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RESEARCH ARTICLE

The acceptability and side effects of COVID-19 vaccine among health care workers in Nigeria: a cross-sectional study

[version 1; peer review: 2 approved with reservations]

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Abstract

Background: The COVID-19 pandemic is global public health crisis. Mass vaccination, until herd immunity is achieved, is one of the most effective ways of combating the deadly infectious virus. The disposition of health workers towards the AstraZeneca vaccine will most likely determine if other members of the community will be willing to get vaccinated or not. Thus, the purpose of this study is to determine the attitudes of healthcare workers to the COVID-19 vaccine, as well as determine the various side effects experienced by those who have already been vaccinated.

Method: Frequency tables were created, and Chi-square was used to determine the relationship between respondents' socio-demographic characteristics, as well as their acceptance or rejection of the COVID-19 vaccine and attitude towards it. Using IBM SPSS Statistics for Windows, version 22.0, multinomial logistic regression was used to determine the key factors which influenced respondents' decision to have the vaccine.

Result: There was a statistically significant relationship between the cadre of health care workers, their tribe, and their involvement in the care of COVID-19 patients and their attitude towards the vaccine.

Conclusion: Previous involvement in the care of COVID-19 patients is one of the most important determinants of health care workers' acceptance of the COVID-19 vaccine. Most respondents were positive about the vaccine; however, the fear of side effects was the primary

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reason why those who were yet to be vaccinated, do not plan to do so. The most common side effect reported by those who had already been vaccinated, was pain at the injection site. Public awareness of the vaccine and its benefits should be increased, and the vaccine should be made available in all health care facilities.

Keywords

COVID-19, vaccine, acceptance rate, health care workers

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Introduction

Following its emergence in Wuhan, China, in November 2019, the coronavirus disease (COVID-19) was declared a global pandemic in March 2020.¹ Globally, there were 126,359,540 confirmed COVID-19 cases and 2,769,473 deaths as of 28th March 2021. On the 30th January 2020, COVID-19 was declared as Public Health of International concern (PHEIC) by the World Health Organization (WHO). The disease has ravaged more than 200 countries worldwide, which necessitated its declaration as a global pandemic in March 2020.

COVID-19 was first detected in Nigeria on 24th March 2020. Since then, the pandemic has spread rapidly throughout the country, with over 146,000 cases and 2402 deaths as of 16th March 2021. The Nigerian healthcare system was unprepared for the pandemic; facing issues such as a lack of training and retraining of health workers on disease preparedness, lack of personal protective equipment, lack of testing centres in many cities, and unwillingness to be tested.²

Different national governments have imposed a number of measures and protocols to help halt the spread of COVID-19, including the mandatory wearing of face masks, lockdowns, social distancing, and frequent hand washing with soap and water, among other measures. Following the introduction of the non-pharmaceutical interventions, vaccines have been developed to curb the spread of COVID-19 infection.² Herd immunity is defined as the indirect protection from an infectious disease that happens when a population is immune either through vaccination or immunity developed through previous infection. To curb COVID-19, experts estimate that herd immunity would require around 80-90% of the population to have COVID-19 immunity. Hence there is a need to get the populace immunized.³

Vaccination is an effective method of combating infectious diseases by training the immune system to recognize and combat pathogens, either viruses or bacteria.⁴ Pharmaceutical companies and researchers around the world have collaborated to develop safe and effective vaccines. Pfizer, Sinovac, Janssen, Oxford/AstraZeneca, Moderna, Sputnik V, and Sinopharm are among the companies that have produced COVID-19 vaccines to combat the virus's spread.⁵ The AstraZeneca vaccine was the only vaccine available for use in Nigeria as at the time of this study and it is the vaccine still currently being given. AstraZeneca was rolled out in Nigeria on the 18th of February 2021, however at the time of study, vaccinations had not commenced in some states. The vaccine is available free of charge to all, at government health facilities throughout Nigeria. The availability of a vaccine does of course not guarantee its uptake, and the acceptance of the COVID-19 vaccination is entirely voluntary in Nigeria. In a study done among healthcare providers in Nigeria on COVID-19 vaccine acceptability, 53.5% of respondents were willing to get vaccinated against the disease and the reason why 69.4% of respondents will not receive the COVID-19 vaccine was because of fear of side effects.⁶

Health care workers are an important group to consider, as they are in a pivotal position to determine if other members of the populace will be willing to get vaccinated or not.⁷ Health care workers are a reliable source of vaccination information to the general public and thus their acceptance or rejection of the COVID-19 vaccine may be critical to its uptake among the general population.⁷ Identifying the reasons why healthcare workers may be hesitant to take the COVID-19 vaccine could be used to inform policy makers, in modifying such factors to ensure better attitudes towards vaccination, and thus increased herd immunity.⁸ The purpose of this study is to determine the acceptability of the COVID-19 vaccine among healthcare workers, as well as the various side effects experienced by those who have already been vaccinated. Knowledge of the side effect will help pharmaceutical companies modify the production of the vaccines in order to limit the side effects.

Methods

Ethics

The research team obtained approval from the Ethical Review Committee of LAUTECH Teaching Hospital, Ogbomosho.

Respondents took part in a cross-sectional study by filling out an online survey through Google forms; all participants were health workers from Nigeria's six geopolitical zones. Health care workers in different health institutions across the six geopolitical zones in Nigeria who were colleagues and former colleagues of the authors were randomly selected and contacted through their already known phone numbers. They helped to circulate the link on their various hospital health workers' WhatsApp groups. Respondents' WhatsApp details were obtained from their colleagues. Some participants also shared the link via e-mails to colleagues who were not active on WhatsApp. The respondents did not undergo any form of screening before they were recruited. The introductory part of the Google form contained a statement on the aim and details of the study and it also contained a request for the patient's consent to be part of the study. The Google form was designed to learn about the participants' attitudes towards the vaccine, side effects experienced by those already vaccinated, and willingness to get vaccinated (*Extended data* (Ilori *et al.*, 2021)). The survey was available to participants from the 23rd March 2021 to the 3rd May 2021. Only responses that were completed were counted and recorded. Surveys completed by respondents with the same email address were disqualified because they were deemed to be overlapping

responses. Ethical approval was obtained from the Ethical Review Committee of LAUTECH Teaching Hospital, Ogbomoso.

A total of 309 responses were collected and analysed using SPSS version 22 [16]. Questions 1-6 were on socio-demographic characteristics of respondents, questions 7-19 handled the willingness to get vaccinated and questions 20-27 answered the attitudinal questions. After data collection, numbers were assigned to answers for the purpose of computing. Respondents' attitudes were graded by assigning scores to the likert scale responses. All the likert scale questions were negative except the penultimate and the last questions which were neutral and positive respectively. For the negative statements, strongly agreed, agree, indifferent, disagree and strongly disagree corresponds to scores of 1,2,3,4,5 respectively. For the positive statement, strongly agreed, agree, indifferent, disagree and strongly disagree corresponds to 5,4,3,2,1 respectively. The mean was calculated by adding the sum of all the scores for all respondents. Respondents who scored higher than the calculated mean were considered to have a positive attitude towards the AstraZeneca vaccine, while those who scored lower than the calculated mean were considered to have a negative attitude toward the vaccine. The questions on the respondents' willingness to accept the vaccine and the readiness to recommend same for others were scored 1 for a 'yes' answer and 0 for a 'no' answer. Vaccine acceptability was determined by adding the scores for willingness to be vaccinated and readiness to recommend the vaccine to patients. The mean was calculated after adding up all the scores. Respondents with scores lower than the mean were considered to have poor acceptability, while those with scores higher than the mean were considered to have good acceptability. Data was analysed using SPSS version 22, after sorting. Frequency tables were created, and the Chi square test was used to determine the relationship between respondents' socio-demographic characteristics, as well as their attitude and acceptability of the AstraZeneca COVID-19 vaccine. The factors influencing COVID-19 acceptability were identified using multinominal logistic regression. Tribe of respondents, cadre as well as past involvement in management of COVID-19, were tested for their association with vaccine acceptability at the multivariate level.

Results

Table 1 shows that 195 respondents were female, while 114 (36.9 %) were male. The majority (82.2%) were Yorubas, and 237 (76.7%) were Christians. The majority of the respondents came from the geopolitical zone of the South West. 121 respondents (39.2%) were Doctors, 89 (28.8%) were Community Health Extension Workers (CHEWs) and 57 (18.4%) were Nurses. Physiotherapists, Pharmacists, and Porters were among the 17% (5.4 percent).

Table 2: At the time of this research, 238 respondents (80.3%) were willing to be vaccinated, and 117 (37.9%) were already vaccinated; the majority of whom were only one week away from the day of vaccination. The reason given by 127 (66.2%) of those who had not been vaccinated was that the vaccine was not yet available in their facility. Even if the vaccine was made available, 41 (60.3%) of respondents would not get vaccinated because they are not just at peace with the vaccine.

Table 3 shows that 250 (80.9%), 250 (80.9%), and 111 (35.9%) of respondents can recommend COVID-19 vaccine to their patients, have attended COVID-19 seminars, and have been involved in the care of COVID-19 patients.

Table 4 shows that 85 respondents (72.6%) experienced side effects after receiving the COVID-19 vaccine, while 32 (27.4%) did not. 73 participants (85.9%) reported pain at the injection site, while 36 (42.3%) and 34 (40.0%) reported fever and headache, respectively.

Table 5 shows that 168 (54.4%) of respondents had a positive attitude toward COVID-19 vaccination, while 141 (45.6%) had a negative attitude.

Table 6 shows that 237 (76.7%) of respondents thought the COVID-19 vaccine was acceptable, while 72 (23.3%) had a poor acceptability of the vaccine.

Table 7 shows a statistically significant relationship between respondent's tribe and cadre, and their attitude toward COVID-19 vaccination. More males and respondents of Christian religion had good attitude towards COVID-19 vaccination

Table 8: When compared to their acceptability of COVID-19 vaccination, there is a statistically significant association between tribe and cadre of respondents; more laboratory scientists had poor acceptability of the COVID-19 vaccination, while a high proportion of CHEWs had good acceptability of the COVID-19 vaccination.

Table 1. Sociodemographic characteristics of respondents.

Variables	Frequency	Percentage (%)
Age		
<20 years	0	0
21-40	146	47.2
41-60	158	51.1
>60	5	1.6
Sex		
Female	195	63.1
Male	114	36.9
Tribe		
Hausa	6	1.9
Igbo	25	8.1
Others	24	7.8
Yoruba	254	82.2
Religion		
Christianity	237	76.7
Islam	72	23.3
Traditionalist	0	0.0
Geopolitical zone of residence		
South West	248	80.3
South East	13	4.2
South	11	3.6
North Central	27	8.7
North East	1	0.3
North West	9	2.9
Cadre		
Doctor	121	39.2
Nurse	57	18.4
Medical Laboratory Scientist	25	8.1
Pharmacist	2	0.6
Physiotherapist	8	2.6
CHEW	89	28.8
Ward Orderly/Porter	7	2.3

Table 9 lists the predictors of COVID-19 vaccine acceptability among health workers, which include Tribe, Cadre, and involvement in the care of a COVID-19 patient. The Igbo and other tribes are 3.962 and 3.631 times more likely, respectively, to accept the COVID-19 vaccine, than the Yoruba tribe. When compared to Doctors, CHEWS are 0.048 times less likely to accept COVID-19 vaccination. Participants who have been involved in the care of a COVID-19 patient are 1.824 times more likely than those who have not to accept the vaccine.

Discussion

This study aims to determine the willingness and acceptability of COVID-19 vaccination among Nigerian health care workers, as well as the potential side effects among those who have already been vaccinated. A higher proportion of health workers were willing to get vaccinated with AstraZeneca vaccine available in Nigeria than a similar study done among health workers in France and the French-speaking part of Belgium, which had a 46.8 % acceptance rate of the same AstraZeneca vaccine.⁷ Our findings could be attributed to increased vaccine awareness. Despite the widespread misconception about vaccination, health care worker's acceptance of the COVID-19 vaccine will go a long way toward informing patients about the importance of getting vaccinated.

Our findings are quite different from another study conducted in Ghana, where there was a self-reported, low intention of health workers to accept the AstraZeneca vaccine.⁴ The reason for this similarity may be because of several myths about the vaccine as well as the rapidity in the development of the vaccine. Some of the myths and misconception about the vaccine are that there was inadequate clinical trials to support its usage, mutation of gene etc..⁹ Many respondents may have been sceptical about the Nigerian government's ability to intervene by providing a liable vaccine within a year of the commencement of the pandemic in such a short period of time. Continuous public sensitization about the benefits of getting vaccinated against this infectious disease will go a long way toward convincing health workers and the general population in this category to reconsider accepting the vaccine. In study conducted in Saudi Arabia between 8th December to 14th December 2020, out of 673 health workers sampled, half were willing to receive the COVID-19 vaccine, and

Table 2. Willingness to get vaccinated with COVID-19 vaccine.

Variables	Frequency	Percentage (%)
Willing to get vaccinated?		
Yes	248	80.3
No	34	11.0
Undecided	36	11.7
Have you been vaccinated with COVID-19 vaccine?		
Yes	117	37.9
No	192	62.1
If yes, when were you vaccinated?		
Last one month	31	26.5
Less than one week ago	83	70.9
More than a month	3	2.6
If you are not yet vaccinated, why?		
I don't want to take the vaccine	45	23.4
Vaccine not yet available in my facility	127	66.2
Vaccine not yet available in my state	20	10.4
If the vaccine is available, will you get vaccinated?		
No, I will not get the vaccine	8	4.1
No, I will wait for three months to review safety profile	14	7.3
No, I will wait for six months to review safety profile	7	3.6
No, I will wait for one year to review safety profile	13	6.7
Undecided	23	11.9
Yes, as soon as I can get it	124	64.6
Yes, only if it is required by employer	3	1.5
If you will not get vaccinated, why?		
COVID-19 infection has reduced worldwide	5	7.3
I am not just at peace with the vaccine	41	60.3
I heard the vaccine is more dangerous than the virus	7	10.2
No need for the vaccine, I am immune	7	10.2
Vaccine is not safe	8	11.8
The vaccine can change my gene	0	0.0
COVID-19 is not real	0	0.0
The vaccine can kill faster than the infection	0	0.0
Vaccine itself can cause COVID-19	0	0.0

Table 3. Recommendation of COVID-19 vaccine by respondents.

Variables	Frequency	Percentage (%)
Would you recommend the vaccine to your patients/family/friends?		
Yes	250	80.9
No	19	6.1
Undecided	40	12.9
Have you ever attended a seminar on COVID-19?		
Yes	250	80.9
No	59	19.1
Have you been involved in the care of a COVID-19 patient before?		
Yes	111	35.9
No	198	64.1

49.71% planned to do so as soon as it became available.¹⁰ Their findings are comparable to those in this study, in which more than three-quarters of respondents said they would get vaccinated as soon as they could. This is very encouraging because a high vaccination rate is essential to achieving herd immunity within the global population and working towards managing the spread of the virus.

The AstraZeneca COVID-19 vaccine's side effects have been widely documented within research. In a study conducted in the United Kingdom, among Pfizer-BioNTech vaccine recipients, two-thirds of those polled reported one or more side effects, with fatigue and headache being the most common.¹¹ This is in contrast to the findings of the current study, which found that pain at the injection site was the most common side effect experienced. The likely reason for this is due to the

Table 4. Side effects from the vaccine.

Variables	Frequency	Percentage (%)
Have you experienced any side effects from the vaccine?		
Yes	85	72.6
No	32	27.4
Side effects		
Pain at injection site	73	85.9
Dizziness	13	15.3
Headache	34	40.0
Fever	36	42.3
Chills	23	27.1
Diarrhoea	6	7.1
Muscle pain	43	50.6
Nausea	8	9.4

Table 5. Attitude of respondents towards Covid-19 vaccine.

Variables	Frequency	Percentage
Attitude		
Poor	141	45.6
Good	168	54.4

Table 6. Acceptability of Covid-19 Vaccine.

Variables	Frequency	Percentage
Acceptability		
Good	237	76.7
Poor	72	23.3

Table 7. Association between socio-demographic characteristics and attitude towards the COVID-19 vaccine.

Variables	Attitude		Total	Statistics
	Poor	Good		
Sex				
Male	33 (28.9)	81 (71.1)	114 (100.0)	CHI = 3.223 df = 1 P value = 0.073
Female	39 (20.0)	156 (80.0)	195 (100.0)	
Tribe				
Yoruba	48 (18.9)	206 (81.1)	254 (100.0)	CHI = 18.225 df = 3 *P value = 0.001
Igbo	12 (48.0)	13 (52.0)	25 (100.0)	
Hausa	1 (16.7)	5 (83.3)	6 (100.0)	
Others	0 (0.0)	0 (0)	0 (0)	
Religion				
Christianity	60 (25.3)	177 (74.7)	237 (100.0)	CHI = 2.312 df = 1 P value = 0.128
Islam	12 (16.7)	60 (83.3)	72 (100.0)	
Traditionalist	0 (0)	0 (0)	0 (0)	
Cadre				
Doctor	39 (32.2)	82 (67.8)	121 (100.0)	CHI = 43.560 df = 6 P value = 0.000
Nurse	14 (24.6)	43 (75.4)	57 (100.0)	
Medical Lab	9 (36.0)	16 (64.0)	25 (100.0)	
Pharmacist	2 (100.0)	0 (0.0)	2 (100.0)	
Physiotherapy	5 (62.5)	3 (37.5)	8 (100.0)	
CHEW	2 (2.2)	87 (97.8)	89 (100.0)	
Ward Orderly/Porter	1 (14.3)	6 (85.7)	7 (100.0)	

Table 8. Association between sociodemographic characteristics and acceptability of the COVID-19 vaccine.

Variables	Acceptability		Total	Statistics
	Poor	Good		
Sex				
Male	33 (28.9)	81 (71.1)	114 (100.0)	CHI = 3.223 df = 1 P value = 0.073
Female	39 (20.0)	156 (80.0)	195 (100.0)	
Tribe				
Yoruba	105 (41.3)	149 (58.7)	254 (100.0)	CHI = 14.229 df = 3 *P value = 0.003
Igbo	19 (76.0)	6 (24.0)	25 (100.0)	
Hausa	2 (33.3)	4 (66.7)	6 (100.0)	
Others	0 (0.0)	0 (0)	0 (0.0)	
Religion				
Christianity	114 (48.1)	123 (51.9)	237 (100.0)	CHI = 2.502 df = 1 P value = 0.114
Islam	27 (37.5)	45 (62.5)	72 (100.0)	
Traditionalist	0 (0.0)	0 (0.0)	0 (0.0)	
Cadre				
Doctor	38 (32.2)	82 (67.8)	121 (100.0)	CHI = 22.680 df = 6 *P value = 0.001
Nurse	14 (24.6)	43 (75.4)	57 (100.0)	
Medical Lab	9 (36.0)	16 (64.0)	25 (100.0)	
Pharmacist	2 (100.0)	0 (0.0)	2 (100.0)	
Physiotherapy	5 (62.5)	3 (37.5)	8 (100.0)	
CHEW	2 (2.2)	87 (97.8)	89 (100.0)	
Ward Orderly/Porter	2 (28.6)	5 (71.4)	7 (100.0)	

Table 9. Predictors of COVID-19 acceptability among respondents.

Explanatory factors	Odd ratio	95% Confident interval	p-value
Tribe			
Yoruba (reference category)			
Igbo	3.962	1.701-9.224	0.001*
Hausa	0.858	0.098-7.517	0.890
Others	3.631	1.533-8.601	0.003*
Cadre			
Doctor (reference category)			
Nurse	0.685	0.335-1.397	0.298
Medical Lab	1.183	0.480-2.913	0.715
Physiotherapist	3.504	0.797-15.413	0.097
CHEW	0.048	0.011-0.207	0.0001*
Ward Orderly/Porter	0.350	0.041-3.012	0.339
Have you been involved in the care of a COVID patient?			
No (reference category)			
Yes	1.824	1.067-3.118	0.028*

different types of vaccines used in both study areas. There is an urgent need for the manufacturers to ensure that the side effects of these vaccines, regardless of type, are kept to a minimum to encourage greater acceptance.

In a similar study conducted among health care workers in New York, USA, gender, age, and place of residence were statistically significant with the willingness to get vaccinated with BioNTech Pfizer COVID-19 vaccine.⁹ However, in this study, the statistically significant factors were cadre of health care workers and their tribe. The probable reason why tribe is statistically significant may be because tribal values are held in high esteem in African communities. Thus, people of the same tribe tend to share similar views about general health issues including vaccination. Furthermore, when compared to CHEWs, doctors were more willing to accept the vaccination. The reason for this among the various cadres of health workers may be that doctors are more likely have had the opportunity to treat as well as witness complications associated with COVID-related illnesses, than the other cadres of health care workers. This could explain why those who had previously been involved in the care and management of COVID-19 patients were significantly more likely to accept COVID-19 vaccination than those who have never treated COVID-19 patients.

In terms of the limitations of the study, considering the fact that the study was conducted online, only respondents who got the link through WhatsApp or e-mail alone were able to respond to the questions. Thus, it is not every health worker that is active on WhatsApp and there is no common data base where email of all health workers could be assessed.

Conclusion

In this study, the rate of acceptance of COVID-19 vaccination among health workers was quite high, especially among doctors when compared with other cadres. The acceptability of COVID-19 vaccination was statistically significant by tribe and cadre of respondents, and health workers who had been involved in COVID-19 management were more likely to accept the vaccine. The main reason respondents would not get vaccinated was the fear of side effects which was closely linked to various myths accrued to AstraZeneca vaccines available in Nigeria, such as getting infected with the virus through the vaccine, alteration of recipient's gene etc. To encourage vaccine acceptability by the general population, side effects from COVID-19 vaccine, regardless of the brand, should be kept to a minimum.

Data availability

Underlying data

Figshare: Ilori *et al.*, 2021 The acceptability and side effects of COVID-19 vaccine among health care workers in Nigeria: a cross sectional study. https://figshare.com/articles/dataset/The_Acceptability_and_side_effects_of_COVID_19_vaccine_among_health_care_workers_in_Nigeria_a_cross_sectional_study/15078498/1 (Ilori *et al.*, 2021).¹¹

This project contains the following underlying data:

- Data file 1. (Complete survey responses, CSV format).

Extended data

Figshare: Ilori *et al.*, 2021 Copy of online survey. https://figshare.com/articles/figure/Copy_of_online_survey_used_in_Health_Care_Worker_survey_2021/15078588/1 (Ilori *et al.*, 2021).¹²

This project contains the following underlying data:

- Copy of online survey used in Health Care Worker survey 2021.

Data are available under the terms of the [Creative Commons Attribution 4.0 International \(CC BY 4.0\)](#).

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Competing interests

No competing interests were disclosed.

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Open Peer Review

Current Peer Review Status: ? ?

Version 1

Reviewer Report 14 December 2021

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Malina Binti Osman

Department of Medical Microbiology, Faculty of Medicine,, Universiti Putra Malaysia, Selangor, Malaysia

- Definition of acceptability based on the mean of the scores in my opinion is not suitable in this kind of situation. As we have to deal with a pandemic and all matters related to its management, stricter rules should be imposed.
- Contents/items for acceptability have not been explained clearly, I recommend if the authors can present the descriptive data on each question that has been asked to the respondents.
- I am not sure how the tool for the study was developed, and the authors did not mention at all the reliability and validity of the instrument used.
- The number of sample size was not calculated, I'm not sure whether the samples were representative or not. But obviously, this study adopted a non-probability sampling technique.
- Finally, the statistical analysis in my opinion needs further analysis, particularly when the contingency table is more than 2x2. Difficult to conclude when there was no posthoc test being performed.
- The table for regression was too simple, and based on my understanding it needs further detailed explanation.

Is the work clearly and accurately presented and does it cite the current literature?

Yes

Is the study design appropriate and is the work technically sound?

Yes

Are sufficient details of methods and analysis provided to allow replication by others?

Partly

If applicable, is the statistical analysis and its interpretation appropriate?

Partly

Are all the source data underlying the results available to ensure full reproducibility?

Partly

Are the conclusions drawn adequately supported by the results?

Partly

Competing Interests: No competing interests were disclosed.

Reviewer Expertise: Infectious disease; epidemiology; socio-behavioural study

I confirm that I have read this submission and believe that I have an appropriate level of expertise to confirm that it is of an acceptable scientific standard, however I have significant reservations, as outlined above.

Reviewer Report 17 November 2021

<https://doi.org/10.5256/f1000research.58120.r98181>

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Ozayr H. Mahomed

Public Health Medicine, University of KwaZulu-Natal, Durban, South Africa

The authors' work is commendable. The strength of the study is in clear explanation. However, I have the following points:

- The abstract is weak and needs to be more focused on the objectives.
- The methodology is not provided - needs to be clearly articulated using sub-headings.
- The conclusion is not linked to the findings.
- Introduction: lines 14 to 17 should be after the explanation of vaccines.
- The results section should be represented in line with explaining findings from the table.
- The odds ratio adjusted and unadjusted have not been provided. What were the confounding variables?
- Limitation of the study not discussed.

Is the work clearly and accurately presented and does it cite the current literature?

Yes

Is the study design appropriate and is the work technically sound?

Yes

Are sufficient details of methods and analysis provided to allow replication by others?

Partly

If applicable, is the statistical analysis and its interpretation appropriate?

Partly

Are all the source data underlying the results available to ensure full reproducibility?

Yes

Are the conclusions drawn adequately supported by the results?

Partly

Competing Interests: No competing interests were disclosed.

Reviewer Expertise: Health system strengthening

I confirm that I have read this submission and believe that I have an appropriate level of expertise to confirm that it is of an acceptable scientific standard, however I have significant reservations, as outlined above.

Comments on this article

Version 1

Reader Comment 04 Sep 2021

Mohammad Ali, Uttara Adhunik Medical College and Hospital, Dhaka, Bangladesh

This is an important study, however, authors must include more evidence from Low and Middle-Income Countries (LMICs). You can check this PubMed article: <https://pubmed.ncbi.nlm.nih.gov/34429316/>

Competing Interests: None

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