Uptake of COVID-19 Vaccination among Healthcare Providers in Busia County in Kenya

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ABSTRACT

Context: The novel coronavirus was announced as a global rampant disease in March 2020. Non-pharmaceutical interventions were imposed globally to assist in controlling the spread of the disease, which had negatively impacted the wellness of individuals and contributed to a significant decline in the global economy. Through rigorous research, the world realized the development of effective and safe vaccines given emergency use authorizations. Healthcare providers are at the highest risk of COVID-19 occasioned by their nature of work.

Aim: This study aimed at assessing the uptake of the COVID-19 vaccines among healthcare providers in Busia County.

Methods: In a cross-sectional study, multi-stage sampling to a sample size of 423 healthcare care providers in healthcare facilities distributed over seven sub-counties of Busia County, Kenya, was determined using the Fishers formula. Data was collected using a self-administered questionnaire on Kobo collect and analysis done in SPSS version 26 software.

Results: Most healthcare providers (n=399) had received at least one dose of the vaccine at the time of the study, indicating an uptake rate of 94.3%, with 86.5% having gotten at least two doses. Age, gender, marital status, and living with others significantly influenced vaccine uptake. The uptake rate of those with comorbidities was significantly lower than those without (p=0.03, OR:0.3, CI:0.1-0.9). 97.1% of the healthcare providers were knowledgeable about COVID-19 vaccines that positively influenced vaccine uptake (OR: 16.3; 95% CI: 6.7–39.8; p <0.001). Healthcare providers receiving information from their colleagues (OR: 5; CI: 1.7-14.7; p=0.009) and print media (OR: 4.6; CI: 1.7-12.5; p=0.007) were five times more likely to uptake the vaccine.

Conclusion: Vaccine uptake was favorably high. It was found to be higher among the knowledgeable, lower among those with chronic illnesses, and increased with age. Further research should focus on establishing the effects of non-pharmaceutical interventions on the general population.

Keywords: COVID-19, vaccination uptake, healthcare providers

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1. Introduction

The Severe Acute Respiratory Syndrome Corona Virus 2 (SARS-CoV-2), popularly known as COVID-19, was declared a pandemic on March 11, 2020 *(WHO, 2020a).* Between January 1, 2020, and December 31, 2021, it reportedly killed approximately 14.9 million *(WHO, 2020b).*

The pandemic presented an unusual inconvenience to the vital socioeconomic undertakings of millions of people. Most of the socioeconomic impacts of COVID-19 result from some of the non-pharmaceutical interventions (NPI), like partial or total lockdowns meant to control the disease progression *(WHO, 2022).* By the end of 2020, WHO had announced an emergency use listing of the COVID-19 vaccines. The initial phase of the vaccine rollout was geared towards strategic prevention among the high-risk groups and those at risk of severe outcomes of COVID-19 *(WHO, 2022).*

Challenges with the availability of vaccines, which could have affected uptake, were alleviated by the end of 2021. There was little change in the vaccination rates, giving a pointer to other possible causes of not being vaccinated. Efforts to enhance the use of novel interventions have been seen to harness the uptake of the COVID-19 vaccine *(Sekhon et al., 2017; AlQudah et al., 2021).* Knowledge of the COVID-19 vaccines has been shown to influence their uptake among healthcare providers, who are great influencers in vaccine adherence and reduce hesitation among the population. However, this has not been demonstrated in the current study setting *(Kwena et al., 2022).* Therefore, an assessment of the uptake of these

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vaccines and the associated factors among healthcare providers was essential in the fight against the disease.

2. Significance of the study

The coronavirus disease brought about health, economic, and social crises affecting communities at their core *(Zabaniotou, 2020).* Most countries also prioritized health care providers in the first phase of vaccination. However, there is still low coverage in Busia County, where by November 25, 2021, only 519 out of 1475 professional healthcare providers (35.1%) had taken their first dose of the vaccine. This finding shows that a majority were still unvaccinated and, therefore, remained perilously exposed to the extreme form of COVID-19 *(Health Sector Working Group Report –Busia County-2022)*.

This phenomenon was of great concern because Busia County is one of the counties in Western Kenya that was highly affected by the COVID-19 pandemic due to the porous border, long-distance truck drivers, and other factors like cross-border traders. It is also important to have high vaccine coverage among healthcare providers for their protection and their patients to ensure healthcare systems are operating during a time of extreme need. It is also crucial to have increased vaccination coverage among healthcare providers for their benefit and the entire population they attend to care for them. This practice guarantees that preventive medical health institutions are working during trying times.

Since the development of the COVID-19 vaccine, much less is known about its acceptance and uptake in the communities *(Miner et al., 2023).* Based on the review of initially available literature, there was a clear indication that a limited amount of research and knowledge has been conducted on factors influencing the acceptance and uptake of the COVID-19 vaccine in the world; none had been done to evaluate these in Busia County, Kenya.

3. Aim of the study

This study aims to assess the uptake of the COVID-19 vaccines among healthcare providers in Busia County.

4. Subjects & Methods

4.1. Research Design

The study was conducted as an online descriptive, cross-sectional study. The study assessed the level and factors that influence the uptake of the COVID-19 vaccine among healthcare providers in Busia County. The study employed quantitative techniques to collect data from health providers in facilities found in Busia County in Kenya.

4.2. Study setting

The study was carried out in Busia County- Kenya, in the seven sub-counties, in 1 county referral hospital, 7 level 4 hospitals, 14 level 3 health centers, and 49 level 2 dispensaries.

4.3. Subjects

The study population was health care providers in health facilities in Busia County. Busia has 1475 health care providers distributed across the seven sub-counties, with the government (GOK) having more than 90% of the staff. The study included all the licensed professional healthcare providers working in health facilities within Busia who consented to participate. Students and health care workers on internship were excluded from the study as they are not legally registered to practice with autonomy.

Table (1): Sample size distribution.

Category	Target population	Percentage (%)
GOK facilities	1350	91.5
Private facilities	22	1.5
Faith-based facilities	103	7
Totals	1475	100

Source: Health Sector Working Group Report –Busia County (2022)

The sample size was calculated using the Fishers formula for cross-sectional studies *(Cooper & Schindler, 2006).* $N=(Z^2pq)/d^2$, where Z is the critical value associated with the level of significance, 1.96 for 95%, p is the proportion of the target population that is COVID-19 vaccinated (set at 50% as no estimates have been established at the time of this study), d is the level of desired accuracy set at 5%=0.05 for this study, and q=1-p. The proportion of the population with and since it was unknown p was set to 0.50, which was the highest variability. Therefore, the sample size was estimated to be 423 participants, with a 10% loss being factored in.

Sampling technique: Multi-stage sampling technique was applied where the seven sub-counties were considered as strata already existing and eligible for the study. All health facilities were eligible to participate and were stratified based on the Kenya Health Essential Package (KEHP) level 2,3,4,5. Thus organized in strata according to the level of service provision. The number of healthcare providers was proportionally allocated to the number of healthcare facilities in the sub-county. Duty rotas were used as lists to randomly select the individuals and the links sent to their phones. Consent was sought on the technology-based tool, and those who consented could complete the questionnaire.

4.4. Tools of data collection

4.4.1. Self-Administered Questionnaire

The study utilized the primary data to get answers to the specific objectives. The data was collected through structured questionnaires that allowed the uniformity of question responses based on *Cooper and Schindler (2006).* Questionnaires were preferred as the respondents could use them anonymously without help. They were cost-effective and quicker than other methods while reaching a larger sample *(Creswell, 2017).*

The primary data was collected using a self-administered questionnaire delivered via a Kobo collect tool. The questions were presented in English language. Open-ended questions assessed socio-demographic information, health background, information source, and vaccination status.

4.4.2. Knowledge Assessment Likert Scale

Likert scales were used to assess knowledge, where 11 elements were used to determine knowledge concerning the COVID-19 vaccine, such as whether it is legally mandatory to be vaccinated for COVID-19, is the COVID-19 vaccine eligible for infants <1 year, children to 18 years. The outcome per respondent for the level of knowledge for the 11 elements was summarized, with "Yes" being counted as one and "No" as 0. A percentage score out of the 11 elements was computed, and thus, overall knowledge was categorized as knowledgeable for a score of 50-100% and not knowledgeable for 0-49%. The tool was preferred for use during the period of data collection.

4.5. Procedures

The COVID-19 cases had risen from 1% and below in February to 12.8 % by June 22, thus making an online tool most suitable (NERCC on COVID-19 update 11th March 2022 and June 2022). Also, as a country and a county, one lesson learned during the pandemic was to use digital technology since it enabled rapid access to accurate and reliable data *(Dabla et al., 2021).*

The data collection process involved the researcher engaging the county health and sub-county health management teams (sub-county medical officers of health and the public health nurse) during their regular meetings to sensitize them on the importance of the study for buying in.

The researcher promised to share the findings with the teams. The county director of health informed the seven sub-county management teams and the facility in charge of the intended survey. Before data collection, the researcher trained seven research assistants to act as team leads to identify active healthcare providers serving within the facilities, line list contacts, and form a WhatsApp group for communication regarding the study.

Ethical consideration: Before conducting the research, the researcher sought ethical approval from Masinde Muliro University's ethics committee. Preceding data collection, the researcher acquired an introduction letter from Masinde Muliro University (Approval number: MMUST/IEREC/034/2022) that assisted in defining the main reason for the study as well as ushering in the researcher to the respondents in adherence to ethical standards. The researcher then sought permission to go to the field from the National Commission for Science, Technology, and Innovations (NACOSTI) (NACOSTI, License No: NACOSTI/P/22/16898). The researcher then wrote to the Director of Health -Busia County to request permission to collect data. The Director, in turn, wrote to the Sub County MOHs, informing them of the researcher's intention to collect data. (Ref. No. CB/BSA/H/ADMIN/1/56/VOL.,11/78), and the data collected was solely for the study and was not to be personalized. Participants were expected to complete an informed consent before participating in the study. They were guaranteed discretion and anonymity. Participants voluntarily participated in the study. All the ethical principles regarding the inclusion of human subjects were followed strictly.

This study conducted a pretest to test the validity and reliability of the research instruments by administering the developed questionnaires to 10% of the sample size (n=423), which sums to a sample of 43 respondents, who comprised of the supervisors, immunization, public and community health experts *(Doody & Doody, 2015)*. This test was to ascertain whether the tool was likely to collect the intended information. They provided feedback on what needed to be improved before proceeding to the field for final data collection. The results obtained from the pilot study were not used to analyze the final study to avoid data contamination.

The interviewees were assured of confidentiality and anonymity, and in addition, they were promised to be briefed on the research findings as a form of incentive. They were also assured that having received or not received vaccinations could not lead to any repercussions. Privacy and confidentiality of the participants were ensured as they were required not to indicate any form of identification on the online tool that was only accessed by the research team.

At the analysis level, there were no e-mail or IP addresses. The phone number was the only identifier that was deleted after data extraction was done. Airtime reimbursement worth Kenya shillings (Ksh) 100 was given to facilitate connectivity. Since the researcher had access to the online data forms, she could view the progress of the responses. Follow-ups were made through phone calls and at Facetimes to face after every three days to those who still needed to complete the tools. This practice was done through the sub-county team leads. A total of 423 questionnaires were filled. The data collection process took three weeks, from May 25 to June 15, 2022.

4.6. Data analysis

Data was extracted from KOBO, collected, and edited for accuracy, readability, consistency, and completeness; then, coded and entered a computer using the software SPSS (Statistical Package for the Social Sciences) version 26. Data was analyzed using descriptive and inferential statistics. Bivariate analysis using the Chi-square statistics was done to measure the associations, and the strength of the associations was determined by the odds ratio at $p \leq 0.05$. Odds ratio to show the strength of the association/predictors, 95% confidence intervals, and p-values were reported. Independent variables included the level of knowledge and sources of information and their significance. Modifying variables were individual attributes like socio-demographic characteristics and health background. The dependent variable was COVID-19 vaccine acceptance.

5. Results

Table 2 shows that 423 responses to the self-administered Kobo collect-based questionnaire were reached. The frequency and percentage distribution of the sample per sub-county are shown in Table 2. The highest participation was from Matayos Sub-County (16.5%), and the lowest was Samia Sub-County (13.2%).

Table 3 presents the distribution of the demographic characteristics of the respondents. The mean age of the respondents was 38.1±10.4. The median age was used as the grouping criteria for the age set into two groups. Females (57.2%) were more than males (42.8%). Most of the respondents (90.8%) were from Government hospitals. Nurses were the majority (72.1%) of the respondents. This finding is followed by the clinical officers (7.3%), with 77.1% of the sampled population being married and living with other people (81.1%).

Table 4 shows that the overall uptake rate for the disease's vaccine was 94.3% of the sampled healthcare workers, with 60.9% of those vaccinated receiving more than one dose. During the interview, a quarter of those vaccinated had received up to 3 doses (25.6%).

Table 5 reveals that AstraZeneca was HCP's most common vaccine, leading with 58.1%, followed by Pfizer (18.9%), with the least being Sinovac (0.7%).

Table 6 demonstrates that health workers aged below 35 years were significantly less likely to accept vaccination compared to their counterparts aged above 35 years (OR: 0.2; 95% CI: 0.1-0.6; p=0.002), while female healthcare workers were more than 2-fold more likely to be vaccinated than their male counterparts (OR: 2.3; 95% CI: 1-5.5; p=0.037). Equally, more healthcare workers who were married (96.3%) and those who lived with other family members (96.2%) were more likely to be vaccinated than their counterparts, 87.6% and 86.3%, respectively. The other socio-demographic aspects disaggregated by employer and cadre did not significantly influence COVID-19 vaccine uptake.

Table 7 demonstrates that forty-four (10.4%) healthcare workers had chronic health conditions. The commonest comorbidities were hypertension 17(38.6%), asthma 10(22.7%), and HIV 6(13.6). The other conditions reported were arthritis, diabetes, peptic ulcer, cancer, glaucoma, goiter, hypercholesterolemia, and spondylosis.

Table 8 illustrates the association between health providers' medical background and the uptake of COVID-19 vaccines. Although having a chronic health condition and having been infected with COVID-19 before were the two main health-related issues analyzed against vaccine uptake, the uptake rate among those who had a chronic medical condition (86.4%) was low (OR: 0.3; 95% CI: 0.1-0.9; p=0.03) as compared to those who reported having no chronic condition (95.2%). Those who had already had COVID-19 infection had a lower uptake rate (87.5%) compared to those who had not had prior COVID-19 infections, although there was no statistically significant difference in proportions (OR: 0.4; 95% CI: 0.1-1.4; p= 0.142).

Table 9 demonstrates that the level of knowledge on adult eligibility criteria for COVID-19 vaccination is the highest (96.9%) for eligibility of adults above 18 years, with knowledge on eligibility for vaccination for persons allergic to food items being at (72.1%).

Table 10 shows the association between knowledge and demographic characteristics. The least knowledgeable cadre concerning the COVID-19 vaccine was doctors (64.3), and the most knowledgeable cadre was the public health officer (100%).

Six socio-demographic aspects were significant determinants of knowledge among the sampled healthcare workers. These aspects were age (OR: 1.8; 95% CI: 0.9-3.6; p=0.054), gender (OR: 2.2; 95% CI: 1.1-4.2; p=0.016), employer (OR: 4.8; 95% CI: 2.2-106; p<0.001), being a doctor (OR:5.9; 95% CI: 1.9-18.7; p =0.006), marital status (OR: 2.5; 95% CI: 1.3-4.9; p=0.008) and living arrangements (OR: 4.2; 95% CI: 2.1-8.4; p<0.001).

Table 11 reveals the healthcare providers' rating of the sources of information that significantly influenced their opinion regarding vaccination. The information sources included national radio/TV news, government agencies, social media, and discussions amongst peers, family, health care providers, print media, and WHO/UN bodies. The respondents later rated these sources as to whether they were considered significant or insignificant sources of information for the respondent. The result demonstrates that only the respondents who considered information from fellow healthcare workers (p=0.009), print media (p=0.007), and UN bodies (p=0.051) as significant sources of information were more likely to be vaccinated (OR: 5, CI: 1.7-14.7, P=0.009), (OR: 4.6; CI: 1.7-12.5; p=0.007) and (OR: 3.4; CI: 1.1-10.9; p=0.051), respectively, as compared to their counterparts who considered other sources of information as being significant.

Generally, the knowledge rating for all 11 elements was 97.1%. The healthcare providers who were rated as being knowledgeable on the COVID-19 vaccine were more likely (97.1%) to be vaccinated against COVID-19 as compared to their counterparts (67.5%) who were rated as not knowledgeable (OR 16.3, CI: 6.7-39.8, p<0.001**)**.

Table (2): Frequency and percentage distribution of sample size per sub-county (n=423).

Sub-County	Frequency	Percent
Bunyala	58	13.7
Betula	59	13.9
Matayos	70	16.5
Nambale	58	13.7
Samia	56	13.2
Teso-North	58	13.7
Teso-South	64	15.1
Total	423	100.0

Tables (3): Frequency and percentage distribution of socio-demographic characteristics of the respondents (n=423).

Socio-demographic characteristics	Frequency	Percent
Age		
20-35	208	48.7
Above 35	215	50.8
Mean ±SD	38.1±10.4	
Gender		
Female	242	57.2
Male	181	42.8
Employer		
Faith-Based Hospital	8	1.9
Government Hospitals	384	90.8
NGO	5	1.2
Private Hospital	26	6.1
Cadre		
Doctor	14	3.3
Nurse	305	72.1
Clinical Officer	31	7.3
Laboratory Technicians	14	3.3
Other healthcare providers	59	13.9
Religion		
Christian	414	97.9
Muslim	9	2.1
Marital status		
Divorced	4	.9
Married	326	77.1
Never Married	79	18.7
Widowed	14	3.3
Living arrangement		
Live alone	80	18.9
Live with other people	343	81.1

Table (4): Frequency and percentage distribution of overall vaccine uptake and number of doses received (n=423).

Variables	Frequency	Percentage
Has been vaccinated against COVID-19 infection		
Yes	399	94.3
No	24	5.7
Number of doses received		
One	54	13.5
Two	243	60.9
Three	102	25.6

Table (5): Frequency and percentage distribution of vaccine uptake by type (n=423).

Vaccines received by HCP.	Frequency	Percent
AstraZeneca	246	58.1
Pfizer	80	18.9
Moderna	55	13.0
Johnson & Johnson	39	9.3
Sinovac	3	0.7
Total	423	100.0

6. Discussion

Healthcare providers are most susceptible to the coronavirus as they manage multiple patients daily. Healthcare workers play a crucial role in building trust between the public and the immunization program and are generally cited as the most trusted source of information on vaccination. Healthcare workers, therefore, must be confident in vaccination as a public health good and be able to transmit this confidence to their patients, family, friends, and community members *(PAHO, 2021)*. This study aims to assess the uptake of the COVID-19 vaccines among healthcare providers in Busia County.

From the current study, the frequency and percentage distribution of the sample per sub-county had the highest participation from the Matayos Sub-County, and the lower percentage was from the Samia Sub-County. This finding is because Matayos sub-county hosts the county referral hospital.

Table (6): Association of vaccine uptake with socio-demographic characteristics (n=423).

Variables	Have been vaccinated against COVID-19				OR	95% CI	P-Value*
	Yes		No				
	No.	%	No.	%			
Age Grouping							
20-35 Years	189	90.9	19	9.1	0.2	0.1-0.6	0.002
Above 35 Years	210	97.7	5	2.3			
Gender							
Female	233	96.3	9	3.7	2.3	1-5.5	0.037
Male	166	91.7	15	8.3			
Employer							
Government	364	94.8	20	5.2	2.1	0.7-6.4	0.170
Non-Government	35	89.7	4	10.3			
Cadre Nurse vs. Other							
Nurse	290	95.1	15	4.9	1.6	0.7-3.8	0.196
Other cadres	109	92.4	9	7.6			
Doctor vs. other							
Doctor	12	85.7	2	14.3	0.3	0.1-1.6	0.185
Other cadres	387	94.6	22	5.4			
Clinical officer vs. other							
Clinical officer	27	87.1	4	12.9	0.4	0.1-1.1	0.089
Other cadres	372	94.9	20	5.1			
Lab Technologist vs. other							
Lab Tech	14	100	0	0	1.1	1-1.1	0.436
Other cadres	385	94.1	24	5.9			
Pharmacist vs other							
Pharmacist	390	94.7	22	5.3	3.9	0.8-19.3	0.124
Other cadres	9	81.8	2	18.2			
Public health officer (PHO) vs. other							
PHO	387	94.4	23	5.6	1.4	0.2-11.3	.537
Other cadres	12	92.3	1	7.7			
Marital status							
Married	314	96.3	12	3.7	3.7	1.6-8.5	0.003
Not married	85	87.6	12	12.4			
Living arrangement							
Lives alone	69	86.3	11	13.8	0.2	0.1-0.6	0.002
Lives with others	330	96.2	13	3.8			

**Significance was determined by Pearson Chi-square analysis. All the P values are two-sided.*

The mean age of the respondents was 38.1±10.4. The median age was used as the grouping criteria for the age set into two groups. This finding was attributed to the government conducting a mass recruitment about 14 years ago where new graduates from school were absorbed into the system.

Females were more than males because more respondents were nurses, and nursing is assumed to be a female-dominated profession. Most of the respondents were from Government hospitals, as the Ministry of Health is the county's major employer of healthcare providers.

Nurses were the majority of the respondents. They constitute more than half the health care providers' workforce in Busia County. This finding is due to their nature of training and the time they dedicate to service delivery, most of them run private hospitals and faith-based organizations.

The uptake rate for the COVID-19 vaccine was above ninety percent. This finding is higher than the reported uptake rates of 82.5 % on COVID-19 vaccine acceptance in a study done in Malawi on a similar population *(Moucheraud et al., 2023)*. In a similar study in Ethiopia, 74.5% (n = 332) of the healthcare workers accepted a COVID-19 vaccine, which is significantly lower than the previous similar study in the USA that showed that 76.98% of healthcare workers accepted the COVID-19 vaccine *(Shekhar et al., 2021; Yilma et al., 2022)*.

A study done in March 2021 in Ghana revealed a significantly low uptake of 39.3% (n = 92). This difference in uptake can be related to the time difference since the USA study was done in December 2020, the Ethiopian study in February 2021, the Malawi and Ghana studies in March 2021, and the current was completed in June 2022. The results in the Malawi study may be more precise since the study was based on health workers being offered the vaccine, while the current study used a self-reported uptake. These differences can be related to the increased availability of vaccines in Africa, which was recommended by studies that had demonstrated a massive difference in uptake between African countries and other countries worldwide partly due to the unavailability of vaccines *(Ackah et al., 2022; Noushad et al., 2021).*

The results also imply success in promoting its acceptability worldwide, more so in Africa, as has been recommended *(Ackah et al., 2022).* The higher uptake rate in the study could be attributed to the vaccine availability that is in constant supply and also due to the gradually increasing knowledge and trust of the vaccine, unlike at the beginning

Table (7): Frequency and percentage distribution of health background of respondents (n=423).

Variables	Frequency	Percent
Has a chronic medical condition		
Yes	44	10.4
No	375	88.6
Do not know	4	1.0
Health Condition		
Hypertension	17	38.6
Asthma	10	22.7
HIV	6	13.6
Arthritis	2	4.5
Diabetes	2	4.5
Peptic Ulcer	2	4.5
Cancer	1	2.3
Glaucoma	1	2.3
Goiter	1	2.3
Hypercholesterolemia	1	2.3
Spondylosis	1	2.3
Total	44	100

Table (8): Association between healthcare providers medical background and uptake of COVID-19 vaccines (n=423).

Morbidity and Vaccine Acceptance	COVID-19 Vaccinated				OR	95% CI	P-value
	Yes		No				
	No.	%	No.	%			
Has a chronic medical condition							
Yes	38	86.4	6	13.6	0.3	0.1 - 0.9	0.03
No	357	95.2	18	4.8			
I already had a COVID-19 infection.							
Yes	21	87.5	3	12.5	0.4	0.1-1.4	0.142
No	378	94.7	21	5.3			

of the vaccine rollout when former studies were conducted *(Noushad et al., 2021).* The main reasons cited for vaccine uptake were personal reasons such as travel, and others for protection from COVID-19 infection, a finding similar to the Ugandan, Egyptian, and Polish studies *(Kanyike et al., 2021; Saied et al., 2021; Szmyd et al., 2021).*

The dominant vaccine among the healthcare providers was AstraZeneca, which accounted for more than half of the doses, followed by Pfizer, then Sinovac. This domination is because, during the vaccine deployment, AstraZeneca was the only available vaccine in the country that dominated the market for over six months before other antigens were introduced. Having been "tested" on other pioneer healthcare providers, most of the fraternity found some confidence in the vaccine, unlike the other types. Vaccines like Sinopharm were less common as they still had not been officially deployed in the county, thus limiting their accessibility to the staff.

Laboratory technicians sampled had the highest uptake rates at 100%, while the doctors had the lowest. This finding is unlike in the Malawi study, where the clinical health workers (Doctors and nurses) and USA study, where direct health caregivers exhibited a higher vaccine uptake rate (49%) than lay workers (health records officer and community assistants) *(Moucheraud et al., 2023; Shekhar et al., 2021).* It is unfavorable since the clinical staff are considered the most informed group and whose decisions regarding health issues have a greater impact on the general population.

The likelihood hood accepting vaccination was lower among the younger respondents than for those above 35 years of age. This result could be attributed to the risk perception for the disease as it was initially associated with age. This result is similar to that of Malawi (74.2% of those aged 20–29 years vs. >85% among respondents aged >30 years) *(Moucheraud et al., 2023; Yilma et al., 2022).*

Female healthcare workers were more likely to be vaccinated than their male counterparts. This finding was attributed to the poor health-seeking behaviors found in men and because most females lived with their children and thus saw the need to be vaccinated to further avoid spreading the disease. Also, nursing, a female-dominated profession contributing to about seventy percent of the workforce, could contribute to the findings. This finding is unlike similar studies in Ethiopia, Ghana, and China, which suggested that males increase their chances of accepting the COVID-19 vaccine. These regional differences can be attributed to cultural differences, which may influence decision-making across the gender divide.

Marital status was seen to positively influence the uptake of COVID-19 vaccine. This finding is a new finding that had not been reported by reviewed studies and related to the increased likelihood of those living with others to be vaccinated, as elicited in this study. Vaccine uptake might result from a need to protect loved ones and referrals for vaccination by a family member.

Table (9): Frequency and percentage distribution of knowledge of healthcare providers regarding the eligibility criteria for COVID-19 vaccines (n=423).

Healthcare providers' knowledge	Frequency	Percentage
It is legally mandatory to be vaccinated for COVID-19		
Yes	87	20.6
No	322	76.1
Do not know	14	3.3
COVID-19 vaccine eligibility		
Infant < 1 year		
Yes	19	4.5
No	374	88.4
Do not know	30	7.1
Children to 18 years		
Yes	383	90.5
No	27	6.4
Do not know	13	3.1
Adults above 18 years		
Yes	410	96.9
No	7	1.7
Do not know	6	1.4
Pregnant ladies and lactating mothers		
Yes	317	74.9
No	72	17.0
Do not know	34	8.0
Patients with chronic illnesses		
Yes	352	83.2
No	53	12.5
Do not know	18	4.3
Persons with active COVID-19		
Yes	49	11.6
No	325	76.8
Do not know	49	11.6
Persons who recovered from COVID-19		
Yes	362	85.6
No	45	10.6
Do not know	16	3.8
Persons allergic to food items		
Yes	305	72.1
No	64	15.1
Do not know	54	12.8
Immunocompromised		
Yes	347	82.0
No	49	11.6
Do not know	27	6.4
COVID-19 vaccine confers immunity against COVID-19 infection after		
After the first dose	62	14.7
After the second dose	210	49.6
After 14 days after the first dose	93	22.0
Do not know	58	13.7

The current study demonstrates a low comorbidity rate among the respondents (around one-tenth), similar to a study done in Ghana, which reported a rate of 9.4% but lower than that of 18.4% reported by a Malawian study. This result is key since several studies have reported a significant influence of comorbidity on vaccine uptake *(Dzieciolowska et al., 2021; Ye et al., 2020).* Those with comorbidities were less likely to uptake the vaccines. This finding could be attributed to misinformation on COVID-19 vaccines being contra-indicated to those with comorbidities and the fear of the side effects associated with the vaccines. Those who had already had COVID-19 infection had a lower uptake rate compared to those who had not had prior COVID-19 infections, although there was no statistically significant difference). This finding was attributed to the impression that one developed some form of immunity once they contracted the COVID-19 disease; thus, most people did not see the need for vaccination.

The level of knowledge on the COVID-19 vaccine was high at 97.1%, which is favorable considering knowledge has been shown to influence decisions on preventive action against the disease. This finding was slightly higher than in another study in Ethiopia that reported knowledge levels of 62.5% *(Adane et al., 2022).*

Table (10): Association of participants' knowledge and socio-demographic aspects (n=423).

Socio-demographic characteristic	Knowledgeable				OR	95% CI	P-Value*
	Yes		No				
	No.	%	No.	%			
Age							
Above 35	200	93	15	7	1.8	0.9-3.6	0.054
20-35	183	88	25	12			
Gender							
Female	226	93.4	16	6.6	2.2	1.1-4.2	0.016
Male	157	86.7	24	13.3			
Employer							
Government Hosp.	355	92.4	29	7.6	4.8	2.2-106	<0.001
Other	28	71.8	11	28.2			
Cadre Nurse vs. Other							
Nurse	280	91.8	25	8.2	1.6	0.8-3.2	0.110
Other	103	87.3	15	12.7			
Doctor vs. other							
Other	374	91.4	35	8.6	5.9	1.9-18.7	0.006
Doctor	9	64.3	5	35.7			
Clinical officer vs. other							
Clinical officer	28	90.3	3	9.7	1.0	0.3-3.4	0.580
Other	355	90.6	37	9.4			
Lab Technologist vs. other							
Lab Tech	12	85.7	2	14.3	.6	0.1-2.8	0.389
Other	371	90.7	38	9.3			
Pharmacist vs other							
Other	375	91	37	9	3.8	1.0-14.9	0.076
Pharmacist	8	72.7	3	27.3			
Public health officer (PHO) vs. other							
Other	370	90.2	40	9.8	.9	0.8-0.9	0.270
PHO	13	100	0	0			
Marital status							
Married	302	92.6	24	7.4	2.5	1.3-4.9	0.008
Not married	81	83.5	16	16.5			
Living arrangement							
Lives with other	321	93.6	22	6.4	4.2	2.1-8.4	<0.001
Live alone	62	77.5	18	22.5			

**Significance was determined by Pearson Chi-square analysis. All the P values are two-sided. N=423.*

Furthermore, there has been increased health knowledge-seeking behavior in the era of COVID, notably from internet sources, as has been demonstrated by several studies similar to the current study *(Moucheraud et al., 2023; Elharake et al., 2021; Yilma et al., 2022).*

The least knowledgeable cadre concerning the COVID-19 vaccine was the doctors, with the most knowledgeable cadre being public health officers (100%), which differs from a study done in Canada that reported a higher level of education among physicians *(Dzieciolowska et al., 2021).* COVID-19 being a public health issue, it is perfectly understandable that public health officers at the forefront of fighting the disease in the current setting are highly knowledgeable and willing to accept the vaccine.

In the current study, age, gender, employer, being a doctor, marital status, and living arrangements were significant determinants of level of knowledge. This finding could have been attributed to the older population being more aggressive in seeking information concerning COVID-19, as it was thought to be initially a disease of older people. Most employees in government institutions benefitted from the training undertaken, unlike in the private sector, where there is a high staff turnover. Also, the faith-based and private hospitals recorded low numbers of respondents as most of the health care providers were found to offer part - time services to these facilities and thus could only be interviewed once. It is assumed that there was information sharing on COVID-19 vaccination among those living with others, thus the high uptake among the said variables. This finding agrees with the earlier findings that demonstrated that these factors affected the level of acceptability alongside knowledge. This finding implies a need for these socio-demographic factors to be considered when planning to increase knowledge levels in similar populations and sustain an optimum acceptability rate for the vaccine *(Shekhar et al., 2021)*.

Table (11): The association between the information sources and COVID-19 vaccine uptake (n=423).

Cues towards being COVID-19 Vaccinated	COVID-19 Vaccinated				OR	95% CI	P-Value*
	Yes		No				
	No.	%	No.	%			
News from national radio /television							
Yes	374	94.9	20	5.1	3	0.9-9.4	0.072
No	25	86.2	4	13.8			
Government agencies							
Yes	373	94.9	20	5.1	2.9	0.9-9	0.08
No	26	86.7	4	13.3			
Social media							
Yes	334	95.2	17	4.8	2.1	0.8-5.3	0.093
No	65	90.3	7	9.7			
Discussion amongst peers, family							
Yes	339	94.7	19	5.3	1.5	0.5-4.1	0.302
No	60	92.3	5	7.7			
Health care providers							
Yes	379	95.2	19	4.8	5	1.7-14.7	0.009
No	20	80	5	20			
Print media							
Yes	372	95.4	18	4.6	4.6	1.7-12.5	0.007
No	27	81.8	6	18.2			
WHO/UN bodies							
Yes	377	95	20	5	3.4	1.1-10.9	0.051
No	22	84.6	4	15.4			
The government releases sufficient data on vaccine safety/efficacy.							
Yes	261	97	8	3	4.1	1.5-10.9	0.006
No	72	88.9	9	11.1			
Many people are taking the COVID-19 vaccine.							
Yes	224	96.6	8	3.4	3.5	1.4-8.9	0.006
No	95	88.8	12	11.2			
Total Knowledgeable about the COVID-19 vaccine							
Yes	372	97.1	11	2.9	16.3	6.7-39.8	<0.001
No	27	67.5	13	32.5			

**Significance was determined by Pearson Chi-square analysis. Values in bold are statistically significant at P≤0.05. All the P values are two-sided.*

Agyekum et al. (2021) reported news and social media as the most common source of information on COVID-19 in Ghana at 58%. Similarly, *Yilma et al. (2022)* reported that 72% of their respondents named social media as their major source of information compared to a paltry 16% mentioning journals. This finding resonates with the current study's findings, where most respondents cited social media as the major source of information.

The current study also demonstrated that despite social media being a major source of their information, respondents tend to trust information derived from the government and international agencies like the WHO, which was favorable, and this had yet to be elicited in the reviewed studies. Further, this study has shown that those who considered government agencies as ideal sources of information had a 3-fold positive influence on their level of COVID-19 vaccination, reinforcing the authenticity of these information sources.

7. Conclusion

The uptake rate was higher among lay health workers like health records officers than clinical health workers like nurses and doctors. Youthful health providers (less than 35 years old) were less likely to accept the vaccines than older ones. Uptake was higher among female health providers compared to their male counterparts. Being married and living with others increased the chances of accepting the vaccine in this population. There was a lower vaccine uptake level among those with chronic conditions than those who reported not having chronic conditions.

Knowledge of COVID-19 and its vaccines was high at (97.1%) and was demonstrated as a key influencer of vaccine acceptability since those found knowledgeable had a 16-fold likelihood to accept the vaccine.

8. Recommendations

There is a need to sustain the current efforts in educating healthcare workers about COVID-19 vaccination uptake targeting the youth, males, and those with comorbidities.

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