory building and for practice. Theoretically, the present study and its findings adds to the existing knowledge on vaccine administration in Africa by exploring the factors that correlates with intended Covid-19 use. Specifically, the present study explores a broad range of factors that correlates with vaccine use Practically, the current study and its findings have serious policy implications for developing policies that can help improve public acceptance and intended use of the Covid-19 vaccine in Africa.

In conclusion, globally, the Covid-19 virus that started in Wuhan, China in 2019 has been devastating for many individuals and nations. Among the notable effects of the virus are the collapse of world economies and businesses, the pressure on healthcare systems and professionals, a decline in the emotional and physical wellbeing of individuals, unemployment, and the death of hundreds of thousands of people (Nkengasong et al., 2020; Afolabi & Ilesanmi, 2021). In attempts to find a solution to the negative consequences of the pandemic, the Covid-19 vaccine was developed. However, stakeholders continue to ponder whether the general public will accept and use the vaccine (Afolabi & Ilesanmi, 2021). In Africa, historical and empirical evidence suggest that vaccine acceptance and intended use is a challenge on the continent because of public fear, misconception,

and religious beliefs (Ojakaa et al., 2011). The empirical evidence from the present study reveals several important and intriguing associations between the predictor variables and the outcome variable – Covid-19 vaccine acceptance and intended use. Based on the empirical evidence of the current study we make the following recommendations. We recommend prioritizing community involvement and collaboration involving various stakeholders. African governments must work collaboratively with local stakeholders like the traditional, religious leaders, and public healthcare professionals to conscientize the public. Failure to adopt a community involvement and collaborative approach by African governments could further add on to the unfamiliarity and misconception about vaccines among the public.

## REFERENCES


1. Amadasun, S. (2020). COVID-19 palaver: Ending rights violations of vulnerable groups in Africa. *World Development*, *134*, 105054–105054. https://doi.org/10.1016/j.worlddev.2020.105054
2. Afolabi, A. A., & Ilesanmi, O. S. (2021). Dealing with vaccine hesitancy in Africa: the prospective COVID-19 vaccine context. *The Pan African Medical Journal*, *38*, 3–3. https://doi.org/10.11604/pamj.2021.38.3.27401
3. Bowman, B. (2020). On the biopolitics of breathing: race, protests, and state violence under the global threat of COVID-19. *South African Journal of Psychology*, *50*(3), 312–315. https://doi.org/10.1177/0081246320947856
4. Cooper, S., Betsch, C., Sambala, E. Z., Mchiza, N., & Wiysonge, C. S. (2018). Vaccine hesitancy - a potential threat to the achievements of vaccination programmes in Africa. *Human Vaccines & Immunotherapeutics*, *14*(10), 2355–2357. https://doi.org/10.1080/21645515.2018.1460987
5. Dinga, J. N., Sinda, L. K., & Titanji, V. P. K. (2021). Assessment of Vaccine Hesitancy to a COVID-19 Vaccine in Cameroonian Adults and Its Global Implication. *Vaccines (Basel)*, *9*(2), 175–. https://doi.org/10.3390/vaccines9020175
6. Dubé, E., Gagnon, D., Ouakki, M., Bettinger, J. A., Guay, M., Halperin, S., Wilson, K., Graham, J., Witteman, H. O., MacDonald, S., Fisher, W., Monnais, L., Tran, D., Gagneur, A., Guichon, J., Saini, V., Heffernan, J. M., Meyer, S., Driedger, S. M., … MacDougall, H. (2016). Understanding Vaccine Hesitancy in Canada: Results of a Consultation Study by the Canadian Immunization Research Network. *PloS One*, *11*(6), e0156118–e0156118. https://doi.org/10.1371/journal.pone.0156118
7. Dzordzormenyoh, M., Asafo, D. M., & Domeh, T. (2021). Place, People & Diseases: The Association Between Geography & Diseases in Ghana. *The Columbia University Journal of Global Health*, *10*(2). https://doi.org/10.52214/thecujgh.v10i2.7111
8. Febir, L. G., Asante, K. P., Dzorgbo, D.-B. S., Senah, K. A., Letsa, T. S., & Owusu-Agyei, S. (2013). Community perceptions of a malaria vaccine in the Kintampo districts of Ghana. *Malaria Journal*, *12*(1), 156–156. https://doi.org/10.1186/1475-2875-12-156
9. Fine, P., Eames, K., & Heymann, D. L. (2011). "Herd Immunity": A Rough Guide. *Clinical Infectious Diseases*, *52*(7), 911–916. https://doi.org/10.1093/cid/cir007
10. Freeman, D., Loe, B. S., Chadwick, A., Vaccari, C., Waite, F., Rosebrock, L., Jenner, L., Petit, A., Lewandowsky, S., Vanderslott, S., Innocenti, S., Larkin, M., Giubilini, A., Yu, L.-M., McShane, H., Pollard, A. J., & Lambe, S. (2020). COVID-19 vaccine hesitancy in the UK: the Oxford coronavirus explanations, attitudes, and narratives survey (Oceans) II. *Psychological Medicine*, 1–15. https://doi.org/10.1017/S0033291720005188
11. Huo, X., Shi, G., Li, X., Lai, X., Deng, L., Xu, F., Chen, M., Wei, Q., Samba, T., & Liang, X. (2016). Knowledge and attitudes about Ebola vaccine among the general population in Sierra Leone. *Vaccine*, *34*(15), 1767–1772. https://doi.org/10.1016/j.vaccine.2016.02.046
12. Hotez, P. J., & Bottazzi, M. E. (2020). Developing a low-cost and accessible COVID-19 vaccine for global health. *PLoS Neglected Tropical Diseases*, *14*(7), e0008548–. https://doi.org/10.1371/journal.pntd.0008548
13. Jegede, A. S. (2007). What led to the Nigerian boycott of the polio vaccination campaign? *PLoS Medicine*, *4*(3), e73–e73. https://doi.org/10.1371/journal.pmed.0040073
14. The Lancet. (2020). An African plan to control COVID-19 is urgently needed. *The Lancet (British Edition)*, *396*(10265), 1777–1777. https://doi.org/10.1016/S0140-6736(20)32580-0
15. Madhi, S. A., Baillie, V., Cutland, C. L., Voysey, M., Koen, A. L., Fairlie, L., ... & Izu, A. (2021). Safety and efficacy of the ChAdOx1 nCoV-19 (AZD1222) Covid-19 vaccine against the B. 1.351 variant in South Africa. *MedRxiv*.
16. Makoni, M. (2020). COVID-19 vaccine trials in Africa. *The Lancet Respiratory Medicine*, *8*(11), e79-e80. https://doi.org/10.1016/S2213-2600(20)30401-X
17. Marti, M., de Cola, M., MacDonald, N. E., Dumolard, L., & Duclos, P. (2017). Assessments of global drivers of vaccine hesitancy in 2014-Looking beyond safety concerns. *PloS One*, *12*(3), e0172310–e0172310. https://doi.org/10.1371/journal.pone.0172310
18. Matrajt, L., Eaton, J., Leung, T., & Brown, E. R. (2020). Vaccine optimization for COVID-19: Who to vaccinate first? *Science Advances*, *7*(6), eabf1374–. https://doi.org/10.1126/sciadv.abf1374
19. Mbow, M., Lell, B., Jochems, S. P., Cisse, B., Mboup, S., Dewals, B. G., Jaye, A., Dieye, A., & Yazdanbakhsh, M. (2020). COVID-19 in Africa: Dampening the storm? *Science (American Association for the Advancement of Science)*, *369*(6504), 624–626. https://doi.org/10.1126/science.abd3902
20. Mellet, J., & Pepper, M. S. (2021). A COVID-19 Vaccine: Big Strides Come with Big Challenges. *Vaccines (Basel)*, *9*(1), 39–. https://doi.org/10.3390/vaccines9010039
21. Murphy, J., Vallières, F., Bentall, R. P., Shevlin, M., McBride, O., Hartman, T. K., McKay, R., Bennett, K., Mason, L., Gibson-Miller, J., Levita, L., Martinez, A. P., Stocks, T. V. A., Karatzias, T., & Hyland, P. (2021). Psychological characteristics associated with COVID-19 vaccine hesitancy and resistance in Ireland and the United Kingdom. *Nature Communications*, *12*(1), 29–29. https://doi.org/10.1038/s41467-020-20226-9
22. Nachega, J. B., Sam-Agudu, N. A., Mellors, J. W., Zumla, A., & Mofenson, L. M. (2021). Scaling Up Covid-19 Vaccination in Africa — Lessons from the HIV Pandemic. *The New England Journal of Medicine*, *385*(3), 196–198. https://doi.org/10.1056/NEJMp2103313
23. Nkengasong, J. N., Ndembi, N., Tshangela, A., & Raji, T. (2020). COVID-19 vaccines: how to ensure Africa has access. *Nature (London)*, *586*(7828), 197–199. https://doi.org/10.1038/d41586-020-02774-8
24. Ojakaa, D. I., Ofware, P., Machira, Y. W., Yamo, E., Collymore, Y., Ba-Nguz, A., Vansadia, P., & Bingham, A. (2011).

Community perceptions of malaria and vaccines in the South Coast and Busia regions of Kenya. *Malaria Journal*, *10*(1), 147–147. https://doi.org/10.1186/1475-2875-10-147

25. Oliver, S. E., Gargano, J. W., Marin, M., Wallace, M., Curran, K. G., Chamberland, M., McClung, N., Campos-Outcalt, D., Morgan, R. L., Mbaeyi, S., Romero, J. R., Talbot, H. K., Lee, G. M., Bell, B. P., & Dooling, K. (2020). The Advisory Committee on Immunization Practices' Interim Recommendation for Use of Pfizer-BioNTech COVID-19 Vaccine - United States, December 2020. *MMWR. Morbidity and Mortality Weekly Report*, *69*(50), 1922–1924. https://doi.org/10.15585/MMWR.MM6950E2
26. Olson, O., Berry, C., & Kumar, N. (2020). Addressing parental vaccine hesitancy towards childhood vaccines in the United States: A systematic literature review of communication interventions and strategies. *Vaccines (Basel)*, *8*(4), 1–25. https://doi.org/10.3390/vaccines8040590
27. Osama El-Gendy, A., Saeed, H., Ali, A. M.., Zawbaa, H. M., Gomaa, D., Harb, H. S., Madney, Y. M., Osama, H., Abdelrahman, M. A., & Abdelrahim, M. E. (2020). Bacillus Calmette–Guérin vaccine, antimalarial, age and gender relation to COVID-19 spread and mortality. *Vaccine*, *38*(35), 5564–5568. https://doi.org/10.1016/j.vaccine.2020.06.083
28. Patel, M., Lee, A. D., Redd, S. B., Clemmons, N. S., McNall, R. J., Cohn, A. C., & Gastañaduy, P. A. (2019). Increase in Measles Cases - United States, January 1-April 26, 2019. *MMWR. Morbidity and Mortality Weekly Report*, *68*(17), 402–404. https://doi.org/10.15585/mmwr.mm6817e1
29. Rosenthal, P. J., Breman, J. G., Djimde, A. A., John, C. C., Kamya, M. R., Leke, R. G., Moeti, M. R., Nkengasong, J., & Bausch, D. G. (2020). COVID-19: Shining the light on Africa. *The American Journal of Tropical Medicine and Hygiene*, *102*(6), 1145–1148. https://doi.org/10.4269/ajtmh.20-0380
30. Singh, J. A. (2020). The Case for Why Africa Should Host COVID-19 Candidate Vaccine Trials. *The Journal of Infectious Diseases*, *222*(3), 351–355. https://doi.org/10.1093/infdis/jiaa303
31. Wiysonge, C. S., Ndwandwe, D., Ryan, J., Jaca, A., Batouré, O., Anya, B.-P. M., & Cooper, S. (n.d.). Vaccine hesitancy in the era of COVID-19: could lessons from the past help in divining the future? *Human Vaccines & Immunotherapeutics*, *ahead-of-print*(ahead-of-print), 1–3. https://doi.org/10.1080/21645515.2021.1893062
32. World Health Organization. (September 10, 2021). Fifteen African Countries hit the 10% Covid-19 Vaccination Goal. https://www.afro.who.int/news/fifteen-african-countries-hit-10-covid-19-vaccination-goal. Accessed: December 19, 2021.