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Determinants of COVID-19 vaccine acceptance in the Afadzato south district of Ghana

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Abstract

Background COVID-19 vaccine hesitancy is a major public health challenge with the potential to prevent communities from achieving the coverage level necessary for herd immunity against the COVID-19 virus.

Objective/aim The study determined COVID-19 vaccine acceptance and associated factors among residents of the Afadzato South District of Ghana.

Methods A descriptive cross-sectional study was conducted among 422 respondents aged 18 years and above using a self-administered and interviewer administered structured questionnaires for persons who could read and with no formal education respectively. The study was conducted and reported in line with the Strobe statement for cross sectional studies. Data analysis was done using the Stata-17.0 software. The association between the dependent and independent variables was examined using a logistic regression analysis, with a p-value of < 0.05 considered statistically significant.

Results More than half of the respondents (n = 291, 68.96%) were below 25 years old. Majority of the respondents were females (n = 218, 51.66%) and had attained secondary education (n = 291, 68.96%). Less than half of the respondents 35.5% (151) indicated acceptance of the COVID-19 vaccine and more than half (n = 271, 64.22%) indicated non-acceptance of the COVID-19 vaccine. The results showed that education level, information source, overall knowledge of COVID-19 vaccine, and misconception of COVID-19 vaccine were significantly associated with acceptance of the COVID-19 vaccine.

Conclusion The study found high vaccine hesitancy among the respondents. Important significant predictors of COVID-19 vaccine hesitancy were education level, information source, overall knowledge of COVID-19 vaccine, and misconception of COVID-19 vaccine. In the attempt to address vaccine hesitancy by health agencies, it is important to take into consideration the varying educational backgrounds of the population in context and their diversified sources of information. This may ensure that everyone in the community is reached with important information on COVID-19 and its vaccines to reduce misconceptions and misinformation.

Keywords COVID-19 · Vaccine hesitancy · Vaccine acceptance · Ghana

1 Introduction

The outbreak of the COVID-19 pandemic was first reported in Wuhan, China, on 31 December 2019 [1]. Subsequently, the World Health Organization (WHO) declared COVID-19 a Public Health Emergency of International Concern (PHEIC) on 30th January 2020 and a pandemic on 11th March 2020 due to its rapid spread across the regions of the world [2].

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Since then, the world has faced significant challenges in curbing the spread and the burden of COVID-19, including dealing with new and emerging viral strains [3]. More than 116 million cases of COVID-19 and 1.8 million mortalities have been reported as of March 2021 [4], posing significant health, economic, social, and political effects on nearly all countries of the world [5, 6]. In Ghana, the national prevalence of COVID-19 from March 2020 to April 2024 is reported to be 172,075 (GHS COVID-19 Dashboard). The distribution of COVID-19 cases in Ghana shows that all the 16 administrative regions recorded cases of COVID-19 by June 30, 2020 and largely attributed to internal migration between the hotspots and other regions [7].

To address and ultimately end the COVID-19 pandemic, several measures have been implemented, including vaccinations. Some experts have indicated that large scale vaccination is the best way to control the pandemic and achieve herd immunity nationally and across the globe [7–10]. However, convincing the target population that the vaccine is safe and effective in controlling the COVID-19 pandemic has become a major barrier to achieving universal vaccine coverage [10, 11]. According to the WHO strategic advisory groups of expert (SAGE), vaccine hesitancy is defined as "the delay in the acceptance or refusal of vaccination despite the availability of vaccination services" [12].

The determinants for vaccine hesitancy are explained by the 5C model which includes confidence, complacency, constraints, risk calculation, and collective responsibility. Vaccine confidence refers to the public's trust, effectiveness and safety of the vaccines [13–15]. Complacency refers to the perception the population holds about the disease as threat and the necessity of the vaccination [16]. Constraints describe the structural, psychological and social barriers that may be associated with the intention and uptake of the vaccine [16]. Risk calculation refers to comparing the personal health risks of contracting the infection with those of getting vaccinated [17].

Vaccine hesitancy has been a major public health challenge prior to the COVID-19 pandemic and the WHO describes it as the 7th global public health threat to vaccine preventable diseases (VPD) in sub-Sharan Africa [18]. Vaccine hesitancy is a multifaceted concept, context-specific that varies according to place, populations and the type of vaccines [12]. It is also characterized by issues of safety, adverse events following vaccination and misconceptions about vaccines [19, 20]. Addressing vaccine hesitancy requires an understanding of the context-based determinants to design interventions that effectively meet the needs of the people. A previous study showed that the self-reported receipt of a COVID-19 vaccine was 75·2% among 14 million participants across 90 countries [21]. Self-reported receipt of the vaccine was significantly higher in developed countries than developing countries with experiences of significant barriers to vaccination [21]. A multi-country study in West Africa reported COVID-19 vaccine hesitancy ranging from 11% in Senegal, 50% in Sierra Leone to 60% in Guinea [22]. COVID-19 vaccine hesitancy in West African countries has largely been associated with myths, misconceptions and conspiracies such as the rapid development of the vaccine rendering it unsafe, ineffective and untrustworthy [23]. Other studies have reported that some individuals believe that the COVID-19 vaccine may alter the human DNA, be used as a microchip, or that the COVID-19 virus does not exist [24, 25].

In Ghana, pre-COVID-19 vaccination studies reported that approximately 51.0% to 62.7% of the population [26, 27] were willing to be vaccinated. During the rollout of the COVID-19 vaccination exercise, vaccine hesitancy has been reported to range between 30.6% and 52.2% in some population-based studies [28, 29]. A community-based survey equally reported COVID-19 vaccine hesitancy to be 30.6% [28]. Other subpopulation studies among health-care providers showed that pre-COVID-19 vaccine hesitancy was 39.3% and 14.9% during the vaccine rollout [30].

The Ghana Health Service COVID-19 dashboard shows that nearly 14,867,012 people have received one dose of the vaccine with 11,782,609 people fully vaccinated out of the 20.7 million target population with the Volta Region reporting the lowest vaccination rate (44.3%) among the 16 administrative regions of Ghana as at 31 December 2023 [31]. The current factors accounting for the low COVID-19 vaccination rate in the Volta Region have not been fully explored. Historically, reports by the Ghana Health Service suggest that the Volta Region has been successful with some previous immunization programs [13]. Even though there is equitable and effective distribution of the COVID-19 vaccine, the current factors influencing acceptance and hesitancy are not well known, highlighting the unmet need for COVID-19 vaccination in the Region. The study aimed to determine COVID-19 vaccine hesitancy (that is the delay in acceptance or refusal in acceptance despite the availability of the vaccine) and associated factors in a peri-urban setting in the Volta Region of Ghana. That is, a setting that is gradually transitioning from rural characteristics to an urban like characteristics.

2 Materials and methods

2.1 Study design and area

A cross-sectional study design was employed to determine the factors influencing vaccine acceptance and hesitancy using a self and interviewer-administered structured questionnaire. The study was conducted and reported in accordance with the strobe statement for cross-sectional studies [32]. The study was conducted between February 2022 and June, 2023 among residents in the Afadzato South District, Volta Region, Ghana.

The district's estimated population is approximately 117,258 with females accounting for 51.3% (59,590) and males accounting for 48.7% (57,668) of the population and an annual growth rate of 2.5% [33]. The district is situated in the northernmost portion of the Volta Region and one of the 46 administrative districts established in 2012. The district consists of six subdistricts namely: Have/Nyagbo, Logba-Tafi, Weto, Leklebi, Ve Golokuati, and Liati. The district is located about 58 km from Ho, 20 km from Hohoe, and 200 km from Accra. The district features twenty-one (21) health institutions spread throughout several suburbs [34].

2.2 Study population

The study population consisted of residents aged 18 years and older in the Afadzato South District.

2.3 Inclusion criteria

This study included all adult residents aged 18 years and older, residing within the Afadzato South District for at least a year and willing to voluntarily participate. The respondent must be physically and mentally capacitated to participate in the study. Additionally, the respondent must have been a resident of the relevant subdistrict for at least one year at the time they completed the questionnaire in order to accurately reflect the district dynamics regarding acceptance and hesitancy of the COVID-19 vaccine.

2.4 Exclusion criteria

Respondents less than 18 years of age, physically and mentally incapacitated to participate in the study were excluded. Respondents who have lived in the Afadzato South district for less than a year and are on visit to the area were excluded. Similarly, persons who were in the hospitals were excluded. Likewise, the study excluded non-residents of the relevant subdistricts.

2.5 Sample size determination

The Cochran (1977) formula was used to determine the sample size for this study [35]. Sample size was calculated as $n = (Z^2\ pq)/d^2$; where Z being the confidence intervals, which in this study were calculated at a 95% level of confidence and 1.96 as the critical value, p is the estimated proportion of the population and was assumed to be 50% (0.5) to allow for the estimation of large and conservative sample size that may detect the true proportion of population with the event of interest (COVID-19 vaccine hesitancy). Similarly, q was the acceptable deviation from the assumed proportion (1–0.5 = 0.50), and d was the margin of error around p, which in this study was estimated to be 0.05. Therefore, $n = n = \frac{(1.96)^2 \times (0.50) \times (0.5)}{(0.05)^2} = 384.16 \approx 384$.

Adding 10% non-response ($384 \times 0.10 = 38.4 \approx 38$) gives $384 + 38 = 422$. A total sample size of 422 respondents were recruited for the study.

2.6 Sampling method

Multiple sampling approach was used in the selection and recruitment of respondents. First, the Afadzato South District was stratified into the six sub-districts. Communities within the subdistricts were subsequently divided into zones. Using simple random sampling, 4 zones were selected from each of the subdistricts for respondents'

recruitment. Using household data from the district/Ghana Statistical Service as the sampling frame, maps and address listings were used to identify eligible households after using random number generation. The study population were respondents aged 18 years and above.

The calculated sample size was distributed proportionally to each chosen subdistricts size (Table 1). In a household where there were more than one eligible respondents' simple random technique was applied through drawing from a box without replacement. The box contained pieces of papers with a "yes" and "no" inscriptions. A selection of "yes" piece of paper denoted inclusion, whereas persons who selected a "no" were not included into the study. In households where only one eligible respondent was available, the researchers explained the study and inquired about the respondent's availability to be part of the study. Only those who agreed to be part of the study were recruited. In situations where a respondent declines to be part of the study, the next randomly generated household was visited to recruit eligible respondent till the sample size was achieved.

Calculating sample size for each subdistrict using the population sample size (422).

$$\text{Sample size per district} = \frac{\textbf{\textit{Number of respondents per sub} - \textbf{\textit{district}}}}{\textbf{\textit{Total number of Respondents in select district}}} \times \text{Population sample size}$$

2.7 Study variables

This study has two types of variables: three outcome (dependent) variables and three (3) independent (explanatory) variables.

2.8 Dependent variable

The dependent variable for this study was COVID-19 vaccine hesitancy, and was defined as the delay in acceptance or refusal to accept despite the availability of the vaccine. The dependent variable was treated as a binary variable whose responses were either a "yes" or "no". It measured whether or not the respondent will accept or have accepted the COVID-19 vaccine.

2.9 Independent (explanatory) variables

The study seeks to determine three (3) groups of independent variables of the respondent and how they determine COVID-19 vaccine acceptance and hesitancy. These are socio-demographic variables, respondents' source of information on the COVID-19 vaccine variable, and the contextual factors of COVID-19 vaccine hesitancy variables.

2.10 Data collection method, procedure, and instruments

The data was collected using an English and Ewe versions pretested structured questionnaire for individuals who could read and write in English and individuals who could not. The questionnaire was first designed in the English Language, and went through a peer review. The questionnaire was subsequently translated into the Ewe language by an expert and

Table 1 Sample size based on subdistrict population proportionate to size (PPS)

Name of sub-district	Estimated population	Percent of the sample (%)	Sample size N = 422
Ve Golokuati	17, 697	25	104
Weto	18, 827	26	111
Leklebi	14, 029	19	82
Liati	9, 376	13	55
Logba-Tafi	7, 500	10	44
Have/Nyagbo	4, 405	7	26
Total	7 1,834	100%	422

later translated from the Ewe language to the English language and was subjected to another expert review. The back translation from the Ewe language to the English language was done to ensure that the questionnaire conveyed the same meaning, either using the Ewe or English version of the questionnaire and to minimize or eliminate translational biases.

The questionnaire was developed based on previous studies on COVID-19 vaccine hesitance [10, 11, 26, 36–38]. There were four sections on the questionnaire namely; A, B, C, and D. Sociodemographic information on the respondents was recorded in Section A. Data on COVID-19 vaccination uptake, the COVID-19 vaccine acceptance, and factors related to COVID-19 vaccine hesitancy were recorded in Sections B and C, respectively. Section D contained questions on respondents' willingness to be vaccinated with COVID-19.

The final questionnaire was pretested and modifications were made where necessary. The pretesting of the questionnaire and the data collection process was conducted with the help of three (3) research assistants who had received adequate training about the study, data collection tool and the ethical considerations in the study. The research assistants were persons with first degree training background and could write, speak and understand the local dialect (Ewe) and English. Research assistants' fluency in the local dialect facilitated the data collection process among respondents who could not read and give responses in the English language by explaining the meaning of the various items on the questionnaire and the respective options to choose from.

The questionnaire was paper-based and administered to eligible respondents who could read and write in the English language whereas the research assistants assisted persons who were not able to read either in Ewe or English to attempt the questionnaire. The data collection lasted for approximately 7 weeks between July and August 2022. The time spent on completing the questionnaire ranged from 20 and 25 minutes, allowing respondents to adequately read, understand, and respond to the various items.

2.11 Data analysis

The data was cross-checked for accuracy and consistency, and then coded before being entered into the statistical tool Epi Data version 4.1. For analysis, data were cleaned and exported to STATA Windows version 17.0. All variables were described using descriptive statistics. In order to determine proportions for all categorical variables, a frequency distribution was used. The standard deviation of the mean age and its computation were used to assess how closely the individual data values adhere to the mean value. Logistic regression analyses were used to determine the socio-demographics, predictors, sources of information, and contextual factors of the COVID-19 vaccine acceptance rate, hesitancy, and individual willingness to vaccinate. This was done by first running a chi-square test analysis between acceptance, willingness, and all factors associated with covid-19 vaccine acceptance and hesitancy. Variables with p values ≤ 0.05 in the chi-square analysis were fitted in the final logistic regression models to assess the strength of association by looking at the Adjusted Odds Ratio (aOR) with a 95% confidence interval (CI).

2.12 Ethical issues

Ethical clearance was sought from the University of Health and Allied Sciences (UHAS) Research Ethics Committee (UHAS-REC A.10[124] 21–22). The study was equally guided by the Helsinki Declaration for ethical principles for medical research involving human subjects. Prior to the data collection, a written informed consent was obtained from respondents. Before each interview, the participants were given written informed consent form that contained a detailed description of the study, processes involved, confidentiality, privacy of information, compensations, potential harms and benefits. The researchers equally took time to explain the scope and objectives of the study to all eligible respondents. All respondents were equally informed that signing or consenting to participate in the study was not binding and were at liberty to discontinue participation at any point of the study if their rights were being infringed upon by the researchers. Respondents who could not sign to the consent form were made to thumbprint. No direct respondent identifiers were collected.

2.13 Study results

2.13.1 COVID-19 vaccine acceptance among participants

Out of the 422 respondents who participated in the study, 35.3% (151) of them indicated acceptance of COVID-19 vaccines while more than half (n = 271, 64.22%) indicated non-acceptance of COVID-19 vaccines (Fig. 1).

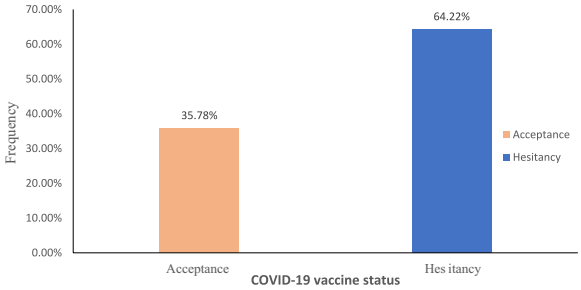

Fig. 1 COVID-19 vaccine acceptance among participants

2.13.2 Demographic characteristics and distribution of COVID-19 vaccine

Out of the 422 respondents recruited in the study, more than half (n = 291, 68.96%) were below 25 years old and females (n = 218, 51.66%). A high proportion of the respondents were Christians (367, 86.97%), and belonged to the Ewe tribe (76.78%). Most of the respondents were married (n = 188, 47.16%) and had attained secondary level of education (n = 165, 39.10%). However, most of the respondents were unemployed (n = 204, 48.34%) and 88 (20.85%) of the respondents indicated they have chronic disease. The Chi-square test showed significant associations between COVID-19 vaccine acceptance and Education level ($p < 0.001$) and Employment status ($p = 0.004$) (Table 2).

2.13.3 Respondents' Knowledge of COVID-19 Vaccine

Majority of the respondents 64.93% (274/422) [Vaccine acceptance; 64.90% (98/151) vs Vaccine hesitancy; 64.94% (176/271)] specified that the COVID-19 vaccines are effective at keeping you from getting COVID-19; Getting a COVID-19 vaccine will also help keep one from getting seriously ill even if you get COVID-19 185(43.84%) [Vaccine acceptance; 54.30% (82/151) vs Vaccine hesitancy; 38.01% (103/271)]. A higher proportion of respondents 76.78% (324) [Vaccine acceptance; (69.54% (105/151) vs Vaccine hesitancy; 80.81% (219/271)] agreed that its dangerous to use an overdose of COVID-19 vaccine.

Approximately half of the respondents 51.42% (217) [Vaccine acceptance; 36.42% (55/151) vs Vaccine hesitancy; 59.78% (162/271)] mentioned that the COVID-19 vaccination increases allergic reactions. In addition, some respondents 35.07% (148) [Vaccine acceptance; 19.21% (29/151) vs Vaccine hesitancy; 43.91% (119/271)] indicated that the COVID-19 vaccination increases autoimmune disease.

The acceptance of COVID-19 vaccine was statistically associated with Getting a COVID-19 vaccine will keep one from getting seriously ill even if you get COVID-19 ($p = 0.001$); Dangerous to use an overdose of COVID-19 vaccine ($p = 0.009$); and COVID-19 vaccination increase allergic reactions ($p < 0.001$) in the Chi-square test analysis (Table 3).

2.13.4 Respondents' sources of information on COVID-19 vaccine

The current finding revealed that the majority 296 (70.14%) of the respondents use traditional media source (radio, TV,) as sources of information towards the COVID-19 vaccine. About 43 (10.19%) of the respondents used social media (WhatsApp, Facebook) as sources of information about the COVID-19 vaccine. A lower number of respondents 23 (5.45%) used webpage/ internet as sources of information towards the COVID-19 vaccine. Furthermore, only 31(7.35%) of the respondents received information about the COVID-19 vaccine from their friends and relatives (Table 4).

2.13.5 Perception of respondents towards COVID-19 vaccine

The finding of the study revealed that majority 302 (71.56%) of the respondents were concerned about serious adverse effects of the COVID-19 vaccines. On the other hand, more than half 216(51.18%) of respondents perceived that COVID-19 vaccines are not needed because the COVID-19 virus is not common anymore. About 124(29.38%) of the respondents mentioned that the COVID-19 vaccine is for people living in the cities. Besides, nearly three-quarter 233(55.21%) of the respondents agreed that there is a lack of trust in any vaccine made for COVID -19. One-hundred and sixty (160, 38.15%) of the respondents indicated that the COVID-19 vaccine is a conspiracy.

Additionally, about 260 (61.61%) of the respondents perceived that there is a lack of trust in the information coming from the government and public health experts on COVID-19 and its vaccine, while 202 (47.87%) perceived that

Table 2 Demographic characteristics and distribution of COVID-19 vaccine

Variables	Vaccine acceptance n(%) 151(35.78)	Vaccine hesitancy n(%) 271(64.22)	Total n = 422 (%)	p value
Age of respondents				0.805
< 25	103(68.21)	188(69.37)	291(68.96)	
≥ 25	48(31.79)	83(30.63)	131(31.04)	
Sex of respondent				0.309
Female	73(48.34)	145(53.51)	218(51.66)	
Male	78(51.66)	126(46.49)	204(48.34)	
Marital status				0.118
Single	58(38.41)	130(47.97)	188(44.55)	
Married	83(54.97)	116(42.80)	199(47.16)	
Divorced	4(2.65)	9(3.32)	13(3.08)	
Widowed	6(3.97)	16(5.90)	22(5.21)	
Religion				0.130
Christian	138(91.39)	229(84.50)	367(86.97)	
Muslim	9(5.96)	30(11.07)	39(9.24)	
Traditionalist	4(2.65)	12(4.43)	16(3.79)	
Ethnicity				0.799
Akan	12(7.95)	25(9.23)	37(8.77)	
Ewe	121(80.13)	203(74.91)	324(76.78)	
Ga	3(1.99)	8(2.95)	11(2.61)	
Guan	8(5.30)	20(7.38)	28(6.64)	
Other	7(4.64)	15(5.54)	22(5.21)	
Education level				**p < 0.001**
No education	4(2.65)	38(14.02)	42(9.95)	
Basic education	34(22.52)	55(20.20)	89(21.09)	
Secondary	53(35.10)	112(41.33)	165(39.10)	
Tertiary	60(39.74)	66(24.35)	126(29.86)	
Employment				**0.004**
Employed	83(54.97)	104(38.38)	187(44.31)	
Unemployed	58(38.41)	146(53.87)	204(48.34)	
Retired	10(6.62)	21(7.75)	21(7.75)	
Chronic diseases				0.061
No	127(84.11)	207(76.38)	334(79.15)	
Yes	24(15.89)	64(23.62)	88(20.85)	

Bold values indicate statistically significant values at p-value <0.05

they are not at risk of getting COVID -19. Approximately, 58% of the respondents had a perception that the magnitude of the COVID-19 cases in their community is not serious enough. Finally, this study pointed that 161 (39.34%) of the respondents perceived that the vaccine will not protect them against the COVID-19 disease (Table 5).

2.13.6 Misconception of COVID-19 vaccine among respondents

About one-fourth (n = 139, 32.94%) [Vaccine acceptance; 18.54% (28/151) vs Vaccine hesitancy; 40.96% (111/271)] of the study respondents believed that the COVID-19 vaccine is a biological weapon designed by the governments to reduce lives. Majority (n = 288, 68.25%) [Vaccine acceptance; 62.91% (95/151) vs Vaccine hesitancy; 71.22% (193/271)] of the respondents agreed that an exaggeration by the media caused fear and panic in taking the vaccine. About (n = 131, 31.04%) [Vaccine acceptance; 15.89% (24/151) vs Vaccine hesitancy; 39.48% (107/271)] stated that a COVID-19 vaccine can make them sick with the COVI-19 virus (Table 6).

Table 3 Respondents' Knowledge of COVID-19 vaccine

Variables	Vaccine acceptance n(%) 151(35.78)	Vaccine hesitancy n(%) 271(64.22)	Total n = 422 (%)	p value
COVID-19 vaccines are effective at keeping you from getting COVID-19				0.993
No	53(35.10)	95(35.06)	148(35.07)	
Yes	98(64.90)	176(64.94)	274(64.93)	
Getting a COVID-19 vaccine will keep one from getting seriously ill even if you get COVID-19				**0.001**
No	69(45.70)	168(61.99)	237(56.16)	
Yes	82(54.30)	103(38.01)	185(43.84)	
*Is it Dangerous to use an overdose of COVID-19 vaccine?				**0.009**
No	46(30.46)	52(19.19)	98(23.22)	
Yes	105(69.54)	219(80.81)	324(76.78)	
Does COVID-19 vaccination increase allergic reactions?				**p < 0.001**
No	96(63.58)	109(40.22)	205(48.58)	
Yes	55(36.42)	162(59.78)	217(51.42)	
Does COVID-19 vaccination increase autoimmune disease?				**0.201**
No	122(80.79)	152(56.09)	274(64.93)	
Yes	29(19.21)	119(43.91)	148(35.07)	
Overall score Knowledge on covid-19 vaccine				**0.039**
Poor	73(48.34)	103(38.01)	176(41.71)	
Good	78(51.66)	168(61.99)	246(58.29)	

*Overdose of COVID-19 vaccine; Though the dosing of vaccines is based on empirical clinical trials, designed to optimise safety and efficacy. The question addresses a misconception that taking a double of a medication (vaccine) may hasten the healing or recovery process or give full protection in the case of vaccines

Table 4 Respondents' sources of information on COVID-19 vaccine

Information source	Frequency	Percentage
Friends or Family members	31	7.35
Guidance from government officials	29	6.87
Social media (WhatsApp, Facebook)	43	10.19
Traditional media source (radio, TV,)	296	70.14
webpage/internet	23	5.45

2.13.7 Factors associated with COVID-19 vaccine acceptance among respondents

The results showed that education level, information source, overall knowledge of COVID-19 vaccine, and misconception of COVID-19 vaccine were significantly associated with acceptance of the COVID-19 vaccine. The crude odds ratio analysis showed that respondents with secondary level of education were 2.17 times more likely to accept the COVID-19 vaccine as compared to respondents with no educational background [cOR; 2.17, 95% CI (0.05–0.58), p = 0.005]. This association was statistically significant after adjusting for other variables [aOR = 2.20, 95% CI (0.06–0.71), p = 0.013]. Also, the adjusted odds ratio showed that respondents with tertiary level of education had an increased odds ratio of 1.11 times of accepting the COVID-19 vaccine as compared to respondents with no education background and the difference was statistically significant [aOR = 1.11, 95% CI (0.03–0.40), p = 0.001].

Respondents who were unemployed had significantly 2.01 times the odds of accepting the COVID-19 vaccine compared to respondents who were employed [cOR = 2.01; 95% CI (1.32–3.05), p = 0.004]. However, after adjusting for other variables this association was found not to be significant [aOR = 1.53, 95% CI (0.95–2.45), p = 0.075]. The odds of accepting the COVID-19 vaccine were increased among respondents who received guidance from government officials compared to respondents who received information from friends or family members [aOR = 1.46, 95% CI (0.13–1.60), p = 0.033]. The unadjusted odds ratio showed that respondents who had good knowledge of the COVID-19 vaccine were 1.52 times

Table 5 Perception of Respondents towards COVID-19 vaccine

Variable	Frequency	Percentage
Concerned about the serious adverse effects of the COVID-19 vaccines		
No	120	28.44
Yes	302	71.56
COVID-19 vaccines are not needed for the disease is not common anymore		
No	206	48.82
Yes	216	51.18
The COVID-19 vaccine is for people living in the cities		
No	298	70.62
Yes	124	29.38
There is a lack of trust in any vaccine made for COVID -19		
No	189	44.79
Yes	233	55.21
The Covid-19 vaccine is a conspiracy		
No	261	61.85
Yes	161	38.15
There is a lack of trust or the information coming from the government and public health experts on COVID-19 and its vaccine		
No	162	38.39
Yes	260	61.61
I don't feel at risk of getting COVID-19		
No	220	52.13
Yes	202	47.87
The magnitude of the pandemic in my community is not serious enough		
No	178	42.18
Yes	244	57.82
The vaccine will not protect me against the covid-19 disease		
No	256	60.66
Yes	166	39.34

more likely to accept the COVID-19 vaccine compared to who had poor knowledge about the COVID-19 vaccine [cOR; 1.52, 95%CI (1.02–2.28), p = 0.039]. After adjusting with other variables, the odds accepting the COVID-19 vaccine was increased among respondents who had good knowledge about the COVID-19 vaccine [aOR = 1.56, 95% CI (1.01–2.43), p = 0.046]. However, the acceptance of the COVID-19 vaccine was reduced by 59% among respondents who believed that the COVID-19 vaccine contains microchip to track people compared to their counterpart and the difference was statistically significant [aOR = 0.41, 95% CI (1.48–19.75), p = 0.011] (Table 7).

3 Discussion

The study assessed COVID-19 vaccine hesitancy among peri-urban settlers in the Volta Region of Ghana. COVID-19 vaccine hesitancy was high and consistent with the findings of a general population survey of vaccine acceptance and hesitancy in the Volta Region that showed that less than half of the population are fully vaccinated [39]. However, a nationwide study showed lower COVID-19 vaccine hesitancy in 2020 but was higher in 2022 at a prevalence of 52.2% [40]. The findings from the current study and that of [39, 40] generally reflects refusal to take the vaccine before and after the introduction of the COVID-19 vaccine, there is a greater need to promote the acceptance of the vaccine among the Ghanaian population. Ghana introduced its COVID-19 vaccine drive in 2021, however, hesitancy remains a challenge, though major measures such as National COVID-19 Vaccination Day Campaigns, risk communications and community engagements have been implemented to improve vaccine acceptance and uptake. It is therefore important to go beyond the current campaigns to address key challenges that may be barriers to vaccine uptake.

Table 6 Misconception of COVID-19 vaccine among respondents

Variables	Vaccine acceptance n(%) 151(35.78)	Vaccine hesitancy n(%) 271(64.22)	Total n = 422 (%)	p value
The COVID-19 vaccine is a biological weapon designed by the governments to reduce lives				0.091
No	123(81.46)	160(59.04)	283(67.06)	
Yes	28(18.54)	111(40.96)	139(32.94)	
An exaggeration by the media caused fear and panic				0.079
No	56(37.09)	78(28.78)	134(31.75)	
Yes	95(62.91)	193(71.22)	288(68.25)	
The COVID-19 vaccine is a virus designed by pharmaceutical companies to sell their drugs				0.211
No	121(80.13)	164(60.52)	285(67.54)	
Yes	30(19.87)	107(39.48)	137(32.46)	
The vaccine contains microchip to track people				**0.004**
No	142(94.04)	179(66.05)	321(76.07)	
Yes	9(5.96)	92(33.95)	101(23.93)	
Receiving the vaccine can make me magnetic				**p < 0.001**
No	140(92.72)	181(66.79)	321(76.07)	
Yes	11(7.28)	90(33.21)	101(23.93)	
A COVID-19 vaccine can make me sick with COVI-19 virus				**p < 0.001**
No	127(84.11)	164(60.52)	291(68.96)	
Yes	24(15.89)	107(39.48)	131(31.04)	

Table 7 Factors associated with COVID-19 vaccine acceptance among Respondents

Variables	cOR (95%CI)	p-value	aOR (95%CI)	p-value
Education level				
No education	Ref		Ref	
Basic education	0.13(0.37–0.45)	0.311	0.15(0.04–0.57)	0.105
Secondary	**2.17(0.05–0.58)**	**0.005**	**2.20(0.06–0.71)**	**0.013**
Tertiary	**1.08(0.02–0.30)**	**P < 0.001**	**1.11(0.03–0.40)**	**0.001**
Employment				
Employed	Ref		Ref	
Unemployed	2.01(1.32–3.05)	**0.001**	1.53(0.95–2.45)	0.075
Retired	1.67(0.74–3.75)	0.209	1.33(0.49–3.60)	0.564
Chronic diseases				
No	Ref		Ref	
Yes	1.63(0.97–2.74)	0.063	1.62(0.83–3.15)	0.151
Information source				
Friends or Family members	Ref		Ref	
Guidance from government officials (Health care workers)	**1.29(0.09–0.93)**	**0.038**	**1.46(0.13–1.60)**	**0.033**
Social media (WhatsApp, Facebook)	0.79(0.25–2.47)	0.688	1.27(0.38–4.23)	0.695
Traditional media source (radio, TV,)	0.37(0.14–0.93)	0.036	0.50(0.18–1.33)	0.168
webpage/internet	0.68(0.18–2.46)	0.557	1.29(0.31–5.25)	0.718
Overall score Knowledge on covid-19 vaccine				
Poor	Ref		Ref	
Good	**1.52(1.02–2.28)**	**0.039**	**1.56(1.01–2.43)**	**0.046**
The vaccine contains microchip to track people				
No	Ref		Ref	
Yes	**0.10(3.95–16.64)**	**0.001**	**0.41(1.48–19.75)**	**0.011**

Ref = Reference category; * significance value; cOR = Crude Odds Ratio; aOR = Adjusted Odds Ratio

Generally, the refusal to take the vaccines have largely been attributed to inadequate understanding, and poor attitude toward vaccination [2, 3]. However, our study showed that more than half of the study participants had good knowledge of the COVID-19 vaccine which should have ideally resulted in increased vaccine uptake. This is in contrast with a previous study which showed that persons with good knowledge of the COVID-19 vaccine were willing to accept the vaccine [41]. It is important to understand the driving factors of persons with good knowledge of the vaccine but have not accepted the vaccine through a qualitative study, which is beyond the scope of the current study. However, a study in Ghana showed that mistrust of vaccine safety and efficacy are important factors for vaccine hesitancy among literates [4]. Other studies have equally shown that persons with good knowledge of COVID-19 vaccine were more likely to accept the vaccine [42, 43]. Addressing vaccine hesitancy should not end at increasing awareness and education but practical steps should be taken to address concerns of adverse effects of the COVID-19 vaccine, unfavourable perceptions, trust issues and misconceptions that have been highlighted in this study and previous studies [3, 5]. Addressing these fundamental barriers and gaps in perceptions and information are critical to increase uptake and boost public confidence in the COVID-19 vaccine [6]. Importantly, majority of the respondents have access and received COVID-19 vaccine related information via traditional media source such as the radio, and television, and the new media such as WhatsApp, Facebook and webpage/internet. These sources of information to respondents can be maximised for a greater impact for COVID-19 vaccine acceptance. The design of information flow using these channels should take into consideration the culturally and linguistic diverse nature of the population to improve better understanding of COVID-19 and its vaccines.

A logistic regression analysis confirmed that secondary and tertiary level of education, guidance from health care workers, good knowledge of COVID-19 vaccine, were significantly associated with acceptance of the COVID-19 vaccine. However, the misconception of the vaccine containing a microchip to track people was found to be less likely to influence vaccine acceptance. The findings are consistent with the reports of other studies elsewhere [7, 8].

3.1 Study limitation and strength

This is a cross-sectional study that assessed a section of the population at a point in time on COVID-19 vaccine acceptance, the responses given may vary with time. However, using a representative sample size for the study, information solicited may reflect the population's perspectives on COVID-19 vaccine hesitancy. The study was conducted in the South Dayi District, Volta Region, Ghana, limiting it geographically. However, the population of the region is homogenous in nature and therefore the findings may be helpful to address COVID-19 vaccine hesitancy in the region. It is important to equally indicate that the use of the study findings for decision making should be contextualized and under caution for other regions in Ghana and elsewhere with heterogenous populations. The findings of this study equally highlight the gaps in understanding of the COVID-19 vaccine in the study's setting. Leveraging on the key findings in this study to design context-based COVID vaccine promotional campaigns will help to address the current low vaccine uptake in the study setting.

4 Conclusion

The study found high vaccine hesitancy among the respondents. Important significant predictors of COVID-19 vaccine hesitancy were education level, information source, overall knowledge of COVID-19 vaccine, and misconception of COVID-19 vaccine. In the attempt to address vaccine hesitancy by health agencies, it is important to take into consideration the varying educational backgrounds of the population in context and their diversified source of information. This may ensure that everyone in the community or population is reached with important information on COVID-19 and its vaccines to reduce misconceptions and misinformation.

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Declarations

Competing interests The authors declare no competing interests.

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