Predictors of COVID-19 Vaccine Acceptance among Healthcare Workers in Nigeria

Victory Chizaram Nnaemeka[1,2], Reuben Ogba Onwe[1,3], Adaku Lydia Ekwedike[1], Oluwakemi Elizabeth Oyedele[4], Thomas Sambo Tsiterimam[5], Ogbole Emmanuel Ochepo[6], Nkiru Nenye Nwokoye[7], Anthony Chibuogwu Ike [1*].

[1]Department of Microbiology, Faculty of Biological Sciences, University of Nigeria, Nsukka, 410001 Nigeria

[2]Applied Bioscience and Biotechnology, South Kensington Campus, Imperial College London, SW7 2AZ UK

[3]Biomedical Sciences, SUNY Upstate Medical University, NY 13210 USA

[4]Cell Biology and Genetics, Faculty of Science,University of Lagos, 101017 Nigeria

[5]Department of Obstetrics and Gynaecology, University of Abuja Teaching Hospital, 902101 Nigeria

[6]Department of Biochemistry, School of Life Science, Federal University of Technology Minna, 920101 Nigeria

[7]KNCV TB Foundation, Abuja FCT, 900211 Nigeria

Running Title: COVID-19 Vaccine Acceptance among HCW

*Correspondence to:

Anthony C. Ike

Department of Microbiology

University of Nigeria, Nsukka

Enugu State, Nigeria

E-mail: anthonyc.ike@unn.edu.ng

Phone: +234 706 631 7800

 doi:10.20944/preprints202209.0016.v1

Abstract

Healthcare workers (HCWs) are regarded as role models regarding health-related issues including vaccination. Therefore, it is essential to identify the predictors for COVID-19 vaccine acceptance among them. A cross-sectional study to assess the risk perception, attitudes and knowledge of HCWs toward COVID-19 vaccination was carried out. A total of 710 responses were received between September 2021 to March 2022, from HCWs in the Northern, Western and Eastern regions of Nigeria. Cross tabulations were performed to determine statistical relations between sociodemographic variables, knowledge, attitudes and risk perceptions concerning COVID-19 vaccine acceptance. Multinomial Logistic Regression analysis was performed to determine the predictive variables for COVID-19 vaccine acceptance. Statistical analyses were performed and P-values less than 0.05 were considered statistically significant at a CI of 95%. Results showed that 59.3% of the participants were amenable to COVID-19 vaccines. Multinomial regression analysis identified 14 variables at $\alpha < 0.05$ as predictors for vaccine acceptance. Male HCWs were 2.8 times more likely to accept the vaccine than their female counterparts. HCWs that were knowledgeable of the different kinds of vaccines, willing to recommend the vaccines to their patients, believe that the timing of COVID-19 vaccination was appropriate and had recent vaccination history within three years were 1.6, 24.9, 4.4 and 3.1 times more likely to take COVID-19 vaccine than those not sure. The study found a relatively high trust (51.3%) in the Nigerian Center for Disease Control (NCDC) for information regarding COVID-19 vaccines. Therefore, the NDCD should disseminate more robust insights regarding the safety profiles of various COVID-19 vaccines.

Keywords: COVID-19 vaccine; acceptance; healthcare workers; knowledge; risk perception; Nigeria.

 doi:10.20944/preprints202209.0016.v1

1.0 Introduction

The 2019 coronavirus pandemic, declared by the World Health Organization (WHO) in March 2020, remains a significant public health concern worldwide [1,2], due to the epidemic of new variants, which has resulted in new waves in various countries. Globally, over 518 million confirmed cases and over six million deaths have been confirmed by the WHO of May 15, 2022 [3]. As soon as SARS-CoV-2 was identified as the causative agent, its genome sequence was pubished and various therapeutic solutions were sought. Six vaccines (Pfizer-BioNTech, Moderna, Janssen (J&J), AstraZeneca-Oxford, Sinopharm and Sinovac-CoronaVac) with different storage distribution logistics, ingredients and side effects received emergency use authorization by the United States, Center for Disease Control on August 6, 2021 [4].

The emergence of efficacious vaccination is essential to mitigating the high morbidity and mortality rate of COVID-19, as immunization is adequate to a varying extent in reducing the severity of complications [5,6], leading to reduced hospitalization and mortality [7,8]. COVAX, the Gavi-led financing scheme to provide COVID-19 vaccines to low-income and middle-income countries (LMICs), planned to have 2 billion vaccine doses available by the end of 2021 [9-11]. Despite these advances, the vaccination of two-thirds of Africa's 1·2 billion population will still require massive investment for programmatic efforts to overcome vaccine hesitancy in this region [10]. According to a WHO analysis, the African region has an average score of 33% readiness for a SARS-CoV-2 vaccine roll-out—far below the necessary 80% benchmark [12]. COVAX aims to secure enough doses of available COVID-19 vaccine to protect an initial 20% of people at most risk in signatory countries [10]. Health care workers (HCWs) are a critical high-risk group and play a vital role in advising patients and communities about vaccination [1]. Hence, it is essential to consider their attitudes and risk perceptions about COVID-19 vaccines as these variables mirror their vaccine acceptance. Whereas much information is known regarding vaccine acceptance for developed countries, little is known about COVID-19 vaccine acceptance in Sub-Saharan Africa [13].

Worrisomely, Nigeria as a country has once had a severe case of mass vaccine refusal, an event which took place in the year 2003–2004, when northern Nigeria boycotted the polio vaccination program, which led to a resurgence of the disease in the country and beyond [14-17]. To this end, this survey study investigates the acceptance, risk perceptions, attitudes and predictors of COVID-19 vaccine acceptance among HCWs in Nigeria. This is the best we can tell of the broadest study

 doi:10.20944/preprints202209.0016.v1

undertaken to determine COVID-19 vaccine acceptance among HCWs, considering the major geopolitical zones in Nigeria.

2.0 METHODS

2.1 Study Design and Data Collection

A self-administered anonymous manual survey was conducted among HCWs in selected states in all the geographical zones in the country between September 28 and March 30 2022. The invitation for this survey contained consent providing information regarding study purposes, procedures and confidentiality.

2.2 Inclusion criteria include (1) being between the age of 15 and 65 years of age, (2) being currently a healthcare worker in a designated healthcare facility in Nigeria, and (3) being willing to supply the information contained in the questionnaire.

2.3 Sampling: A descriptive cross-sectional sampling method was utilized. The survey tool was distributed manually to healthcare workers in various healthcare facilities in the selected representative state in the North (Taraba State, Abuja), West (Lagos state, Ondo State), and East (Enugu State, Anambra State).

3.0 MEASURED PARAMETERS

3.1 Sociodemographic

The respondents were asked to supply information on their Age group, Gender, Ethnicity, Occupational cohort, Ward type, Health Care Facility, Location and Geopolitical Zone for data analysis. The sociodemographic were coded as: gender (1 = male and 2 = female); ethnicity (1 = Igbo, 2 = Hausa, 3 = Yoruba and 4 = others); Occupational cohort (1 = Physician, 2 = Nurse, 3 = Pharmacist, 4 = Physiotherapist, 5 = Scientist, 6 = Radiographer 7 = Administrative Staff, 8. Others); Ward Type (1 = Respiratory department 2 = Emergency Department 3 = Intensive care unit 4 = Medical Imaging, 5 = Medical Laboratory, 6 = Others), Location (1 =Urban, 2 = Sub urban 3 = Rural) and Geopolitical Regions North = 1, East = 3, West = 4 Other= 5).

3.2 Acceptance of COVID-19 Vaccine

To assess participants' perceptions and willingness to take COVID-19 vaccine, the following questions is asked: Will you take the COVID-19 vaccine if made Available (Yes, No, Not Sure).

3.3 Knowledge and Attitudes Towards COVID-19 Vaccination

 doi:10.20944/preprints202209.0016.v1

In assessing the participants' general attitudes towards COVID-19 vaccination and knowledge of the different kinds of vaccines, the following questions were asked;

Have You Taken any Vaccine for the Past Three Years? (Yes, No, Not Sure). Will you recommend COVID-19 vaccine to your patient? (Yes, No, Not Sure). Do you know the different COVID-19 vaccines currently in use in Nigeria? (Yes, No, Not sure). Do you trust professional staff advice on COVID-19 vaccine? (Yes, No, Not Sure). Is the timing for the current COVID-19 Vaccine appropriate? (Yes, No, Not sure). Do you think COVID-19 vaccines should be made mandatory? (Yes, No, Not sure). What are the most reliable sources of information for the COVID-19 vaccine? (NCDC, WHO, Pharmaceutical industries, social media, religious bodies, Family, Friends and Others). Which approved COVID-19 vaccine candidate do you prefer? (Pfizer-BioNTech, Moderna, Oxford-AstraZeneca, COVAX BBIBP-CorV, Covaxin, CoronaVac, CoviVac, Sputnik V, Convidicea, Johnson & Johnson, EpiVacCorona, Others)**.**

3.4 Risk Perception of COVID-19 Vaccine

Participants' risk perception of COVID-19 vaccines was assessed by asking them the following questions: Do you have any medical comorbidities? (No, Yes). Are you concerned about the side effects of the COVID-19 vaccine? (Yes, No, Not Sure). Do you think the COVID-19 vaccine contains dangerous substances? (Yes, No, Not sure). Do you think that the current COVID-19 vaccine has passed full clinical trials? (Yes, No, Not Sure). Do you think the COVID-19 vaccine is safe? (Yes, No, Not Sure).

4.0 Data Analysis

The data entered were initially vetted for possible data entry error(s), and proper coding of Descriptive statistics for Sociodemographic, COVID-19 Vaccine Acceptance, Risk Perception and General Attitudes Towards COVID-19 Vaccination were performed. Cross tabulations were performed to determine statistical relations between sociodemographic variables, knowledge, attitudes and risk perceptions concerning COVID-19 vaccine acceptance. Finally, a Multinomial Logistic Regression analysis was performed to determine the predictive variables for COVID-19 Acceptance. IBM SPSS statistics 23 was used for all statistical analyses. A P-value less than 0.05 was considered statistically significant at a CI of 95%.

Preprints (www.preprints.org) | NOT PEER-REVIEWED | Posted: 1 September 2022 doi:10.20944/preprints202209.0016.v1

5.0 Results

Descriptive statistics and multinomial logistics regression of sociodemographic characteristics and COVID-19 Vaccine Acceptance among HCWs in Nigeria.

- **Descriptive Statistics**

Seven hundred and ten (710) health care workers completed the survey, with 281(39.6%) males and 429 (60.4%) females. The age groups 15-25 years and 26-36 contributed 71.7% of the total respondents. Of the 710 respondents, 307 (43.2 %) were from health care facilities in Northern Nigeria. A total of 421 (60.0%) of the health care facilities were located in urban regions. Interms of ethnicity, 229 (32%) of the respondents were Igbo, 135 (19.2%) were Hausas, 193 (27.4%) were Yorubas and 147 (20.9%) were from other ethnic groups. Of all the respondents, 587 (81.9%) have no known chronic illness, while 128 (18.0%) said "Yes" they have. More details of the sociodemographic characteristics are shown in the first column of Table 1.

Table 1. Demographic Characteristics and Multinomial Logistics regression COVID-19 Vaccine Acceptance among HCWs in Nigeria

Variables	n (%)	**COVID-19 Vaccine Acceptance** (Total = 418/705; 59.3% n (%)	OR	P Value	95% CI
Gender					
Male	281 (39.6%)	66.9%	**2.8**	< **0.000**	1.7-4.6
Female	429 (60.4%)	54.1%	Ref		
Age					
15-25	308 (43.4%)	52.8%	0.6	0.5	0.1-2.9
26-36	202 (28.5%)	62.4%	0.8	0.8	0.7-4.0
37-47	102(14.3%)	68.6%	0.7	0.6	0.1-3.3
48-58	75 (10.5%)	65.3%	0.8	0.8	0.1-4.4
59-69	22 (3.1%)	59.1%	Ref		
Zone in Nigeria					
North	307(43.2%)	55.1%	0.4	**0.004**	0.2-0.8
East	202 (28.5%)	42.1%	0.1	**0.000**	0.1– 0.3
West	201 (28.3%)	83.0%	Ref		

Preprints (www.preprints.org) | NOT PEER-REVIEWED | Posted: 1 September 2022 doi:10.20944/preprints202209.0016.v1

Ethnicity					
Igbo	229 (32.5%)	48.2%	0.8	0.357	0.5-1.3
Hausa	135 (19.2%)	60.9%	**4.5**	**< 0.001**	1.8-10.9
Yoruba	193 (27.4%)	78.6%	**3.5**	**< 0.000**	1.8-7.1
Others	147 (20.9%)	48.6%	Ref		
Location					
Urban	421 (60.0%)	63.9%	**2.4**	**0.004**	1.5-4.8
Suburban	192 (27.4%)	51.1%	1.1	0.7	0.3-1.4
Rural	89 (12.7%)	53.9%	Ref		
Facility					
Teaching Hospital	119 (17.0%)	47.0%	0.364	1.442	0.7-3.2
Federal Medical Centre	228(32.5%)	57.9%	0.083	1.733	0.9-3.2
Private Hospital	138 (19.7%)	65.7%	**1.7**	**< 0.020**	0.8-3.7
Primary Health Care	103 (14.7%)	83.2%	**4.4**	**< 0.004**	1.6 -12.3
Others	114 (16.2%)	45.6%	Ref		
Ward					
Respiratory Unit	53 (7.6%)	54.7%	2.9	0.1	0.6- 3.8
Emergency Unit	104 (14.9%)	64.4%	2.0	0.17	0.3-2.0
Intensive Unit	106(15.2%)	67.0%	2.0	0.18	0.3-2.0
Medical Imaging	28 (4.0)	66.7%	2.5	0.2	0.2-2.4
Medical Laboratory Unit	41 (5.9%)	56.5%	1.4	0.5	0.5-2.3
Others	367 (52.5%)	53.7%	Ref		
Cohort					
Physician	111(15.7%)	62.4%	**2.4**	**0.031**	1.1 – 5.4
Nurse	46(6.5%)	62.2%	2.0	0.9	0.4 – 2.2
Pharmacist	157(22.2%)	64.1 %	1.2	0.5	0.7 – 2.2
Physiotherapist	20(2.8%)	75.0%	4.8	0.1	0.6 – 37.8
Scientist	114(16.1%)	43.9%	0.6	0.2	0.3 – 1.2
Radiographer	27(3.8%)	76.9%	3.2	0.1	0.7 – 14.4

Preprints (www.preprints.org) | NOT PEER-REVIEWED | Posted: 1 September 2022 doi:10.20944/preprints202209.0016.v1

Administrative staff	50(7.0%)	70.0%	2.8	0.7	0.9 – 8.5
Others	181 (25.5%)		Ref		
Chronic Illness					
Yes	128 (18.0%)	61.4%	1.1	0.8	0.670-1.665
No	578(81.9%)	58.7%	Ref		

- **COVID-19 Vaccine Acceptance**

Of the 710 participants surveyed, 418 (59.3%) said they would accept a COVID-19 vaccine (Table 1). Vaccine acceptance among the health care population differed by several demographic characteristics. Males (69.9%), Females (54.1%), Western Nigeria (83.0%), Northern Nigeria (55.1%) and Eastern Nigeria (42.1%). Health care workers in facilities located in urban regions had a higher vaccine acceptance of 60.0%. More details of the vaccine acceptance of the demographics are shown in the third column of Table 1.

- **Multinomial Logistic Regression**

The odd ratio, level of significance, and confidence intervals for sociodemographic variables influencing vaccine acceptance were determined using multinomial logistic regression analysis (Table 1, Column 3). After adjusting for sociodemographic variables, HCWs who were males were 2.8 times more likely to accept the COVD-19 vaccine than females. Other sociodemographic predictor variables that determined vaccine acceptance (at $\alpha < 0.05$) are health care workers in the northern and western zones, the Hausa and Yoruba ethnicity, health care workers who work in urban health care facilities, primary health care facilities, private health care facilities and Physician.

Multinomial Logistic Regression of COVID-19 Vaccine Acceptance and Attitudes/Knowledge of Respondents Towards COVID-19 Vaccines.

As shown in Table 2, 46.6% of the respondents were sure to have taken a vaccine in the past three years and are 3.1 times more likely to take the COVID-19 vaccine than those that are not sure. Also, 62.3% of the participants would recommend the COVID-19 vaccine to their patients and were 24.9 times more likely to take the COVID-19 vaccine than those that weren't sure. Of the participants, 64.8% knew the different COVID-19 vaccines in use and were 1.6 times more likely to subject themselves to vaccination than those that were not sure. Again, 53.6% of the participants

Preprints (www.preprints.org) | NOT PEER-REVIEWED | Posted: 1 September 2022 doi:10.20944/preprints202209.0016.v1

agreed that the timing of the COVID-19 vaccination was appropriate and were 4.4 times more likely to subject self to be vaccinated than those that were not sure. Similarly, 32.3% of the participant believe that the COVID-19 vaccine should be made mandatory and were 7.7 times more likely to take the vaccine than those that were not sure (Table 2).

Table 2. Multinomial Logistic Regression of COVID-19 Vaccine Acceptance and Attitudes/ Knowledge of Respondents Towards COVID-19 Vaccines.

Knowledge and Attitude Towards COVID-19 Vaccination	n%	COVID-19 Vaccine Acceptance	OR	P-Value	95% CI
Have You Taken any Vaccine in the Past Three Years?	Yes (46.6%) No (46.8 %) Not Sure (6.6%)	Yes (71.6%)	3.1	**0.027**	1.1-8.3
Will you recommend the COVID-19 vaccine to your patient?	Yes (62.3%) No (22.2%) Not Sure (15.5%)	Yes (88.3%)	24.9	**0.000**	12.6-49.3
Do you know the different COVID-19 vaccines currently in use in Nigeria?	Yes (64.8%) No (22.2%) Not Sure (10.9%)	Yes (68.8 %)	1.6	**0.024**	0.5 -5.2
Is the timing for the current COVID 19 Vaccine Appropriate	Yes (53.6%) No (17.1%) Not Sure (29.3)	Yes (79.1)	4.4	**0.000**	2.4– 8.0
Do you think Covid 19 vaccines should be made mandatory?	Yes (32.3%) No (53.9%) Not Sure (13.7%)	Yes (90.6%)	7.6	**0.00**	3.3 – 17.8

Multinomial Logistic Regression of COVID-19 Vaccine Acceptance across Risk Perception Characteristics

As shown in Table 3, 81.3% of the respondents were concerned about the side effects of COVID-19 vaccines, and 51.6% thought that the current COVID-19 vaccine has passed complete clinical trials. In addition, 33% of the respondents believed that the COVID-19 vaccines contain dangerous substances, and 47.7% agreed that the vaccines are not safe. Furthermore, participants that believed

Preprints (www.preprints.org) | NOT PEER-REVIEWED | Posted: 1 September 2022 doi:10.20944/preprints202209.0016.v1

that the COVID-19 vaccine has passed complete clinical trials were 6.1 times more likely to take the COVID-19 vaccine than those that are not sure. While those that thought that the vaccine is safe and does not contain dangerous substances were 5.2 and 4.5 times, respectively, more likely to take the COVID-19 vaccine than those that were not sure (Table 3).

Table 3. Multinomial Logistic Regression of COVID-19 Vaccine Acceptance across Risk Perception Characteristics

Risk Perceptions and COVID-19 Vaccination	n%	COVID-19 Vaccine Acceptance	OR	P value	95% CI
Are you concerned about the side effects of COVID-19 Vaccines?	Yes (81.3%)	Yes (61.2%)	1.5	0.3	0.8- 2.8
	No (18.7%)		Ref		
Do you think the current Covid 19 vaccines have passed full clinical trials?	Yes (51.6%)	Yes (87.1%)	**6.1**	**0.000**	3.1 – 12.2
	No (29.5%)		1.4	0.3	0.7 – 2.6
	Not Sure (18.9%)				
Do you think the COVID-19 vaccine contains dangerous substances?	Yes (33%)	Yes (53.7%)	1.7	0.106	0.9 - 3.1
	No (36.2%)		4.5	**0.000**	2.0 – 10.1
	Not Sure (30.8%)		Ref		
Do you think Covid 19 Vaccine is safe?	Yes (47.7%)	Yes (90.5%)	5.2	**0.000**	2.50 -10.92
	No (19.5)		0.7	0.8	0.4 – 1.74
	Not Sure (32.8%)		Ref		

 doi:10.20944/preprints202209.0016.v1

6.0 Discussion

Several surveys have been conducted since the announcement of efforts to develop a COVID-19 vaccine to measure public perception and acceptance of the vaccine [2,18]. The majority of surveys have concentrated on the general population. Nonetheless, the roll-out of the vaccine, particularly in developing countries, is tiered to various subgroups of the population based on limited availability. HCWs are among the first subgroups of the Nigerian people to have access to the vaccine. Therefore, HCWs are also likely to be an essential source of information about the vaccine for the general population [1]. As a result, it is neccessary to assess the predictors of vaccine acceptance among HCWs, which will assist institutions and policy experts in allocating resources to maximize uptake.

This is, to the best of our knowledge, one of Nigeria's most inclusive studies on health care works regarding the major geopolitical zones. In our survey, a total of 710 health care workers completed the questionnaire, with the majority of the participants being female (60.4%) and the highest number of respondents being in the age group of 15 – 25 years (308; 43.4%) followed by those within the age group of 26 – 36 years (202; 28.5%), while the least number of respondents are within the age group 59-69 years (22; 3.1%). Most of the respondents are Igbos (229; 32.5%). The higher number of females in the study is in tandem with the results of other studies [1,2,19]. Contrary to this, some other studies [20-22] had a lower female respondents. The majority of the participants (59.3%) were amenable to COVID-19 vaccination, with the age group 37-47 having the highest vaccine acceptance of (68.3%) while the oldest age group, 59-69, had the least vaccine acceptance of (55.1%). Although the study carried out by Agha *et al*. [20] also showed a higher vaccine acceptance of 68.5% in a similar age of 30-39, there is a broad consensus that vaccine acceptance is higher in the older age group [2,4,23].

In this study, the western zone and the yoruba ethnicity were identified to have the highest vaccine acceptance of 81.3% and 78.6%, respectively, among Nigeria's three major zones and ethnicities. The higher vaccine acceptance rate is probably because western Nigeria, precisely Lagos State, is the epicentre of the pandemic in Nigeria, and a plethora of studies have shown that the higher the perceived risk of the COVID-19 diseases, the more the vaccine acceptance [2,23,25,26].

As shown in Table 1, the trend of the perceived risk of COVID-19 infection mirroring vaccine acceptance was also observed in other demographics, with HCWs involved in direct patient care and those working in the intensive care unit having higher vaccine acceptance of 59.8% and 67%,

 doi:10.20944/preprints202209.0016.v1

respectively, compared to other variables in their categories. A study had shown that the level of enlightenment and exposure positively affects motivation for vaccine acceptance [27], which correlated with our studies that identified vaccine acceptance to be higher in health care workers in urban regions than those in the suburbs. In addition, a survey carried out among 1182 HCWs in primary health care facilities identified a high vaccine acceptance of 95% [28]. This result resonates with our study as primary health care workers had the highest vaccine acceptance of 83.5% relative to HCWs in other facilities.

The trust of HCWs in national institutions will have a direct relationship with their level of acceptance of information they disseminate, affecting their compliance with government directives. Thus, in response to the most reliable source of data on the COVID-19 vaccine, the majority of the respondents (about 51.3%) preferred the Nigeria Center for Disease Control (NCDC), while 41.2% chose the World Health Organization (Figure 1). The relatively heavy reliance on NCDC and WHO for information about COVID-19 vaccines may be attributed to the quality and reliability of the information published weekly, monthly and quarterly by the institutions on current issues about COVID-19 vaccines, especially on the safety profile, clinical trials and approval. Similarly, a study among Indians revealed that a little less than two-thirds (64.5%) of the respondents have higher trust in India's healthcare system [19].

Preprints (www.preprints.org) | NOT PEER-REVIEWED | Posted: 1 September 2022 doi:10.20944/preprints202209.0016.v1

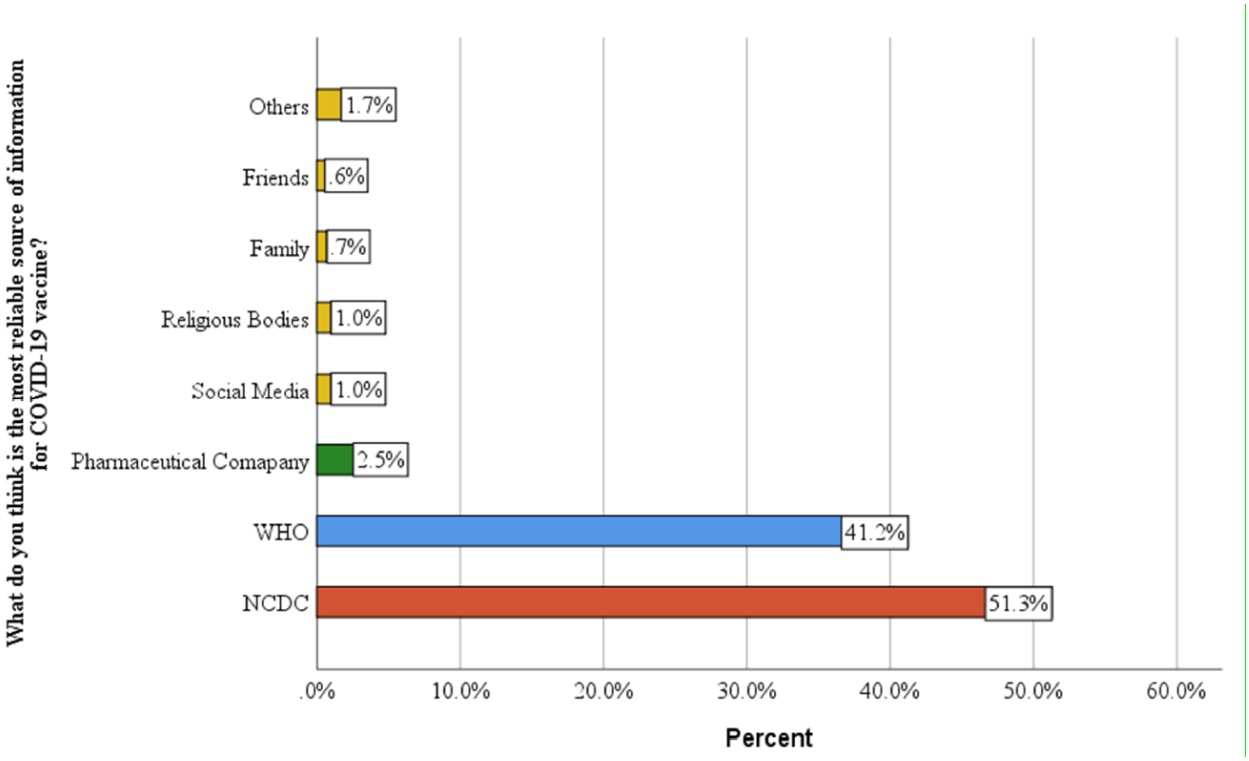

Figure 1: Reliability of COVID-19 Sources of Information across COVID-19 Vaccine Landscape

Several European countries, in March and April 2021, suspended the AstraZeneca COVID-19 vaccine, while the US FDA paused the use of Johnson and Johnson COVID-19 vaccines after several suspected, reported death and severe cases of a type of blood clotting following vaccination. These events definitely would increase the risk perceptions of prospective uptake of these vaccines. This study revealed that the participants have a higher preference for the Moderna and Pfizer vaccine as shown in Figure 2, despite the increased availability of the AstraZeneca vaccine made available through the COVAX, Gavi-led vaccine support in Nigeria [29].

Preprints (www.preprints.org) | NOT PEER-REVIEWED | Posted: 1 September 2022 doi:10.20944/preprints202209.0016.v1

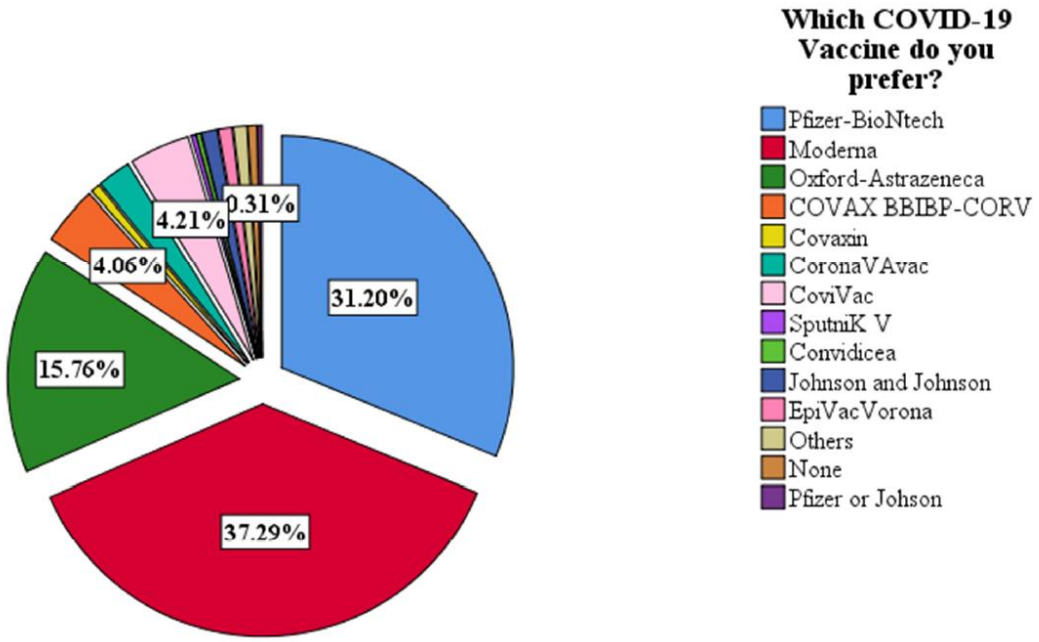

Figure 2: COVID-19 Vaccines preference among HCWs

Furthermore, the predictors for COVID-19 vaccine acceptance via the multinomial logistic regression analysis was accessed, and it was identified that the female HCWs were 2.8 times less likely to take the vaccine than males. This result is consistent with those of other studies [24,30,31]. This gender gap in COVID-19 vaccine acceptance may be the reason buttressed by many studies that males have reported a higher risk of COVID-19 hospitalizations, infections and deaths. Also, there is a lack of data on the effect of COVID-19 vaccines on pregnant women and thus may contribute to negative risk perceptions [32-34].

The Yoruba and Hausa ethnicity were also identified to contribute to the vaccine acceptance rate, whereas the Igbo and other minor ethnic groups didn't. This is probably due to the higher perceived risk of COVID-19 vaccine infection in the western and northern regions, as they were primarily the epicentre of the pandemic in Nigeria. Moreso, a study that sampled 440 respondents in Ibadan, a western state in Nigeria, reported a high positive vaccine acceptance of 79.5 % [35], similar to the vaccine acceptance in this study of which the Yoruba ethnic group had the highest vaccine acceptance of 78.6% as shown in Figure 3.

Preprints (www.preprints.org) | NOT PEER-REVIEWED | Posted: 1 September 2022 doi:10.20944/preprints202209.0016.v1

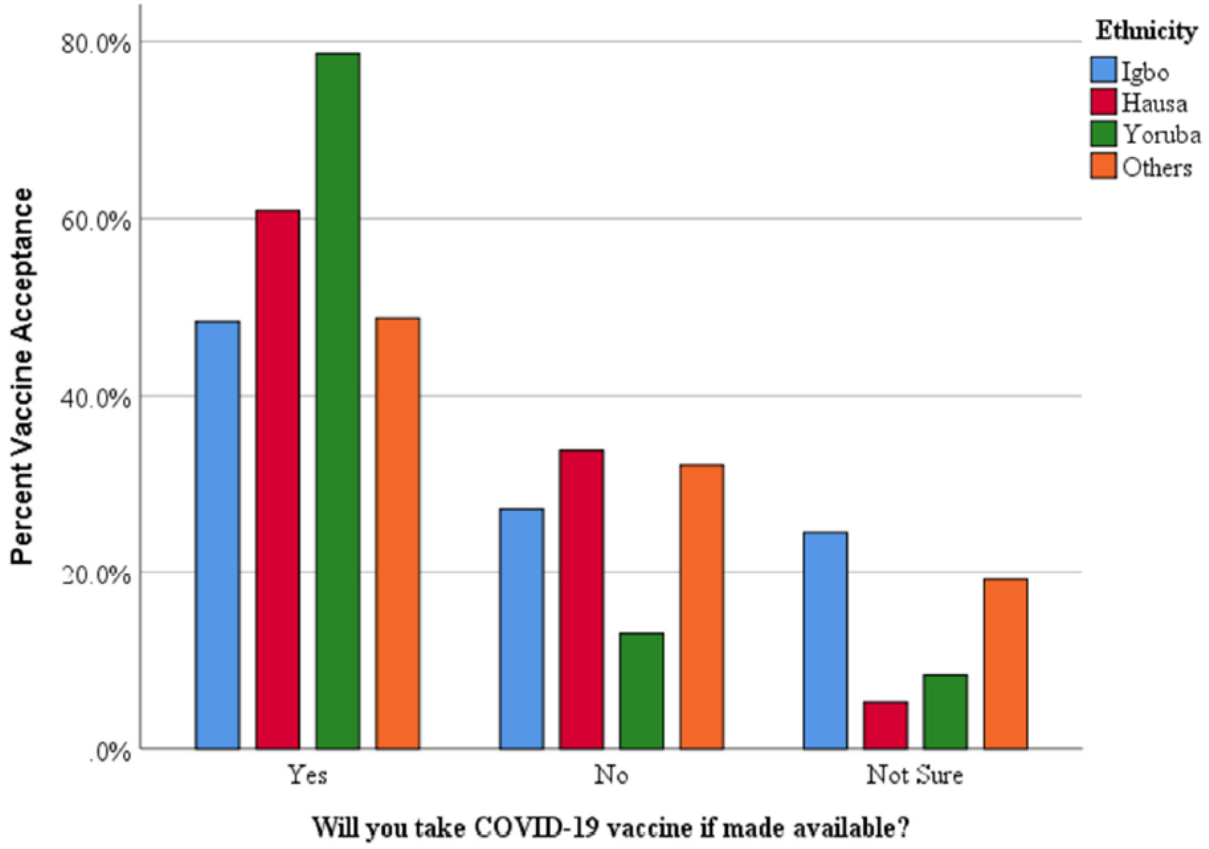

Figure 3: Vaccine Acceptance across various ethnicities in Nigeria

Furthermore, the study carried out in Ethiopia among HCWs reveals that safety concerns and educational status played a huge role in the higher vaccine acceptance in physicians compared to other HCWs [27]. This present study similarly identified Physicians and HCWs in the Intensive Care Unit as predictors of COVID-19 vaccine acceptance. Finally, among other sociodemographic variables, HCWs in primary and private health care facilities contributed to vaccine acceptance, probably due to the higher vaccine acceptance observed in the descriptive statistics (*Table 1*, column 1).

Regarding risk perception and attitudes toward vaccination with vaccine acceptance, the regression analysis further indicated seven factors (bordered around safety and positive attitude towards vaccination) significantly associated with the willingness to accept COVID-19 vaccines (*Table 2 and Table 3*). These factors were corroborated in a multicenter study of 1398 HCWs in 20 emergency departments in the United States, where the main reason for the decline of the COVID-19 vaccine was linked to vaccine safety [23]. The results of this study showed that HCWs who

 doi:10.20944/preprints202209.0016.v1

believe that the vaccines have passed complete clinical trials and are safe are 6.1 and 5.2 times more likely to accept the vaccine than those who are not sure. Many COVID-19 vaccine hesitancy studies worldwide have identified similar concerns among HCWs and the general population [36-38].

The rapid development of COVID-19 vaccines in less than a year may explain why HCWs don't believe it passed through full clinical trials [24]. Moreover, 33% of the participants thought that the COVID-19 vaccine contained a dangerous substance, whereas those who said No, were 4.5 times more likely to take the COVID-19 vaccine. The conspiracy theories that the vaccines contained microchips, a depopulation product and a mutagen received high backing by Nigerians in a study carried out before the rollout of COVID-19 vaccine in the country [39].

Various studies have shown that knowledge and positive attitudes towards vaccination positively correlate with vaccine acceptance [1,20,40]. Our regression analysis backs up these findings, as participants who have received other vaccines in the last three years and are willing to recommend the vaccine to their patients are 3.1 and 24.9 times more likely to receive the vaccine, respectively, than those who are unsure about having received other vaccines in the last three years and are unsure about recommending the vaccine.

The association between the high willingness to recommend COVID-19 vaccines and the vaccine acceptance in our study contradicts the study of [23] where willingness to see others take the vaccine is inversely proportional to vaccine acceptance. Finally, those participants who know the different kinds of COVID-19 vaccines available in Nigeria and believe that the timing for the vaccination is right are 1.6 times and 4.4 times more likely to take the vaccines. Various studies have shown that education about vaccines correlates positively with vaccine acceptance [18,41,42]. So, the more knowledge an individual has regarding the available COVID-19 vaccines, the higher the vaccine acceptance.

7.0 Conclusions

Only 59.3% of the participants are amenable to COVID-19 vaccinations, with some variations across the demographic variables. The main predictors for COVID-19 vaccine acceptance were bordered around safety concerns and potential side effects of the COVID-19 vaccines. Moreover, participants with positive attitudes towards vaccination showed higher vaccine acceptance with a

general preference for the Moderna and Pfizer vaccines. Our findings also highlighted the suitability of the Nigeria Centre for Disease Control, among other information sources, to frame public health messages to best address vaccine hesitancy among HCWs in Nigeria.

Additionally, the NCDC should disseminate more robust information regarding the safety profile of various COVID-19 vaccines, echoing the significance of herd immunity in blocking transmission, as most of the demographics with less risk perception about the pandemic had lower vaccine acceptance.

Author Contributions: Conceptualization, V.C.N. and A.C.I.; Methodology, V.C.N., R.O.O. and A.L.E.; Validation, V.C.N., N.N.N. and A.C.I.; Investigation, A.L.E., O.E.Oy., T.S.T. and O.E.Oc.; Data curation, V.C.N. and R.O.O.; Writing – original draft preparation, V.C.N., R.O.O. and A.L.E.; Writing – review and editing, N.N.N. and A.C.I.; Visualization, O.E.Oy., T.S.T. and O.E.Oc.; Supervision, A.C.I.

Funding: This research received no external funding

Informed Consent Statement: Consent was sought and obtained orally since the questionnaire were administered manually and participants were well informed, healthy and adults.

Conflicts of Interest: The authors declare no conflict of interest.

 doi:10.20944/preprints202209.0016.v1

References

1. Paudel, S.; Palaian, S.; Shankar, P.R.; Subedi, N. Risk perception and hesitancy toward COVID-19 vaccination among healthcare workers and staff at a medical college in Nepal. *Risk Manag. Healthc. Policy* **2021**, *14*, 2253-2261.
2. Shekhar, R.; Garg, I.; Pal, S.; Kottewar, S.; Sheikh, A.B. (2021). COVID-19 Vaccine Booster: To Boost or Not to Boost. *Infect. Dis. Rep.* **2021**, *13*, 924-929.
3. WHO Weekly Epidemiological and Operational updates March 2022 https://www.who.int/emergencies/diseases/novel-coronavirus-2019/situation-reports Accessed May 17, 2022.
4. Malik, J.A.; Ahmed, S.; Mir, A.; Shinde, M.; Bender, O.; Alshmmari, F.; Ansari, M.; Anwar, S. The SARS-CoV-2 mutations versus vaccine effectiveness: New opportunities to new challenges. *J. Infect. Public Health* **2022**, *15*, 228-240. Doi: 10.1016/j.jiph
5. Buckner, J.H.; Chowell, G.; Springborn, M.R. Dynamic prioritization of COVID-19 vaccines when social distancing is limited for essential workers. *Proc. Natl. Acad. Sci. USA* **2021**, *118*, e2025786118.
6. Glatman-Freedman, A.; Bromberg, M.; Dichtiar, R.; Hershkovitz, Y.; Keinan-Boker, L. The BNT162b2 vaccine effectiveness against new COVID-19 cases and complications of breakthrough cases: A nation-wide retrospective longitudinal multiple cohort analysis using individualized data. *EBioMed.* **2021**, *72*, 103574.
7. Arbel, R.; Sergienko, R.; Friger, M.; Peretz, A.; Beckenstein, T.; Yaron, S.; Netzer D.; Hammerman, A. Effectiveness of a second BNT162b2 booster vaccine against hospitalization and death from COVID-19 in adults aged over 60 years. *Nat. Med.*, **2022**, *28*, 1486-1490. Doi: 10.1038/s41591-022-01832-0
8. Moghadas, S.M.; Vilches, T.N.; Zhang, K.; Wells, C.R.; Shoukat, A.; Singer, B.H.; Meyers, L.A.; Neuzil, K.M.; Langley, J.M.; Fitpatrick, M.C.; et al. The impact of vaccination on coronavirus disease 2019 (COVID-19) outbreaks in the United States. *Clin. Infect. Dis.* **2021**, *73*, 2257-2264. Doi: 10.1093/cid/ciab079
9. Afolabi, A.A.; Ilesanmi, O.S. Dealing with vaccine hesitancy in Africa: the prospective COVID-19 vaccine context. *Pan Afr. Med. J.* **2021**, *38*.
10. Lancet. An African plan to control COVID-19 is urgently needed. *Lancet*, **2020**, *396*, 1777.

11. Dzinamarira, T.; Nachipo, B.; Phiri, B.; Musuka, G. COVID-19 vaccine roll-out in South Africa and Zimbabwe: urgent need to address community preparedness, fears and hesitancy. *Vaccines*, **2021**, *9*, 250.
12. Diab, M.M.; Zimmerman, A.; Dixit, S.; Mao, W.; Bharali, I.; Kristoffersen, A.; Yamey, G.; Ogbuoji, O. The Cost of Procuring and Delivering COVID-19 Vaccines in Low-and Middle-Income Countries: A Model of Projected Resource Needs. *EurPMC* **2021**, 309459 (Preprint).
13. Ditekemena, J.D.; Nkamba, D.M.; Mutwadi, A.; Mavoko, H.M.; Fodjo, J.N.S.; Luhata, C.; Obimpeh, M.; Hees, S.V.; Nachega, J.B; Colebunders, R. COVID-19 Vaccine Acceptance in the Democratic Republic of Congo: A Cross-Sectional Survey. *Vaccines*, **2021**, *9*, 153. Doi: 10.3390/vaccines9020153
14. Ike, A.C.; Reward, E.E.; Mbaawuaga, E.M.; Nnabuife, O.O.; Orabueze, I.N.A. Current status and underlying problems of eradication of poliomyelitis in the remaining endemic countries. *Eur. J. Prev. Med.* **2018**, *6*, 23-28. Doi: 10.11648/j.ejpm.20180601.15
15. Nzaji, M.K.; Ngombe, L.K.; Mwamba, G.N.; Ndala, D.B.B.; Miema, J.M.; Lungoyo, C.L.; Mwimba, B.L.; Bene, A.C.M.; Musenga, E.M. Acceptability of Vaccination Against COVID-19 Among Healthcare Workers in the Democratic Republic of the Congo. *Pragmat. Obs. Res.* **2020**, *11*, 103–109.
16. Adebisi, Y.A.; Alaran, A.J.; Bolarinwa, O.A.; Sholabi, W.A.; Lucero-Prisno III, D.E. (2021). When it is available, will we take it? Public perception of hypothetical COVID-19 vaccine in Nigeria. *Pan Afr. J.* **2021**, *38*, 230. Doi: 10.110604/pamj.38.230.27325
17. Tobin, E.A.; Okonofua, M.; Adeke, A.; Obi, A. (2021). Willingness to Accept a COVID-19 Vaccine in Nigeria: A Population-based Cross-sectional Study. *Cent. Afr. J. Public Health* **2021**, ***7***, 53-60. Doi: 10.11648/j.cajph.20210702.12
18. Ferguson, D.G.; Hughes, S.J.; Mello, E.J.; Burgess, R.; Berges, B.K.; Quaye, A.; Poole, B.D. Influences on Attitudes Regarding Potential COVID-19 Vaccination in the United States. *Vaccines* **2020**, *8*, 582.
19. Jain, L.; Vij, J.; Satapathy, P.; Chakrapani, C.; Patro, B.; Kar, S.S.; Singh, R.; Pala, S.; Sankhe, L.; Modi, B.; et al. Factors Influencing COVID-19 Vaccination Intentions Among College Students: A Cross-Sectional Study in India. *Front. Public Health* **2018**, *9*, 735902. Doi: 10.3389/fpubh.2021.735902.

20. Agha, S.; Chine, A.; Lalika, M.; Pandey, S.; Seth, A.; Wiyeh, A.; Seng, A; Rao, N; Badshah, A. Drivers of COVID-19 Vaccine Uptake amongst Healthcare Workers (HCWs) in Nigeria. *Vaccines*, **2021**, *9*, 1162.
21. Ekwebene, O.C.; Obidile, V.C.; Azubuike, P.C.; Nnamani, C.P.; Dankano, N.E.; Egbuniwe, M.C. COVID-19 Vaccine Knowledge and Acceptability among Healthcare Providers in Nigeria. *Int. J. Trop. Dis. Health* **2021**, *42*, 51-60.
22. Onwe, R.O.; Nnaemeka, VC.; Ekwedike, A.L.; Ihedioha, J.I.; Ahamefule, C.S.; Nnabuife, O.O.; Ike, A.C. COVID-19 vaccine: vaccine acceptance, risk perception, and attitude towards vaccination among college students and staff in the southeastern universities, Nigeria. *Res. Sq.* **2022** Doi: 10.21203/rs.3-rs-1899334/v1 (Preprint).
23. Dzieciolowska, S.; Hamel, D.; Gadio, S.; Dionne, M.; Gagnon, D.; Robitaille, L.; Cook, E.; Caron, I.; Talib, A.; Parkes, L.; et al. COVID-19 vaccine acceptance, hesitancy, and refusal among Canadian healthcare workers: A multicenter survey. *Am. J. Infect. Control* **2021**, *49*, 1152-1157.
24. Elharake, J.A.; Galal, B.; Alqahtani, S.A.; Kattan, R.F.; Barry, M.A.; Temsah, M-H.; Malik, A.A.; McFadden, S.M.; Yildirim, I.; Khoshnood, K.; et al. COVID-19 vaccine acceptance among health care workers in the Kingdom of Saudi Arabia. *Int. J. Infect. Dis.* **2021**, *109*, 286-293.
25. Guidry, J.P.D.; Laestadius, L.I.; Vraga, E.K.; Miller, C.A.; Berrin, P.B.; Burton, C.W.; Ryan, M.; Fuemmeler, B.F.; Carlyle, K.E. willingness to get the COVID-19 vaccine with and without emergency use authorization. *Am. J. Infect. Control* **2021**, *49*, 137-142.
26. Lin, Y.; Hu, Z.; Zhao, Q.; Alias, H.; Danaee, M.; Wong, L.P. Understanding COVID-19 vaccine demand and hesitancy: a nationwide online survey in China. *PLoS Negl. Trop. Dis.* **2020**, *14*, e0008961.
27. Yilma, D.; Mohammed, R.; Abdela, S.G.; Enbiale, W.; Seifu, F.; Pareyn, M.; Liesenborghs, L.; van Griensven, J.; van Henten, S. COVID-19 vaccine acceptability among healthcare workers in Ethiopia: Do we practice what we preach? *Trop. Med. Int. Health* **2022**, *27*, 418-425.
28. Koh, S.W.C.; Tan, H.M.; Lee, W.H.; Mathews, J.; Young, D. COVID-19 vaccine booster hesitancy among healthcare workers: a retrospective observational study in Singapore. *Vaccines* **2022**, *10*, 464.

29. Kayode, O.R.; Babatunde, O.A.; Adekunle, O.; Igbalajobi, M.; Abiodun, A.K. COVID-19 Vac-cine Hesitancy: Maximizing the Extending Roles of Community Pharmacists in Nigeria in Driving Behavioural Changes in Public Health Interventions. *J. Infect. Dis. Epidemiol*. **2021**, *7*, 205.
30. Magadmi, R.M.; Kamel, F.O. Beliefs and barriers associated with COVID-19 vaccination among the general population in Saudi Arabia. *BMC Public Health* **2021**, *21*, 1-8.
31. Barry, M.; Temsah, M-H.; Alhuzaimi, A.; Alamro, N.; Al-Eyadhy, A.; Aljamaan, F.; Saddik, B.; Alhaboob, A.; Alsohime, F.; Alhasan, K.; et al. COVID-19 vaccine confidence and hesitancy among health care workers: A cross-sectional survey from a MERS-CoV experienced nation. *PloS One* **2021**, *16*, e0244415.
32. Chen, F.; Zhu, S.; Dai, Z.; Hao, L.; Luan, C.; Guo, Q.; Meng, C.; Zhang, Y. Effects of COVID-19 and mRNA vaccines on human fertility. *Hum. Reprod.* **2020**, *37*, 5-13.
33. Schaler, L.; Wingfield, M. COVID-19 vaccine – can it affect fertility? *Ir. J. Med. Sci.* **2021**, 1-3. [E pub ahead of print]
34. Vassallo, A.; Shajahan, S.; Harris, K.; Hallam, L.; Hockham, C.; Womersley, K.; Woodward, M.; Sheel, M. Sex and gender in COVID-19 vaccine research: Substantial evidence gaps remain. *Front. Glob. Womens Health* **2021**, *2*, 761511.
35. Ilesanmi, O.; Afolabi, A.; Uchendu, O. The prospective COVID-19 vaccine willingness to pay and perception of community members in Ibadan, Nigeria. *PeerJ* **2021**, *9*, e11153.
36. Chou, W.Y.S. Budenz, A. Considering emotion in COVID-19 vaccine communication: addressing vaccine hesitancy and fostering vaccine confidence. *Health Comm.* **2020**, *35*, 1718-1722.
37. Dror, A.A.; Eisenbach, N.; Taiber, S.; Morozov, N.G.; Mizrachi, M.; Zigron, A.; Srouji, S.; Sela, E. Vaccine hesitancy: the next challenge in the fight against COVID-19. *Eur. J. Eepidemiol.* **2020**, *35*, 775-779.
38. Murphy, J.; Vallières, F.; Bentall, R.P.; Shevlin, M.; McBride, O.; Hartman, T.K.; McKay, R.; Benneth, K.; Mason, L.; Gibson-Miller, J. et al. Psychological characteristics associated with COVID-19 vaccine hesitancy and resistance in Ireland and the United Kingdom. *Nat. Comm.* **2021**, *12*, 29.

39. Enitan, S.S.; Oyekale, A.O.; Akele, R.Y.; Olawuyi, K.A.; Olabisi, E.O.; Nwankiti, A.J.; Enitan, C.B. Assessment of knowledge, perception and readiness of Nigerians to participate in the COVID-19 vaccine trial. *Int. J. Vacc. Immunol*. **2020**, *4*, 1-3.
40. Qiao, S.; Tam, C.C.; Li, X. Risk exposures, risk perceptions, negative attitudes toward general vaccination, and COVID-19 vaccine acceptance among college students in South Carolina. *MedRxiv* 2020, Doi: 10.1101/2020.11.26.20239483 (Preprint).
41. Fisher, K.A.; Bloomstone, S.J.; Walder, J.; Crawford, S.L.; Fouayzi, H.; Mazor, K.M. Attitudes Toward a Potential SARS-CoV-2 Vaccine. *Ann. Intern. Med*. **2020**, *173*, 964–973.
42. Malik, A.A.; McFadden, S.M.; Elharake, J.; Omer, S.B. Determinants of COVID-19 vaccine acceptance in the US. *E. Clin. Med*. **2020**, *26*, 100495.