

**Original Article****Open Access****Determinants of COVID-19 vaccine acceptance amongst doctors practising in Cross River State, Nigeria**

*¹Iwuafor, A. A., ¹Ogban, G. I., ¹Ita, O. I., ²Offiong, A. B., ²Owai, P. A., ¹Udoh, U. A., and ³Elem, D. E.

¹Department of Medical Microbiology and Parasitology, Faculty of Basic Clinical Sciences, University of Calabar, Nigeria

²Department of Medical Microbiology and Parasitology, University of Calabar Teaching Hospital, Calabar, Nigeria

³Department of Internal Medicine, University of Calabar Teaching Hospital, Calabar, Nigeria

*Correspondence to: tonyiwuafor@unical.edu.ng; +2348033441539; ORCID ID: 0000-0001-6796-3870

Abstract:

Background: COVID-19 vaccine is one of the most effective public health intervention approaches for prevention of COVID-19. Despite its well-known efficacy and safety, significant proportion of frontline COVID-19 healthcare workers remain hesitant about accepting the vaccine for whatever reasons. This study aimed to determine acceptance rate and determinants of vaccine refusal among doctors in Cross River State, Nigeria.

Methodology: This was a cross-sectional survey of doctors using structured online questionnaire administered via the WhatsApp platform of the medical doctors' association, in order to assess their rate of acceptance of COVID-19 vaccines, and reasons for vaccine refusal. The predictors of vaccine acceptance were analysed by univariate and multivariate logistic regression analyses.

Results: Of the 443 medical doctors targeted on the WhatsApp platform, 164 responded to the questionnaire survey, giving a response rate of 37.0% (164/443). The mean age of the respondents is 38 ±6.28 years, 91 (55.5%) are 38 years old and above, 97 (59.1%) are males and 67 (40.9%) are females, giving a male-to-female ratio of 1.4:1. The greater proportion of the respondents are physicians (70/148, 47.3%) and about three-quarter of the participants (127/164, 77.4%) had received COVID-19 vaccine. The proportion of physicians who had received COVID-19 vaccine (57/70, 81.4%) was more than the proportion of general practitioners (31/42, 73.8%) and surgeons (24/35, 68.6%). Low perceived benefit of vaccination was the main reason given for COVID-19 vaccine refusal (45.9%, 17/37). No significant association was found between vaccine refusal and suspected predictors ($p>0.05$).

Conclusion: Our study revealed high rate of COVID-19 vaccine acceptance among medical doctors especially among the physicians, with the surgeons showing lowest acceptance rate. A significant proportion would not take vaccine because they perceived it lacks much benefits. To raise vaccine acceptance among doctors, more efforts on vaccine literacy that would target doctors from all sub-specialties especially surgeons and incorporate vaccine benefits should be made.

Keywords: COVID-19 vaccine, vaccine acceptance, vaccine hesitance, Calabar, Nigeria

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Déterminants de l'acceptation du vaccin COVID-19 parmi les médecins exerçant dans l'État de Cross River, au Nigeria

*¹Iwuafor, A. A., ¹Ogban, G. I., ¹Ita, O. I., ²Offiong, A. B., ²Owai, P. A., ¹Udoh, U. A., et ³Elem, D. E.

¹Département de Microbiologie Médicale et de Parasitologie, Faculté des Sciences Cliniques Fondamentales, Université de Calabar, Nigéria

²Département de Microbiologie Médicale et de Parasitologie, Hôpital Universitaire de Calabar, Calabar, Nigéria

³Département de Médecine Interne, Hôpital Universitaire de Calabar, Calabar, Nigéria

*Correspondance à: tonyiwuafor@unical.edu.ng; +2348033441539; ID ORCID: 0000-0001-6796-3870

Résumé:

Contexte: Le vaccin contre la COVID-19 est l'une des approches d'intervention de santé publique les plus efficaces pour la prévention de la COVID-19. Malgré son efficacité et son innocuité bien connues, une proportion importante de travailleurs de la santé de première ligne contre la COVID-19 hésitent à accepter le vaccin pour quelque raison que ce soit. Cette étude visait à déterminer le taux d'acceptation et les déterminants du refus du vaccin chez les médecins de l'État de Cross River, au Nigeria.

Méthodologie: Il s'agissait d'une enquête transversale auprès de médecins utilisant un questionnaire en ligne structuré administré via la plateforme WhatsApp de l'association des médecins, afin d'évaluer leur taux d'acceptation des vaccins COVID-19 et les raisons de leur refus de vaccin. Les prédicteurs de l'acceptation du vaccin ont été analysés par des analyses de régression logistique univariées et multivariées.

Résultats: Sur les 443 médecins ciblés sur la plateforme WhatsApp, 164 ont répondu à l'enquête par questionnaire, soit un taux de réponse de 37,0% (164/443). L'âge moyen des répondants est de 38±6,28 ans, 91 (55,5%) ont 38 ans et plus, 97 (59,1%) sont des hommes et 67 (40,9%) sont des femmes, soit un ratio hommes-femmes de 1,4:1. La plus grande proportion des répondants sont des médecins (70/148, 47,3%) et environ les trois quarts des participants (127/164, 77,4%) ont reçu le vaccin contre la COVID-19. La proportion de médecins ayant reçu le vaccin COVID-19 (57/70, 81,4%) était supérieure à la proportion de médecins généralistes (31/42, 73,8%) et de chirurgiens (24/35, 68,6%). Le faible bénéfice perçu de la vaccination était la principale raison invoquée pour le refus du vaccin COVID-19 (45,9%, 17/37). Aucune association significative n'a été trouvée entre le refus du vaccin et les prédicteurs suspectés ($p>0,05$).

Conclusion: Notre étude a révélé un taux élevé d'acceptation du vaccin COVID-19 parmi les médecins, en particulier parmi les médecins, les chirurgiens affichant le taux d'acceptation le plus bas. Une proportion importante ne prendrait pas le vaccin parce qu'ils estimaient qu'il manque de beaucoup d'avantages. Pour augmenter l'acceptation des vaccins parmi les médecins, davantage d'efforts sur la connaissance des vaccins qui cibleraient les médecins de toutes les sous-spécialités, en particulier les chirurgiens, et intégreraient les avantages des vaccins devraient être faits.

Mots-clés: vaccin COVID-19, acceptation du vaccin, hésitation à la vaccination, Calabar, Nigeria

Introduction:

The world is still grappling with the challenges of the coronavirus disease-2019 (COVID-19), a pandemic of global public health concern (1,2). Globally, as of 18 November 2022, there have been 633,601,048 confirmed cases of the COVID-19, including 6,596,542 deaths and as of 16 November 2022, a total of 12,943741,540 vaccine doses have been administered (3). As of 21 November, 2022 in Nigeria, a total of 259,640 confirmed cases and 3,155 deaths have been recorded in the 36 States and the Federal Capital Territory (4). There have been reportedly increased poverty and hunger globally occasioned by breakdown in social and economic activities brought about by the COVID-19 pandemic (5)

COVID-19 is an infectious disease that is caused by the severe acute respiratory syndrome coronavirus-2 (SARS-CoV-2). Majority of the people infected with the virus will only develop mild to moderate respiratory illness and do usually recover even without any specialised care, however some will develop severe illness that will warrant special treatment (6). There is as yet no known definitive therapy for the treatment of COVID-19, prompting the use of non-pharmacological means for its prevention and control (7). Social distancing, lockdown, use of well fitted face mask, ensuring spaces of stay are well-ventilated, observing of hand and respiratory hygiene are still effective preventive measures against the spread of COVID-19 (6,8,9). However, vaccination still remains the safest and

most efficient means of preventing infectious diseases known to man and it has recorded much successes globally (10).

Currently, there are four main types of COVID-19 vaccines; whole virus, protein sub-unit, nucleic acid, and viral vector-based types. COVID-19 vaccines development is moving at record speed with over 170 different vaccines in trials. They are different from each other but all try to achieve the same result of providing immunity against the virus and stop transmission (11). Other benefits of COVID-19 vaccine includes slowing transmission rate, induction of herd immunity, reduction in risk of COVID-19, including developing severe illness and deaths (12). In as much as COVID-19 vaccines tend to be promising in containing the global pandemic, there are still some concerns surrounding its use. The overall effectiveness of COVID-19 vaccines has been tied to its efficacy, safety, cost-effectiveness and public acceptance (13,14).

Vaccine acceptance has been defined as the extent to which individuals accept, question, or completely refuse vaccination. This determines vaccine uptake rate and ultimately, vaccine distribution success (15). COVID-19 vaccine uptake is an important public health challenge to tackle. There have been fluctuations in COVID-19 vaccine acceptance rates in different studies ranging from 23.6% to 97% (14,16,17,18). The rates among healthcare workers (HCWs) have also fluctuated between 27.7% to 78.1% (19,

20).

COVID-19 vaccine acceptance has also been shown to be influenced by some important demographic factors such as sex, age, education and marital status (14,18,19). Medical doctors are important source of health information to their communities, and their attitudes and perception towards COVID-19 vaccination can positively or negatively affect vaccine acceptance in the community where they work (21,22). Therefore, doctors occupy the position of role models, and even their body languages concerning COVID-19 vaccination have important communication to the patients they treat, family and friends and ultimately extending to the community they practice in.

Doctors amid other HCWs were prioritized during the early days of COVID-19 vaccine paucity among the high-risk-groups and were considered for early vaccination. Currently, there are no data in Cross River State of Nigeria vaccine acceptance rate among doctors and the determinants of their willingness to accept, which can affect their networks. This study was therefore conducted to fill this research gap by determining COVID-19 vaccine acceptance and its determinants among doctors practicing in Cross River State, Nigeria.

Materials and method:

Study setting:

The study was conducted in Cross River State, Nigeria, a coastal state named after Cross River. Cross River State is one of the States in the south-south geopolitical zone of Nigeria. The capital city is Calabar. The majority of the medical doctors working in Cross River State reside in Calabar. Other major towns hosting medical doctors and other medical professionals are Akamkpa, Odukpani, Ikon, Obubra, Ogoja, Ugep, Obudu, Akpabuyo, and Obanliku.

Cross River State occupies 23,074 km² and shares boundaries with Benue State to the north, Enugu and Abia States to the west, Republic of Cameroon to the east, and to the south, Akwa-Ibom and Atlantic Ocean (23). The State belongs to tropical rainfall belt with humid tropical climate, annual (seasonal) rainfall of about 1300-3000mm and 30°C mean annual temperature. However, Obudu plateau is subtemperate with temperature of 4°-10°C (23).

Study design:

A cross-sectional online survey was conducted from August 22, 2022 to September 23, 2022 to determine COVID-19 vaccine acceptance and its predictors among medical doctors practicing in Cross River State, Nigeria.

Study participants and method of sampling:

The convenience sampling method was used to select the study participants from the doctors who were either specialist or non-specialist doctors. The specialists were grouped into; (i) surgeons which comprise of specialist doctors from general surgery, intensive care unit, orthopaedic, urology, ear-nose-throat, and obstetrics and gynaecology; (ii) physicians, comprising of specialist doctors from internal medicine, paediatrics, community medicine, laboratory medicine, and dermatology; and (iii) general practitioners, which consists of both specialists from family medicine plus other non-specialist general practitioners. All the doctors are certificated by the Medical and Dental Council of Nigeria (MDCN) and all belong to one umbrella organization, Nigeria Medical Association (NMA).

Simple size determination:

The sample size was calculated with an online sample size calculator (25) using a confidence level of 95%, margin of error 5%, population size of 443 (number of doctors on the Cross River State Branch of the Nigerian Medical Association WhatsApp Group at the time of survey), and population proportion of 38.8% based on a similar study (26). A sample size of at least 202 was required for the study, however only 164 doctors responded and submitted their survey.

Ethical considerations:

The ethical principles of Helsinki Declaration in medical research involving human participants were followed (24). Questionnaires were only self-administered to ensure confidentiality and anonymity, not requiring participants names, emails, or Ip addresses, and only the principal investigator had access to the survey account. The e-consent section followed the introductory section. Participants were asked; "Do you consent to participate in this study?" Answering "No" signified "no consent" and such participant would not proceed to answer further questions on the form while "Yes" signified "consent", which allowed the participants access to proceed to respond to the ensuing study questions.

As the study was based on filling form online with no direct link to the participant, with no plausibility to cause harm or stigma to the participants, and none inclusion of clinical data of the participants, a preliminary evaluation by an Ethical Committee was not applied for.

Survey instrument and administration:

The questionnaire was designed using the Google forms (Google LLC; Menlo Park, CA,

USA), and consisted of questions to assess the medical doctors' acceptance or refusal of the COVID-19 vaccine as well as COVID-19 vaccine acceptance predictors among practicing doctors in Cross River State. The questionnaire was segmented into; (i) introductory and e-consent, which contained information about the study and its objectives followed by the e-consent for participation; (ii) biodata, which contained information on sociodemographic characteristics of the participants including age, gender and marital status; and (iii) medical sub-specialties, which indicate the different medical sub-specialties (twelve) summarized into three main sub-groups; surgeons, physicians and general practitioners.

The COVID-19 vaccine practice section, has 3-item questions; (i) have you received COVID-19 vaccine?, with the responses of "yes" or "no", which was basically a question used to determine doctors' vaccine acceptance/refusal; (ii) reasons for refusal (not accepting) to receive COVID-19 vaccine, with the participants made to choose the best answer out of the best-of-seven multiple reasons, which included perceived possibility of serious adverse reactions, low perceived benefit of vaccination, low perceived risk of contracting COVID-19, health concerns, lack of information, religious or spiritual reasons, and systemic mistrust; and (iii) have you completed your COVID-19 vaccine dose?, with a "yes" or "no" answer. It took approximately 6-10 minutes to complete the questionnaire.

Statistical analysis:

The raw data were entered into Excel sheet and imported into the Statistical Package for Social Sciences (SPSS) software for Windows (version 19.0 SPSS Inc. Chicago, IL. USA) for analysis. Categorical variables were summarized and initially reported as frequencies and percentages, while continuous variables were summarized and reported as mean \pm standard deviations. Univariate analysis was conducted to evaluate associations between outcome and explanatory variables, while logistic regression was used to predict the determinants of vaccine acc-

eptance, utilizing odds ratio (OR), 95% confidence interval (95% CI), and p -value. Predicted variable was acceptance of COVID-19 vaccine dichotomized into yes or no. Predictor variables included age, gender, marital status, and sub-specialties. Statistical significance was considered for $p < 0.05$.

Results:

Socio-demographic characteristics of the study participants:

Out of 443 medical doctors targeted in the WhatsApp platform in which our questionnaire was posted, 164 responded and submitted the survey, giving a response rate of 37.0% (164/443). The mean age of the participants is 38 ± 6.28 years, 91 (55.5%) are 38 years of age and above, 97 (59.1%) are males and 67 (40.9%) are females, giving a male-to-female ratio of 1.4:1. About three-quarter (74.4%, 122/164) of the participants are married. Concerning the areas of specialization of the participants, majority (47.3%, 70/148) are physicians. Table 1 illustrates the socio-demographic characteristics of the participants.

Frequency of acceptance/refusal of COVID-19 vaccine:

One hundred and twenty-seven (77.4%) reported to have received COVID-19 vaccine, while only 37 (22.6%) refused to receive the vaccine (Fig 1). High frequency of doctors aged 38 years and above than below 38 years (56% vs 54%, $p > 0.05$), males than females (81.1% vs 71.6%, $p > 0.05$), married than single (77.7% vs 75.6%, $p > 0.05$) accepted COVID-19 vaccine (Table 2). Furthermore, among the three medical sub-specialties, higher number of physicians than surgeons (81.4% vs 68.6%, $p > 0.05$), and physicians than general practitioners (81.4% vs 73.8%, $p > 0.05$) accepted COVID-19 vaccine.

Fig 2 shows the percentage frequency of acceptance per each sub-specialty. Figs 3-5 illustrate the frequency distribution of acceptance/refusal by age, gender, marital status, and medical sub-specialties.

Table 1. Socio-demographic characteristics of study participants (practising medical doctors) in Cross River State, Nigeria

Socio-demographic characteristics	Frequency	Percentage
Mean age ± SD (in years)	38.28±6.28	
Age group (years)		
< 38	73	44.5
≥ 38	91	55.5
Gender		
Female	67	40.9
Male	97	59.1
Marital status		
Single	42	25.6
Married	122	74.4
Medical sub-specialty		
Physicians	70	47.3
General Practitioners	42	28.4
Surgeons	36	24.3

About 46% (17/37) of participants who refused COVID-19 vaccine cited low perceived benefit of vaccination, 19% (7/37) cited perceived possibility of serious adverse reactions, and only 5.4% (2/37) cited religious/spiritual reasons for refusal to accept vaccine. None of the participants cited "lack of information or low

perceived risk of contracting COVID-19" as reasons for not accepting to receive the vaccine (Fig 7). Of the 127 participants who have received COVID-19 vaccine, 110 (89.4%) had completed the required doses of the vaccine while only 13 (10.6%) were yet to complete their required doses (Fig 8).

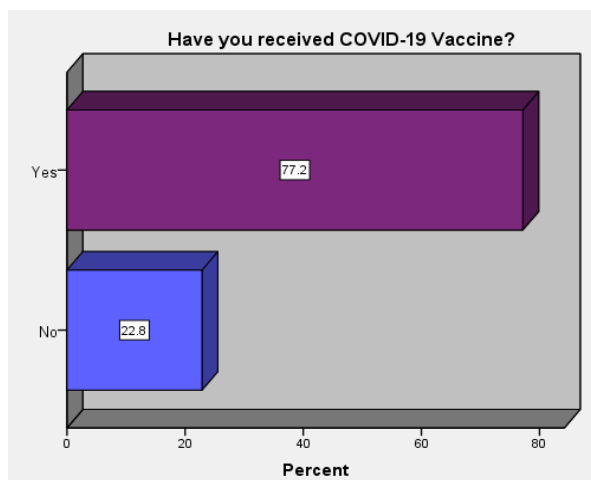


Fig 1: Frequency of COVID-19 vaccine acceptance/refusal among the study participants

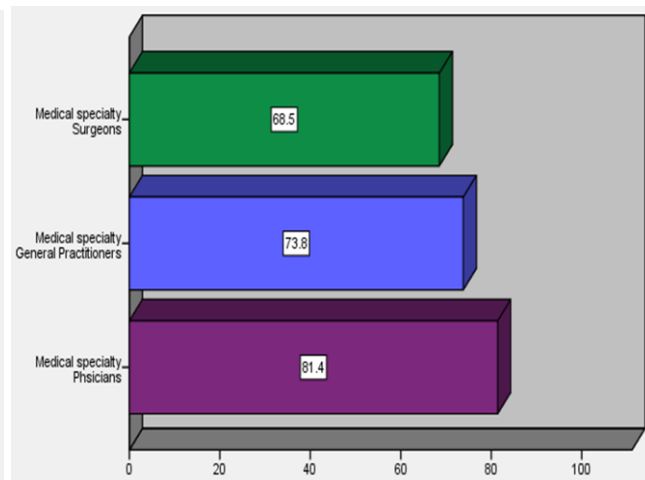


Fig 2: Frequency distribution of doctor participants who received COVID-19 vaccine with respect to sub-specialty

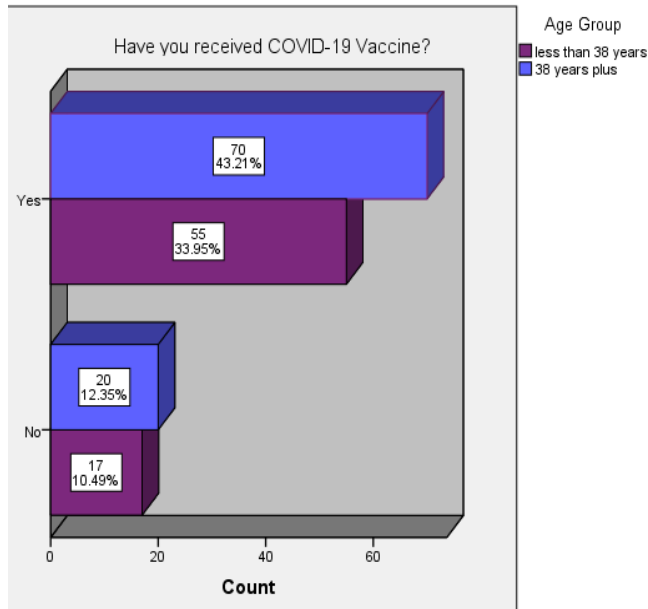


Fig 3: Age group distribution of doctor participants with respect to COVID-19 vaccine acceptance/refusal

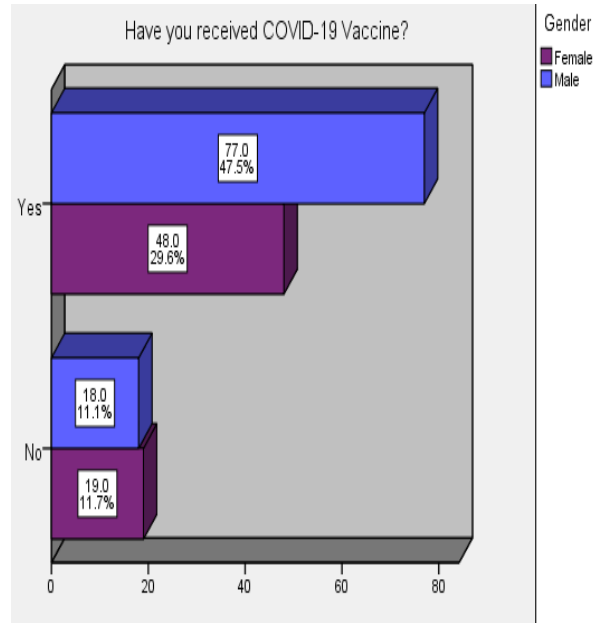


Fig 4: Gender distribution of doctor participants with respect to COVID-19 vaccine acceptance/refusal

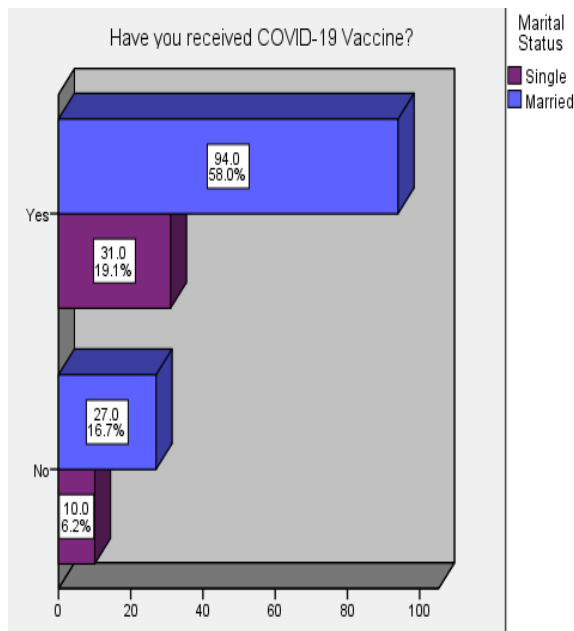


Fig 5: Distribution of doctor participants on COVID-19 vaccine acceptance/refusal by marital status

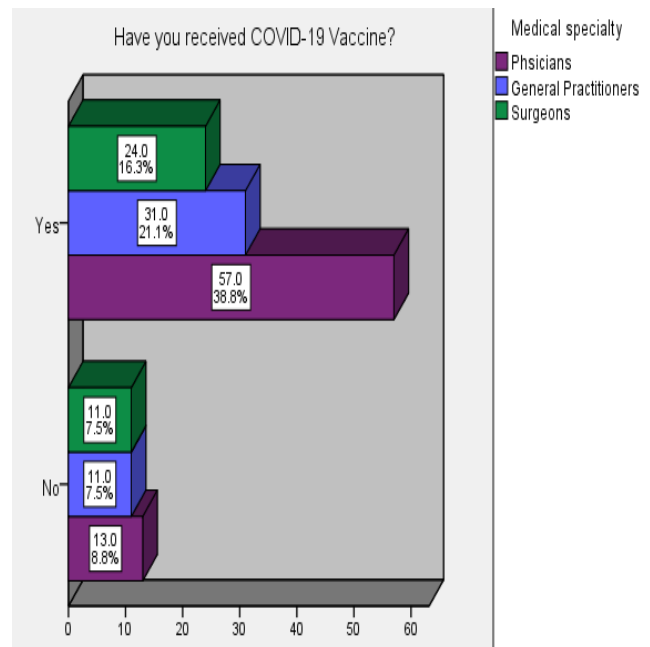


Fig 6: Distribution of doctor participants on COVID-19 vaccine acceptance/refusal by medical sub-specialties

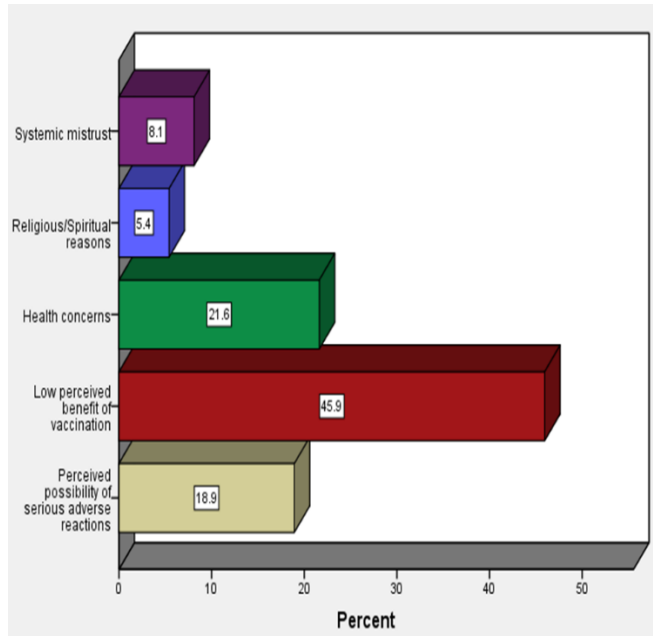


Fig 7: Reasons for COVID-19 vaccine refusals among the doctors

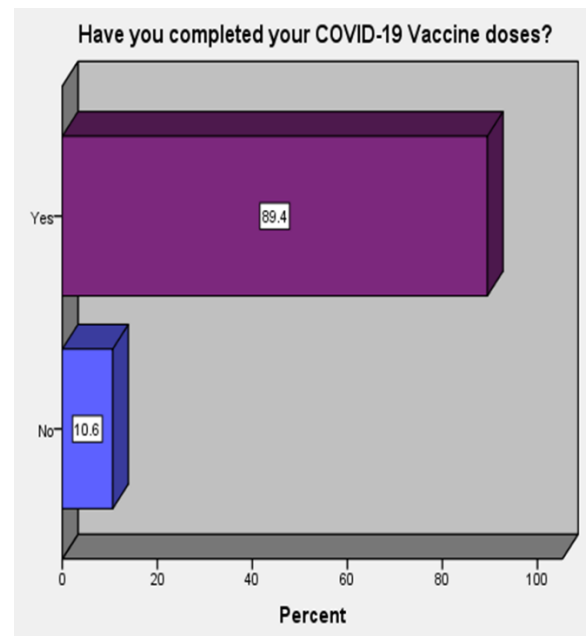


Fig 8: Frequency of COVID-19 vaccine doses completion among the doctors who received COVID-19 vaccine

Determinants of COVID-19 vaccine acceptance:

Table 2 illustrates the logistic regression analysis of factors that determine the acceptability of COVID-19 vaccine. Although none of the tested predictors were statistically significant ($p > 0.05$), the odd of receiving COVID-19 vaccines was 1.01 times more among doctors who are 38 years of age and above (OR=1.01, 95% CI=0.44-2.37, $p=0.97$), but the odd of receiving COVID-19 vaccine was less (0.55 times) in females compared to males (OR=0.55, 95%

CI=0.25-1.20, $p=0.135$).

The table also shows that the odd of married doctors receiving COVID vaccine was 1.06 times more than their single (unmarried) counterparts (OR=1.06, 95% CI=0.43-2.63, $p=0.897$) and the odds of physicians receiving the vaccine was 2.04 (OR=2.04, 95% CI=0.79-5.26, $p=0.141$) and 1.37 times (OR=1.37, 95% CI=0.49-3.78, $p=0.541$) more than their surgeon and general practitioner colleagues respectively.

Table 2: Univariate and multivariate logistic regression analyses of COVID-19 vaccine intake and predictors of vaccine acceptance amongst the study participants

Variable	n (%)	Have not received COVID-19 vaccine n (%)	Have received COVID-19 vaccine n (%)	χ^2	p-value	Logistic Regression		
						B	OR (95% CI)	p-value
Age group (years)	162							
<38	(98.8)	17 (23.6)	55 (76.4)	0.00	0.983	0.014	1.01 (0.44-2.37)	0.97
≥ 38		20 (22.2)	70 (77.8)					
Gender	162							
Female	(98.8)	19 (28.4)	48 (71.6)	1.477	0.2243	-0.58	0.55 (0.25-1.20)	0.135
Male		18 (18.9)	77 (81.1)					
Marital status	162							
Single	(98.8)	10 (24.4)	31 (75.6)	0.00342	0.9534	0.06	1.06 (0.43-2.63)	0.897
Married		27 (22.3)	94 (77.7)					
Sub-specialty	147							
Physicians	(89.6)	13 (18.6)	57 (81.4)	2.31	0.315	0.71	2.04 (0.79-5.26)	0.141
General Practitioner		11 (26.2)	31 (73.8)			0.32	1.37 (0.49-3.78)	0.541
Surgeons		11 (31.4)	24 (68.6)					

n=number; χ^2 =Chi square; OR=Odd ratio; CI=Confidence interval

Discussion:

Although vaccination is regarded as one of the greatest achievements of science, vaccination hesitancy or outright refusal have persisted (27). Since currently, there is no specific standard treatment for COVID-19, vaccination remains one of the most effective means of preventing the disease (28,29). COVID-19 vaccine acceptance among a large population of susceptible people can positively influence the control of COVID-19 pandemic. As of 22 November 2022, seven vaccines have been approved for use in Nigeria including Moderna (Spikevax), Pfizer/BioNTech (Comirnaty), Gamaleya (Sputnik V), Janssen (Johnson & Johnson) (Jcovden), Oxford/AstraZeneca (Vaxzeviria), Serum Institute of India (Covishield), and Sinopharm (Covilo) (30). A successful vaccine campaign in Nigeria might require an investigation about the readiness of medical doctors to take the vaccine as well as the factors that will determine their decisions. This is so because medical doctors are seen as role model everyone look up to in health decision taking. Their unwillingness to accept COVID-19 vaccine will negatively affect the possibility of a successful vaccine campaign. This study therefore aimed to evaluate the acceptance of COVID-19 vaccine among medical doctors as well as the determinants of these decisions to accept or refuse.

According to the findings of this survey, the COVID-19 acceptance rate among doctors in Cross River State, Nigeria is considerably high, about three-quarter of the participants having reportedly received the vaccine. Previous studies have reported that vaccine acceptance is generally higher among HCWs especially medical doctors (15,18,31). This acceptance rate is quite encouraging and shows improvement over the rates obtained in the country previously that ranged between 20.0-58.2% according to data pooled from a systematic review on COVID-19 vaccine acceptance and associated factors in Nigeria (32). The finding has also outperformed the 38.8% rate reported by Nri-Ezedi et al., (26) in a similar study that involved only medical doctors in Nigeria in 2021, although, in their study, the participants were only asked for their intention to accept COVID-19 vaccine, unlike in the current study that involved actual vaccine acceptors. To sum this up, there seems to be significant variations in vaccine acceptance based on the timing of surveys and the type of population involved. The time-trend patterns of vaccine acceptance rates among HCWs in Nigeria had fluctuated from 55.5% in October 2020, 32.5% in January 2021, to 45.6% in March 2021 (32).

Participants knowledge and COVID-19 awareness level among a given population may influence the vaccine acceptance level. Also, availability of the vaccines in-country and the accorded priority to HCWs during the early phase of COVID-19 campaign could be linked to the high acceptance rate (33). Comparable results of our study participants attitude towards COVID-19 vaccination had been reported among HCWs from other countries such as Israel (78.1%) in March 2020, Canada (72.4%) in October 2020 and Thailand (77.0%) (20,34). Strikingly, Colombia (90.7%) in 2021 and Thailand (95.6%) had much higher acceptance rates than in our study (35,36).

Demographic differences such as gender, age, and presence of comorbidity have been observed among vaccine and non-vaccine acceptors (19,20). This current study revealed that greater proportion of doctors 38 years of age and above accepted COVID-19 vaccine than the younger doctors. This finding was expected considering the facts that studies have associated old age with increased risk of morbidity and mortality. This knowledge could have been the driver for the demonstrated higher acceptance among older doctors in this study. There have been reports of lower vaccine acceptance among younger generation of doctors caring for COVID-19 patients (14,19,20,24). The age of medical doctors correlated negatively with their willingness to accept COVID-19 vaccine in a previous study in Nigeria (26). This observation prompted most health facilities in Nigeria then to institute work-from-home concept for elderly doctors to lower the possibility of them contacting a potentially infected patients who came to the health facility (26).

Male doctors were about 2 times more likely than female doctors to accept COVID-19 vaccine in this study. This finding is congruent to an earlier study in Nigeria and in United States of America (26,37). Also, Dror et al., (34) in Israel in 2020 found a similar male preponderance to acceptance of COVID-19 vaccine than female. A likely reason for this observation may stem from the procreation point of view, in that female of child-bearing age, especially expectant mothers may be advised by their HCWs and family members to keep off from drugs other than those prescribed by their doctors. The observation that adverse outcomes from COVID-19 are more with males than females may also be the reason for the male preponderance in COVID vaccine acceptance (38).

Interestingly, we observed in our study that the odd for the physicians to receive COVID-19 vaccine was twice and over one-and-half times more than their colleagues in surgery and

general practice respectively. We could not readily find other studies that have assessed medical sub-specialties association with COVID-19 vaccine acceptance or hesitancy. However, some studies have compared medical doctors and other HCWs. Dzieciolowska et al., (39) observed that physicians were more likely to accept vaccination compared to nurses and other HCWs. According to health belief model, peoples' beliefs about their susceptibility to a disease and their perceptions of benefits of trying to avoid it could have influenced physicians' willingness to accept COVID-19 vaccine (40). Since physicians seem to be more directly involved in the fight against COVID-19, and having witnessed firsthand, the devastating effects of the virus, this could have boosted their willingness to get vaccinated (41). Shehata et al., (42) noted that physicians not taking care of COVID-19 patients relatively had lower acceptance rate than those who indirectly or directly contact COVID-19 patients. Probably, the surgeons and the general practitioners in this study felt they are lower risk for contracting COVID-19 than their physician colleagues. Perhaps, more study will be needed to understand much better factors associated with poor COVID-19 vaccine in other medical sub-specialties when compared with physicians so as to apply tailored health intervention to address it.

In contrast to many other studies that found safety issues as main reasons for vaccine hesitancy/refusal, this study found that low perceived benefit of vaccination followed by safety reasons were the main reasons for vaccine non-acceptance (20,26,43). Based on the theory of diffusion of innovation, there is firm belief that with time, as more positive information emerge about the effectiveness and safety of the vaccines, more vaccine refusers would become vaccine acceptors (44). The use of targeted interventions among HCWs to address safety issues around COVID-19 vaccine should be encouraged. Improving the national safety surveillance and publicly publishing national data to address any concerns the citizens may have with the vaccines other than the use of foreign data should be the way to go (45). There are two sub-groups among those who refuse COVID-19 vaccine; the vaccine hesitant and the firm refusers. Our study would have captured more of the later than the former, considering the prolonged time interval since the first commencement of COVID-19 vaccine in Nigeria.

Our study has some limitations. The first limitation is the study design, in which cause-effect relationship cannot be established. Second, the use of convenience sampling method would produce research findings that cannot be generalized to the population of medical doctors

in Nigeria. Third, being an online survey, only invited doctors who have internet access and are motivated could have participated. Fourth, the sample size used was smaller than the calculated sample size. The calculated sample that would have given a statistical power of at least 80% was 202, however, only 164 doctors responded, therefore, the statistical power to detect differences and associations will be negatively affected.

Conclusion:

The level of acceptance of COVID-19 vaccine among medical doctors in Cross River State, Nigeria, is considerably high, although there is still room for improvement. There was no significant difference between vaccine accepting and vaccine-refusing doctors with respect to age group, gender, marital status, and medical specialty. Low perceived benefit of the vaccine, health concerns and safety concerns were the main reasons for not accepting vaccine.

To attain optimum COVID-19 vaccine acceptance rate, we recommend increased awareness and health education campaign targeting health institutions to disseminate reliable and accurate information about vaccines. There should also be the need to improve on vaccine safety and efficacy surveillance to counteract the aberrations of fears and mistrust arising from conspiracy theories and social media.

Contributions of authors:

IAA was involved in the study conceptualization, formal analysis, methodology, supervision, visualization, original manuscript draft writing, review and editing; OGI was involved in methodology, resources provision, supervision, manuscript review and editing; OPA was involved in project administration, original manuscript writing, review and editing; IOI was involved in project administration; UUA was involved in project administration; EDE was involved in project administration, resources provision and visualization; and OAB was involved in resources provision and visualization. All authors approved the final manuscript submitted.

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