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Potential determinants of childhood COVID-19 vaccine confidence among the primary school's stakeholders in Bangladesh: A cross-sectional study to assess the effects of education

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Abstract:

BACKGROUND: Rapid corona virus disease 2019 (COVID-19) vaccination drives aimed to immunize primary school-aged youth have a potential for health safety and supportive academic attainment. This study aimed to identify the potential factors influencing childhood COVID-19 vaccine confidence among the primary school's stakeholders in Bangladesh and assess the effects of health education on vaccine confidence and receptivity.

MATERIALS AND METHODS: This cross-sectional study used a bilingual, multi-item, closed-ended, anonymous questionnaire adopted from the extant literature studies on the topic. Data were collected purposively by the face-to-face interview approach. In total, 627 primary school's stakeholders participated in this study. The binary logistic regressions and Chi-square tests were employed to investigate and rationalize the study-outlined objectives where <0.05 was considered statistically significant.

RESULTS: The pooled childhood vaccine confidence and receptivity against COVID-19 was 91% (95% CI 89–93) among the primary school's stakeholders. The regression analysis revealed that of eight potential determinants of vaccine confidence, "safety" and "effectiveness" had a highly significant ($P = 0.006$, $P = 0.001$, respectively) and positive association and "efficacy" had a significant ($P = 0.03$) and positive association, while "rumor" had a highly significant ($P = 0.000$) and negative association with childhood vaccine confidence. The analysis also showed that "health education" had a significant ($P = 0.04$) and positive association with childhood vaccine confidence and receptivity against COVID-19. Although the odds ratio for receiving childhood vaccine was found to be 0.6, the result was insignificant ($P > 0.05$) in the Chi-squared test. Hence, there was no vaccine-hesitant risky recipient group identified in implementing upcoming childhood COVID-19 vaccination programs.

CONCLUSIONS: This study confirms the importance of a positive perception of vaccine safety, efficacy, effectiveness, and health education for vaccine confidence under any circumstances. Childhood COVID-19 vaccine confidence is Improved if vaccination data become more available to the guardians and school community. Public health education would be considered a preferred approach for building trust and fostering childhood vaccine confidence against COVID-19 in Bangladesh.

Keywords:

Bangladesh, childhood, COVID-19 vaccine, education, primary schools

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Introduction

The corona virus disease 2019 (COVID-19) that affected community people from all walks of life and imposed a heavy disease burden around the world is not over yet. The treatment protocol for COVID-19 is facing challenges due to the absence of precise antiviral medication against novel corona pathogens.^[1] In the last five decades, vaccine has proven its effectiveness for rescuing millions of lives because it was one of the greatest felicities in medical science.^[2] However, at the beginning of 2021, the COVID-19 vaccination program was started in different countries, as vaccination is the most effective and fundamental therapeutic tool to eradicate pandemic virus.^[3] Like many other countries, Bangladesh also moved forward with its vaccination policy and mass inoculation programs against COVID-19 pandemic. The government of Bangladesh has launched the biggest-ever mass vaccination program to vaccinate 80% (over 130 million) of the country's total population.^[4] Although a pilot vaccination event started on January 27, 2021, by delivering Covishield, the Oxford–AstraZeneca COVID-19 vaccine,^[5] countrywide vaccine drive among the various priority groups was started on February 7, 2021.

After the long-term shutdown, on February 22, 2022, the government of Bangladesh ordered to reopen all educational institutes when the third wave of COVID-19 outbreak started to decline the severity of infection spread.^[6] The success of having a collaborative decision on how to avoid contamination and guarantee the security of teachers, students, and staff against COVID-19 without compromising the quality education is the major dilemma that schools' stakeholders faced worldwide.^[7] Furthermore, schools ought to open safely and as soon as conceivable to accomplish the benefits of face-to-face learning.^[8] With this, schools' stakeholders believed that vaccination against novel corona virus is the fundamental tool in making an informed decision to continue sustainable and long-term school class continuation, resumption of in-person's classes, and strictly follow the academic calendar. To accomplish this, a significant portion of people ought to be vaccinated to achieve herd immunity and to stop the re-emergence of COVID-19.^[9]

Despite the undeniable immunization success, nowadays vaccine is perceived as unsafe and unnecessary by a growing segment of populations and a large segment of doubtful attitudes toward vaccine immunization represent a serious danger to public health that has been collectively known as "hesitancy."^[10] Vaccine confidence and hesitancy provide a dichotomous perspective on the perception, confidence, beliefs, and behaviors related to vaccines.^[11] The complex nature of motives behind the

COVID-9 vaccine hesitancy among the people varies widely depending on the context, way of measurement, and the pandemic stage.^[12] COVID-19 vaccine hesitancy is a growing concern among the various subgroup populations, with substantial regional variability.^[13]

Meanwhile, positive concerns over safety, efficacy, and effectiveness data of a particular vaccine were the most common predictors associated with COVID-19 vaccine confidence among the public that has been noted to date.^[14,15] However, effective health education could be cornerstone in the primary prevention and control of infectious disease because information provided by educational intervention has been reported to be significantly correlated with positive attitudes toward vaccine confidence.^[16] Adequate health education helps to restore the trust that would boost COVID-19 vaccine confidence by reducing anti-vaccination sentiments.^[17] Taken all together, we primarily fixed two study hypotheses as follows: (a) Vaccine-related predictors such as safety, efficacy, and effectiveness have a significant and positive association with childhood COVID-19 vaccine confidence and receptivity, and (b) health education (literacy about the pandemic and vaccine consequences) has a significant and positive association with childhood COVID-19 vaccine confidence.

Until recently, several studies are focusing on COVID-19 vaccine acceptability among the general people,^[18-20] university students,^[21] and rural people^[22] in Bangladesh. As COVID-19 vaccination campaign targets to vaccinate primary school children aged between 5 and 12 will be started in the middle of August 2022, by delivering Pfizer vaccine,^[23] this cross-sectional study, thus, aimed to identify the potential factors influencing childhood COVID-19 vaccine confidence and receptivity among the primary school's stakeholders in Bangladesh.

Materials and Methods

We have deposited step-by-step descriptions of the study protocols on *protocols.io* (dx.doi.org/10.17504/protocols.io.ewov1o2b2lr2/v1).

Study design and setting

This cross-sectional study supplied an anonymous multi-item questionnaire to the eligible respondents who participated from numerous primary schools throughout the country. The questionnaire was adopted from the extant literatures to dies on the topic and deployed paper-based. The participants were purposively interviewed between February 25, 2022, and April 15, 2022, via a face-to-face approach. The Institutional Review Board approved this study as exempt. No funding was available.

Questionnaire and survey administration

A validated, anonymous, semi-structured, multi-item questionnaire was adopted from the theoretical analysis of scholarly articles focusing on childhood vaccinations^[24-26] and COVID-19 vaccine confidence.^[14,15,27] The questionnaire was originally developed in English language and then translated by the expert to the native language (Bengali) because translating into the native language was considered a key task in capturing the respondent's perception in a survey-based research. The items in the preliminary questionnaire were validated by a panel of public health experts from the reputed universities in Bangladesh to ensure the relevance and clarity of the questionnaires. The purposive sampling technique was used for systematic data gathering from the face-to-face interview approach. This process created survey with the goal of collecting maximum insights from respondent's sample of entities for the purpose of developing quantitative variables of the attributes. To avoid the potential source of non response bias, the questionnaire was distributed among the parents, teachers, and administrative personnel and encourages them to participate in this study. Face-to-face interview method denied the acceptance of missing data.

Study participants and sampling

We carried out this cross-sectional study by applying self-administered anonymous questionnaire to eligible primary school stakeholders in Bangladesh who were capable to submit the required data. The participants were purposively interviewed by the face-to-face approach. Initially, we selected several up azillain the southwestern part of Bangladesh to collect data initially using a purposive sampling technique. The areas were selected because of convenience for data collections by the investigators. According to the latest census of 2020, of a population over 160 million in Bangladesh approximately 66.88% were residing in rural places; of them, at least 46.72% were women and girls. Bangladesh has a total of 108516 primary schools of which 63041 are government schools and 45475 are private schools. Nonetheless, the southwestern parts of Bangladesh have a total of 8348 primary schools. Informed consent was provided to individual participant. However, of 680 participants, 7.8% declined to give consent and 627 participants were included in this study.

Participants' inclusion criteria

The eligibility criteria for the participants were as follows: (i) to sign a consent form and agree to the study objectives, (ii) agreed to provide anonymous data on childhood COVID-19 vaccine and vaccination, (iii) parent or owner of the primary school's students, (iv) teacher of the primary educational institutes, and (vi) administrative staff of the primary schools.

Study variables

The response variable of the study measured receptivity and childhood COVID-19 vaccine confidence, while the responses were measured as a binary variable (1 = yes, 0 = no). Socio demographic characteristics of the respondents were also captured. For analyzing the data in the binary regression model, we investigated the impact of several sociopsychological and vaccine-related determinants on outcome response variable (vaccine confidence) dichotomized into 1 = yes and 0 = no.

For observational studies with large sample size, taking a minimum sample size of 500 is necessary to derive the 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 as follows: $n = 100 + 50i$, where i indicates the number of the independent variables incorporated in the final model.^[28] Thus, the included 627 sample sizes comply with the standard of the binary regression.

Data analysis

The descriptive statistics utilized weighted frequencies and percentage for expressing values. A nonparametric data analytical tool, the binary logistic regression, was employed to explore the pattern of association between explanatory variables and response variable. All relevant key assumptions of the regression analysis were performed to adjust the suitability of the model. Accordingly, the model summary was evaluated and goodness-of-fit model was assessed. Raw data were inserted into Microsoft Excel version 10 and imported into Statistical Package for Social Sciences (SPSS) software. IBMSPSS version 25 was used for the data analyzing purposes, and $P < 0.05$ was considered statistically significant. A face-to-face data collection approach denied receiving incomplete survey instrument, which ensured collection of complete responses. Thus, no missing data were received in the binary analysis.

Ethical consideration

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.

Results

Respondents' characteristics

Table 1 displays the socio demographic and socioeconomic characteristics of the study populations. We examined the eligibility criteria and confirmed the eligible 627 participants. A total of 352 (56.14%) men and 275 (43.86%) women participated in the study.

Descriptive statistic findings

The descriptive statistic of the independent variables and the outcome variable is shown in Table 2. Importantly, 571 (91%, 95% CI 89–93) participants had the confidence to receive childhood COVID-19 vaccine for inoculating 6- to 11-year-olds school-going youth. As the face-to-face approach bars acceptance of any incomplete survey instrument, the study variable of interest produced no missing data.

Model summary

We employed a binary logistic regression model, and the most common assessment of overall model fit in the logistic regression is the likelihood ratio test. The joint impact of the independent variables on the dependent

variable was determined using the Nagelkerke R Square test that explained the model summary. The result of Cox and Snell R² indicates that outcome variable was explained (18.8%–41.6%) by the independent variables in the predictive model, which is assumed to be satisfactory level presented in Table 3.

Goodness-of-fit model

The *P*-value of omnibus tests of model coefficients is significant, that is, less than 0.05, which indicates a very good model fit. Furthermore, according to the Hosmer and Lemeshow test, the *P*-value is 0.123, which is insignificant and indicates a good model fit as shown in Table 4.

Binary logistic regression model

Table 5 displays the result of correlation analysis of explanatory variables with the dependent variables in the binary regression analysis model. We examined the association pattern between predictor variable and binary outcome variable in the regression model. The analyses of the binary regression revealed that “safety” and “effectiveness” had a highly significant (*P* = 0.006, *P* = 0.001, respectively) and positive association and “efficacy” had a significant (*P* = 0.03) and positive association with vaccine confidence, while “rumor” had a highly significant (*P* = 0.000) and negative association with childhood COVID-19 vaccine confidence. According to the results, the social determinant “health education” had a significant (*P* = 0.04) and positive association with childhood COVID-19 vaccine confidence and receptivity among the primary school’s stakeholders in Bangladesh.

Table 6 represents the results of Pearson’s Chi-squared test and odds ratio for estimating the vaccine-hesitant risky group toward childhood COVID-19 vaccines.

Table 1: Respondent’s demography (n=627)

Variable	f	%
Age distribution		
18-29 years	40	6.4
30-39 years	509	81.2
40-49 years	69	11
50-59 years	8	1.3
60+	1	0.2
Participant’s type		
Parents	410	65.39
Teachers	138	22
Administrative staff	79	12.61
Educational status		
Below SSC	73	11.64
SSC/equivalent	101	16.1
HSC/equivalent	145	23.12
Degree (Hon’s)/equivalent	206	32.85
Masters/equivalent	102	16.2
Participants by school location		
Metropolitan city	51	8.13
District city	98	15.62
Thana city	138	22
Union/ward level	340	54.22
Religion		
Muslim	489	77.99
Hindu	138	22.01
Gender		
Male	352	56.14
Female	275	43.86
Marital status		
Single	84	13.4
Married	543	86.6
Experience of COVID-positive		
Not infected	490	78.15
Having experience of corona infection	137	21.85
Vaccine confidence		
Having confidence toward COVID-19 vaccine	571	91
No confidence in vaccination	56	9
Intention to receive vaccine		
Reservation to receive childhood vaccine	56	9
Accept vaccination for children/students	571	91

Table 2: Descriptive results of variables and questionnaire

Operational definition of variables	Mean	SD
I have confidence towards COVID-19 vaccine and I intend to receive it for children uptake (yes=1, otherwise=0)	0.91	0.285
I am confirm that the vaccination is safe (yes=1, otherwise=0)	0.95	0.217
I am confident on vaccine efficacy (yes=1, otherwise=0)	0.97	0.172
I believe the vaccination has effectiveness to protect long time (yes=1, otherwise=0)	0.98	0.153
Many negative thoughts about the vaccination has been delivered to me (yes=1, otherwise=0)	0.19	0.391
I received vaccine education from nearby health awareness campaign (yes=1, otherwise=0)	0.98	0.148
I received vaccine information from many sources (yes=1, otherwise=0)	0.78	0.584
I am well communicated about the vaccination (yes=1, otherwise=0)	0.96	0.184
I have a trust on the vaccination (yes=1, otherwise=0)	0.93	0.253

However, the odds ratio for receiving vaccine was 0.6, which was found insignificant ($P > 0.05$) according to the Chi-square test.

Discussion

This study investigated COVID-19 vaccine confidence and receptivity for school-aged children against COVID-19 pandemic and explored the major determinants of parental childhood vaccine confidence. The variation in the respondent’s demography and large sample size provides much strength to anticipate the generalizability of the study results in addressing the large population and delivering health messages

Table 3: Model summary

-2 Log likelihood	Cox and Snell R square	Nagelkerke R square
246.853 ^a	0.188	0.416

Table 4: Omnibus tests of model coefficients and Hosmer and Lemeshow test

	Chi-square	df	Sig.
Step	130.536	8	0.000
Block	130.536	8	0.000
Model	130.536	8	0.000
Hosmer and Lemeshow test	5.770	3	0.123

Table 5: Results of the binary logistic regression

Variables	B	S.E.	Wald	Sig.	Exp (B)	95% C.I. for EXP (B)	
						Lower	Upper
Safety	1.510***	0.550	7.546	0.006	4.527	1.541	13.297
Efficacy	1.300**	0.604	4.630	0.031	3.668	1.123	11.985
Effectiveness	2.592***	0.747	12.054	0.001	13.354	3.091	57.681
Rumor	-2.796***	0.364	59.034	0.000	0.061	0.030	0.125
Health education	1.397**	0.711	3.859	0.049	4.045	1.003	16.306
Information	-0.337	0.186	3.279	0.070	0.714	0.496	1.028
Communication	-1.172	0.960	1.489	0.222	0.310	0.047	2.035
Trust	-0.340	0.544	0.391	0.532	0.712	0.245	2.068
Constant	-1.147	1.374	0.697	0.404	0.318		

***=significant at <0.01, **=significant at <0.05

Table 6: Pearson’s Chi-square test results

	Value	Chi-square tests		
		Asymptotic significance (two-sided)	Exact sig. (two-sided)	Exact sig. (one-sided)
Pearson’s Chi-square	3.301 ^a	0.069		
Continuity correction ^b	2.808	0.094		
Likelihood ratio	3.272	0.070		
Fisher’s exact test			0.090	0.047
Linear-by-linear association	3.296	0.069		
No. of valid cases	627	0.069		
		Value	95% confidence interval	
			Lower	Upper
Risk estimate	Odds ratio for gender: (male/female)	0.602	0.346	1.045
	For cohort, I intend to accept vaccination anytime=no	0.630	0.381	1.042
	For cohort, I intend to accept vaccination anytime=yes	1.047	0.995	1.102
	No. of valid cases	627		

to increase public confidence in current COVID-19 vaccination.

Vaccine hesitancy or refusal is a dynamic and heterogeneous phenomenon that has steadily increased in more than 90% of countries since.^[29] The pooled COVID-19 vaccine confidence and receptivity among the primary school’s stakeholders has been estimated to be 91%, which was satisfactory. A cross-sectional online survey conducted across nine LMICs (Low and middle income country) including Bangladesh showed that the prevalence of COVID-19 vaccine confidence and receptivity varied from 76.4% to 88.8%.^[30] In the recent past, parental acceptance for childhood influenza vaccines was reported to be 81.5% in the United States.^[31] In Italy, parental vaccine willingness for childhood HPV vaccination was 85%^[32] and for COVID-19 vaccination was 82.1%.^[33] Moreover, Bangladesh has had a successful history of childhood immunization and is able to achieve high vaccination coverage against vaccine-preventable disease under nationwide Expanded Program on Immunization (EPI) as well as non-EPI programs.^[34] These findings are supportive of our study results.

The binary regression model demonstrated that “safety” had a highly significant and positive association with

vaccine confidence. Individuals who perceive vaccine as safe are more likely to accept it and how large the safety margin of a vaccine that an individual consider in administering a new vaccine. For the COVID-19 vaccine drive, safety was one of the primary concerns among 45% of general people in India,^[35] 39.1% of young adults in Saudi Arabia,^[36] 47.8% in China,^[37] 46% in Qatar,^[38] and 25.5% in Bangladeshi people^[19] documented from Asian countries, while 60.4% were found in African and Middle East rejoin.^[39] Hence, safety issue was identified as the key component for COVID-19 vaccine confidence and receptivity. In our study, “efficacy” was recognized as a key predictor that had a highly significant and positive association with vaccine confidence. In the recent past studies, efficacy has been identified as an important predictor by 25% of participants in France,^[40] 10.6% in India,^[41] and 62.7% in Uganda.^[42] Provided the long-term effectiveness of COVID-19 vaccine might increase public confidence to get vaccinated, vaccine effectiveness has been recognized as an important indicator in making vaccine decision among 53.8% of general people in India,^[35] 49.9% in Saudi Arabia,^[36] 16% in Qatar,^[38] and 14.7% in Jordan^[43] reported from Asian continents, while 15.1% were identified in LMICs.^[30]

Anti-vaccination beliefs and rumors potentially led to mistrust contributing to vaccine hesitancy, and hesitancy has been found to be negatively correlated with vaccine confidence among the school’s stakeholders in the Philippines.^[44] Our study result demonstrated that rumor had a highly significant and negative association with COVID-19 vaccine confidence. Fake news and misinformation were important predictors that negatively influenced COVID-19 vaccine acceptance intention and reduced vaccine confidence in Asian countries.^[45] Health educational programs conducted by resourceful personnel could be an effective way to provide information for encountering fake news, rumor, and negative attributes on vaccinations. Information provided in health education campaigns would play a key role in building confidence has already seen to use as a fundamental tool in preventing infectious disease.^[46] Education aiming to promote COVID-19 vaccine has practical application in vaccine policy implication where education of children and adolescents on the basics of immunization, decision-making, and critical thinking would be the strategies to overcome vaccine rejection.^[47] Therefore, health education has been found to have significant effect as well as positive association with childhood vaccine confidence that supported the study-outlined hypothesis. Multi-disciplinary educational intervention need be adopted to improve public adherence and knowledge about childhood vaccine consequences and limit periodic vaccine skepticism.

The study had some limitations, and the foremost limitation was the sample size. As the study, thus, did not involve the largest number of sample size, a non response bias is a possibility as those who did not respond might have more confidence or hesitancy regarding the COVID-19 vaccines than the study respondents. This non response bias would undermine the true prevalence of COVID-19 vaccine confidence and receptivity. The possibility that there are some other confounding predictors of childhood vaccination is still unutilized in this study.

It is worth mentioning that citizens who refused to be vaccinated and parents who delayed or opted not to vaccinate their school-aged children increased the risk of disease re-emergence and prolonged the shutdown of educational institutes.^[48]

This study has some practical implications in research, policy, and practices. This study, thus, acts as scientific evidence for initiating further predictive studies of COVID-19 vaccine confidence by examining the association between childhood vaccine acceptance and explanatory variables. Our study findings largely benefit the health policy makers and vaccine promoters to practice evidence-based promotional policies for involving child health during the COVID-19 vaccination programs thus insights better educational attainment in Bangladesh and other developing countries. As vaccine apprehension and confidence can alter over time among various sub-group population^[49,50] with substantial regional variability^[51], a long-term surveillance study would be adopted for monitoring upcoming childhood COVID-19 vaccine confidence and receptivity.

Conclusions

Massive vaccination programs have already been shown to be an immense success in reducing COVID-19-induced morbidity and mortality; however, achieving high vaccine confidence is a fundamental aspect of successful childhood vaccination drive against global pandemic. This study confirms the importance of a positive perception of vaccine safety, efficacy, effectiveness, and information for vaccine confidence under any circumstances. The preference for vaccination information and tailored communication has an unprecedented importance to reduce anti-vaccination beliefs and rumors. It is also essential to remain truthful and transparent in providing information regarding vaccines, as public acceptance regarding vaccine’s data is closely associated with childhood vaccine confidence. The prospective health benefits of childhood vaccinations (e.g., protecting the vulnerable others) need to be highlighted in campaigns and educational materials. The study findings support the researchers, health policy makers, and vaccine

administrators gain a better understanding of childhood COVID-19 vaccination strategies in near real-time and calls for implementing multidisciplinary curriculum within formal, informal, and non-formal education systems in Bangladesh.

Data availability

All data used for the analysis in this manuscript are available from the corresponding author or first author upon reasonable request.

Consent to participate

All participants provided objectives of the study and informed consent prior to the study participation.

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Conflicts 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.

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