

The Determinants of COVID-19 Vaccine Acceptance in Sumatra

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Abstract

In light of the current coronavirus disease 2019 (COVID-19) vaccination programs being implemented worldwide, this study aimed to evaluate the COVID-19 vaccine acceptance survey in Indonesia conducted by the World Health Organization (WHO), the Ministry of Health of the Republic of Indonesia, the National Immunization Technical Advisory Group (NITAG), and the United Nations Children's Fund (UNICEF), published in November 2020. It was found that Sumatra Island having lower COVID-19 vaccine acceptance rates, with Aceh Province displaying the lowest level of vaccine acceptance. Thus, a cross-sectional study was conducted, and a logistic regression analysis was used to identify the factors affecting COVID-19 vaccine acceptance. Out of 368 respondents who participated in the survey, 143 (38.9%) accepted the vaccine, and 225 (61.1%) refused it. Vaccine safety concerns constituted the most reported reason for refusal (43.6%). This study also found that province of residence and basic immunization status were determinants of COVID-19 vaccine acceptance in Sumatra. Concerns regarding vaccine safety might be the reason for the low level of vaccination in Sumatra. Increased education and encouragement from healthcare professionals and regional authority figures can alleviate public concerns and improve vaccine acceptance.

Keywords: COVID-19, determinants, vaccine

Introduction

The coronavirus disease 2019 (COVID-19) pandemic has impacted the lives of millions of people worldwide. In Indonesia, a cumulative total of 1,460,184 confirmed cases and 39,550 deaths have been reported to date.¹ As the number of COVID-19 cases continues to increase; nations have rapidly developed vaccines to be made readily available for health workers and the general population. Vaccination programs have been implemented globally to relieve the socioeconomic burden on the healthcare system. The Indonesian Government has taken numerous measures towards implementing of a COVID-19 vaccination program. On January 11, 2021, the National Agency of Drug and Food Control/*Badan Pengawas Obat dan Makanan* (BPOM) published an Emergency Use Authorization (EUA) for the COVID-19 vaccine CoronaVac developed by Sinovac Biotech.² On January 13, 2021, the President of the Republic of Indonesia, Joko Widodo, was the first Indonesian citizen to be vaccinated at the presidential palace, officially launching the COVID-19 vaccination program in

Indonesia.³ However, for the program to be successful, it is imperative to evaluate the public's perception and acceptance of the vaccine.

Several studies have explored the prevalence of COVID-19 vaccine acceptance and its determinants among various populations in different countries. The World Health Organization (WHO), together with the Indonesian Ministry of Health, the Indonesia Technical Advisory Group on Immunization (ITAGI), and the United Nations Children's Fund (UNICEF), made a comprehensive report on COVID-19 vaccine acceptance in Indonesia in 2020. The survey revealed that 65% of respondents were willing to accept the vaccine, 8% refused, and the remaining respondents expressed hesitancy.⁴ However, this study did not elaborate on the factors that might have resulted in vaccine acceptance in each province. The survey was a descriptive study, while this study conducted an association analysis of the determinants specifically regarding the Sumatran population. Vaccine hesitancy, a delay in acceptance or refusal of vaccination regardless of its availability, is a

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barrier to achieving herd immunity.⁵ The study reported that provinces in Sumatra were amongst those with lower COVID-19 vaccine acceptance rates, with Aceh having the lowest acceptance rate.⁴ Previous studies also reported that the provinces in Sumatra had incomplete immunization coverage rates of more than 70% in eight of ten provinces.⁶⁻⁸

The survey also demonstrated that vaccine acceptance varied based on geographical regions and socioeconomic factors such as economic status, religious and cultural beliefs, gender, insurance availability, and several concerns regarding the vaccine.⁴ Sociodemographic factors such as age, province, gender, and marital status were included as variables to stratify demographic factors on COVID-19 vaccine acceptance. Immunization status, religion, economic status, education, employment, healthcare worker status, and insurance ownership have been found to affect vaccine acceptance rates by previous studies.⁴ Incomplete immunization status often reflects limited knowledge and awareness regarding immunization, impacting vaccine acceptance.⁹ Religion was included as a variable due to concerns about whether the COVID-19 vaccine is considered halal (permissible), which may impact vaccine acceptance in the Indonesian population. Lower economic status, education, and unemployment have been correlated with lower vaccine acceptance rates.¹⁰⁻¹² Healthcare workers may have more comprehensive knowledge of COVID-19 and relatively high awareness of the importance of vaccination and may be more willing to accept the vaccine.¹³⁻¹⁵ Insurance ownership, prior experience with COVID-19, knowledge of COVID-19 vaccine distribution by the government, and willingness to pay are also variables that could potentially impact vaccine acceptance.

Evaluating the various factors contributing to vaccine acceptance and hesitancy in each geographical location is essential. These were important because vaccine hesitancy is complicated and context-specific.¹⁶ This study was conducted to evaluate the determinants of COVID-19 vaccine acceptance in Sumatra. The second aim of the study was to understand the underlying issues present and develop strategies to overcome them.

Method

A cross-sectional online survey was designed using Google Forms and distributed through WhatsApp, Line, and Instagram between January and February 2021. Study samples were collected from ten provinces in Sumatra using a purposive sampling strategy. Inclusion criteria were respondents who consented to participate and were older than ten years of age. Respondents who did not complete the questionnaire were excluded. A previous study showed that 67% of respondents demonstrated acceptance of a potential COVID-19 vaccine.¹⁵

$$n = \frac{Z\alpha^2(pq)}{d^2} = 339 \approx 350$$

Formula 1. Sample Size Estimation

Sample size was calculated using the formula as in Formula 1, where *n* is sample size, *p* = proportion, $\alpha = 0.05$, $Z\alpha = 1.96$, and *d* = 0.05.

After accounting for incomplete questionnaires and dropouts, the final optimal sample size was estimated to be 350 completed questionnaires. The questionnaire used in this study was a modified version of the WHO COVID-19 Vaccine Acceptance Survey in Indonesia questionnaire.⁴ The possible responses for "occupation" were modified to "unemployed non-healthcare worker," "employed non-healthcare worker," and "healthcare worker," which would be grouped into employment (employed/unemployed). Healthcare workers grouped into healthcare worker/non-healthcare worker status during data analysis. As previous studies have demonstrated the positive impact of prior immunization on future vaccine acceptance, an additional question regarding previous immunization history was added to the questionnaire.¹⁷⁻²²

Ten provinces in Sumatra were grouped into high and low immunization coverage categories based on WHO statements that a vaccine coverage of $\geq 80\%$ is considered high.²³ Data from UNICEF's Sustainable Development Goals (SDG) Baseline Report on Children in Indonesia on immunization coverage of the third dose of diphtheria, pertussis, and tetanus (DPT3) vaccine was used.²⁴ Data on DPT3 rather than measles vaccine coverage was used because the national immunization coverage for DPT3 was lower and better reflected the immunization coverage in Sumatra. Provinces with low immunization coverage included Aceh, Jambi, North Sumatra, Riau, South Sumatra, and West Sumatra. Those with high immunization coverage included Bangka Belitung Islands, Bengkulu, Lampung, and Riau Islands. Religion was reported as either Muslim or non-Muslim because the majority of the population of Sumatra is Muslim.²⁵ Economic status was categorized as poor/aspiring middle-class and middle/upper class based on an average household monthly expense cutoff of IDR 4,800,000 (equivalent to US\$ 328.23 according to the April 12, 2021 exchange rate).²⁶ Education was grouped into tertiary education and elementary and secondary education based on The Indonesian Law no. 20 of 2003 Concerning the National Education System.²⁷

The data were analyzed using descriptive statistics. First, a cross-tabulation analysis was performed to evaluate the participants' response to vaccine acceptance

Table 1. Sociodemographic Characteristics

Variable	Category	n	%
Age	<25 years	121	32.9
	≥25 years	247	67.1
Province	Provinces with low immunization coverage (Aceh, Jambi, North Sumatra, Riau, South Sumatra, West Sumatra)	244	66.3
	Provinces with high immunization coverage (Bangka Belitung Islands, Bengkulu, Lampung, Riau Islands)	124	33.7
Gender	Females	135	36.7
	Males	233	63.3
Marital status	Unmarried (single, divorced, or widowed)	166	45.1
	Married	202	54.9
Basic immunization	Incomplete	131	35.6
	Complete	237	64.4
Religion	Non-Muslim	134	36.4
	Muslim	234	63.6
Economic status	Poor/aspiring middle-class	283	76.9
	Middle/upper class	85	23.1
Education	Elementary and secondary education	208	56.5
	Tertiary Education	160	43.5
Employment	Unemployed	14	3.8
	Employed	354	96.2
Healthcare worker	Non-healthcare worker	334	90.8
	Healthcare worker	34	9.2
Insurance ownership	No Insurance	33	9
	Owns insurance	335	91
Experience with COVID-19: Have you ever been infected with COVID-19, or do you know someone close to you who has been infected with COVID-19?	No	281	76.4
	Yes	87	23.6
Do you know that the Government of the Republic of Indonesia has planned to provide the COVID-19 vaccine?	No	37	10.1
	Yes	331	89.9
Willingness to pay: Are you willing to pay for the COVID-19 vaccine?	Not willing/not sure	247	67.1
	Willing	121	32.9

concerning each independent variable. A bivariate analysis evaluated the associations between each independent variable and vaccine acceptance separately. Then, independent variables with a $p\text{-value} \leq 0.25$ and independent variables theoretically associated with vaccine acceptance were included in the multivariate analysis. For the multivariate analysis, the model was analyzed for confounding variables and potential interactions between the independent variables. The final logistic regression model was used to identify COVID-19 vaccine acceptance determinants in Sumatra. All data analyses were performed using SPSS software (IBM Corp., released 2020, IBM SPSS Statistics for Macintosh, version 27.0, Armonk, NY).

Results

A total of 368 respondents provided consent and completed the survey (Table 1). The majority (67.1%) of respondents were 25 years or older, and 66.3% were from provinces with low immunization coverage. More male respondents than female ones; 54.9% were married, and 64.4% received complete basic immunization. For the rest of the sociodemographic variables,

Table 2. Reasons for Vaccine Refusal

Reasons	(n = 225)	%
Concerns about the vaccine’s safety	98	43.6
Concerns about the vaccine side effects	57	25.3
Concerns about the vaccine’s efficacy	36	16.0
Other unspecified reason	11	4.9
Lack of trust	9	4.0
Unsure if a family will accept the vaccine	5	2.2
Religious beliefs	4	1.8
Comorbidities	3	1.3
Lack of knowledge of the vaccine	2	0.9

63.6% were Muslim, 76.9% belonged to the poor/aspiring middle-class category, 43.5% received tertiary education, 96.2% were employed, 90.8% were non-healthcare workers, and 91% owned health insurance. Concerns regarding vaccine safety constituted the most reported reason for refusal (43.6%), followed by side effects and efficacy (Table 2).

Cross-tabulation and bivariate analysis was done between the independent variables and vaccine acceptance (Table 3). Out of 368 respondents, 143 (38.9%) respondents answered “yes” to receiving the

Table 3. Cross-tabulation and Bivariate Analysis

Variable	Category	Willingness to Receive the Vaccine		p-value	Exp(B)	95% CI for Exp(B)	
		No	Yes			Lower	Upper
		(n = 225) (%)	(n = 143) (%)				
Age	<25 years	63 (52.1)	58 (47.9)	0.015	1.755	1.127	2.732
	≥25 years	162 (65.6)	85 (54.4)	Ref			
Province	Provinces with high immunization coverage (Bangka Belitung Islands, Bengkulu, Lampung, Riau Islands)	67 (54.0)	57 (46.0)	0.047	1.563	1.007	2.427
	Provinces with low immunization coverage (Aceh, Jambi, North Sumatra, Riau, South Sumatra, West Sumatra)	158 (64.8)	86 (55.2)	Ref			
Gender	Females	80 (59.5)	55 (40.7)	0.573	1.133	0.734	1.748
	Males	145 (62.2)	88 (57.8)	Ref			
Marital status	Unmarried (single, divorced, or widowed)	90 (54.2)	76 (45.8)	0.014	1.701	1.114	2.598
	Married	155 (66.8)	67 (53.2)	Ref			
Basic immunization	Complete	131 (55.5)	106 (44.7)	0.002	2.056	1.3	3.252
	Incomplete	94 (71.8)	57 (28.2)	Ref			
Religion	Non-Muslim	70 (52.2)	64 (47.8)	0.008	1.794	1.162	2.769
	Muslim	155 (66.2)	79 (53.8)	Ref			
Economic status	Middle/upper class	45 (52.9)	40 (47.1)	0.078	1.553	0.952	2.535
	Poor/aspiring middle-class	180 (63.6)	103 (56.4)	Ref			
Education	Elementary and secondary education	121 (58.2)	87 (41.8)	0.183	1.335	0.872	2.044
	Tertiary education	104 (65.0)	56 (55.0)	Ref			
Employment	Employed	216 (61.0)	138 (39.0)	0.806	1.15	0.378	3.503
	Unemployed	9 (64.3)	5 (55.7)	Ref			
Healthcare worker	Healthcare worker	17 (50.0)	17 (50.0)	0.165	1.651	0.813	3.35
	Non-Healthcare worker	208 (62.3)	126 (57.7)	Ref			
Insurance ownership	Owens insurance	205 (60.6)	132 (39.4)	0.496	1.3	0.611	2.77
	No insurance	22 (66.7)	11 (53.3)	Ref			
Experience with COVID-19: Have you ever been infected with COVID-19, or do you know someone close to you who has been infected with COVID-19?	Yes	45 (51.7)	42 (48.3)	0.04	1.663	1.023	2.704
	No/Not sure	180 (64.1)	101 (55.9)	Ref			
Do you know that the government of the Republic of Indonesia has planned to provide the COVID-19 vaccine?	Yes	200 (60.4)	131 (39.6)	0.399	1.365	0.662	2.811
	No	25 (67.6)	12 (52.4)	Ref			
Willingness to pay: Are you willing to pay for the COVID-19 vaccine?	Willing	41 (33.9)	80 (66.1)	<0.001	5.699	3.552	9.144
	Not Willing/Not sure	184 (74.5)	63 (25.5)	Ref			

Note: CI = Confidence Interval

vaccine, and the remaining 225 (61.1%) respondents answered “no.” The variables that demonstrated significant associations with vaccine acceptance were age, province, marital status, basic immunization, religion, willingness to pay, and experience with COVID-19 (p-value<0.05).

In the logistic regression analysis (Table 4), the authors included all variables from the bivariate analysis that were statistically significant (p-value<0.25), including age, province, marital status, basic immunization, religion, economic status, education, healthcare worker, willingness to pay, and experience with COVID-19. However, several studies on factors affecting vaccine

acceptance have consistently shown that employment status is associated with vaccine acceptance;^{28,29} therefore, employment status was added to the multivariate analysis. The authors removed all variables with a p-value>0.05 and did not alter other variables' odds ratio (OR) by more than 10%. Variables that were removed included employment status, marital status, healthcare worker, and experience with COVID-19. Confounding variables included age, religion, economic status, and education—willingness to pay significantly associated with age, province, and religion (p-value<0.05). Seven variables were associated with vaccine acceptance: age, province, basic immunization,

Table 4. Logistic Regression Analysis of Determinants of COVID-19 Vaccine Acceptance, Final Model

Variable	β	Sig. (p-value)	Exp(B)	95% CI for Exp(B)	
				Lower	Upper
Age (<25 years old)	-0.505	0.271	0.603	0.246	1.483
Province (High immunization coverage)	1.001	0.002	2.721	1.453	5.096
Basic immunization (Complete)	0.709	0.009	2.031	1.194	3.455
Religion (Muslim)	-0.745	0.114	0.475	0.189	1.196
Economic status (Poor/aspiring middle-class)	0.338	0.289	1.402	0.751	2.615
Education (Elementary and secondary education)	0.135	0.612	1.144	0.68	1.924
Willingness to pay (Willing)	0.691	0.26	1.995	0.599	6.639
Willingness to pay (Willing) by Age (<25 years old)	1.683	0.011	5.38	1.467	19.722
Willingness to pay (Willing) by Province (High immunization coverage)	-1.333	0.022	0.264	0.084	0.828
Willingness to pay (Willing) by Religion (Muslim)	1.954	0.006	7.058	1.755	28.381

Note: CI = Confidence Interval

religion, economic status, education, and willingness to pay. Province and basic immunization were significant determinants of COVID-19 vaccine acceptance (p-value<0.05). Respondents from provinces with high immunization coverage were 2.721 times more likely to accept COVID-19 vaccination than provinces with low immunization coverage (OR = 2.721; 95% confidence interval [CI] = 1.453–5.096; p-value = 0.002). Respondents with completed immunization history were 2.031 times more likely to accept COVID-19 vaccination compared to those with incomplete immunization history (OR = 2.031; 95% CI = 1.194–3.455; p-value = 0.009).

Discussion

Vaccination programs were developed as part of a global effort to achieve herd immunity. However, a certain threshold of vaccination must be achieved for success. Studies on COVID-19 vaccine acceptance have been conducted in various countries and population groups worldwide to identify existing barriers and develop evidence-based interventions to overcome them. This study evaluated the determinants of COVID-19 vaccine acceptance in Sumatra only. Overall, there was a low rate of COVID-19 vaccine acceptance in Sumatra, with only 38.9% of respondents being willing to accept the vaccine. This finding agreed with the WHO COVID-19 Vaccine Acceptance Survey results in Indonesia, showing that provinces in Sumatra had low vaccine acceptance rates.⁴ Differences in acceptance rates between this study and the WHO survey may be due to the progression of the COVID-19 vaccination program concerning the time of data collection and difference in sample size. Previous studies on vaccine acceptance and immunization coverage in Sumatra have also demonstrated similar findings.³⁰⁻³³ In this study, the province of residence and basic immunization status were significantly associated with COVID-19 vaccine acceptance.

The age was not associated to the vaccine acceptance. Previous systematic review found that sex was the demographic variables examined most frequently across the ten studies and there was no consistent association between these variables.²¹ Education was also not associated to the vaccine acceptance. This was stated from previous study that there were no differences between developing and developed countries in term of vaccine acceptance.¹⁹

Vaccine acceptance was 2.721 times more likely in provinces with high immunization coverage than provinces with low immunization coverage (OR = 2.721; 95% CI = 1.453–5.096; p-value = 0.002). A possible reason for this is the presence of religious norms and beliefs in areas with low immunization coverage.^{34,35} The majority of the population in Sumatra is Muslim, and the Islamic Shari'ah law may affect public acceptance towards vaccination due to its conservatism. In the past, vaccine acceptance has been a challenge due to fear that vaccines may contain animal-derived products, considered haram (forbidden) in Islamic law.^{35,36} In 2001, the WHO issued a statement based on Islamic religious scholars' opinions that animal-derived products that have been transformed are considered halal for medical use.^{35,36} The COVID-19 pandemic presents a similar situation in that concerns about the vaccine's halal status have impacted vaccine acceptance in the Indonesian population. For reassurance, the Indonesian Ulama Council/Majelis Ulama Indonesia (MUI) released a fatwa (pronouncement) declaring that the COVID-19 vaccine is halal for use.³⁷

Respondents with complete immunization history were 2.031 times more likely to accept the vaccine than those with incomplete immunization (OR = 2.031; 95% CI = 1.194–3.455; p-value = 0.009). Previous studies have consistently proven the positive impact of prior vaccination on future vaccine acceptance.^{19,22,38} A study in China reported that past influenza vaccination increased

COVID-19 vaccine acceptance by 1.43–2.51-fold.²² A systematic review also reported that previous vaccination history had the most significant effect on accepting of a newly released vaccine during a pandemic.²² Out of seven studies that evaluated previous vaccination and future vaccine acceptance, six reported ORs ranging from 1.27 to 5.03. Two studies reported that prior vaccination was one of the top three determinants of vaccine acceptance.^{19,22,38}

Most respondents cited concerns on vaccine safety, side effects, and efficacy. The vaccination of the President of the Republic of Indonesia was broadcast on television to increase the public's trust in the vaccine. In Indonesia, the COVID-19 vaccine was distributed in four phases. This study conducted surveys from January to February 2021, during which the vaccination program in Indonesia had only just begun, and healthcare workers were the first to receive the vaccine. Because only healthcare workers had been vaccinated, the public may still have had uncertainties regarding the vaccine's safety. Additionally, constant media coverage may have increased salience among the public regarding the vaccine. This situation, along with a lack of knowledge and information,³⁹ may have hindered vaccine acceptance.

The result of this study can aid the government and healthcare systems in implementing effective vaccination strategies to improve vaccine acceptance in Sumatra. Sumatra's low vaccine acceptance rate is partly caused by conservatism and a history of vaccine refusal, as shown by incomplete immunization history. Therefore, measures should be taken to increase education and communicate vaccination to the general public in understandable, layperson's terms, especially regarding vaccine safety. Together with other sectors such as religious or political authority figures, the Ministry of Health should reach out to all population groups and educate them on the importance of vaccination. Lack of knowledge and understanding, together with misinformation and salience, results in a lack of confidence, uncertainty, and fear of the vaccine. Increasing public health education on the mechanics and benefits of vaccination may improve not only COVID-19 vaccination rates but overall immunization rates in the province of Sumatra. Implementing these measures will be one step closer to ensuring the public's confidence in the vaccine and improving vaccine acceptance rates.

This study is among the first to evaluate determinants of COVID-19 vaccine acceptance on an island of Indonesia. It could provide reliable data on participants' responses as this study used a questionnaire similar to the survey conducted by the WHO, the Indonesian Ministry of Health, NITAG, and UNICEF. This study also had no missing data, and the collected sample was fairly representative of the population of Sumatra. Most im-

portantly, this could stratify data based on sociodemographic parameters and provincial regions to predict COVID-19 vaccine acceptance in Sumatra. This understanding of the current barriers to vaccine acceptance may help identify population groups that require further attention and develop effective immunization strategies within the COVID-19 vaccination program.

This study has several limitations. Because the study was cross-sectional, the results reflect respondents' attitudes at the time of data collection only. Respondents' attitudes may change over time. The authors also did not evaluate other factors such as risk perception and trust in the health system.^{29,30,40} The sample only included 34 health workers, potentially producing biased results on whether health worker status affected vaccine acceptance. The sampling technique may also have led to selection bias. Respondents required a smartphone or computer and internet access to participate. Generalizability sample due to the exclusion of lower socioeconomic classes, those with a lack of access to technology, and illiterate individuals.

Conclusion and Recommendation

This study found that province with high immunization coverage, previous complete basic immunization, and willingness to pay of vaccine were the determinants of vaccine acceptance in Sumatra region. Increasing public health education by healthcare workers and authority figures is a viable strategy to improve vaccine acceptance. Alleviating public concerns about the vaccine is one of strategy to increase vaccine acceptance.

Abbreviations

COVID-19: coronavirus disease 2019; WHO: World Health Organization; ITAGI: Indonesia Technical Advisory Group on Immunization; UNICEF: The United Nations Children's Fund; BPOM: *Badan Pengawas Obat dan Makanan*; EUA: Emergency Use Authorization; SDG: Sustainable Development Goals; DPT3: Third Dose of Diphtheria, Pertussis, and Tetanus; CI: Confidence Interval; OR: Odds Ratio; MUI: *Majelis Ulama Indonesia*.

Ethics Approval and Consent to Participate

Ethics approval was obtained from the Faculty of Medicine, Pelita Harapan University's Research Ethics Committee, approval number 085/K- LKJ/ETIK/II/2021.

Competing Interest

The authors declare that there are no significant competing financial, professional, or personal interests that might have affected the performance.

Availability of Data and Materials

The data are not publicly available as it contains information that could compromise the privacy of research participants.

Authors' Contribution

CS conceptualized the study, outlined the design, analyzed the data, and wrote the manuscript. AK, NPHL, and JIS validated the study, supervised and revised the final manuscript. VS provided statistical advice, supervised and revised the final manuscript. NLS, SAR, TDS, CM assisted in data collection, RSH, DAH, CJ, FW, BS, EM, JW, JJA, MI, MI, NKH assisted in research proposal development and data collection.

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Not Applicable

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