Covid-19 Vaccine Uptake among University Students in Ghana: A Case Study of First-year AAMUSTED Students

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Abstract

Background: The World Health Organization (WHO) endorses the COVID-19 vaccination as the most effective method of curbing the SARS-CoV-2 infection. Vaccine hesitancy is ranked among the top ten significant global health threats due to people's perceptions and conspiracies. However, there is a scarcity of data on university students' vaccination status in Ghana.

Aim: The purpose of the study was to determine the attitudes of Ghanaian university students towards COVID-19 and its vaccination program.

Methods: A descriptive cross-sectional survey was used to assess students' perceptions of the COVID-19 vaccination program using standardized questionnaires. A total of 1000 validated questionnaires were distributed to respondents, and 700 responded, indicating a 70% response rate.

Results: The results revealed that 55.3% of the respondents were vaccinated $[X^2 (1) = 7.734, p < 0.05]$ with a few (38.5%) having shown some form of adverse effects. About 38.5% of the participants had no idea about the type of vaccine they took, while most of them (89.4%) desired to recommend the vaccine to those who haven't yet taken their jab $[X^2 (1) = 223.089, p < 0.05)]$. Out of the 381 (53%) that were vaccinated, 219 (59.7%) did so willingly trusting the approval of the vaccines by World Health Organization (WHO) meanwhile a few of the participants $[X^2 (5) = 1419.210, p < 0.05]$ had misconceptions and doubts about the vaccine. It was also observed that conspiracy theories impede the uptake of the COVID-19 vaccine. From the study, the binary logistic regression analysis of the data discovered that age has a significant impact on the vaccination status of students [AOR = 0.351, CI (0.136, 0.911), P-value = 0.031].

Conclusion: The rate of COVID-19 vaccination coverage among Ghanaian university students is lower than expected. Mistrust, misconceptions, conspiracy theories, and socio-demographic factors are major impediments to vaccine success in Ghana. The study's findings suggest that any interventions aimed at increasing COVID-19 vaccination uptake among university students should focus on mass education in order to build participants' trust in vaccination and decrease misconceptions and conspiracy theories about the vaccination program.

Keywords: Pandemic; Vaccination; Vaccine Hesitancy; Conspiracy Theory; SARS-CoV-2; COVID-19

Introduction

In human history, pandemics and their predicaments are reported to have had vastly destructive impacts on human well-being, frugality, and even national security [1]. The plague of Athens, for instance, killed more than 1.7% of the global human population in 430 BC [2,3]. In addition, the top five (5) deadliest global plagues in human history are smallpox, the black death, the Justinian plague, the Spanish flu, and AIDS/HIV, which have resulted in 356 million, 200 million, 50 million, 50 million, and 25 million deaths, respectively [3].

WHO declared COVID-19 a pandemic in 2020, and it had globally infected 435 million people and caused 6 million deaths as of February 26, 2022 [4]. The rapid upsurge in morbidity and mortality rates of COVID-19 disease is a threat to the human race, hence the need for efficient techniques for curbing this global catastrophe. The upwelling of the death rate is evident and supports the view that COVID-19 is a biological weapon. To thwart the quick spread of this pestilence, several countries instituted numerous control measures that include travel restrictions, the wearing of a nose mask, social distancing, lockdown, vaccination, and others [5,6]. Considering the dilapidated nature of the health system, the meager number of infrastructure and social amenities, the privation of basic healthcare, and the low level of public education on global infections in most of the sub-Saharan regions, the re-emergence of SARS-CoV-2 may cause great devastation to these underdeveloped nations. This massive global infection burden has escalated vaccine development. Vaccine hesitancy is the main impediment to vaccination programs in west Africa. Vaccination misinformation, conspiracy theories, and misconceptions that were escalated by mainstream and social media have led to mistrust, which is a key factor in vaccine hesitancy. To overcome this impediment, public education and transparency of the vaccine should be improved [7,8].

Instead of using social and other media to help mitigate the effects of pandemics, people are rather using the media to blow out misinformation about COVID-19 and its vaccination, which may play a negative role in the combat against this pandemic [9]. For instance, Ghanaian comedian and actor Clemento Suarez gave the coronavirus the name "colonial virus" in one of his comic videos. Also, an international diplomatic consultant (Farouk Al-Wahab) on Kofi TV on January 2, 2022, made several claims that "Covid-19 is a man-made virus that focuses on vaccination, and it is going to be a business around the world". He further claimed that we are in the third phase of the third world war, which is only a war of economics and health. He finally said, "China stimulated COVID to exploit money from Africa, but God has been so good to Africans". People's perceptions and beliefs mostly affect or shape their way of life. Firstly, most West Africans greatly mistrust and stigmatize most products (including vaccines) produced in western countries due to the unforgettable history of colonization, which is just a few decades old. Finally, there are social and traditional media claims that HIV and Ebola are biological weapons manufactured by the West to wipe out the black race [10].

The government of Ghana announced the implementation of a "no vaccine, no entry" policy, about which some Ghanaians have expressed their concern. There are also a lot of misconceptions and conspiracies about the COVID-19 vaccination, hence the need for this study.

Purpose of the Study

The purpose of this study was to determine the attitudes of Ghanaian university students toward COVID-19 and its vaccination program by evaluating Ghana's "no vaccine, no entry" policy, determining the frequency of COVID-19 vaccination in Ghanaian tertiary students, and testing some misconceptions and conspiracy theories about COVID-19 and its vaccination in Ghana.

Materials and Methods

Study area

This research was carried out from January to July 2022 at the Akenten Appiah-Menka University of skill training and entrepreneurial development, Mampong campus (AAMUSTED-M). The school has an estimated population of 5,000 students. AAMUSTED-M is located in Asante Mampong, the administrative capital of Mampong Municipal. AAMUSTED-M is one of the four tertiary institutions in Mampong Municipality of the Ashanti Region of Ghana. The land size of this town covers an area of 2,345 km^2, with approximately 220 communi-

ties mostly located in the countryside [11]. The Akenten Appiah-Menka University of Skills Training and Entrepreneurial Development (AAMUSTED) was established on August 27, 2020, under Act 1026 of 2020 of the Parliament of the Republic of Ghana. The main campus is located in Kumasi, whilst the Asante-Mampong Campus, which is 63 kilometres from the main campus is located in Asante-Mampong. The Asante-Mampong Campus has four (4) Faculties and eleven (11) Academic Departments. The school currently have students from all over the 16 regions of Ghana with the majority from the Ashanti region. The student number increases each year as new programmes are installed [12].

Study design

A descriptive survey design was used in this study to assess COVID-19 vaccine uptake among first-year AAMUSTED-M students, Asante-Mampong, Ghana.

Population and sample size

The research was conducted on AAMUSTED-M first-year undergraduate and postgraduate students. The entire population of the university is estimated to be around 5000 people, with 1000 being first-year students. Since the research was intended for first year students, 700 of them were sampled for the study (N=700). This implies that 70% of the first-years were involved in the study.

Sampling techniques

A convenient sampling technique was used to select first-year students for the study during their medical registration and orientation programme.

Data collection

A structured questionnaire that comprised of 29 questions were used to collect data from first-year AAMUSTED students via face-to-face interviews. The questions were formulated simply and are presented in a logical order. 1,000 questionnaires were printed and evenly distributed to the applicants. 700 respondents completed the questionnaires (70% response rate), and a team of four field assistants entered the responses into a Google Form. The questionnaire was divided into 4 sections: Socio-demographic characteristics, COVID-19 vaccine status, Perception on vaccine uptake and "No vaccine No entry" policy.

Statistical analysis

The collected data was entered and stored in an MS Excel sheet (version 2016). The data was analyzed using the descriptive statistics of the Statistical Package for the Social Sciences (SPSS) version 22. The results were then presented in the form of tables showing frequencies and percentages, among others. Chi-square analysis was used to determine statistical associations between outcome and explanatory variables. The level of significance was held at a 95% confidence interval and a 0.05 level of precision. In addition, different variables of the samples were compared, establishing relationships between variables using logistic regression statistics (COR and AOR) and cross-tabulation to determine the significant difference at a 95% confidence interval (P < 0.05) and (P > 0.05) being not significant. The good logistic regression model of fit was tested using the Hosmer-Lemeshow goodness-of-fit.

Ethical consideration

A standard proposal of the work was presented to the head of Public Health Department for acceptance and approved by the Ethical Clearance Board of AAMUSTED-M. Official permission was also sought from the head of medicals of the university clinic before commencement. The consent of the respondents was obtained during the students' orientation section, during which the content, and purpose of the survey were explained. Respondents were allowed to decide whether or not to participate. Respondents' details such as names and index numbers were not disclosed on the questionnaires.

Results

The variables of the questionnaires were grouped into four (4) categories: sociodemographic characteristics of respondents; COVID-19 vaccine status of respondents; participants' perceptions of vaccine uptake; participants' agreements with or views on the "no vaccine to entry" policy.

The sociodemographic of the respondents comprised 64.14% males, 34.29% females, and 1.57% did not indicate their sexes; however, it can be significantly stated that there is an association between the sexes (X^2 (2) = 63.398, p < .05) (Table 1). The majority of the respondents (47.43%) are significantly within the age range of 20 - 25 years, and 2.14% of the respondents did not indicate their age range (X^2 (4) = 350.825, p < 0.05) (Table 1). Almost all of the participants (98.42%) are undergraduate students, with less than 2% being postgraduate students. The majority (32%) of respondents (X^2 (11) = 378.751, p < 0.05) read B.Sc. in Agriculture Science Education (Table 1). Few of the respondents (23.43%) are married, and the majority, 64.14%, are not in any serious relationship. Almost all (99.28%) AAMUSTED students are religious, with 85.43% Christian, 13.42% Muslim, 0.43% Traditional or Spiritualist, 0.43% Atheist, and 0.29% not specified. However, there was a significant association between Christians, Muslims, traditions, atheists, and others (X^2 (4) = 1402.046, p < .05) (Table 1). Majority of the respondents are from the Ashanti region of Ghana (41%) and the entire subjects of this study are significantly spread across or are from all the sixteen (16) region in Ghana (X^2 (14) = 1474.318, p < .05) (Table 1). In this study, the Ahafo and Brong Ahafo regions were combined as the Ahafo region, and the Northern and North East regions were combined as one region, totaling 14 regions.

Demographic characteristics	Frequency (%)	X^2	p-value
Age range			
Less than 20	44 (6.29)		
20 to 25	332 (47.43)		
26 to 30	248 (35.43)	350.825	< 0.001
Above 30	61 (8.71)		
Not indicated	15 (2.14)		
Level of study			
Undergraduate	689 (98.42)		
Postgraduate	9 (1.29)	662.464	< 0.001
Not indicated	2 (0.29)		
Program			
Agriculture	224 (32.00)		
Biological sciences	98 (14.00)		
Chemistry	12 (1.71)		
Early childhood	46 (6.57)		
Environmental Health Sanitation	44 (6.23)		
Integrated science	77 (11.00)		
Agribusiness	10 (1.43)	378.751	< 0.001
Public Health	34 (4.86)		
JSS Education	103 (14.71)		
Upper primary Education	25 (3.57)		
Mathematics	19 (2.71)		
Physics	8 (1.14)		

Gender/Sex			
Female	240 (34.29)		
Male	449 (64.14)	63.398	< 0.001
Not indicated	11 (1.57)		
Are you in relationship			
Yes	240 (34.29)		
No	449 (64.14)	63.398	< 0.001
Not indicated	11 (1.57)		
Marital status			
Married	164 (23.43)		
Living together	508 (72.57)	176.095	< 0.001
Not indicated	28 (4.00)		
Are you employed			
Yes	258 (36.86)		
No	392 (56.0)	27.625	< 0.001
Not indicated	50 (7.14)		
Religion			
Christian	598 (85.43)		
Muslim	94 (13.42)		
Traditional/spiritualist	3 (0.43)	1402.046	< 0.001
No religion	3 (0.43)		
Not indicated	2 (0.29)		
Region/permanent destination			
Ahafo	13 (1.86)		
Ashanti	287 (41.00)		
Bono east	21 (3.00)		
Central	29 (4.14)		
Eastern	22 (3.14)		
Greater Accra	26 (3.71)		
North East	39 (5.57)		
Oti	21 (3.00)	1474.318	< 0.001
Savanna	6 (0.86)		
Upper East	37 (5.29)		
Upper West	29 (4.14)		
Volta	15 (2.14)		
Western	31 (4.43)		
Western north	40 (5.71)		
Not indicated	84 (12.0)		

Table 1: Socio-demographic characteristics of respondents: chi-square goodness of fit.

Covid-19 vaccine status of respondents

More than half of (55.3%) AAMUSTED Mampong students have been vaccinated (X^2 (1) = 7.734, p < 0.05) (Table 2). Majority of the respondents (41.9%) received their vaccine dosage from the health centers or clinics whiles few people (6.7%) got vaccinated at their workplace (X^2 (3) = 104.051, p < 0.05) (Table 2). A significant number of people (38.5%) experienced adverse reaction after vaccinated (X^2 (1) = 20.077, p < 0.05) (Table 2). Majority (36.6%) of these educated and matured adults did not have any idea on the type of COVID-19 vaccines they were receiving, however, 32.4% indicated that they received the Oxford/Astrazeneca COVID-19 vaccine (X^2 (7) = 301.371, p < 0.05) (Table 2). Majority (89.4%) indicated that they will recommend the COVID-19 vaccines to other people (X^2 (1) = 223.089, p < 0.05) (Table 2). Majority that received the vaccines (59.7%) were motivated by the fact that the vaccines were scientifically proven by WHO to prevent COVID-19 infection. However, a good number of people (27.8%) indicated that, they were persuaded to be vaccinated by the government of Ghana (X^2 (3) = 223.089, p < 0.05) (Table 2). Majority (62.1%) perceived the vaccine to be effective enough to prevent or reduce the burden of the COVID-19, however, 37.9% have other perceptions and misconceptions about the vaccine that includes; it is being experimenting on black people (3.1%), it is a means to cripple the world economy by the world powerful countries (3.6%), COVID-19 disease is not real (3.9%), the vaccine is a weapon to wipe out black race (4.6%) and the vaccine is a symbol of the anti-christ-666 (5.7%) (X^2 (5) = 1419.210, p < 0.05) (Table 2).

Variable	Frequency (%)	X^2	p-value
Have you vaccinated?			
Yes	381 (55.3)	7.734	= 0.005
No	308 (44.7)		
Place of vaccination			
Health center/ Clinic	157 (41.9)	104.051	< 0.001
Government Hospital	74 (19.7)		
Workplace	25 (6.7)		
Community	119 (31.7)		
Experienced adverse reaction after vaccinated?			
Yes	145 (38.5)	20.077	< 0.001
No	232 (61.5)		
Which vaccine did you receive?			
Moderna	36 (10.4)	301.371	< 0.001
Pfizer	25 (7.3)		
Gamaleya (Sputnik V)	1 (0.4)		
Janssen [(Johnson and Johnson)	36 (10.4)		
Oxford/AstraZeneca	114 (32.4)		
Oxford/AstraZeneca formulation	12 (2.5)		
Don't know	129 (36.6)		
Will you recommend covid-19 vaccine to someone?			
Yes	321 (89.4)	223.089	< 0.001
No	38 (10.6)		
Why did you receive the Covid-19 vaccine jab?			
Its scientifically proven by WHO to prevent Covid-19 infection	219 (59.7)	223.089	< 0.001
I was not afraid	31 (8.4)		
The Government asked me to	102 (27.8)		
I took it because others were taking it	15 (4.1)		

Why have you NOT been vaccinated?			
It's because of religious reasons	20 (7.4)		
I have no access to vaccine	75 (27.7)		
It's because I'm afraid of side effect	117 (43.2)	206.321	< 0.001
I just don't want to	38 (14.0)		
Because lot of conspiracy theories	20 (7.4)		
Others	1 (0.3)		
Your perception about the covid-19 vaccine?			
It's a weapon to wipe out black race	32 (4.6)		
It's a symbol of the anti-Christ- 666	40 (5.7)		
It's being experimented on black people	22 (3.1)		
Covid-19 disease is not real	27 (3.9)	1419.210	< 0.001
It's a means to cripple world economy	25 (3.6)		
The vaccine is approved by WHO/GHS and prevent infection/reduce its burden	435 (62.1)		

Table 2: *Covid-19 vaccine status of respondents: chi-square goodness of fit.*

Perception on vaccine uptake among respondents

More than half of (52.4%) AAMUSTED Mampong students agrees that it is wrong to make the COVID-19 vaccine uptake compulsory and agrees that it should be voluntary (X^2 (4) = 117.691, p < 0.05) (Table 3). Majority of the respondents (69.9%) contradictory agrees that the government should pass a law to make the COVID-19 vaccine uptake compulsory (X^2 (4) = 291.613, p < 0.05) (Table 3). A significant number of people (37.5%) indicated that they will not take the vaccine because they do believe that it is not protective enough (X^2 (4) = 112.151, p < 0.05) (Table 3). Majority (62.3%) of the respondents disagree that they would not take the vaccine because it is not able to prevent the COHID-19 infection (X^2 (4) = 276.666, p < 0.05) (Table 3).

Variables	Frequency (%)	X^2	p-value
Wrong to make Covid-19 vaccine uptake compulsory			
Strongly agree	167 (24.8)		
Agree	186 (27.6)		
Are neutral	55 (8.2)	117.691	< 0.001
Disagree	187 (27.7)		
Strongly disagree	79 (11.7)		
Covid-19 vaccine uptake should be voluntary			
Strongly agree	167 (24.8)		
Agree	186 (27.6)		
Are neutral	55 (8.2)	117.691	< 0.001
Disagree	187 (27.7)		
Strongly disagree	79 (11.7)		
Government should make law to make it compulsory			

Strongly agree	192 (28.8)	291.613	< 0.001
Agree	274 (41.1)		
Are neutral	41 (6.1)		
Disagree	107 (16.1)		
Strongly disagree	53 (7.9)		
Covid-19 vaccine is not protective enough			
Strongly agree	97 (14.3)	112.151	< 0.001
Agree	157 (23.2)		
Are neutral	58 (8.6)		
Disagree	220 (32.5)		
Strongly disagree	144 (21.3)		
Covid-19 vaccine is not able to prevent infection			
Strongly agree	80 (12.2)	276.666	< 0.001
Agree	86 (13.1)		
Are neutral	82 (12.5)		
Disagree	301 (45.7)		
Strongly disagree	109 (16.6)		

Table 3: *Perception on vaccine uptake of respondents: chi-square goodness of fit.*

Respondents' opinions on the "no vaccine no entry" policy

Majority of the respondents (59.6%) indicated that the "no vaccine no entry" policy is not good policy whiles 24.7% agrees that it is a good policy (X^2 (4) = 227.912, p < 0.05) (Table 4). Majority of the respondents (51.9%) disagrees on the government enforcement of the "No Vaccine No Entry" policy whiles 39.2% agrees that the policy is good and should be enforced by government. Also, 39.4% agrees that the policy should be enforced in government institutions. About half (45.8%) indicated that they wouldn't willingly take the COVID-19 vaccine if they had not taken it yet (X^2 (4) = 45.620, p < 0.05) (Table 4).

Variables	Frequency (%)	X^2	p-value
"No Vaccine No Entry" is a good policy			
Strongly agree	74 (11.2)	227.912	< 0.001
Agree	89 (13.5)		
Are neutral	103 (15.6)		
Disagree	285 (43.2)		
Strongly disagree	108 (16.4)		
Government should enforce the policy			
Strongly agree	98 (14.7)	118.625	< 0.001
Agree	163 (24.5)		
Are neutral	59 (8.9)		
Disagree	223 (33.5)		
Strongly disagree	123 (18.4)		

The policy should be enforced in all govt intuitions			
Strongly agree	93 (14.0)		
Agree	181 (27.3)		
Are neutral	64 (9.6)	102.898	< 0.001
Disagree	203 (30.6)		
Strongly disagree	123 (18.5)		
The policy should be enforced in tertiary intuitions			
Strongly agree	98 (14.8)		
Agree	163 (24.6)		
Are neutral	65 (9.8)	99.768	< 0.001
Disagree	213 (32.1)		
Strongly disagree	124 (18.7)		
The policy should be enforced in AAMUSTED			
Strongly agree	94 (14.2)		
Agree	164 (24.8)		
Are neutral	69 (10.4)	106.172	< 0.001
Disagree	218 (32.9)		
Strongly disagree	117 (17.7)		
Willing to take the vaccine if not vaccinated already			
Yes	178 (27.5)		
No	297 (45.8)	45.620	< 0.001
I am already vaccinate	173 (26.7)		

Table 4: Respondents' views on the "no vaccine no entry policy": chi-square goodness of fit.

Factors that may influence vaccination status: demographic characteristic verses vaccine status

From table 5A, the outcome of the logistic regression static stated that, the selected model was a good logistic regression model fit, since the Hosmer-Lemeshow goodness-of-fit, the P-value was 0.838, it greater than 0.05, then fail to reject the null hypothesis, and it is stated that the logistic model is good fit for the data set (X^2 = 4.208, Df = 8, p = 0.838) (Table 5A). Additionally, the Pseudo R-regression result showed that the square of the correlation between the model's predicted values and the actual values resulting from this correlation was 10.6%. The model explained 10.6% (Nagelkerke R square) of the variance in vaccination status and the risk factors that influences vaccine status of the participants (Table 5A). From table 5B bellow, Matured students, thus students aged greater than 30 years were 0.351 less likely to receive the COVID-19 vaccines as compare to students within the age range less than 30 years [AOR= 0.351, CI (0.136, 0.911), P-value= 0.031]. In other words, students greater than 30 years old were 64.9% (1-0.351 = 0.649) less likely to receive the COVID-19 vaccines as compare to students within the age range less than 30 years. Students from the Upper East region of Ghana were 10.201 more likely not to receive the COVID-19 vaccines as compare to students from the other sixteen regions of Ghana [AOR = 10.201, CI (1.799,57.853)0.009] (Table 5B).

	Model Summary			Hosmer and Lemeshow Test		
Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square	Chi-square	Df	P-value
1	707.285[a]	0.079	0.106	4.208	8	0.838

Table 5A: The model summary and Hosmer and Lemeshow test of adjusted odd ratio (AOR).

Risk factors	Vaccination Status		Nagelkerke R square of COR	(X²) (p-value)	COR (95%CI)p-value	AOR (95%CI)p-value
	Yes vaccinated (%)	Not vaccinated (%)				
Sex						
Female	135 (57.0)	102 (43.0)	0.001	0.443 (0.506)	**Ref.**	**Ref.**
Male	240 (54.3)	202 (45.7)			1.114 (0.811, 1.531)0.506	1.123 (0.764, 1.650)0.556
Age						
< 20	18 (40.9)	26 (59.1)			**Ref.**	**Ref.**
20 - 25	184 (56.3)	143 (43.7)	0.017	8.613 (0.035)	0.538 (0.284, 1.020)0.057	0.629 (0.311, 1.270)0.196
26 - 30	129 (52.9)	115 (47.1)			0.617 (0.322, 1.184)0.146	0.663 (0.321, 1.366)0.265
> 30	41 (68.3)	19 (31.7)			0.321 (0.143, 0.722)0.006	0.351 (0.136, 0.911)0.031*
Employed before						
Yes	145 (57.1)	109 (42.9)	0.002	0.751 (0.386)	**Ref.**	**Ref.**
No	201 (53.6)	180 (46.4)			1.151 (0.837, 1.583)0.386	1.033 (0.693, 1.540)0.874
Religion						
Christians	322 (54.7)	267 (45.3)			**Ref.**	**Ref.**
Muslims	59 (64.1)	33 (35.9)			0.675 (0.428, 1.064)0.091	0.677 (0.386, 1.188)0.174
Traditional	0 (0.0)	3 (100)	0.025		Omitted	Omitted
No region	0 (0.0)	3 (100)		12.706 (0.005)	Omitted	Omitted
Location/ Region						
Ahafo	11 (84.8)	2 (15.4)			**Ref.**	**Ref.**
Ashanti	155 (54.6)	129 (45.4)			0.121 (0.024, 0.621)0.011	3.285 (0.688, 15.68)0.136
Bono east	15 (71.4)	6 (28.6)			0.555 (0.283, 1.089)0.087	1.133 (0.168, 7.622)0.898
Central	16 (55.2)	13 (44.8)			0.267 (0.085, 0.833)0.023	3.041 (0.531, 17.424)0.212
Eastern	13 (59.1)	9 (40.9)			0.542 (0.206, 1.425)0.214	2.774 (0.470, 16.361)0.260
Greater Accra	14 (53.8)	12 (46.2)			0.462 (0.160, 1.331)0.153	3.294 (0.566, 19.159)0.184
North east	27 (69.2)	12 (30.8)			0.571 (0.211, 1.549)0.271	1.993 (0.363, 10.954)0.428
Oti	11 (52.4)	10 (47.6)	0.077	36.244 (0.001)	0.296 (0.117, 0.750)0.010	3.969 (0.655, 24.055)0.134
Savanna	5 (83.3)	1 (16.7)			0.606 (0.209, 1.758)0.357	0.928 (0.062, 13.92)0.957
Upper east	10 (27.0)	27 (73.0)			0.133 (0.014, 1.250)0.078	10.201 (1.799,57.853)0.009*
Upper west	21 (72.4)	8 (27.6)			1.80 (0.687, 4.713)0.231	1.266 (0.209, 7.664)0.797
Volta	11 (73.3)	4 (26.7)			0.254 (0.091, 0.712)0.009	1.874 (0.264, 13.307)0.530
Western	21 (67.7)	10 (32.3)			0.242 (0.066, 0.896)0.034	1.643 (0.288, 9.385)0.577
Western north	16 (40.0)	24 (60.0)			0.317 (0.119, 0.849)0.022	4.352 (0.807, 23.471)0.087

Table 5B: *The cofounders of vaccination status of the respondents.*

Factors that may influence vaccination status: Perception on vaccine uptake of respondents against vaccine status

From table 6A, the outcome of the logistic regression static stated that, the selected model was a good logistic regression model fit, since the Hosmer-Lemeshow goodness-of-fit, the P-value was 0.526, it greater than 0.05, then fail to reject the null hypothesis, and it is stated that the logistic model is good fit for the data set ($X^2 = 7.103$, Df = 8, p = 0.526). Additionally, the Pseudo R-regression result showed that the square of the correlation between the model's predicted values and the actual values resulting from this correlation was 10.6%. The model explained 22.0% (Nagelkerke R square) of the variance in vaccination status and the risk factors that influences vaccine status of the participants (Table 6A). This study discovered that, conspiracies influences the uptake of the vaccine. Thus, from table 6B bellow, students with the view that the vaccine is being experimented on black people or black people are being used as lab rat were 4.555 more likely not to receive the COVID-19 vaccines as compare to students with different perceptions [AOR = 4.555, CI (1.093, 18.989), P-value = 0.037]. Moreover, students with the view that the vaccine is scientifically approved by WHO/GHS and prevent infection or reduce its burden were 0.308 less likely to not to receive the COVID-19 vaccines as compare to students with different perceptions [AOR = 0.308, CI (0.144, 0.660), P-value = 0.002]. In other words, students with the view that the COVID-19 vaccines are scientifically approved by WHO/GHS and prevent infection or reduce its burden were 69.2% (1-0.308 = 0.692) less likely not to receive the COVID-19 vaccines as compare to students with different opinions.

	Model Summary			**Hosmer and Lemeshow Test**		
Step	**-2 Log likelihood**	**Cox & Snell R Square**	**Nagelkerke R Square**	**Chi-square**	**Df**	**P-value**
1	655.617[a]	0.163	0.220	7.103	8	0.526

Table 6A: *The model summary and Hosmer and Lemeshow test of adjusted odd ratio (AOR).*

Variables	**Vaccination Status**		**(X²) (p-value)**	**COR (95%CI)p-value**	**AOR (95%CI) p-value**
	Yes vaccinated (%)	**Not vaccinated (%)**			
Your perception about the co-vid-19 vaccine					
It's a weapon to wipe out black race	14 (43.8)	18 (56.3)		**Ref.**	**Ref.**
It's a symbol of the anti-Christ- 666	10 (25)	30 (75)		2.333 (0.858, 6.343)0.097	2.523 (0.898, 7.091)0.079
It's being experimented on black people	3 (13.6)	19 (86.4)		4.926 (1.210, 20.050)0.026*	4.555 (1.093, 18.989)0.037*
Covid-19 disease is not real	7 (25.9)	20 (74.1)	93.006 (0.000)	2.222 (0.733, 6.733)0.158	2.452 (0.753, 7.978)0.136
It's a means to cripple world economy	5 (20)	20 (80)		3.111 (0.934, 10.364)0.065	2.866 (0.844, 9.740)0.091
The vaccine is approved by WHO/GHS and prevent infection/reduce its burden	304 (70.2)	129 (29.8)		0.330 (0.159, 0.684)0.003*	0.308 (0.144, 0.660)0.002*
It's wrong to make Covid-19 vac-cine uptake compulsory					

Strongly agree	81 (49.4)	83 (50.6)		Ref.	Ref.
Agree	113 (61.4)	71 (38.6)		0.613 (0.400,0.939)0.025*	0.588 (0.318, 1.086)0.090
Are neutral	30 (54.5)	25 (45.5)	6.358 (0.174)	0.813 (0.441,1.501)0.508	0.751 (0.308, 1.830)0.529
Disagree	98 (53.6)	85 (46.4)		0.846 (0.555,1.291)0.439	1.041 (0.570, 1.903)0.896
Strongly disagree	47 (61.0)	30 (39.0)		0.623 (0.359.1.081)0.092	0.824 (0.406, 1.674)0.593
Laws should pass to make Co-vid-19 vaccination compulsory					
Strongly agree	102 (53.1)	90 (46.9)		Ref.	Ref.
Agree	154 (57.2)	115 (42.8)		0.846 (0.583,1.228)0.380	1.318 (0.761, 2.283)0.325
Are neutral	21 (53.8)	18 (46.2)	0.875 (0.928)	0.971 (0.487,1.938)0.934	1.565 (0.593, 4.130)0.366
Disagree	59 (56.7)	45 (43.3)		0.864 (0.535,1.398)0.552	1.359 (0.705, 2.618)0.360
Strongly disagree	29 (55.8)	23 (44.2)		0.899 (0.485,1.665)0.735	1.212 (0.551, 2.667)0.632

***Table 6B:** Perception on vaccine uptake of respondents against vaccine status.*

Experienced adverse reaction after vaccinated verses recommendations

From table 7A, the outcome of the logistic regression static stated that, the selected model was a good logistic regression model fit, since the Hosmer-Lemeshow goodness-of-fit, the P-value was 0.893, it greater than 0.05, then fail to reject the null hypothesis, and it is stated that the logistic model is good fit for the data set (X^2 = 2.273, Df = 6, p = 0.893). Additionally, the Pseudo R-regression result showed that the square of the correlation between the model's predicted values and the actual values resulting from this correlation was 0.3%. The model explained 0.3% (Nagelkerke R square) of the variance in participants' recommendation of the COVID-19 vaccines to their loved ones (Table 7A). From table 7B, 88.6% students that experienced adverse reaction indicated that they will recommend the covid-19 vaccine to your loved ones whiles 90.2% students that did not experienced adverse reaction indicated that they will recommend the co-vid-19 vaccine to your loved ones [X^2 = 0.221, df (1) p = 0.718]. Also more of the participants that are Christians (10.8%) will not recommend the covid-19 vaccine to your loved ones as compare to 9.3% of Muslims that will not recommend the covid-19 vaccine to your loved ones [X^2 = 0.118, df (3) p = 0.477]. Gender does not really influence whether or not one will recommend the vaccines to their loved ones.

		Model Summary		Hosmer and Lemeshow Test		
Step	**-2 Log likelihood**	**Cox & Snell R Square**	**Nagelkerke R Square**	**Chi-square**	**Df**	**P-value**
1	229.179[a]	0.002	0.003	2.273	6	0.893

***Table 7A:** The model summary and Hosmer and Lemeshow test of adjusted odd ratio (AOR).*

Factors influence vaccination	Recommend covid-19 vaccine to your loved ones		X^2 (p-value)	COR (95%CI)p-value	AOR (95%CI)p-value
	Yes (%)	No (%)			
Sex/Gender					
Female	115 (88.5)	15 (11.5)		Ref.	Ref.
Male	200 (89.7)	23 (10.3)	0.128 (0.720)	0.882 (0.442, 1.757)0.720	0.814 (0.397, 1.676)0.575
Religion					
Christians	272 (89.2)	33 (10.8)		Ref.	Ref.
Muslims	49 (90.7)	5 (9.3)	0.118 (0.477)	0.841 (0.313,2.260)0.477	0.924 (0.340, 2.510)0.877
Traditional	0 (0.00)	0 (0.00)		Omitted	
No region	0 (0.00)	0 (0.00)		Omitted	
Experienced adverse reaction after vaccinated					
Yes	117 (88.6)	15 (11.4)		Ref.	Ref.
No	193 (90.2)	21 (9.8)	0.221 (0.718)	0.849 (0.421,1.711).718	0.893 (0.434, 1.834)0.757

Table 7B: Experienced adverse reaction after vaccinated verses recommendations.

Discussion

According to WHO in 2019, vaccine hesitancy is ranked 8th of the top ten significant global health threats [13-15]. Despite the fact that there are vaccines available, some people choose not to vaccinate themselves or their children. It poses a risk to the significant progress in combating diseases that can be prevented through vaccination. One of the most economical methods of illness prevention is vaccination. Vaccination saves 3 million lives per year and may save 1.5 million more if immunization rates around the world were to improve [16,17]. People opt not to get vaccinated for a variety of reasons. The WHO found three main causes of hesitancy: complacency, difficulty obtaining vaccinations, and mistrust. Health professionals, particularly those who work in communities, continue to be the most reliable source of advice and decision-makers when it comes to immunization. Therefore, it is crucial to assist WHO in delivering reliable evidence about vaccines through surveillances. Globally, most people believe that vaccinations are a "human rights violation". Some people believe that there is a connection between vaccination and autism, as well as other brain disorders, and are concerned about long term side effects, however, there being no scientific evidence supporting that theory [18,19]. This open-minded skepticism courses through the anti-vaccination movement, fueling a range of conspiracy theories, even though science soundly supports vaccines and doctors, who work to keep people healthy, explicitly encourage vaccination. Due to the vaccination program's slow erosion, outbreaks run rampant and may become disastrously routine [20]. Every year, approximately 1.4 million children under the age of five die due to a lack of vaccine availability [21,22]. According to the CDC, vaccines will avert more than 21 million hospital admissions and 732,000 deaths among children born in the last two decades [23].

This study revealed that the majority of university students (64.14%) are males and are within the age range of 20 - 25 years old. Almost all (99.28%) university students in Ghana are religious, with 85.43% Christian, 13.42% Muslim, 0.43% Traditional or Spiritualist, 0.43% Atheist, and 0.29% not specified. The majority of the respondents are from the Ashanti region of Ghana (41%), and the entire subject population of this study is significantly spread across or is from all sixteen (16) regions of Ghana. Students older than 30 years

are 64.9% less likely to receive the COVID-19 vaccine as compared to students within the age range of less than 30 years. Students from the Upper East region of Ghana are ten times less likely to receive the COVID-19 vaccine as compared to students from the other sixteen regions of Ghana. Also, the current study discovered that it is more likely for Muslims to recommend the COVID-19 vaccine to their loved ones as compared to Christians. However, gender does not really influence whether or not one will recommend the vaccines to their loved ones. This is similar to several studies that reported that demographic characteristics such as age, gender, religion, permanent residence, etc. significantly influence the vaccination status of individuals. Thus, a study by Oppong and Oti-Boadi (2013) reported that 56.2% of undergraduate students were male [24], and other studies also reported a significant majority of male and religious undergraduate students in Ghana [25,26].

This study reported that more than half (55.3%) of participants have been vaccinated. The majority of respondents (41.9%) received their vaccine dose from health centers or clinics, while only 6.7% were vaccinated at work. A significant number of people (38.5%) experienced an adverse reaction after being vaccinated. The majority (36.6%) of the respondents did not have any idea what type of COVID-19 vaccines they were receiving; however, 32.4% indicated that they received the Oxford/AstraZeneca COVID-19 vaccine. In general, most (89.4%) of the respondents indicated that they will recommend the COVID-19 vaccines to other people. This could be because most of the respondents have been vaccinated and the majority did not experience any adverse reactions. The majority of those who received the vaccines (59.7%) were motivated by the fact that the vaccines were scientifically proven by the WHO to prevent COVID-19 infection. However, a good number of people (27.8%) indicated that they were persuaded to be vaccinated by the government of Ghana. A significant number of the respondents, 37.9%, have perceptions and misconceptions about the vaccine that include that it is being experimented on black people (3.1%), it is a means to cripple the world economy by the world's powerful countries (3.6%), COVID-19 disease is not real (3.9%), the vaccine is a weapon to wipe out the black race (4.6%), and the vaccine is a symbol of the anti-Christ-666 (5.7%). This study discovered that conspiracies influence the uptake of the vaccine. Thus, students who believed the vaccine was being tested on black people were four times more likely to refuse the COVID-19 vaccines. Moreover, 69.2% of students with the view that the vaccine is scientifically approved by WHO/GHS and will prevent infection or reduce its burden are more likely to receive the COVID-19 vaccine. This study is contrary to a study by Adjei Gyimah., *et al*. (2021), which reported that less than half of the university students in their study (38.2%) have been vaccinated against the hepatitis B vaccine and also that participants who were aged 26 years or older had higher odds of taking the hepatitis B vaccination [27]. Other studies reported that vaccine hesitancy due to vaccine misinformation and other conspiracies has slowed vaccine delivery and is the major impediment to WHO reaching its target of 40% vaccine distribution across the globe [28,29]. A study in Côte d'Ivoire by Yapi., *et al*. (2021) is similar to this study in that it reported that more than one-third of the respondents attributed COVID-19 (and its vaccination) to human influence (non-natural causes) and also had other perceptions about COVID-19 that may influence its control measures, including its vaccination [30]. This study is contrary to a study on influenza about three decades ago that reported that the majority (90%) of respondents got an adverse effect after receiving the influenza vaccine [31].

According to this study, more than half (52.4%) of respondents indicated that it is wrong to make the COVID-19 vaccine uptake compulsory. A significant number of people (37.5%) indicated that they will not take the vaccine because they believe that it is not protective enough. The majority (62.3%) of the respondents disagree that they would not take the vaccine because it is not able to prevent COVID-19 infection. The majority of the respondents (59.6%) indicated that the "No Vaccine, No Entry" policy is not a good one. The majority of the respondents (51.9%) disagree with the government's enforcement of the "No Vaccine, No Entry" policy. Also, 39.4% agree that the policy should be enforced in government institutions. About half (45.7%) indicated that they wouldn't willingly take the COVID-19 vaccine if they had not taken it yet. This study is similar to several others that reported that making vaccination mandatory is against human rights and should be voluntary, and many people are willing to be vaccinated if it is not made compulsory to them [32-34]. Nonetheless, this study contradicts a study on Mongolian Healthcare Workers conducted by Turbat, Sharavyn, and Tsai in 2021, which reported that almost all healthcare workers (93.7%) are highly agreeable to mandatory COVID-19 vaccination of healthcare workers [35]. Finally, this study discovered that students who had an adverse reaction after vaccination were less likely to recommend the COVID-19 vaccine to their loved ones than those who did not have any side effects after vaccination. This is similar to a study in Germany by Graeber., *et al*. (2021), which

reported that the majority (70%) of adults in Germany will voluntarily receive the COVID-19 vaccines if they are not mandatory and are devoid of adverse reactions (side effects) [32].

Conclusion

This study can be summarized that the rate of the COVID-19 vaccination status among university students in Ghana is high. Mistrust, misconceptions, conspiracy theories, and socio-demographic characteristics are key factors that impede the success of vaccinations in Ghana. The majority of students disagree with the government's enforcement of the "no vaccine no entry" policy. The discoveries of the study recommend that any interventions designed to enhance the uptake of COVID-19 vaccination among university students should focus on mass education to establish participants' trust in vaccination, reduce misconceptions and conspiracy theories about the vaccination program, and socio-demographic characteristics, especially age, ethnicity, and residential status, as well as social support.

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Volume 19 Issue 6 June 2023