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Examining confidence and hesitancy towards COVID-19 vaccines: A cross-sectional survey using in-person data collection in rural Ghana

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ABSTRACT

Background: In Ghana, as of 30 July 2022, around one-third of the eligible population are considered fully-vaccinated against COVID-19, and efforts are being made to increase coverage. Vaccine hesitancy is defined by the World Health Organization (WHO) as the delay in the acceptance, or blunt refusal of, vaccines. This study assesses vaccine hesitancy and confidence in Nkwanta South, a rural municipal in Oti region, Ghana.

Methods: Data collection within Nkwanta South took place in sub-municipalities of Alokpatsa (11,028 population), Brewaniase (14,483), and Tutukpene (15,453). Data was collected by 47 local residents, known as Community-Based Surveillance Volunteers (CBSVs), using Kobo Toolbox forms on electronic devices (tablets). Information collected included numerous demographic variables, including age, gender, relationship status, and religion. Further questions covered reasons for vaccine hesitancy and COVID-19 vaccine status. Descriptive and inferential statistics assessed the association between variables to identify predictors of hesitancy.

Findings: Across 1500 respondents, 700 (46.7%) reported having received at least one COVID-19 vaccine dose, and 800 (53.3%) reported being unvaccinated against COVID-19. Among unvaccinated respondents, 556 (69.4%) reported willingness to receive the vaccine once available, 190 (23.7%) said they would not be willing to be vaccinated, and 55 (6.9%) said they were unsure. Overall, this represented 30.6% hesitancy within the currently-unvaccinated group. Common reasons for hesitancy included believing that they did not need the vaccine (33.8%), believing the vaccine to be dangerous (30.6%), concerns about side effects (25.3%), and not having enough information (20.1%). Key predictors of hesitancy among our participants included high levels of mistrust, being female, greater years of education, and being Christian.

Interpretation: The information gathered here can inform how best to target national and local health promotion strategies. Locally-tailored efforts, that understand local context and social dynamics, must remain a core component of public health activity to achieve a high vaccine uptake.

1. Introduction

The COVID-19 pandemic is estimated to have resulted in 18.2 m deaths globally by the end of 2021 [1], with a huge burden of disease also from associated hospitalisations, long COVID, bereavement, and further socio-economic consequences. Sub-Saharan Africa (SSA) has not been impacted as greatly as might have been feared. However, a lack of testing capacity and healthcare infrastructure indicates that cases and COVID-19-related deaths are likely to be much higher than the numbers reported [2]. Without the widespread deployment of COVID-19 vaccines, the death toll and overall impact of the pandemic would be even greater. Over 12 billion doses of a COVID-19 vaccine have been administered as of 30 July 2022 [3], and the evidence base is clear that this huge immunisation rollout has already averted millions of deaths [4].

Vaccine hesitancy is a serious issue that has, to some extent, hindered the COVID-19 vaccine rollout. Vaccine hesitancy is defined by the World Health Organization (WHO) as the delay in

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the acceptance, or blunt refusal of, vaccines. Hesitancy was described by the WHO as one of the top 10 threats to global health in 2019, and has been identified as a growing trend in SSA more generally [5] Thus, developing a deeper understanding of the factors associated with vaccine hesitancy is crucial toward informing locally-tailored health promotion strategies. Misinformation is often a driver for lower uptake of immunisation [6], and there have been numerous examples of individuals and groups passing on bad public health information designed to create hesitancy and reduce vaccination uptake.

The vast majority of those unvaccinated, or partially-vaccinated, against COVID-19 reside in lower-income settings in SSA. This includes Ghana, a country in West Africa with an estimated 30.8 m population. As of 30 July 2022, the Ghana Health Service has reported over 166,000 cases and 1457 deaths [7]. Modelling published in March 2022 estimated there were 35,900 (CI: 28,100–44,700) deaths in Ghana, a ratio of 27.8 on confirmed cases [1], though caution should be expressed as the accuracy of modelling strategies with regards to the situation in Ghana is uncertain.

As of 30 July 2022, Ghana has fully vaccinated around 8.0 million people, which is 34.8% of the eligible population with a COVID-19 vaccine [7]. However, there have been noted components of misinformation circulating in Ghana, including false rumours around vaccine-associated adverse events in the United Kingdom [8]. Internet-based surveys have measured hesitancy in Ghana across the pandemic, with willingness to vaccinate fluctuating over time [9]. As more people in Ghana become immunised, the measures of hesitancy increases among the proportion of the remaining unvaccinated populations. The emergence of increasingly-infectious variants such as Omicron indicate that a high level of coverage will be needed to keep morbidity and mortality as low as possible, and to allow healthcare resources to be directed toward other pressing needs.

To date, there has been little pandemic research in SSA that consider population viewpoints in rural and hard-to-reach areas, particularly in lower-income settings. Most surveys around vaccine hesitancy COVID-19 have been electronic, which are cheap and straightforward to carry out but typically reaches the connected generations who may be younger and based in more urbanised areas [10]. This study utilised in-person surveys within local communities in rural Ghana that took place in January 2022. The study indicates hesitancy trends and describes the groups most associated with vaccine hesitancy using demographic and socioeconomic variables.

2. Methods

2.1. Study setting

The data collection took place in sub-municipals within the Nkwanta South municipality, in the Oti region of Ghana (Fig. 1). Nkwanta South is a municipality of 138,971 population. The included sub-municipalities were Alokpatsa (11,028 population), Brewaniase (14,483), and Tutukpene (15,453).

The survey was administered across 10–21 January 2022. The process was similar to established procedures in Ghana where community members deliver health service activity such as Mass Drug Administrations. Data collection was carried out by a total of 47 local residents, known as Community-Based Surveillance Volunteers (CBSVs), across the three sub-municipalities using forms on electronic devices (tablets). Kobo Toolbox was used for survey design and administration. Residents were trained in the use of the devices, including good research practice (e.g., covering issues such as data security and confidentiality). The Ghana Health Service (GHS) district health directorate carried out the training and also supervised the residents throughout the data collection time period.

A ‘door-to-door’ approach adapted from the Expanded Program on Immunization (EPI) sampling framework was used for the data collection in each community visited. This sampling methodology has been designed for use in resource-poor settings [11]. Supervisors initially took the data collectors to a central point, and spun a pencil on the ground in each community visited to determine the direction of travel. The house to which the pencil pointed was the first house that the data collectors entered. They then walked in that direction and visited every other house (skipping one house at a time) until the sample size was achieved. In situations where the sample size was not reached, data collectors visited the skipped houses to make up the required numbers. However, in communities where the required number of households could not be achieved, the next closest community was added. Data collectors spoke with one household member, who was aged 18 years and above.

Prior to the survey itself, the study was explained to the residents and their consent was sought for participation. Situations in which the residents were not willing to participate, the data collectors left and went to other houses but returned later. Where informed consent was forthcoming, the survey was administered. Participants were required to confirm they were 18 years or older before consenting. The survey was written in English, but questions were explained in local languages, such as Twi or Ewe, where required.

2.2. Measures

2.2.1. Demographics

Participants first indicated their age, gender, education (no formal education, primary, junior, senior secondary, higher), employment (unemployed, self-employed, employed part-time, employed full-time), religion (Christian, Islam, Traditional, other, no religion), and marital status (single, in a relationship, married, separated, divorced).

2.2.2. Vaccine uptake and hesitancy

Participants were asked whether they had received at least one dose of the COVID-19 vaccine (yes, no). If participants answered ‘yes,’ they were asked how many doses they had received. Among those who answered ‘no’, vaccine hesitancy was assessed with the statement: “When the COVID-19 vaccine becomes available to you, would you like to get vaccinated?” (yes, no, I doṅt know). Among those who answered no to accepting the vaccine when available, participants selected their reasons for refusal.

2.2.3. Outcome variables

Participants indicated whether they knew anybody personally who had received the COVID-19 vaccine (yes, no). Then, participants indicated whether they believed in seven COVID-19-related misinformation beliefs recorded to be circulating in sub-Saharan Africa by selecting “yes” if they agreed with the belief, “unsure” if they were uncertain about the belief, or “no” if they did not agree with the belief (e.g. “To the best of your knowledge... [COVID-19] is designed to reduce or control the population”). Participants next selected where they typically retrieved COVID-19 vaccine-related information from (yes, no). These included traditional news sources (mass media), the Ghana Health Service (GHS) or local health workers, and government officials. Finally, participants rated how much trust they had in the Municipal Health Management Teams’ response to the COVID-19 pandemic (1 = *not at all*, 5 = *very much*; *M* = 4.44, *SD* = 1.02), how much trust they had in the safety of the COVID-19 vaccine (1 = *not at all*, 5 = *very much*;

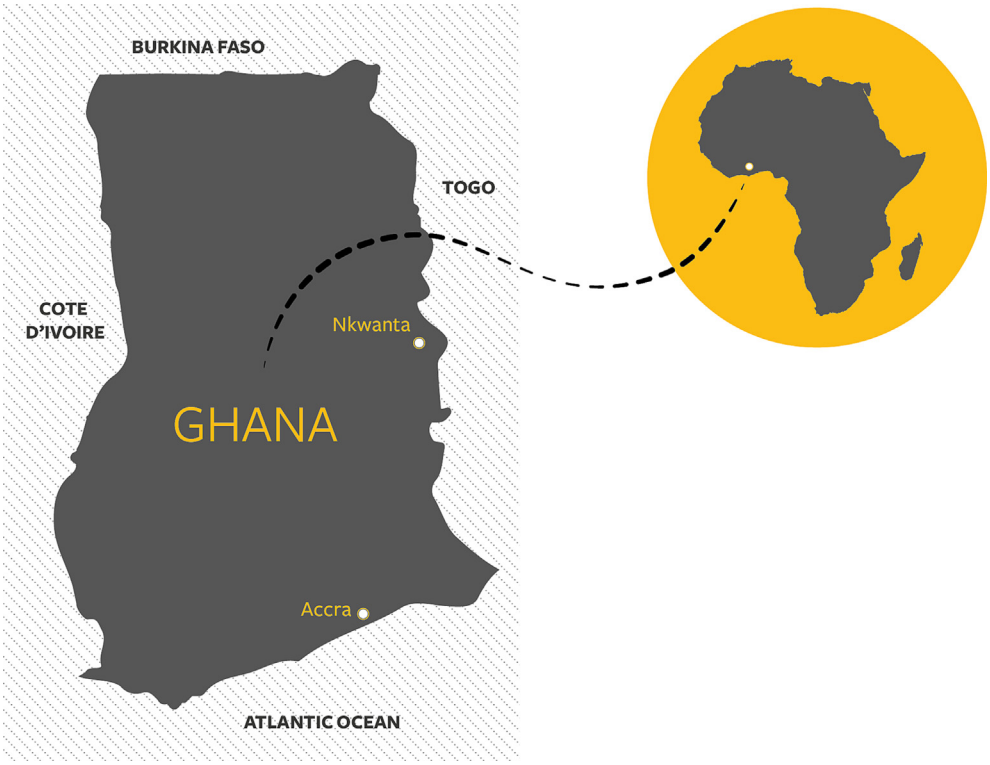

Fig. 1. Map showing location of Ghana, and the Nkwanta South municipality.

M = 3.81, *SD* = 1.52), and how easy or difficult the process of receiving the vaccine would be if they were offered it (1 = *extremely easy*; 5 = *extremely difficult*; *M* = 3.61, *SD* = 1.46).Sample size calculations suggested a recommended sample size of 1059 (with 3% margin of error at 95% confidence). The survey was adapted from previous electronic vaccine hesitancy and COVID-19 attitudes surveys carried out by members of this research team [12].

Datasets were examined, cleaned, and exported into IBM SPSS Statistics 28 for further analysis. Descriptive statistics summarised the demographic of the respondents. Inferential statistics were conducted in three phases. First, chi-Square χ^2 tests were conducted to assess for categorical differences in vaccinated and unvaccinated participants based on sub-municipality, age, gender, marital status, education, occupational status, and religion. Next, temporal trends in hesitancy and population prevalence were conducted, including subjective reasons for hesitancy. At the time of data collection, availability was limited and not all residents had been offered the vaccine. Thus, vaccine hesitancy was coded by dichotomising participants' responses (no, I don't know) to the question: "When the COVID-19 vaccine becomes available to you, would you like to get vaccinated?".

Finally, bivariate logistic regressions were conducted to assess relationships between individual predictors and vaccine hesitancy (S1). Vaccine hesitancy and its associated predictors were rescaled to 0 or 1 in our statistical analyses, which allowed for direct comparison of effect sizes. Independent variables were: age (older (40 +) vs. younger [ref]), gender (female vs. male [ref]), educational level (formal education vs. no formal education [ref]), employment (unemployed vs. employed to some degree [ref]), religion (Islam, Traditional, Christianity [ref]), marital status (single vs. married/in a relationship [ref]), and knowing someone who had received the vaccine (yes vs. no [ref]). Sources of vaccine-related information (i.e., mass media, GHS/health workers, and government officials) were coded (yes vs. no [ref]), as well as firm and uncertain misinformation beliefs (yes vs. no [ref]). We then coded governmental trust and vaccine safety mistrust (high vs. low [ref]), and difficulties in obtaining the vaccine (high vs. low [ref]). Since most of our predictors were categorical variables, a combined logistic regression model was administered containing all predictors in a single model, providing the strictest test of associations with vaccine hesitancy and associated odds ratios.

3. Results

3.1. Participant characteristics

Table 1 shows descriptive statistics of participants. A total of 1500 residents completed the survey from Alokpatsa (*N* = 388; 25.8%), Brewaniase (*N* = 359; 24.0%), and Tutukpene (*N* = 753; 50.2%) sub-municipalities. Of total respondents, 53.1% were male and age range was 18–100 (*M* = 40.65, *SD* = 14.98). Most participants received some level of formal education, in particular up to primary (17.1%) or junior high (31.0%) level, and 32.1% of all participants reported receiving no formal education. Approximately 70.0% reported as being married, and 80.7% were employed in some capacity (including self-employment). The most commonly-reported ethnics groups were Konkomba (33.2%) and Ewe (29.0%). By religion, 74.7% identified as Christian, alongside 18.6% who referred to themselves as having traditional beliefs and 6.7% adhering to the Muslim faith. See Table 2 for fuller summary of characteristics of the study population.

When considering vaccine status, 800 (53.3%) had not yet received a single dose of any COVID-19 vaccine, and 700 (46.7%) had received at least one dose of any COVID-19 vaccine. Within that vaccinated group, 387 (55.7%) reported receiving one dose, and 308 (44.3%) reporting receiving two doses. Specifically, the proportion of participants who received at least one dose was highest in Alokpatsa (61.1%), followed by Brewaniase (46.0%), and Tutukpene (39.6%). One-third of participants (33.6%) did not know which type of immunisation they received. Where this was known,

Table 1
Expressed hesitancy to the COVID-19 vaccine.

	OR	p-value	95% CI
1. Age (Older: 40 +)	1.32	0.219	0.848 – 2.058
2. Female	1.61	0.035	1.034 – 2.532
3. Marital status: Single	1.67	0.078	0.945 – 2.973
4. Formally educated	2.22	0.003	0.128 – 0.355
5. Unemployed	0.97	0.925	0.558 – 1.699
6. Religion			
Muslim	0.32	0.052	0.106 – 1.009
Traditional	0.89	0.698	0.498 – 1.593
7. Firm beliefs in vaccine misinformation	1.82	0.018	1.107 – 2.993
8. Uncertainty about beliefs in vaccine misinformation	2.36	0.000	1.432 – 3.916
9. Personally know somebody who received vaccine (Y)	1.07	0.756	0.698 – 1.641
10. Channels of COVID-19 information			
Mass media (e.g., radio, newspapers, TV)	1.01	0.947	0.612 – 1.690
Ghana Health Service or health workers	0.85	0.493	0.544 – 1.341
Government officials	0.91	0.788	0.463 – 1.794
11. Governmental mistrust (high)	0.65	0.158	0.366 – 1.177
12. Vaccine safety mistrust (high)	13.54	0.000	8.537 – 21.483
13. Difficulty in obtaining vaccine (high)	5.21	0.000	3.336 – 8.150
Number of participants			696
R^2			0.498

51.9% reported receiving the Oxford AstraZeneca vaccine, and 13.4% received Moderna.

By vaccination status, there were no observed differences between gender, age, and occupational status. The proportion of participants who received at least one dose was also higher among respondents who reported as being single (56.1%) compared to non-single participants (43.9%), those who completed senior or higher education (56.5%) compared to those who had completed primary or junior (44.2%) or no education (44.3%), and Christian (48.4%) or Muslim (46.9%) participants compared to those who reported having traditional religious beliefs (39.9%). By sub-municipality, the proportion of participants who received at least one dose was highest in Alokpatsa (61.1%), compared with Brewaniase (46.0%) or Tutukpene (39.6%).

3.2. Vaccine hesitancy

When considering responses from the 800 unvaccinated participants, 556 (69.4%) suggested willingness to vaccinate once it became available to them. However, 190 (23.7%) said they would never be likely to accept the vaccination, and 55 (6.9%) indicated uncertainty. Within unvaccinated participants, there was an observed hesitancy of 30.8% (245). The most common reasons for hesitancy included believing that they did not need the vaccine (33.8%), indicating the vaccine to be dangerous (30.6%), expressing concerns about adverse events (25.3%), and not having received enough information about the vaccine (20.1%).

Analyses exploring vaccine hesitancy according to sub-municipality, analyses showed that 32.5% in Brewaniase and 34.2% in Tutukpene sub-municipalities reported vaccine hesitancy compared to 17.2% of participants in Alokpatsa. This corresponds to our data showing that 61.1% of participants received at least one dose of the vaccine in Alokpatsa compared to approximately 40.0% in Brewaniase and Tutukpene, respectively. High vaccine-related mistrust predicted greater vaccine hesitancy. The odds of expressing vaccine hesitancy were 13.52 times higher for participants who indicated high (vs. low) vaccine-related mistrust (OR: 13.54; 95% CI: 8.53–21.48; $p < .000$). A lack of access to the vaccine was the next strongest predictor of hesitancy in our model, with odds of hesitancy being 5.21 times higher for participants who indicated high (vs. low) difficulties in obtaining the vaccine (OR: 5.21; 95% CI: 3.33–8.15; $p < .000$). Gender is a significant predictor with odds of expressing vaccine hesitancy being 1.61 times higher for females compared to males (OR: 1.61; 95% CI: 1.03–2.53; $p < .035$) (Fig. 2, Table 1).

Years of education received was a key predictor of vaccine hesitancy. The odds of expressing vaccine hesitancy were 2.22 times higher for formally-educated participants (i.e., those who attended primary school and above) compared to participants who received no formal education at all (OR: 2.22; 95% CI: 0.12-0.0.35; $p = .003$). Odds of expressing vaccine hesitancy were 3.05 times lower for Muslims compared to Christian respondents (OR: 0.32; 95% CI: 0.10–1.00; $p = .052$). Participants who indicated agreement with at least one vaccine-related misinformation belief (appendix) were 1.82 times more likely to report hesitancy compared to those who did not report agreement with any misinformation beliefs (OR: 1.82; 95% CI: 1.10–2.99; $p = .018$). Uncertainty about vaccine-related misinformation beliefs (i.e., being "on the fence" about their beliefs) was the strongest predictor of hesitancy, with these participants being 2.36 times more likely to report hesitancy (OR: 1.86; 95% CI: 1.43–3.91; $p < .000$).

4. Discussion

This study assessed willingness to vaccinate, vaccine hesitancy, and vaccine knowledge in three sub-municipalities in Nkwanta South, in the Oti region of Ghana. The vaccines most commonly received were Oxford AZ (51.9%) and Moderna (13.4%). Unvaccinated participants in the Brewaniase and Tutukpene sub-municipalities were least likely to report vaccine hesitancy compared to those in Alokpatsa. The most common reasons for hesitancy was a perception that it was not necessary or important, concerns about safety, or not having enough information to make an informed decision. Key predictors of hesitancy included being female, Christian, or being more highly-educated.

Table 2
Socio-demographic characteristics of three sub-municipalities. Values are presented as percent (n). Note: Some missing *n* due to incomplete responses.

Characteristics	Total (N = 1500)	Alokpatsa (N = 388)	Brewaniase (N = 359)	Tutukpene(N = 754)	*p*
Gender					< 0.001
Male	53.1 (797)	62.0 (240)	49.8 (208)	46.3 (349)	
Female	46.9 (703)	38.0 (147)	50.2 (151)	53.7 (405)	
Age					0.053
18–24	14.2 (213)	18.0 (70)	12.8 (46)	12.9 (97)	
25–34	25.2 (379)	23.7 (92)	25.6 (92)	25.9 (195)	
35–44	23.1 (347)	25.3 (98)	25.6 (92)	20.8 (157)	
45–54	18.6 (279)	18.0 (70)	19.2 (69)	18.6 (140)	
55–64	10.7 (161)	8.5 (33)	8.6 (31)	12.9 (97)	
65+	8.1 (122)	6.4 (25)	8.1 (29)	9.0 (68)	
Ethnic group					< 0.001
Akan	2.7 (41)	3.9 (15)	1.1 (4)	2.9 (22)	
Ewe	29.0 (435)	19.6 (76)	9.5 (34)	43.2 (325)	
Guan	10.3 (154)	4.6 (18)	13.9 (50)	11.4 (86)	
Konkomba	33.2 (497)	71.1 (276)	56.3 (202)	2.5 (19)	
Other	24.8 (372)	0.3 (8)	19.2 (69)	39.9 (300)	
Education					< 0.001
No formal education	32.2 (482)	46.9 (182)	45.9 (164)	18.1 (136)	
Primary school	48.1 (720)	36.9 (143)	37.3 (133)	59.1 (444)	
Junior secondary or higher	19.7 (294)	16.2 (63)	16.8 (60)	22.8 (171)	
Employment					< 0.001
Unemployed	19.3 (281)	23.3 (88)	11.8 (41)	20.8 (152)	
Self-employed	1174 (80.7)	76.7 (289)	88.2 (305)	79.2 (580)	
Religion					< 0.001
Christianity	74.7 (1070)	72.7 (263)	64.2 (210)	80.3 (597)	
Islam	6.7 (96)	0.8 (3)	6.7 (22)	9.6 (71)	
Traditional	18.6 (266)	26.5 (96)	29.1 (95)	10.1 (75)	
Marital status					0.223
Single	22.8 (342)	22.9 (89)	25.9 (93)	21.2 (160)	
Married	77.2 (1158)	77.1 (299)	74.1 (266)	78.8 (593)	
Vaccine received					< 0.001
No	53.3 (800)	38.9 (151)	54.0 (194)	60.4 (455)	
Yes	46.7 (700)	61.1 (237)	40.0 (165)	39.6 (298)	
How many doses received?					< 0.001
One dose	55.7 (387)	46.4 (109)	67.3 (109)	56.7 (169)	
Two doses	44.3 (308)	53.6 (126)	32.7 (53)	43.3 (129)	
Vaccine type					< 0.001
Oxford AZ	51.9 (357)	60.0 (141)	31.7 (52)	56.7 (164)	
Moderna	13.4 (92)	19.6 (46)	9.1 (15)	10.7 (31)	
Johnson & Johnson	0.4 (3)	0.0	0.0	1.0 (3)	
Sputnik	0.7 (5)	0.0	3.0 (5)	0.0	
Unsure	33.6 (231)	20.4 (48)	56.1 (92)	31.5 (91)	
Would you like to get vaccinated?					0.002
No	23.7 (190)	15.2 (23)	25.3 (49)	25.9 (118)	
I don't know	6.9 (55)	2.0 (3)	7.2 (14)	8.3 (38)	
Yes	69.4 (556)	82.8 (125)	67.5 (131)	65.8 (300)	

This survey was carried out in rural Ghana, with some sub-districts being in areas of high poverty and where access to health-care is limited. Arguably, these areas fit within the definition of 'the last mile,' (i.e., those who are among "the poorest of the poor"), and are "under-served and excluded, where development needs are greatest, and where resources are most scarce" [13]. The aim was to assess the viewpoints of populations who are rarely the subject of research, and to allow comparison with other surveys, for example the equivalent electronic surveys carried out by other members of this study team. Those online surveys reached Ghanaian respondents who were typically younger, better connected, and mostly in urban settings.

The findings here were similar to the electronic surveys. Hesitancy was at 30.6%, which is within the range observed across the three electronic surveys (17.2 to 36.8%) [10]. Across both studies, predictors of hesitancy included being female or having received greater years of education. These dynamics appear similar across Ghana, and thus provides useful information for health promotion and public health teams, especially when it comes to building locally-tailored health promotion campaigns and understanding where findings are likely to be generalisable. There are limited resources available to improve population health, and thus targeted activities can help to maximise the use of available skills and person-time. The results from this study have been used by Ghanaian NGOs to compile a training manual on community engagement for vaccine hesitancy in Ghana [14]. Community-focused activities have previously been shown to provide greater benefits around willingness to vaccinate than national messaging alone [15].

An issue with national messaging, typically from – or perceived as coming from – the government in power, is that there may sometimes be a lack of trust in government and thus lower acceptance on their guidance or instructions. Trust in government has been shown to be an important factor in compliance with COVID-19 guidelines, particularly with sustaining appropriate health-related behaviour over time [16]. This may partly explain why education was a significant predictor of hesitancy. Younger populations are more likely to be higher-educated and have

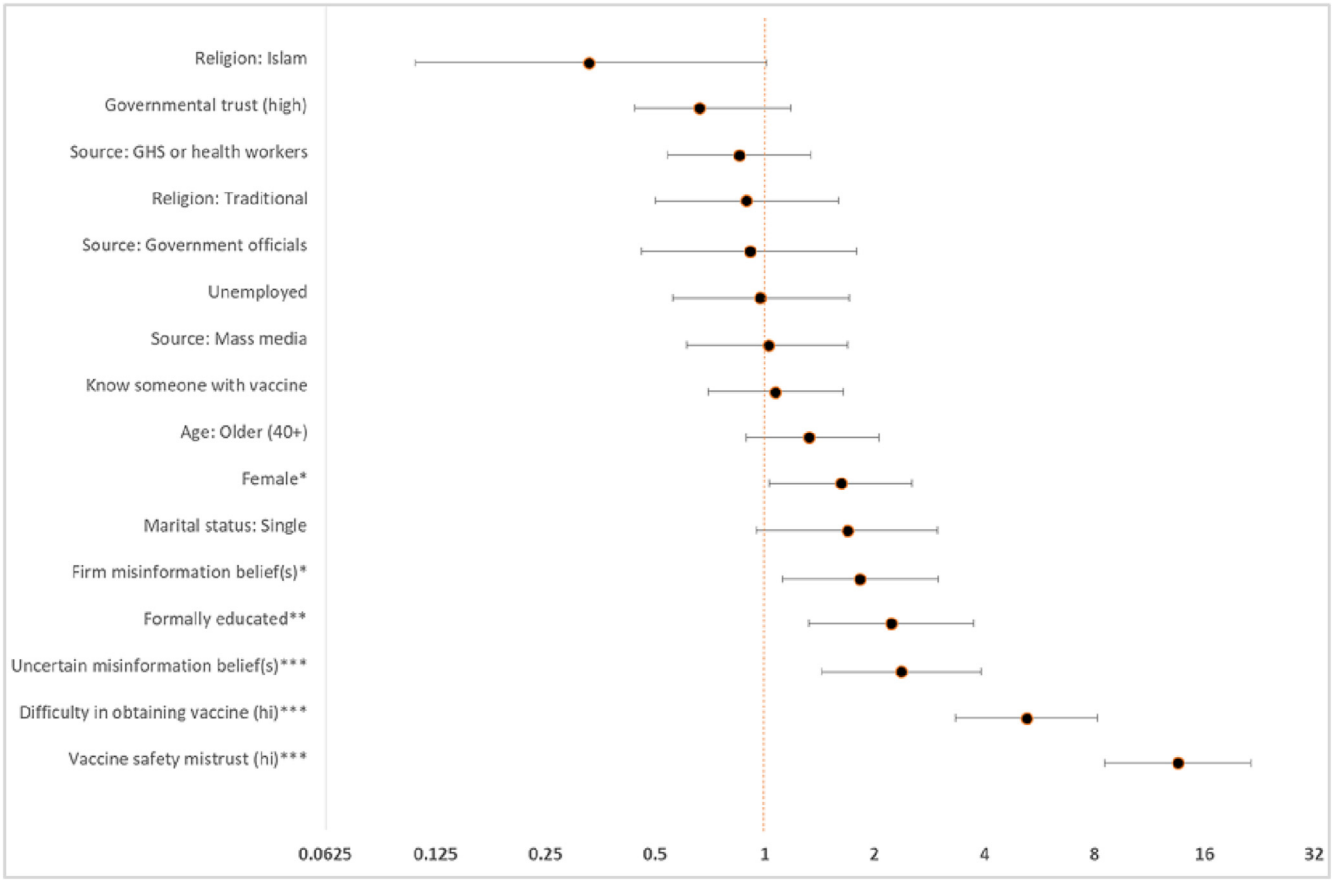

Fig. 2. Predictors of hesitancy among unvaccinated respondents.

greater digital health literacy, and have access to a greater number of sources of information about the pandemic response. Those sources may provide high- or low-quality information about the pandemic. Opposition voters with lower trust in that national messaging may require greater persuasion surrounding the value of COVID-19 policies. This would show the value in local health service activity around promoting the benefits of vaccination and countering any misinformation.

Hesitancy rates vary quite considerably across other African nations. A multi-country study took place from September to December 2020, describing hesitancy rates ranging from 2.1% in Ethiopia and 35.5% in Mali [17]. Timing will be important, as viewpoints will evolve according to the information publicly available. In the electronic nationwide Ghana survey, there was a reduction in willingness to vaccinate between March 2021, when Oxford AstraZeneca had arrived in-country, and June 2021, when there was mixed media coverage and questionable policymaking across Europe and North America about the AstraZeneca vaccine and the associated with haematological events (commonly reported as blood clots). Many of the respondents in that June survey highlighted this coverage and decision-making as a reason for hesitancy [10]. Other Ghanaian research highlights the importance of messaging around vaccine safety and effectiveness, in order to reduce mistrust and improve overall confidence [18]. Their research also highlighted greater hesitancy among female populations, further indicating demographics where future health promotion campaigns can be most useful.

Rural areas may have fewer readily-available information sources, for example a radio show or messaging from the community church leaders. The Christ Embassy, with headquarters in Nigeria but with branches in Ghana and other African countries, is noted for its anti-vaccine stance [19]. This can be a hindrance for district or community health service teams. The findings from our study showed that COVID-19 immunisation was a lower priority or considered unimportant for many of those unvaccinated at the time of the survey. It is important that influential local messengers are on board with appropriate and accurate public health communications, for example highlighting the importance of vaccination.

Education is a variable that can act as a predictor for hesitancy, as described here and in research covering Burkina Faso, Ethiopia, Malawi, and Nigeria [17]. However, conflicting findings are shown in research from Uganda and Malaysia [20,21], where education predicted greater vaccine confidence. There are similar difference in studies when considering religion as a predictor of confidence, here with Christianity being a strong predictor of hesitancy compared with Muslim populations. The reverse scenario was found in a Bangladesh study [22]. This again highlights the need for local research that understands community context and dynamics to best inform locally-tailored health promotion. It may be that education is linked to other factors such as political allegiance and thus trust in government guidance.

This research has some limitations including uncertainty about how generalisable the findings are to similar rural communities in other areas of Ghana, and in other areas of sub-Saharan Africa. This can be offset to some extent by comparisons with the electronic nationwide surveys. The data was collected by local residents, so their community presence may have influenced answers provided by respondents. However, the data collectors received pre-study training and were closely supervised during data collection. This

also is a one-off survey and cannot capture temporal changes in knowledge and attitudes.

This study demonstrated key reasons for vaccine hesitancy in Nkwanta South, rural Ghana, along with predictors of hesitancy. The information gathered here can be further used to inform national and local health promotion strategies. Locally-tailored public health efforts must remain a core component of activity to achieve a high vaccine uptake. Further research can repeat this survey to provide evidence around changing or consistent viewpoints over time, along with consideration of the impact of the pandemic upon confidence in routine immunisation.

Data availability

Data supporting the findings in this manuscript are available from the corresponding author upon request.

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Patient consent statement

Written informed consent was obtained from each study participant. The study design was approved by the the Psychology Ethics Committee, University of Southampton, UK (ref: 57267) and the Institutional Review Board, Ghana Health Service (ID: NHRCIRB440).

Data availability

Data will be made available on request.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Appendix A. Supplementary material

Supplementary data to this article can be found online at https://doi.org/10.1016/j.vaccine.2023.02.024.

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