DETERMINANTS OF UPTAKE OF COVID-19 VACCINATION AMONG TEACHERS IN UGANDA, A CROSS SECTIONAL STUDY USING BARRIER ANALYSIS APPROACH.

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ABSTRACT
Background
The COVID-19 pandemic continues to adversely affect the population with over 233 million infections and over 4 million deaths. COVID-19 resulted in the closure of schools and education institutes in countries including Uganda. Several Covid vaccines have been developed, however, uptake and hesitancy remain big challenges. With the reopening of schools and education institutes tagged to total vaccination of teachers, understanding key determinants for uptake of COVID-19 uptake in teachers may help to develop strategies for improving vaccination programs. This study assessed determinants of COVID-19 vaccine uptake among teachers in Uganda.

Methods
A cross-sectional study was conducted using a barrier analysis approach targeting teachers from the both private and public sectors in five districts across the regions of the country. 448 teachers (224 vaccinated and 224 non-vaccinated) were sampled using a multistage approach. Each sampled vaccinated teacher was matched with a non-vaccinated teacher from the same community using a snowball approach. Sampled teachers were interviewed by trained research assistants using structured electronic questionnaires from May –June 2021. Collected data was cleaned using Excel before exportation to Stata version 15 for analysis. At the bivariate level, factors were considered significant at $p<0.05$

Results
Factors that were positively associated with the uptake of covid-19 vaccine were older age, easy access to the vaccination site, perceived increased risk of contracting COVID-19, belief that the COVID-19 vaccine can protect against COVID-19 disease, and trust in the vaccine. Factors that were negatively associated with the uptake of COVID-19 vaccines were lack of vaccines, long distances from the vaccination site, perceived severity of side effects, and perception that few people contracted COVID-19 in the community.

Conclusion
Increasing access to vaccines through the creation of more vaccination sites, sensitization of safety of COVID-19 vaccines, and risk of contracting COVID-19 are critical to increasing COVID-19 vaccination rates among teachers.

Recommendations
Efforts should be geared towards increasing access to COVID-19 vaccination services.

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INTRODUCTION

The Coronavirus disease 2019 (COVID-19) Pandemic is caused by the novel severe Acute Respiratory Syndrome-Coronavirus-2 (SARS-CoV-2) and has continued to create mayhem across the globe (1). COVID-19 has affected all aspects of human life ranging from Education, Livelihood to Health where it has imposed stress and strain on the capacity of the healthcare care Systems hence reducing its resilience capacity (2)

According to the World Health Organization (WHO), over 233,503,524 million people have been infected with SARS-CoV-2 resulting in over 4,777,503 million deaths worldwide (2) further over 8.3 million cases have been recorded in Africa with over 211,842 deaths (3). As of 2nd October 2021, Uganda had reported 123,445cases with 3,152 deaths based on data from the Ministry of Health (MoH) (4)

Several Public Health interventions ranging from lockdowns, closure of public places like schools, and

churches, and promotion of preventive methods like handwashing, use of facemasks, social distancing, and vaccination have been encouraged (5). Amidst these, vaccination remains the most effective method recommended by WHO (6).

Page | 2   While Vaccination is essential in battling against COVID-19, availability may not guarantee acceptance of vaccination by the population. Low uptake or distance of vaccination programs could be due to several factors like fear of side effects, low trust in the vaccine, lack of technical capacity by the service providers, social and cultural norms, costs associated with vaccination, and limited vaccination sites among others (2,7–10).

World Health Organization (WHO) reports show vaccine hesitancy among the top ten threats to global health which is further aggravated by the emerging conspiracies surrounding COVID-19 and its vaccines (2). It is paramount to establish vaccine acceptance campaigns before they reach the community. This is because the fear of vaccines has grown radically in the past years (11). In some African communities, this fear has led to a significant increase in rates of vaccine refusal which has led to an increase in vaccine-preventable diseases with studies showing that fear of COVID-19 vaccine side effects and low trust of vaccines is responsible for low uptake of COVID -19 vaccination (12–15). Presently, mistrust in health experts, social media propaganda, and myths that most Africans could be immune to the virus are misleading some of the young population in Africa and some of them do not even want to get involved in community health programs *now* (16).

Several vaccine candidates have been developed to date with some approved and others still undergoing clinical trials by different pharmaceutical companies like Pfizer-BioNTech vaccine, and AstraZeneca vaccine among others with approval for emergency use and are already rolled out across the globe including Uganda (17,18). In March 2021, the Ugandan government through the COVAX facility received its first 864,000 doses of the AstraZeneca vaccine (19)With the arrival of the first vaccine batch, Uganda through the Ministry of Health Subsequently rolled out COVID-19 vaccination across the country prioritizing key risky groups mainly healthcare workers, security personnel, teachers, humanitarian frontline workers, and patients at higher risk of severe COVID-19 disease among others (19)

In May 2021, Uganda imposed a total lockdown, and among the most affected were the learning institutions which were locked down (4). Despite the slow opening of other sectors, the Education sector has remained closed with its opening hinged on the total vaccination of teachers.

In Uganda, teachers form a core and major portion of the workforce, working both in Public and Private Education Institutions. Given their high interaction with learners who often come from different backgrounds. This increases the risk of contracting COVID to and from learners. Assess the determinant of uptake of COVID-19 vaccination is critical in designing interventions to increase COVID-19 vaccination rates which is critical for re-opening of schools and other learning institutions as per the Presidential Directive of September 2021(20)

Literature Review shows that no study has been done to assess determinants of uptake for COVID-19 vaccines among teachers in Uganda and most parts of Africa.

Therefore, this study assessed determinants of COVID-19 vaccination among the teachers in Uganda using the Barrier Analysis Approach.

METHODOLOGY

Study Design and Setting
A cross-sectional study using a barrier analysis approach was conducted among institution, primary, and secondary school teachers in 5 districts from 5 regions of the country. Five districts were selected; Rakaiin Central Region, Hoima in the Western Region, Oyam in the Northern Region, Bugiri, and Busia in the Eastern Region. The study was conducted during the second lockdown between May 2021 and June 2021. This was the period when the COVID-19 incidence was highest in the country, and cross-district movement was restricted. The study was conducted 14 months after report of the first case of COVID-19 in Uganda

Study Participants:

The study participants were institutions, primary and secondary schools, and teachers in selected districts. This study used a barrier analysis approach where the vaccinated (doers) were sampled from COVID-19 vaccination registers and then followed in the community for interviews while controls(non-vaccinated) were sampled from the community where the doer was. Each sampled participant was followed up in the community for interviews and in case of 3 unsuccessful attempts, that participant was dropped without replacement

Inclusion and exclusion criteria

Only teachers who were in active service by the time of the COVID-19 outbreak and were residents of the study areas were included in the study. Furthermore, vaccinated teachers had to have been vaccinated from the health facilities within the study area. Teachers who were sick or outside the study area at the time of the study were excluded including those who did not consent

Sampling size:

A single population proportion formula was used to calculate the sample size with the following assumptions; P (50%, (the permissible Margin of error of 5%) and Zα/2 (the value of the standard normal curve score corresponding to the given confidence interval = 1.96) corresponding to 95% confidence level.

After adjusting for the total number of the study population and potential non-response rate, the final sample was 426. These were considered the doers (vaccinated). Hence from each district, a total of 56 vaccinated teachers were sampled from the vaccination registers. Every sampled vaccinated teacher,/was paired with a non-vaccinated teacher as per the Barrier Analysis Approach.

Sampling procedure

A multistage sampling method was used. Firstly, stratification was done based on regions in the country. Then, in every region, one district was selected using a lottery method. In each district, vaccination sites (health facilities) were used as clusters. The number sampled from each of the clusters was proportionate to the number of teachers that had been vaccinated from that site. Finally, study participants were selected systematically using calculated sampling intervals and random starting numbers from the COVID-19 vaccination registers. Each sampled vaccinated teacher was paired with a non-vaccinated teacher from the same community. A non –non-vaccinated teacher was got by referral/ recommendation/identification by the vaccinated teacher.

Data collection tools and procedure

The data was collected using pretested, structured, questionnaires prepared by the investigators and loaded on the phone for electronic data collection. The tool consisted of socio-demographic characteristics, media exposure and access to COVID-related information, access to vaccination services, health beliefs (perceived susceptibility, perceived severity, perceived benefit/efficacy, perceived divine healing, perceived social norms and cultural factors, perceived barrier, and cues to action), knowledge about COVID-19, preventive behaviors towards COVID-19, and COVID-19 vaccination status variables.

Data was collected using electronic questionnaires that were loaded using ODK/Kobo collected on the research assistants' (RAs) mobile phones. For each selected participant, the RA made an interview appointment using the phone number in the COVID-19 register. The interviews were conducted from the participants' households while adhering to ethical issues like confidentiality and informed consent. In case the respondent did not get on the first attempt, 3 follow-ups were made and in the event of an unsuccessful attempt on the third visit, the participant was dropped without replacement. Daily, data was extracted and checked for consistency, and quality and feedback were given to the RAs while in the field. Datasets from the ODK/Kobo collect server were downloaded as Excel files and preliminary data cleaning was conducted before exporting to STATA 15.0 for analysis.

Data Processing and Analysis:

Coded data from Kobo Collect was downloaded and exported to Excel for cleaning. Cleaning involved checking for consistency, correctness, and completeness of the data. Cleaned data from Excel was exported to STATA version 15 statistical software for analysis. Quantitative data analysis was done at a univariate level to generate frequencies, means, median and proportions, standard deviations, interquartile range, and frequencies. Bivariate analysis was done in the state using an odds ratio (OR) as a measure of association with a significance level of 0.05 and confidence intervals. All factors were considered significant at P-value = 0.05.

Ethical consideration

The study protocols were reviewed and approved by the Uganda Ministry of Health, where the principal investigator presented the study protocol to the community health department for review, input consideration, and approval. Furthermore, the study and study protocols were approved by the Institutional Review Board of TASO (TASOREC/084/2020-UG-REC-009). During the data collection, Informed consent and voluntary participation were sought from all participants before participation. During the data collection, handling, and storage, data safety and confidentiality were ensured where minimal participant identifier data was collected, all collected data was stored with a strong password with restricted access.

RESULTS

Socia-demographic characteristics

A total of 428 teachers out of 448 sampled (central region 24.7%, Eastern region 47.1%, Western region 24.77%, and Northern region 2.8%) completed the interviews representing a 95.5% response rate. The low participation by the teachers from the Northern Region was because data collection was done at the peak of the second lockdown down and many of the selected teachers had traveled outside the study area. Of these, 50.47% had been vaccinated (doers), while 49.53% had not been vaccinated (non-doers) at the time of the survey. Most of the teachers who participated in the study were between the ages of 30-39 years (39.32%). Of the teachers who participated, 51.4% were female, and the majority (84.11%) were married at the time of the survey. The majority (77.8%) had tertiary or university education as indicated in the table1.

At the time of the survey, all participants were aware of the COVID-19 pandemic outbreak in the country while only 0.23% of the respondents were not aware of the vaccination exercise in the country. 50.47% of the respondents had been vaccinated at the time of the survey with the majority preferring to be vaccinated from health facilities and at least from the Ministry of Health Office as per the table2. Of the participants who had not been vaccinated, the majority cited a lack of vaccines at vaccination sites (26%) and thought that they still had time to vaccinate (28.8%) as the main reason for not vaccinating.

Of the teachers that had been vaccinated, 81.5% reported that the process of accessing the vaccination service was not difficult while only 21.6% reported to have experienced some pain or side effects after getting the vaccination service.

Table 1: Socio-demographic characteristics of the participants

		Frequency	Percentage (%)
Age	19-29	99	23.13
	30-39	164	39.3
	40-49	111	25.93
	>49	54	12.62
Sex	Male	208	48.6
	Female	220	51.4
Marital status	Married	360	84.11
	Not married	52	12.15
	Separated/divorced	16	3.74
Educational level	Secondary (o-level)	53	12.38
	Secondary(a-level)	22	5.14
	Tertiary/university level	333	77.8
	Postgraduate	20	4.67
Vaccination status	Vaccinated	216	50.47
	No-vaccinated	212	49.53
Reason for not vaccinating	Still thinks have time to get vaccinated	48	28.8
	Not aware of requirements for vaccination	5	1.4
	Worried of side effect	27	13.7
	Disapproval by spouse/next of keen/community	1	0.7
	Distance from vaccination site	829	18.5
	Lack of Covid vaccine at vaccination sites	46	26
	Absence of teachers	11	7.5
	Others reasons (pregnancy Breastfeeding status, Few vaccination point, Illness at time of vaccination	18	10.1

Covid-19 Awareness

Most of the teachers (51.3%) preferred and trusted mainstream (TV, Radio, newspapers) as the source of Covid related information while 49.6 %   preferred and trusted information from medical workers and community teachers. Majority (27.8%) reported that fellow teachers would approve the decision to getting vaccinated while 57.0% reported none would disapprove their decision to getting vaccinated in case of need.

Table 2:   **Covid-19 Awareness**

Table 2

		Frequency	Percentage
Awareness of COVID-19 in Uganda	Yes	428	100%
Awareness of COVID vaccination exercise	Yes	527	99.71
	No	1	0.23
Experience during vaccination	Simple, teachers provided adequate information	176	81.5
	Tedious, long waiting time	26	7.7
	Painful, developed side effect	57	21.6
	Others like unfriendly teachers, lack of time, not mobilized	12	5.6

Perception about Covid-19

62.1% perceive existence of risk of contracting COVID from close persons like family members or workmates with 71.73% reporting that very severe conditions /sicknesses of the Covid in case any family member contracted Covid. 36.5%) believed in the efficacy of COVID -19 vaccine with 71.9% reporting fear of side effect of Covid vaccine. Further, the study revealed that 64.72% strongly agreed that their faith approves use of Covid-19 vaccine as shown in table 3

Table 3: **Participants perception on Covid-19**

		Frequency	percentage
Faith approves use of Covid-19 vaccine	Strongly agree	277	64.72
	Agree	37	8.64
	Disagree	60	14.02
	Strongly disagree	54	12.02
Perceived risk of contracting Covid	Very likely	111	71.73
	Somewhat likely	155	16.86
	Not likely at all	145	8.18
	Don't know	17	3.27
Perceived severity in case of contracting Covid	Very serious	307	71.73
	Somewhat serious	72	16.86
	Not serious at all	35	8.18
	Don't know	14	3.27
Perceived severity of Covid vaccine side effect	Very serious	185	43.22
	Somewhat serious	123	28.74
	Not serious at all	75	17.52
	Don't know	45	10.51
Perceived efficacy of COVID -19 vaccine	Strong agree	138	32.2
	agree	156	436.45
	disagree	65	15.19
	Strong agree	69	16.12

Factors associated with update of COVID-19 vaccination- Bivariate analysis

Bivariate analysis was done using Stata version 15, results show that the likelihood of getting vaccinated increases with an increase in age among teachers with teachers aged above 50 years 4 times significantly likely to be vaccinated compared to those less than 30 years (OR=3.8, P 0.000, CI 1.896-7.712), Single or not married teachers are 0.55times significantly less likely to be vaccinated (OR 0.55, P 0.001 CI 0.373-0.804). Further analysis showed that a teacher's likelihood to be vaccinated increases with an increase in educational level though non-significant. Access to vaccination sites significantly influences a teacher's vaccination with teachers who had easy access to vaccination sites 5 times more likely to get vaccinated compared to those who had hardships while accessing vaccination sites.

Knowledge of persons with COVID in teacher's communities increases the likelihood of teachers getting vaccinated with teachers who know somebody with Covid in the community being 3.3 times more likely to get vaccinated compared to those who know none (OR = 3.3, P= 0.01, CI 1.36-4.72). Teachers' perception of the risk of contracting COVID from a family member or community increases the likelihood of them getting vaccinated teachers who perceived that they are likely to get COVID from family members are 3 times more likely to get vaccinated compared to those who did not (OR= 2.25, P=0.033, CI 1.067-4.761). Fear of side effects was associated with a reduced likelihood of getting vaccinated with teachers who reported no fear of side effects 3 times more likely to get vaccinated compared to those who feared side effects (OR=2.96, P=0.000 CI 1.665-5.263).

The belief that the vaccine can protect one from getting covid-19 was significantly associated with the likelihood of getting vaccinated (OR= 3.03, P= 0.000 CI 1.966-4.654) while the increase in trust in the vaccine significantly increases the likelihood of teachers getting vaccinated with teachers who trusted the vaccine a lot 6 times more likely to get vaccinated compared to those who did not (OR=5.5 P=0.000, CI 2.228-13.743).

Faith had little influence on one's choice of getting vaccinated. Looking at the source of COVID-related information only teachers who were getting information from political leaders were significantly likely to get vaccinated compared to other sources as shown in Table 4

Table 4: Factors associated with uptake of Covid-19 vaccination among teachers

FACTOR		OR	P	CI
AGE	30-39	1.821	**0.023**	1.087-3.049
	40-49	2.803	**0.000**	1.599-4.918
	=>50	3.824	**0.000**	1.896-7.712
Gender	Female	0.054	**0.002**	0.373-0.804
Marriage	Not married/single	0.425	**0.006**	0.230-0.786
Access to vaccination site	Easy	4.58	**0.000**	2.606-8.062
Perception on proportion that have Covid	Some people	0.14	**0.02**	0.028-0.777
	None	0.19	**0.042**	0.422-0.940
Perceived risk of contracting Covid from family member or community	Likely	2.00	**0.006**	1.221-3.285
Perceived risk of contracting Covid due to vaccination	Not likely	2.25	**0.033**	1.067-4.761
Severity of Side effect of Covid vaccine	Not serious	2.96	**0.000**	1.665-5.263
Covid vaccine protection from contracting Covid	Yes	3.02	**0.000**	1.966-4.654
Trust in Covid vaccine	Trust little	4.643	**0.001**	1.877-11.483
	Moderate	3.026	**0.0156**	1.236-7.411
	A lot	5.53	**0.000**	2.228-13.746

DISCUSSION

Results from this study showed that age, easy access to vaccination site, perceived risk of contracting COVID-19, perceived safety of COVID-19 vaccine, perceived protection from COVID-19 by vaccine, and trust of the vaccine were positively associated with increased likelihood of uptake of COVID-19 vaccination. The perception that few or no one is infected with COVID-19, not being married and female gender were negatively associated with the likelihood of uptake of COVID-19 vaccination.

This study shows that age was significantly associated with the likelihood of getting vaccinated among teachers with teachers aged above 50 years 4 times more likely to be vaccinated compared to those below 30 years. This could be due to the perception that the risk of contracting COVID-19 increases with age.

This could also be due to government interventions of including the elderly among the risky groups that also created perceived risk among the older teachers. This finding is consistent with studies like a study by Mohammed et al in Saudi Arabia and a study by Dula et al in Mozambique which showed that older people were more willing to get vaccinated compared to young people (14,21). Furthermore, this study shows that gender is significantly associated with the likelihood of getting vaccinated with females less likely to get vaccinated compared to males. This could be because females tend to be less mobile compared to males which may create a sense of less exposure to risk compared to males. This finding is consistent with the study on determinants of intention to receive the COVID-19 vaccine among school teachers in Gondar City, Northwest Ethiopia by Handebo et al and another by Racey et al in Colombia which showed that the male gender was associated with an increased likelihood of getting vaccinated among the teachers (22,23). However contradictory findings from other studies have shown no gender difference in uptake of covid-19 vaccine among teachers (23,24).

Marital status was significantly associated with the likelihood of being vaccinated with singles or non-married teachers less likely to be vaccinated compared to married teachers. This could be due to the perceived risk of getting infected or infecting the spouse. This finding is further supported by findings that spouses influenced the decision of teachers to get vaccinated. These findings are consistent with findings from a web-based national survey in Saudi Arabia which showed that being married was associated with an increased likelihood of acceptance of covid-19 vaccine (21) but contradict findings from the study in Italy on the University population which showed that not being married was associated with increased likelihood of being vaccinated (25)

An increase in Education levels was associated with the likelihood of vaccination, though this relationship was not significant. Higher education is associated with high exposure to information and more knowledge which helps to understand complex issues and also to demystify some negative beliefs. This is consistent with the study among school teachers in Gondar City, Northwest Ethiopia by Handebo and other studies in countries like Kenya, Zambia which have shown that COVID-19 vaccine uptake increases with an increase in education levels (12,15,22,23,26,27).

Having had family members diagnosed with COVID-19 was associated with the likelihood of vaccinating, this could be due to a perceived increase in risks of contracting COVID-19 due to exposure and experience of nursing a COVID-19 patient. Furthermore, teachers who perceived severe conditions in case of contracting COVID-19 were 3 times more likely to get vaccinated. These findings are consistent with findings by *Viswanath v et al* on the Adult Population in the USA showed that risk perceptions (*severity of and susceptibility to COVID-19)* were significantly associated with vaccine uptake(27).

Teachers who had less fear of COVID-19 vaccine side effects were significantly more likely to be vaccinated.

This also explains why fear of side effects was the main reason for not getting vaccinated among the Health Workers. This could be due to massive awareness creation by MoH on limited side effects of the COVID vaccine and also counseling and sensitization provided by the health workers at the points of vaccination. This finding is consistent with findings from studies like on COVID-19 vaccination intention in the UK which showed that fear of side effects was associated with limited uptake of Covid vaccination (28) and another study in Kenya on level of Covid vaccine confidence also showed similar results (15,29) Easy access to vaccination centers and availability of the vaccine at vaccination centers were significantly associated with the likelihood of getting vaccinated. Access and availability of services affect the utilization of services, especially health services. This is consistent with findings of not being vaccinated as most teachers pointed out the lack of vaccines at Vaccination Centres. This is also in line with the WHO objective and recommendation of increasing access to and availability of the vaccine in the communities (5)

Trust in the COVID-19 vaccine was significantly associated with the likelihood of vaccination. Trust is associated with increased willingness for uptake of recommended

behavior/practice. This is consistent with findings by *Malik Sallam* on a systematic review of studies on the uptake of the COVID-19 vaccine which showed that most studies pointed out the trust of the vaccine as a key determinant for uptake of COVID-19 vaccine irrespective of the study population (26,30,31).

Further findings showed that teachers who trusted COVID-related information from health workers than other sources were more likely to be vaccinated. This could be due to the belief that health workers have correct and up-to-date information compared to other sources. This finding is consistent with findings from the study on COVID-19 vaccine acceptance and uptake from middle and low-income countries and other studies which showed that people who trusted information from health workers were more likely to be vaccinated. However, findings on a trusted source of information contradicted findings from the study by Kazi and Khandaker (31) on Knowledge, Attitude, and Acceptance of a COVID-19 Vaccine which showed that the most trusted source was government sources.

Conclusion

Perceived risk of contracting COVID and the severity of COVID-19 as well as the availability of vaccines at vaccination sites increases the likelihood of getting vaccinated among teachers while the fear of side effects, reduces the likelihood of one getting vaccinated.

Recommendations

Efforts should be geared towards increasing risk communication, the safety of Covid vaccines, and increasing vaccination and vaccination sites in the community like outreach posts

Generalizability

The findings from this study can be generalized to other populations given the study was conducted when the entire country was under lockdown and that efforts were taken to ensure scientific sampling of participants

Limitation

These study findings may have been influenced by the lockdown as the study was carried out during the second wave and the lockdown, which may have affected participation. In addition, the broad definition of teachers could have influenced the results.

Conflicts of Interest

The authors declare that they have no competing interest and that this work is not under review or for publication by another journal

Availability of data and material

The datasets used and analyzed during this study are available from the corresponding author organization on reasonable request.

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List of abbreviations
CI – Confidence interval
COVID-Corona Virus Disease
MoH- Ministry of Health
SARS-COV2- Severe Acute Respiratory Syndrome-Coronavirus-2
ODK- Open Data Kit
OR- Odds Ratio
RA- research assistants
WHO- World Health Organization

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