



Potential factors influencing COVID-19 vaccine acceptance and hesitancy among Bangladeshi people: a cross-sectional study

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Abstract Although vaccines are the most effective tool for preventing infectious disease, COVID-19 vaccination coverage among Bangladeshi mass people was facing challenges because large proportions were hesitant to accept a new vaccine. This study aims to investigate COVID-19 vaccine acceptance intention and to explore the potential factors influencing vaccine acceptance and hesitancy among the Bangladeshi people. A bilingual, self-administered anonymous questionnaire was developed and deployed and mixed-mode approaches (face-to-face and on-line survey) in data collection procedure were applied from 03rd May to 20th June, 2021. In total, 782 Bangladeshi people were participated in this study through random and snowballing sampling technique. Descriptive statistics and binary logistic regression analysis was employed to explore and rationalize the study objectives. Empirical findings revealed that, 69.4% (95% CI 66.1–72.7) respondents had the hesitation to accept newly promoted vaccines. The binary analysis revealed that, “safety” and “efficacy” had highly significant ($p < 0.01$) and positive association with vaccine acceptance.

“Communication” had positive and moderately significant ($p < 0.05$) association; “culture” had positive and significant ($p < 0.1$) association while “rumor” associated moderate significantly ($p < 0.05$) and negatively with COVID-19 vaccine acceptance. According to the Pearson’s Chi-Square test, male had highly significant ($p < 0.01$) willingness to receive vaccines than female gender (OR = 0.501). The prevalence of COVID-19 vaccine hesitancy could be minimized by providing vaccine safety, side effect and, efficacy data to the community through effective communication. Health awareness campaign in remote areas would remove anti-vaccination beliefs and rumors; thus foster COVID-19 vaccine confidence among the culturally motivated Bangladeshi people.

Keywords COVID-19 · Vaccine acceptance · Hesitancy · People · Bangladesh

Abbreviations

COVID-19	Corona virus disease-2019
CDC	Centers for disease control and prevention
LMICs	Low and middle-income countries
EPV	Event per variable
H1N1	The influenza type- A virus
WHO	World health organization
FDA	Food and drug administration
EPI	Extended program on immunization

Introduction

Corona Virus disease (COVID-19) has emerged as the biggest challenges for mankind and affected individuals from all walks of life have been marked as pandemic. The epidemiologist opined that, the virus is here to stay; therefore

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acquiring long-term immunity against novel corona virus became essential. The vaccination is the most effective and fundamental therapeutic tool to eradicate contagious COVID-19 pandemic virus [1]. Likewise other countries, extensive efforts in multidimensional preventive aspects have been implemented to fight against COVID-19 in Bangladesh. Delivering of COVID-19 vaccine is an insight of hope for normal life to return because vaccination is the most effective and efficient preventive measure for the control, elimination, and eradication of infectious viruses [2] and the development of immunity in human body that the country needs to extend. To introduce country-wide COVID-19 vaccination, the government of Bangladesh made an agreement [3] with Beximco Pharmaceutical Ltd requesting to purchase and distribute COVID-19 vaccine from the Serum Institute of India, the world largest vaccine manufacturer licensed from AstraZeneca to manufacture “COVISHIELD” vaccine for supplying to low and middle-income countries (LMICs) including India [4]. The first lot of 30 million vaccine doses reached to Bangladesh on 22nd January 2021 and the government formally launched COVID-19 vaccination programs on the 7th of February, 2021. Bangladesh government completed additional purchase agreement with some other vaccine manufacturers across the world target to vaccinate at least 80% of total country populations [5]. However, a successful mass vaccination drive in union and ward levels depends on examining and encountering of prospective challenges in vaccination programs because response to a vaccine can be understood as a continuum ranging from outright refusal to active demand for immediate acceptance [6]. In this aspect, several studies indicated that vaccine hesitancy; low acceptance intention and refusal decision would be the biggest challenges in LMICs [7].

Vaccine hesitancy or low initial vaccine uptake to a particular vaccine or vaccination program is a common psychological phenomenon observed in global perspective [6]. It is worth mentioning that hesitation in getting a vaccine lead to a massive outbreak of disease previously since vaccine always remains a dilemma among large group of public [8]. Hesitancy to accept influenza vaccine [9] and recently COVID-19 vaccine hesitancy [10] has been demonstrated globally. There are likely to be several psychological attributes that influence attitudes, emotions, beliefs, trust, personality, cognitive styles and socio-political outlooks of an individual distinguishes COVID-19 vaccine resistant from the receptors [11]. Arce et al., (2021), conducted a cross-sectional study in LMICs contained 45,928 respondents in Asia, Africa and South America showed 20% hesitancy and 40% participants mentioned side effects and effectiveness as a primary concern to be vaccinated [12]. The first phase of vaccination among 358 participants in India reported 30% of them

were COVID-19 vaccine hesitant and significant portions were disquiet regarding safety, information and side effects of vaccine [13].

Whilst to date, several factors have been identified which were associated with vaccine acceptance intention and hesitancy reported across the world such as vaccine safety and efficacy [14–19], side effects [20–23], vaccine effectiveness [24, 25], fear and anxiety [14], information sufficiency [26, 27], cultural sensitivity [17, 28], religiosity [28, 29], rumors and fake news [11, 29], conspiracy beliefs [28, 30, 31], communication and misinformation [32], social and psychological facts [33], and socio-demographic characteristics [34].

Although an empirical study in Bangladesh examined the willingness to accept COVID-19 vaccine but the study [35] limits with adult aged respondents and lack of potential factors identification that are associated with vaccine acceptance and hesitancy. Recent concise reviews [22, 36] revealed that, there is a paucity of exploratory studies investigated the key factors influencing COVID-19 vaccine acceptance and hesitancy among the Bangladeshi people. The urgent calls for assessing COVID-19 vaccine acceptance intention, cause and effect of potential factors associated significantly with acceptance and hesitancy among the people provide necessary interventions in implementing a country-wide vaccination programs. Therefore, the current study aims to investigate the willingness to accept COVID-19 vaccine and explore the potential factors influencing COVID-19 vaccine acceptance and hesitancy among the general people of Bangladeshi.

Materials and methods

Study and questionnaire design

A self-administered, semi-structured multi-items questionnaire was adopted from recent studies identified the key areas and issues contributing in vaccine acceptance and resistance [14–34]. Questionnaire content and clarity was assessed and reviewed by two academic public health experts. The draft questionnaire was in bilingual (Bengali and English) format and consisting sections on socio-demographic, perception towards COVID-19 vaccine, participants willingness to accept the vaccine. In survey based research, the translation into native language is considered as a key task in capturing the respondent’s perception. The first part of questionnaire contains the demographic information where the participants were asked about age, gender, occupation, educational level, religion etc., while the later part of the questionnaire comprised of predictor construct of COVID-19 vaccine acceptance.

Respondents

The online Goggle form link was send to 606 individuals who were using digital platform opened the survey form and participated in the study. In total, 578 (95.2% response rate) returned the completed survey that we considered for final evaluation. In addition, we collected 204 data by using face-to-face interview approach for illiterate and semi-literate respondents. Random sampling technique was used for face-to-face interview and snowballing technique was used for digital survey modes of data collection. Initially, we selected several small cities, unions, and wards of south-eastern regions to collect the data in face-to-face approach. The areas were selected based on the convenience of data collections by the investigators and consecutively we spread the data collection process digitally in all over the country for ensuring reliability of the study results. Additionally, we provide special attention to the female respondents and encouraged them to participate. According to the latest census, out of a population over 160 million in Bangladesh approximately 66.88% were residing in rural and semi-urban areas, of them, at least 46.72% was females. However, the selection criteria for the eligible participants were: (i) to understand the study purposes and provide anonymous data on COVID-19 vaccines and vaccination, (ii) residence in Bangladesh, (iii) age of 18 years and above, and (iv) Had the device and understand the questionnaire in Bengali to submit it accurately (for digital data collection mode).

Sample and data collection

The required data were collected between 03rd May, 2021 and 20th June 2021 by using a mixed-mode survey (paper and electronic format) approach, Maximum number of data were collected through digital platforms contacted via social network (Whatsapp, Facebook, group messenger, Immo and Twitter) to the investigators. The survey link was also made available to the public by email during the study period. The elderly and resources less people in remote areas participated in face-to-face interview to the investigator. The sampling technique employed allowed to collect data from eight divisions in Bangladesh. A total of seven hundred eighty two (782) data samples were selected for final statistical analysis. For conducting an observational study with large sample size, taking a minimum sample size of 500 is necessary to derive a binary logistic regression statistics that represent the parameters. The other recommended rules of thumb are event per variable (EPV) of 50 and the formula is; $n = 100 + 50i$, where i indicates to number of independent variable in the final model [37]. To avoid the potential source of non-response bias, the questionnaire was distributed among general people in Bangladesh and encourages participating in this study. The online survey bars acceptance

of any incomplete survey instrument which ensures collection of complete responses. Thus, there was no missing data received and we had no missing data in final data set used for descriptive analysis and logistic regression. Pilot tests ($n = 15$) was conducted to assess the clarity of the survey items in Bengali and English languages and to evaluate the average duration of the survey accomplishment, later were excluded from the final analysis.

Instruments and tools

The survey consisted of questions that assessed (1) Socio-demographic characteristics and COVID-19 awareness; (2) psychological intention to uptake COVID-19 vaccine; and (3) key factors associated with COVID-19 vaccination process. Binary logistic regression tools were used to analyze the correlations and significance level among predictor variables and outcome variable.

Study variables

The response variable of study we measured as willingness to uptake a new vaccine and the responses were measured as a binary variable (1 = Yes, 0 = No). The socio-demographic characteristic and other categorical variable such as age, profession, educational level, gender, marital status, religion, and COVID-19 experiences of the respondents was also captured. We examined the impact of some psychological, social and vaccine-related factors on the outcome variable dichotomized into 1 = Yes and 0 = No.

Equations for regression model

The general form of logistic regression is as follows:

$$y = \text{Constant } (B) + b_1x_1 + b_2x_2 + b_3x_3 + \dots + b_mx_m \quad (1)$$

where y is the linear combination function while defined as Eq. (1) and its value varies from $-\infty$ to $+\infty$, x_1, x_2, \dots, x_m are explanatory variables and the parameters b_1, b_2, \dots, b_m are slope coefficient of the logistic regression model. The dependent variable (z) is denoted as a binary response variable, (0 or 1). If z is value 1 ($z = 1$) means the presence of vaccine uptake intention, and value 0 ($z = 0$) indicates the reservation of vaccination. The computational algorithms are as follows:

$$P = P(z = 1) = Bx / [1 + \exp(Bx)] \quad (2)$$

Here, P is referred as the probability of vaccine uptake intention, x = vector of explanatory variables and B represent the regression coefficient to be estimated. Function of y is represented as logit (p), i.e., the log (to base e) of the odds or likelihood ratio that the dependent variable z is 1.

$$y = \log_e [P/1 - P] = \log it(P) \quad (3)$$

$$P = e^y / (1 + e^{-y}) \quad (4)$$

Usually Eq. (2) and (4) is written as logit (P) or the log odd ratio as follows-

$$\log it(P) = \log_e [P/1 - P] = Bx \quad (5)$$

B reflects the degree of influence of predictor variables on the vaccine uptake intention.

Data analysis

Descriptive statistics expressed as weighted frequencies and percentages was performed on the categorical and socio-demographic characteristics of the respondents. A non-parametric analytical tool (Binary logistic regression) was employed to find out the key influential factors of COVID-19 vaccine acceptance and hesitancy. Model summery was evaluated by Nagelkerke R^2 value and goodness-of-fit for binary model was assessed by using Omnibus Tests of Model Co-efficient and Hosmer and Lemeshow tests [38]. Microsoft excel (version 10) was used for accounting both the sample from paper based and online form, and imported the data set to the SPSS accordingly. The entire analysis was conducted by using the IBM SPSS statistical package (version 25). The minimum significance level (p vale) was set at the value of 0.1.

Results

Respondents' characteristics

In this study, total 782 participants responded in mixed mode data collection process. We examined for eligibility and confirmed the eligible participants by maintaining the standard we adjusted previously. According to established eligibility criteria "Table 1" shows the summery statistics of the socio demographic profile of the study participants in which amongst all the participants, a bit higher was male 437 (55.9%) than female 345 (44.1%) respondents. The majority of the participants 351 (44.9%) was youth aged between 20 and 29 years and the second highest group participants 240 (30.7%) was 30–39 years in age followed by 89 (11.4%) for 40–49 years, 47 (6.0%) for 18–19 years, 35 (4.5%) for 50–59 years and 20 (2.6%) for 60 and above. The highest study participants 265 (33.9%) had Degree (Hon's)/ Equivalent educational level followed by Masters and above educational level was 178 (22.38%), HSC/ Equivalent was 135 (17.3%), below SSC was 123 (15.7%) and SSC/Equivalent was 81(10.3%). The highest participants

Table 1 Respondents demography

Variable	<i>N</i>	%
Age		
18–19 Years	47	6
20–29 Years;	351	44.9
30 -39 Years;	240	30.7
40–49 Years;	89	11.4
50–59 Years;	35	4.5
60 years and above	20	2.6
Education		
Below SSC	123	15.7
SSC/Equivalent	81	10.3
HSC/ Equivalent	135	17.3
Degree(Hon's)/Equivalent	265	33.9
Masters & above	178	22.8
Division		
Dhaka	162	20.7
Rajshahi	112	14.3
Chattogram	96	12.2
Khulna	105	13.4
Sylhet	86	10.9
Barishal	76	9.7
Rangpur	74	9.4
Mymensingh	71	9.0
Religion		
Muslim	553	70.7
Hindu	228	29.2
Others	1	0.1
Gender		
Male	437	55.9
Female	345	44.1
Marital status		
Single	334	42.7
Married	444	56.8
Other	4	0.5
Experience of COVID positive		
Not Infected	710	90.8
Having experience of Corona Infection	72	9.2
Intention to receive vaccine		
Reservation to accept vaccination	543	69.4
Accept Vaccination anytime	239	30.6

162 (20.7%) responded from Dhaka division following Rajshahi 112 (14.3). Most of the participants were Muslim by religion 553 (70.7%), Hindu was 228 (29.3%) and others was 1 (0.1%). 444 (56.8%) married respondents attended in this study. Regarding the experience of COVID-19 positive, 710 (90.8%) reported not infected; however, 72 (9.2%) participants having experience of Corona virus infection. Importantly, 239 (30.6%, 95% CI 27.3–33.9) participants positively responded to accept COVID-19 vaccine any time

Table 2 Descriptive Statistics of the variables

Variable	Mean	SD
I intend to accept vaccination anytime (Yes = 1, otherwise = 0)	0.31	0.461
I am confirm that the vaccination is safe (Yes = 1, otherwise = 0)	0.07	0.262
I think the Vaccination has no significant side effect (Yes = 1, otherwise = 0)	0.05	0.215
I believe the Vaccination has efficacy to protect (Yes = 1, otherwise = 0)	0.08	0.299
I am well communicated about the vaccination (Yes = 1, otherwise = 0)	0.03	0.176
I felt constraints religiously to accept vaccination (Yes = 1, otherwise = 0)	0.03	0.165
I believe there remain a conspiracy against the vaccination (Yes = 1, otherwise = 0)	0.05	0.21
I felt strong pressure from a political party not to accept vaccination (Yes = 1, otherwise = 0)	0.02	0.137
I have a trust on the vaccination (Yes = 1, otherwise = 0)	0.1	0.305
I received many negative communication about the vaccination (Yes = 1, otherwise = 0)	0.95	0.223
Receiving a vaccine is very usual to me (Yes = 1, otherwise = 0)	0.578	0.494
GENDER (Female = 1, otherwise = 0)	0.44	0.497

Table 3 Model summery

-2 Log likelihood	Cox & snell R square	Nagelkerke R SQUARE
499.81	0.447	0.631

while 69.4% (95% CI 66.1–72.7) had the reservation to accept it.

Results of descriptive statistics

“Table 2” describes the descriptive statistics of variables and the dependent variable “vaccine intention” scored 30.6% participants.

Model summery

“Table 3” discusses the model summery; in order to identify predictor variables associated with vaccine uptake intention binary logistic regression model was applied. Moreover, the joint impact of all predictor variables on the dependent variable also determined by using Nagelkerke R Square test that explained the model summery.

The most common assessment of overall model fit in the logistic regression is the likelihood ratio test. The Cox & Snell R square or Nagelkerke R square is an analogous statistic in logistic regression to the coefficient of determination R^2 in linear regression, but not close analogy. The model summery provides some approximation of R^2 statistic in logistic regression. Cox & Snell R square attempts to replicate multiple R square based on likelihood. The result of Cox & Snell R^2 indicates 44% to 63% variance of outcome variable explained by independent variables, which is assumed to be very good level.

Table 4 Omnibus Tests of Model Coefficients

	Chi-square	df	Sig
Step	462.920	11	0.000
Block	462.920	11	0.000
Model	462.920	11	0.000

Table 5 Hosmer and Lemeshow Test

Chi-square	df	Sig
8.927	4	0.063

Goodness of model fit

In “Table 4” the p -value of Omnibus Tests of Model Coefficients is significant and less than 0.05 which indicates a very good model fit.

According to the result of “Table 5”, the p -value is 0.063, if it shows significance below 0.05, indicates a poor model fit. However, since the p -value is 0.063 which is insignificant therefore our fitted logistic model is a good fit in both of logistic assumptions.

Results of binary logistic regression model

“Table 6” displays the result of correlation analysis between explanatory variables and dependent variable in a binary model. According to the result of regression analysis, the predictor variables “safety” and “efficacy” had strong, significant and positive ($p < 0.01$, slope coefficient 3.036*** and 2.693*** respectively) correlation with outcome variable “vaccine acceptance”. “Communication” had moderately significant and positive association with ($p < 0.05$, slope coefficient 2.711**) vaccine uptake intention, whereas

Table 6 Binary logistic regression analysis

	B	S.E	Wald	Sig
Constant	-0.637	0.937	0.462	0.497
Safety	3.036***	0.809	14.079	0
Side effects	2.318*	1.316	3.102	0.078
Efficacy	2.693***	0.549	24.083	0
Communication	2.711**	1.253	4.681	0.031
Religious beliefs	21.242	6087.878	0	0.997
Conspiracy beliefs	20.484	4582.514	0	0.996
Political beliefs	0.246	1.689	0.021	0.884
Trust	22.098	3409.463	0	0.995
Rumor	-2.122**	0.904	5.514	0.019
Culture	1.255*	0.269	21.724	0
Gender	0.197	0.242	0.663	0.416

***=significant at <0.01 , **=significant at <0.05 , *=significant at <0.1 level of significance

“rumor” had moderately significant and negative correlation ($p < 0.05$, slope coefficient 2.122**) and “culture” had significance and positive ($p < 0.1$, slope coefficient 1.255*) correlation with vaccine acceptance intention.

The Table 7 & 8 showed the Chi-squared value and Odds Ratio for gender variable which described that female gender had significantly less involvement in accepting vaccine willingly; thus, female gender was more hesitant than male gender towards a COVID-19 vaccine, and was identified as a risky hesitant group in mass vaccination programs.

Table 7 Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	18.405 ^a	1	0.000		
Continuity Correction ^b	17.740	1	0.000		
Likelihood Ratio	18.734	1	0.000		
Fisher's Exact Test				0.000	0.000
Linear-by-Linear Association	18.381	1	0.000		
N of Valid Cases	782				

Table 8 Risk group estimation

	Value	95% Confidence Interval	
		Lower	Upper
Odds Ratio for GENDER (Male / Female)	0.501	0.364	0.689
For cohort INTENT = 0	0.816	0.745	0.894
For cohort INTENT = 1	1.630	1.294	2.052
N of Valid Cases	782		

Discussion

Rollout of a new vaccine is costly and time consuming process in a developing country because vaccine acceptability is one of the critical indicators that controls overall success of vaccination [39]. To support the country-wide mass vaccination programs, this study aimed to examine the potential factors predict the willingness to accept an approved COVID-19 vaccine in Bangladesh. There is intense media coverage and community members were being encouraged to realize the vaccine safety, associated risk factors and health awareness. In this study, vaccine acceptance intention was reported as 30.6% among the general people. This study was performed in the period when the vaccination in urban areas has progressed slowly and country-wide mass vaccination has not started yet. There was communication gap and lack of adequate vaccine data to these peoples; hence, acceptance intention was shown low in this study. However, COVID-19 vaccine acceptance was 48% in Saudi Arabia [40], 37.4%, in China [15]; 29.4% and 30.9% in Jordan and Kuwait [30]. These prior results are consistent with our finding. The H1N1 vaccine uptake have revealed unsatisfying results as the willingness to vaccinate ranged from 17 to 67% across studied from developed countries [41, 42].

Meanwhile, the government of Bangladesh decided to provide vaccines to different frontline workers and citizens of over 55 years. Later, the authority decided to drop the age limit to 40 years because of the lower population enrolment

for taking vaccines. While the vaccination process has started, many people in the country have remained confused to be vaccinated due to some psychological risk assessments. In some cases, Muslims religions refused immunization on the points that vaccines are non-halal (not permissible under Islam) has been documented as a major issue in Malaysia and many other Muslim countries [30]. This study demonstrated five potential predictors significantly associated with COVID-19 vaccine uptake intention, among these “safety” and “efficacy” had highly significant and positive association with vaccine acceptance intention among Bangladesh people. Safety has always been the most concerning area within vaccination [43]. Although safety and side effect both are important factors in vaccine decision; however, individuals who perceive vaccine as safe are more likely to accept the vaccine and how safe the individual considers the vaccine to be administered [6, 19]. These results are consistent with our study findings.

In our study, “efficacy” was recognized as a key predictor has highly significant and positive association with vaccine uptake intention. World Health Organization (WHO) and Food and Drug Administration (FDA) approved 3 vaccine candidates to administer and granted conditional approval for additional 7 candidates those are in phase three trials and the efficacy of these vaccine candidates varies from 50.7% to 95% [44]. Bangladesh procured “COVISHIELD” vaccine in licensing through Beximco Pharmaceuticals Limited under a tripartite agreement with Serum Institute of India and efficacy of “COVISHIELD” vaccine was reported to 70% [45]. Perhaps large segments of our respondents were concern about the efficacious performance of vaccine which was found to have significant impact on vaccination decision.

According to our study result, communication had moderately significant and positive association with the vaccine uptake intention. In fact, majority of people lives in rural and semi-urban places in Bangladesh. Most of them are resource less, medically deprived, illiterate, and lack of adequate information about vaccines and vaccinations. In addition, large groups of people live on the streets and in slums in cities and have also remained out of the coverage of the vaccination. Several media outlets have indicated that these people do not clearly understand the vaccination and its positive impact. As the “COVISHIELD” vaccine, is being rolled out on a broader scale, the spread of proper communication might increase vaccination among disadvantageous public and dissuade people’s vaccination might positively affect people’s overall intention towards vaccination [9]. Although conspiracy beliefs, religious beliefs, and political influence has been reported at many studies in Asian countries [28–30]; however, in our study these factors found to have insignificant association with vaccine uptake intention. Since the community people were already connected with vaccine awareness programs, hence people were conscious

about vaccine origin data which contributed them to avoid rumors and anti-vaccine beliefs including religious and conspiracy beliefs.

Interestingly, it was seen that rumor had moderately significant and negative correlation with vaccine uptake intention. Initially many people were doubtful about vaccine safety, efficacy, side effects and effectiveness, because different rumor-mongers are propagating various forms of negative information about the vaccine. Therefore, many people are passing the time with the dilemma to decide whether they would take vaccines or not. In Bangladesh, rumor and propaganda against the government vaccine initiatives as a means to achieve the politicized motives may be the barrier for COVID-19 vaccination. Since rural and remote people are lacking behind the adequate information about vaccines, so rumor, propaganda, and other negative attributes negatively impacted COVID-19 vaccine uptake within the general public. Even the positive attitude of general public towards vaccination has been undermined by fake news spread on internet and social media which increased anti-vaccination attitudes [46]. This could be magnified by providing educational and awareness programs from resourceful, scientific and health community as people looks for trustworthy information. Rumor against vaccination will be protected by conducting effective dialogue, advocating, counseling based on trust between health community and lay people. Literacy through health education campaigns also play a key role in reducing misinformation and associated propaganda has already seen to use as one of the basic mechanisms to prevent infections disease and health education aiming to promoting COVID19 vaccination has practical implication [47]. COVID-19 pandemic is very difficult, yet possible, to take the time to enhance the health education campaigns throughout the country. Public health education campaigns must engage with traditional and social media platforms to monitor, counter, and prevent the spread of rumors about future COVID-19 vaccination before dangerous myths take root in the public psyche. To promote acceptance rates of a new COVID-19 vaccine, it is additionally recommended to increase personal awareness to detect fake news and effective communication program [48]. Tracking vaccine misinformation in real-time and engaging with social media to disseminate accurate news could help safeguard for public against anti-vaccination rumors [31]. According to the outcome of our study, culture was significantly and positively associated with vaccine intention. Bangladesh has had a successful history of immunization and is able to achieve high vaccination coverage against vaccine-preventable disease and Bangladeshi peoples are culturally inhabitant with being childhood vaccination in Extended Program on Immunization (EPI) and non EPI programs [49, 50]. We collected data from large scale sample size to ensure external validity or representativeness of the study findings.

More clearly, 782 respondents living in different areas of Bangladesh were participated in this study. The variation in the respondents demography and sample size provide much strength to anticipate the generalizability of the study results in addressing the population and deliver health messaging to increase public interest on COVID-19 vaccination.

While the vaccination process has started successfully in across the country around the world, many people in specific region have remained confused about whether they should take vaccine or not. Therefore, keeping an overwhelming majority of the hesitant population outside the vaccination process, the state worthy attempts to offer free vaccination would not be successful in restraining country's COVID-19 contamination. Given the potential influential factors associated with COVID-19 vaccination consequences, vaccine policy makers should develop guidelines for COVID-19 vaccination on the basis of priority group identification. To reduce pandemic-induced morbidity and mortality rates, COVID-19 vaccine administration should be mandated for elderly and co-morbid individuals, because these groups are more vulnerable to the corona virus than others and there is a strong association of age and co-morbidities with the mortality rate as shown found in a recent systematic review and meta-analysis [51].

The study had some limitations. The foremost limitation was the sample size which was insufficient in comparison with total populations in Bangladesh. The study thus did not involve the largest numbers sample size to ascertain the generalizability of the current findings. As a result, non-response bias is a possibility as those who did not respond might have been more intention or hesitancy regarding COVID-19 vaccine than the study respondents. This non-response would undermine the true prevalence of COVID-19 vaccine acceptance and hesitancy among general public resulted in larger differences between those who were willing to receive a vaccine and those who were not. Secondly, this study assessed uptake intention of a COVID-19 vaccine and identified the key influential factors of receiving a vaccine; this may differ from behavioral context. Still, with frequent changes in the perceived risk of disease, new approval and deployment of existing vaccines and the development of new COVID-19 vaccine themselves, individual's behavioral context may be changed. Therefore, it is difficult to predict in-spot vaccine acceptance and hesitancy level. In addition, there are some additional factors may influences COVID-19 vaccine acceptance intention were truly unidentified in this study.

This study is the first its kind to use binary logistic regression analysis for identifying the potential driver's of COVID-19 vaccination decision among the people in Bangladesh.

Thus, this survey provides a rapid capture of information to implement mass vaccination programs throughout the country. In this study, randomly selected old aged participants of rural areas attended by face-to-face interview, enabled capture the depth of information on vaccination. This study thus contributes to the baseline evidence for examining the key determinants of COVID-19 vaccine acceptance and hesitancy in LMICs and low-resourced countries.

Conclusion

The implementation of vaccinations has already been shown to be a great success to reduce COVID-19 disease and its associated mortality and morbidity globally and achieving high acceptance and uptake rates is an essential aspect of successful COVID-19 vaccination effort. Since mass vaccination programs against COVID-19 have been started worldwide; therefore identifying the factors associated with vaccine acceptance and hesitancy would have a tremendous importance. Understanding uptake intention and attitudes towards COVID-19 vaccine in a developing and populous county like Bangladesh may aid rapid immunization and future public health messaging. This study identified some key factors that could play an influential role in successful and extensive COVID-19 vaccination coverage in Bangladesh which concluded that, the crude vaccination coverage throughout the country is facilitated by empowering health safety issue, delivering more efficacious vaccine and accelerating robust communication with the lay people. Due to the prevalence of COVID-19 vaccine hesitancy, it is thus essential to provide scientific information with effective communication, targeted awareness campaigns on safety, efficacy, and effectiveness data to promote a new vaccine. Country-wide vaccine awareness campaigns and public safety messages may would be the best preferred approach to reduce anti-vaccination sentiments and associated rumors among the general people in Bangladesh. However, the crude vaccine coverage in rural and remote areas will be ensured as soon as the culturally motivated people are connected properly with COVID-19 vaccination consequences while at the same time trustworthy communication channels are used to defend the vaccination rumors. The study findings will contribute to improve country-wide vaccination programs and support policy makers to develop the necessary control strategies with respect to immediate and delayed vaccination in Bangladesh.

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Data availability All data used for analysis in this manuscript is available upon reasonable request from corresponding author or first author.

Declarations

Conflict of 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 manuscript.

Consent to participate All participants provided objectives of the study and informed consent prior to study participations.

Ethics approval The study did not require ethical approval as no clinical experimental procedure was conducted, and data were anonymously collected from participants who previously signed an informed consent.

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