

# Determinant Factors of COVID-19 Vaccine Hesitancy Among Adult and Elderly Population in Central Java, Indonesia

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**Purpose:** The Coronavirus disease (COVID-19) vaccination program has been rolled out to address the pandemic. However, the COVID-19 vaccination coverage rate in Indonesia, especially in Central Java, is low. The study aimed to identify COVID-19 vaccine acceptance and to determine the factors associated with COVID-19 vaccine hesitancy.

**Participants and Methods:** A cross-sectional study was conducted from September to October 2021. A self-reported questionnaire was distributed to participants aged  $\geq 18$  years and living permanently in the area of study by the multistage sampling technique. Bivariate and multivariate analyses were performed to determine the association. All statistical tests were significantly considered if the p-value  $< 0.05$  at 95% confidence interval (CI).

**Results:** A total of 500 participants were eligible, with the age ranging from 18 to 76 years old. COVID-19 vaccine acceptance rate was 93.6%. In the multivariate logistic regression analysis, we found that the elderly (aOR=5.231; 95% CI=1.891–14.468), having comorbidity (aOR=4.808; 95% CI=1.975–11.706), not being exposed to information (aOR=7.039; 95% CI=2.072–23.908), not believing in the vaccine halalness (OR=3.802; 95% CI=1.272–11.364), not believing that vaccines could prevent the COVID-19 infection (OR=4.964; 95% CI=1.970–12.507), and having vaccination-related mild-moderate anxiety (OR=14.169; 95% CI=2.405–83.474) were more likely to have vaccine hesitancy ( $p < 0.05$ ). Place of residence, education level, belief that the vaccine could prevent the severe symptoms of COVID-19, and knowledge were significantly related to the vaccine acceptance in the bivariate analysis ( $p < 0.05$ ), but they were no longer significant in the multivariate ( $p > 0.05$ ).

**Conclusion:** A high acceptance rate of the COVID-19 vaccine was found in this study. However, vaccine hesitancy is a major public health concern for attaining herd immunity and reducing the risk of case mortality. These findings could be the strategic focus for the government to improve COVID-19 vaccination coverage.

**Keywords:** COVID-19, vaccine acceptance, vaccination

## Introduction

A novel Coronavirus (2019-nCoV) was detected on December 31, 2019 in Wuhan City, China.<sup>1</sup> On March 11, 2020, the World Health Organization (WHO) proclaimed the COVID-19 pandemic after the number of cases of Coronavirus disease (COVID-19) outside China rose to over 118,000 and the mortality rate reached 4291 cases in 114 countries.<sup>2</sup> Indonesia identified the first 2 confirmed cases on March 2, 2020 and they have continued to spread every day. As of December 31, 2021, the accumulation of confirmed cases of COVID-19 has caught 4,2 million people and a total of 144,094 people died due to COVID-19 in Indonesia.<sup>3</sup>

WHO has recommended the mass COVID-19 vaccination to address the pandemic. Vaccination aims at achieving herd immunity and can reduce morbidity and mortality of vaccine-preventable diseases.<sup>4–6</sup> COVID-19 unvaccinated individuals were more likely to increase the relative mortality risk when compared to vaccinated individuals.<sup>7</sup> However, vaccine hesitancy has been a complex phenomenon globally. The Strategic Advisory Groups of Experts on Immunization

(SAGE) Working Group defined vaccine hesitancy as “a refusal or delay in the acceptance of vaccination despite the availability of vaccination services”.<sup>8</sup> The previous narrative review reported that the acceptance rate of COVID-19 vaccine worldwide ranged from 13% to 97%.<sup>9</sup> Studies in other countries have suggested that COVID-19 vaccine hesitancy was associated with sociodemographic characteristics, concerns about the side effect and safety of the vaccine, conspiracy beliefs, health status, and knowledge.<sup>10–13</sup>

As with the previous vaccination campaign, vaccine hesitancy has been experienced in Indonesia: against measles, rubella, and Zika.<sup>14,15</sup> Indonesia, as a Muslim majority country, the halalness (permission) of vaccine is the obligatory term to decide the vaccine acceptance.<sup>16</sup> A prior survey found that a total of 48.39% of the 9.39% of respondents who refused the vaccination doubted the COVID-19 vaccine halalness.<sup>17</sup> In addition, vaccine safety and the effectiveness of the vaccine were the two most common concerns for not receiving the COVID-19 vaccine in Indonesia.<sup>18</sup> Furthermore, information about the COVID-19 vaccine has spread fast through various media, regardless of its accuracy and reliability. The Ministry of Communication and Information of Indonesia stated that 850 hoaxes and disinformation regarding COVID-19 were distributed to the public.<sup>19</sup>

A prior study during March – April 2020 in Indonesia by Harapan et al indicated the COVID-19 hesitancy rate for the 95% and 50% effectiveness vaccines were 3.7% and 33%, respectively,<sup>20</sup> but in September 2020 the hesitancy rate rose to 35.2% in a study, based on a request from the Indonesian Technical Advisory Group on Immunization, established by the Ministry of Health, and supported by WHO and the United Nations Children’s Fund (UNICEF).<sup>18</sup> Both studies were conducted at a time when the COVID-19 vaccination program had not been rolled out. The authors identified a lack of other possible factors related to COVID-19 vaccine acceptance in recent studies that would be interesting to be studied.

Based on WHO recommendations, the Indonesian government has carried out the COVID-19 vaccination program since January 2021.<sup>21</sup> It has been expected to offer a good way to address the COVID-19 pandemic. However, at the end of August 2021, the COVID-19 vaccination coverage rate of doses 1 and 2 in Indonesia only reached 31.10% and 18.10% of the target, respectively; meanwhile, Central Java Province, the third most populated province in Indonesia, respectively, reached 26.37% and 15.24%, respectively.<sup>22</sup> This number has not met the target of 40% total population by the end-2021 and further work is required to meet the WHO goal of 70% COVID-19 vaccine coverage by mid-2022.<sup>23</sup>

The government must have a complex strategy to address the obstacles to vaccine acceptance. A comprehensive study about the COVID-19 vaccine acceptance and its possible barriers in Central Java, Indonesia has not yet been reported. Hence, this study aimed at identifying acceptance of COVID-19 vaccine and assessing the determinant factors associated with the vaccine hesitancy in Central Java, Indonesia.

## Materials and Methods

### Study Design and Setting

An observational analytic study using a cross-sectional design was conducted in Central Java, Indonesia, from September 1 to October 4, 2021. The study participants were residents who met inclusion criteria including adults aged 18 years and older, capable of communicating well, and living permanently in the study area for at least 6 months.

The sample size of the study was determined by 5% of  $\alpha$ ;  $\beta$  20%;  $P_0$ , the proportion of cases in the rural area of 0.65;  $P_1$ , the proportion of cases in the urban area of 0.45; and  $r$ , the ratio of population between rural and urban areas of 1:1. The minimum sample size in each population was 218 subjects. A multistage sampling method was used to collect the subjects. First, we divided Central Java Province into 2 clusters: rural and urban areas. The selection of the areas was considered to represent the urban and rural populations proportionally. A total of 10 villages in each district from the rural and urban areas that participated in the study were selected by cluster random sampling. Second, convenient non-probability sampling was employed to pick the respondents in each village. A total of 506 participants responded the survey (263 subjects in rural areas and 243 subjects in urban areas). Six participants under the age of 18 and duplicate entries were excluded from the study.

## Variables and Data Collection

Data was collected through a questionnaire distributed to the subjects by the researchers and enumerators. We had a self-administered questionnaire in the Google Form (g-form) to collect data from urban respondents. The enumerators sent the g-form link to the respondent's phone number, and they were asked to complete the g-form. A printed questionnaire was needed for rural respondents because a lot of them had no access to handphones or the internet. The printed questionnaires were distributed to rural respondents and filled out by themselves. For some rural respondents who had difficulty filling in the questionnaire, the enumerator helped them complete it.

A pilot study has been conducted to examine the validity and reliability of the questionnaire. Acceptance of the COVID-19 vaccine was identified by the question "Are you willing to be COVID-19 vaccinated?". The responses including "yes, I am willing" or "I have been vaccinated" were categorized as "yes" to accept the vaccination. Respondents were categorized as "no" or hesitant to be vaccinated if they responded "no, I'm not willing" or "I am in doubt". The explanatory variables of this study were sociodemographic information (age, gender, place of residence, education level, employment status), having comorbidity, belief in the halalness of the COVID-19 vaccines, belief in the effectiveness of vaccines, information exposure, knowledge, and vaccination-related anxiety.

The history of comorbidity was inquired by the question "Do you have any comorbidities?" with the answer 'yes' or "no". Hypertension, diabetes mellitus, stroke, kidney disease, heart disease, chronic respiratory disease, autoimmune disease, and others were among the comorbidities mentioned by respondents.

The belief in the halalness of the COVID-19 vaccine was determined by the question "Do you believe that the COVID-19 vaccine is halal?". The belief in the vaccine's effectiveness was measured by the questions "Do you believe that COVID-19 vaccination will prevent you from getting COVID-19 infection?" and "Do you believe that COVID-19 vaccination can prevent you from experiencing severe symptoms if infected with COVID-19?". Responses to these questions were graded on a Likert scale (1=strongly believe to 4=strongly not believe). Scale 1–2 were classified as "not sure", while scale 3–4 were classified "sure". Cronbach's reliability coefficient for these items was 0.875.

The purpose of asking "Have you ever gained information about the COVID-19 vaccine?" was to assess information exposure, the respondents then mentioned the source of the information. The knowledge level was assessed with 10 questions. The knowledge topics were the definition, type of COVID-19 vaccines, the importance of the health protocol after being vaccinated, the vaccine recipients, benefits, and the adverse effects after vaccination. Respondents were categorized as having good (score of  $\geq 8$ ), moderate (score of 6–7), and poor knowledge (score of  $\leq 5$ ).

Vaccination-related anxiety was determined by the Indonesian version of Zung Self-Rating Anxiety Scale (SAS/SRAS) questionnaire. Cronbach's reliability coefficient for this questionnaire was 0.919. The Zung SRAS is an anxiety assessment designed by William W.K.Zung consisting of 20 items.<sup>24</sup> Each item has a 4 point scale (1= none or a little of the time; 2= some of the time; 3= good part of the time 4= most of the time) with a total score of 20–80.<sup>24</sup> The anxiety scores were classified as normal (score of 20–44), mild to moderate (score of 45–59), marked to severe (score of 60–74), and extreme (score of 75–80).

## Data Analysis

Data was analyzed using SPSS 26.0 software. The bivariate associations between explanatory variables and the vaccine acceptance were performed by the Chi-Square test. Binary (multivariate) logistic regression was used to determine the most predictor factors simultaneously related to COVID-19 vaccine hesitancy. The bivariate statistical results with a p-value  $<0.25$  were included in the multivariate logistic regression. All statistical tests with a p-value  $<0.05$  at 95% confidence interval were significantly considered. Adjusted odds ratios were presented to measure the association.

## Results

### Univariate Analysis

Of 500 respondents, 260 (52%) respondents lived in the rural areas and 240 (48%) were in the urban areas. The age of the respondents varied from 18 to 76 years, with the highest number being adults aged 18–59 years (92.6%). More than half

(53.6%) of respondents were employed, and 79% were female. The proportion of education levels was equally distributed across 3 levels: high (31.2%), moderate (38.2%), and low (30.6%) (see Table 1).

A total of 19.6% of respondents revealed having comorbidities, belief that vaccination could prevent COVID-19 infection (85.8%), belief that vaccination could prevent severe symptoms (87.4%), and belief in the vaccine halalness (92%). About 95.4% of respondents have been exposed to information about COVID-19 vaccines and 87.6% had good knowledge. Information about COVID-19 vaccination was obtained from heterogeneous sources, such as social media (66.6%), telecommunications media (15.2%), online platforms (6.2%), TV (49.6%), radio (4.6%), printed and electronic newspapers (13.2%), face-to-face communication (35.8%), and official government websites (17%). Only 2% of respondents had vaccination-related anxiety (Table 2).

## Acceptance of COVID-19 Vaccination

Overall, 467 (93.4%) respondents expressed willingness to accept the COVID-19 vaccination. Only 33 (6.7%) respondents were hesitant to be vaccinated. The most common reasons for hesitancy toward COVID-19 vaccination were worries about vaccine adverse effects (69.7%), followed by the vaccine's effectiveness concerns (63.6%) and worries about being infected of COVID-19 after the vaccination (48.5%) (Figure 1).

## Bivariate Association with COVID-19 Vaccine Hesitancy

Table 3 shows the factors related to COVID-19 vaccine hesitancy in the bivariate analysis. Living in rural areas (OR=3.085; 95% CI=1.363–6.981;  $p=0.005$ ), being elderly (OR=8.481; 95% CI=3.717–19.348;  $p<0.001$ ), having a low education level (OR=2.661; 95% CI=1.071–6.613;  $p=0.030$ ), and having comorbidity (OR=5.085, 95% CI=2.808–12.001;  $p<0.001$ ) were significantly associated with COVID-19 vaccination hesitancy. Males (OR=1.221; 95% CI=0.534–2.791;  $p=0.636$ ), respondents with a moderate education level (OR=1.053; 95% CI=0.383–2.893;  $p=0.921$ ), and unemployed respondents (OR=1.851; 95% CI=0.899–3.808;  $p=0.090$ ) were also more likely to hesitate the vaccination, but these associations were not statistically significant.

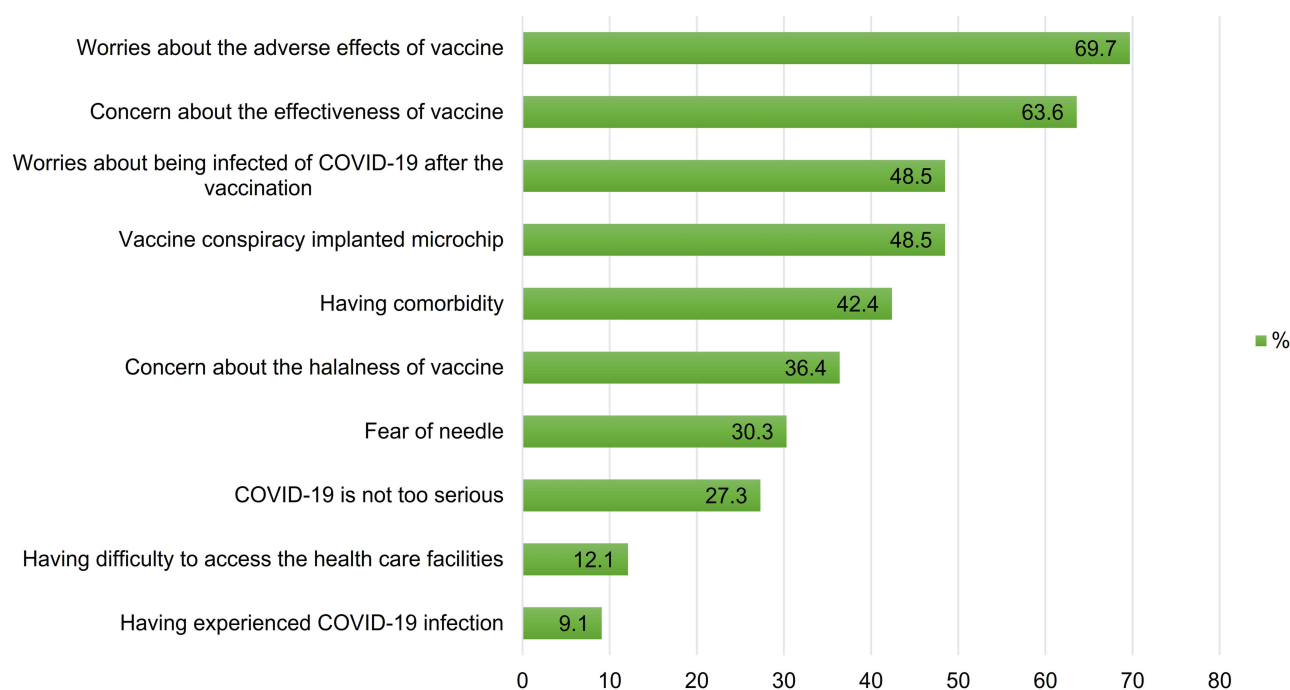
**Table 1** Sociodemographic Characteristics of Respondents in Central Java, Indonesia

Variables	Frequency (n=500)	Percentage (%)
Place of residence		
Rural	260	52
Urban	240	48
Age		
Elderly ( $\geq 60$ years)	37	7.4
Adult (18–59 years)	463	92.6
Gender		
Female	395	79
Male	105	21
Education level		
Low (secondary and primary school)	153	30.6
Moderate (high school)	191	38.2
High (diploma/bachelor)	156	31.2
Employment status		
Unemployed	232	46.4
Employed	268	53.6

**Table 2** Frequency Distributions of Variables in Central Java, Indonesia, 2021

Variables	Frequency (n=500)	Percentage (%)
COVID-19 vaccine acceptance		
No	33	6.6
Yes	467	93.4
Having comorbidity		
Yes	98	19.6
No	402	80.4
Belief that vaccines could prevent the infection of COVID-19		
Not sure	71	14.2
Sure	429	85.8
Belief that vaccines could prevent severe symptoms of COVID-19		
Not sure	63	12.6
Sure	437	87.4
Belief in the halalness of COVID-19 vaccines		
Not sure	40	8
Sure	460	92
Information exposure		
No	23	4.6
Yes	477	95.4
Source of information exposure		
Social media	333	66.6
Telecommunication media	76	15.2
Online platform (zoom, skype)	31	6.2
TV	248	49.6
Radio	23	4.6
Printed and electronic newspaper	66	13.2
Face-to-face communication	179	35.8
Official government website	85	17
Knowledge level		
Poor	11	2.2
Moderate	51	10.2
Good	438	87.6
Vaccination-related anxiety level		
Severe	2	0.4
Mild to moderate	8	1.6
Normal	490	98

The respondents who did not believe that vaccination could prevent infection of COVID-19 (OR=8.126; 95% CI=3.880–17.019;  $p<0.001$ ), did not believe that vaccination could prevent severe symptoms (OR=7.274; 95% CI=3.445–15.361,  $p<0.001$ ), and did not believe in the halalness of the vaccine (OR=7.552; 95% CI=3.341–17.070;  $p<0.001$ ) were more at risk to have COVID-19 vaccination hesitancy. Exposure to information about the COVID-19 vaccine had a significant relationship with the acceptance of vaccination (OR=7.589; 95% CI=2.871–20.063;  $p<0.001$ ). When compared to respondents with good knowledge, those with poor knowledge (OR=7.838; 95% CI=1.931–31.805;  $p=0.015$ ) and moderate knowledge (OR=5.098; 95% CI=2.236–11.621;  $p<0.001$ ) were more likely to be hesitant to get



**Figure 1** The reasons for the COVID-19 vaccine hesitancy (n=33).

vaccinated. Respondents who had mild-moderate vaccination-related anxieties were significantly less likely to receive a COVID-19 vaccine than those who had no anxieties (OR=28.580, 95% CI=6.486–125.931,  $p<0.001$ ).

## Determinant Factors of COVID-19 Vaccine Hesitancy

The results of the multivariate logistic regression were shown in the Table 4. The elderly had a higher odds of COVID-19 vaccine hesitancy (OR=5.231; 95% CI=1.891–14.468;  $p=0.001$ ) compared to adults respondents. Respondents with a history of comorbidity (OR=4.808; 95% CI=1.975–11.706;  $p=0.001$ ), who did not believe in vaccine halalness (OR=3.802; 95% CI=1.272–11.364;  $p=0.017$ ), and who did not believe that vaccines could prevent COVID-19 infection (OR=4.964; 95% CI=1.970–12.507;  $p=0.001$ ) and were less likely to accept the COVID-19 vaccination. Mild to moderate anxiety (OR=14.169; 95% CI=2.405–83.474;  $p=0.003$ ) and not gaining the information about COVID-19 vaccines (OR=7.039; 95% CI=2.072–23.908;  $p=0.002$ ) were the most significant factors related to vaccination hesitancy.

## Discussion

COVID-19 vaccine acceptance rate of 93.4% in this study is greater than the acceptance rate outlined in the previous study conducted in 2020 in Bali, Indonesia at 60.8%.<sup>25</sup> Even in 2020, low vaccine acceptance in other countries was found to be 53.1% in Kuwait, 64.58% in Saudi Arabia, and 65.4% in Malaysia.<sup>26–28</sup> The high acceptance rate of COVID-19 vaccine in the present study might be explained by the data collection time conducted in September 2021, when the vaccination program has been rolled out in Indonesia since January 2021.

This finding indicates good opportunities for the government to establish a strategy to achieve the target of COVID-19 vaccination of 208,265,720 (80% of the population in Indonesia). Nevertheless, this study just identified the COVID-19 vaccine acceptance, regardless of the willingness to accept the vaccination completely or not. The finding might be in line with the data which showed the high vaccination coverage in doses 1 and the lower in doses 2. The vaccination coverage of doses 1 and 2 in Indonesia has reached 190,976,872 doses (91.70% of target) and 144,505,941 doses (69.39%) by March 1, 2022, while in Central Java, it is slightly lower compared to the nationwide vaccination coverage rate.<sup>22</sup> The low vaccination coverage in doses 2 might be related to the policy of the government, which only obligates the public to get a minimum of dose 1 vaccine. The public is required to show the vaccine certificate for dose 1 only

**Table 3** Factors Related to COVID-19 Vaccine Hesitancy in Central Java, 2021

Variables	Vaccination Acceptance		Bivariate Analysis		
	No n (%)	Yes n (%)	Crude OR <sup>a</sup>	95% CI	p-value
Place of residence					
Rural	25 (9.6)	235 (90.4)	3.085	1.363–6.981	0.005*
Urban	8 (3.3)	232 (96.7)	Ref		
Age					
Elderly (>60 years)	11 (29.7)	26 (70.3)	8.481	3.717–19.348	<0.001*
Adult (18–59 years)	22 (4.8)	441 (95.2)	Ref		
Gender					
Male	8 (7.6)	97 (92.4)	1.221	0.534–2.791	0.636
Female	25 (6.3)	370 (93.7)	Ref		
Education level					
Low	17 (11.1)	136 (88.9)	2.661	1.071–6.613	0.030*
Moderate	9 (4.7)	182 (95.3)	1.053	0.383–2.893	0.921
High	7 (4.5)	149 (95.5)	Ref		
Employment status					
Unemployed	20 (8.6)	212 (91.4)	1.851	0.899–3.808	0.090
Employed	13 (4.9)	255 (95.1)	Ref		
Having comorbidity					
Yes	18 (18.4)	80 (81.6)	5.085	2.808–12.001	<0.001*
No	15 (3.7)	387 (96.3)	Ref		
Belief that vaccines could prevent the infection of COVID-19					
No	17 (23.9)	54 (76.1)	8.126	3.880–17.019	<0.001*
Yes	16 (3.7)	413 (96.3)	Ref		
Belief that vaccines could prevent severe symptoms of COVID-19					
No	15 (23.8)	48 (76.2)	7.274	3.445–15.361	<0.001*
Yes	18 (4.1)	419 (95.9)	Ref		
Belief in the halalness of COVID-19 vaccines					
No	11 (27.5)	29 (72.5)	7.552	3.341–17.070	<0.001*
Yes	22 (4.8)	438 (95.2)	Ref		
Information exposure					
No	7 (30.4)	16 (69.6)	7.589	2.871–20.063	<0.001*
Yes	26 (5.5)	451 (94.5)			
Knowledge					
Poor	3 (27.3)	8 (72.7)	7.838	1.931–31.805	0.015*
Moderate	10 (19.6)	41 (80.4)	5.098	2.236–11.621	<0.001*
Good	20 (4.6)	418 (95.4)	Ref		
Vaccination-related anxiety level					
Severe	1 (50)	1 (50)	17.148	1.044–281.668	0.111
Mild-moderate	5 (62.5)	3 (37.5)	28.580	6.486–125.931	<0.001*
Normal	27 (5.5)	463 (94.5)	Ref		

**Notes:** \*significant if p-value < 0.05. <sup>a</sup>Odds ratio.

when they have a plan to access public facilities, such as department stores and public transportation. The Indonesian government has made a regulation about the mandatory COVID-19 vaccination, which at the time of study data collection, the population target of the COVID-19 vaccination program was adults aged 18 years and older.<sup>29</sup>

**Table 4** Determinant Factors in COVID-19 Hesitancy in the Multivariate Model

Variables	Adjusted OR <sup>a</sup>	95% CI		p-value
		Lower	Upper	
Age Elderly (≥60 years) Adult (18–59 years)	5.231 Ref	1.891	14.468	0.001*
Having comorbidity Yes No	4.808 Ref	1.975	11.706	0.001*
Belief in the halalness of COVID-19 vaccines Not sure Sure	3.802 Ref	1.272	11.364	0.017*
Belief that vaccines could prevent the infection of COVID-19 Not sure Sure	4.964 Ref	1.970	12.507	0.001*
Information exposure No Yes	7.039 Ref	2.072	23.908	0.002*
Vaccination-related anxiety level Severe Mild-moderate Normal	9.541 14.169 Ref	0.081 2.405	1117.366 83.474	0.353 0.003*

**Notes:** \*Significant if p-value < 0.05. <sup>a</sup>Odds ratio was adjusted by place of residence, age, education level, employment status, having comorbidity, belief, information exposure, knowledge, and vaccination-related anxiety level.

Vaccine hesitancy is a feasible threat to public health in achieving the success of the COVID-19 vaccination program. Escalating issues of vaccine hesitancy were the doubts about the halalness and effectiveness of COVID-19 vaccines.<sup>18</sup> This study showed that respondents who did not believe in the vaccine's effectiveness in preventing COVID-19 infection were more likely to have vaccination hesitancy. It strengthened the descriptive finding that explained the second biggest reason for respondents' unwillingness to be vaccinated was concerns about the effectiveness of a COVID-19 vaccine. Vaccine willingness decreases as vaccine effectiveness decreases.<sup>20,30</sup> Respondents who did not believe in the vaccine halalness were significantly more at risk of having vaccine hesitancy than the respondents having a belief in its halalness. Being a country with a Muslim majority population, a religious-based view about the halalness of COVID-19 vaccines could influence the vaccine's acceptance.<sup>16,18</sup> However, this doubtfulness has been answered by the Indonesian Ulema Council (*Majelis Ulama Indonesia*) in Fatwa Number 2 of 2021, which states that COVID-19 vaccines are holy and halal. This fatwa should be recognized comprehensively by the public.<sup>31</sup>

Like the previous pandemics, the COVID-19 pandemic is related to feelings of worry, fear, and anxiety.<sup>32,33</sup> High general anxiety was correlated with the unwillingness to receive the vaccine.<sup>34</sup> Although only a few respondents had COVID-19 vaccination-related anxiety in the current study, vaccination-related anxiety was the factor associated most significantly with vaccine hesitancy in this study. Anxieties could be influenced by several factors. Vaccination-related anxieties might be related to the worries about the adverse effects of the COVID-19 vaccine and the fear of getting infected with COVID-19 after the vaccination, which can be seen in [Figure 1](#). In contrast, COVID-19-related anxiety was correlated with higher vaccine acceptance in a previous study in Germany.<sup>35</sup> This finding revealed that the vaccination-related anxiety might be different from the COVID-19-related anxiety. In-depth studies about vaccination-related anxiety are required.



Respondents who had received information about COVID-19 vaccination were more willing to receive the vaccine in this study. The biggest source of information about the COVID-19 vaccine was from social media, in line with the previous study in Pakistan.<sup>36</sup> Social media in the era of digitalization is one of the fastest mediums for delivering information. But, the rise of social media has given anti-vaccination views, an unprecedented opportunity to grow, potentially leading to misinformation.<sup>37</sup> A previous study has found that rural residents had lower access to online health information like social media compared to urban residents.<sup>38</sup> Trusted media information sources could influence the public on COVID-19 vaccination acceptance.<sup>25</sup> This study suggested that television was the alternative information source after social media as the biggest one. The government needs to improve the delivery of information about COVID-19 vaccination through reliable and accessible media information sources such as primary care providers, televisions, and other media platforms, so this can cover all residents both in rural and urban areas.

Lack of information or misinformation could affect poor knowledge.<sup>39</sup> Knowledge was not a predictive factor in the multivariate model; however, poor knowledge was less likely related to vaccine acceptance than good knowledge in the bivariate analysis. Inadequate knowledge could lead individuals to practice inappropriately,<sup>40</sup> but otherwise the good knowledge could affect respondents' awareness of protecting themselves and their families, so this can lead to respondents' willingness to get vaccination.<sup>20</sup> Therefore, increasing public knowledge should be an effective way to increase vaccine acceptance.

This study depicted that elderly respondents were less likely to accept COVID-19 vaccination than adults, in accordance with other studies in Bangladesh and Saudi Arabia.<sup>27,41</sup> This finding can be justified by the possibility that the elderly people spend more time at home, so they perceived being less exposed to the virus outside.<sup>20</sup> Moreover, it might be related to a lack of access to vaccination information and worries about the adverse effects in the older people.

Having comorbidity was the prominent variable associated with higher vaccine acceptance.<sup>30,42</sup> On the contrary, this study showed having comorbidity was more likely to have COVID-19 vaccine hesitancy. In Indonesia, misinformation about the safety of COVID-19 vaccines has existed since vaccines were not available, such as disinformation and perceived vaccine unsafety for an individual having pre-existing comorbid conditions.<sup>43</sup> This could be seen in this study that feeling worry about the adverse effects of the vaccine was the most common reason to hesitate the COVID-19 vaccination. COVID-19 vaccination has been recommended for people with comorbidities that have been identified to bear a high risk of severe and mortality from COVID-19.<sup>21,44</sup> It is crucial to give an understanding of a person having comorbidities about the COVID-19 vaccine's benefits and safety. Medical practitioners' advice to patients with comorbidities was needed to convince them.

The limitation of our study is that the use of the online self-administered questionnaire in urban respondents might not reach the internet non-users in the population. Additionally, the worry about safety or adverse effect of COVID-19 vaccine has become the main reason among respondents, which could influence vaccine acceptance, but this study asked about the belief in vaccine safety for hesitant respondents only. Further research is necessary to assess the relationship between the trust in vaccine safety and COVID-19 vaccine acceptance. As the data collection was conducted during the vaccination program, respondents who received a COVID-19 vaccine in the acceptance group might cause selection bias. Nevertheless, the inclusion of the respondents could be justified for representing the population, and could be beneficial to discuss the finding of COVID-19 vaccine acceptance rate before and after the vaccination program. The study design was cross-sectional, thus there were no causal implications to be drawn. However, it is still the best model to assess the determinant factors of COVID-19 vaccine hesitancy, so these findings could give the evidence for policymakers to address the COVID-19 pandemic.

## Conclusion

A high level of acceptance of the COVID-19 vaccine was found in this study. However, vaccine hesitancy is still a concern for public health. The determinant factors associated with COVID-19 vaccine hesitancy were being elderly, having comorbidity, not being exposed to information about COVID-19, not believing in vaccine halalness, not believing that vaccines could prevent COVID-19 infection, and having mild-moderate anxiety levels. These findings provide essential insights for the government on vaccine hesitancy challenges and how to develop evidence-based interventions to improve vaccine coverage among the adult and elderly population. The government needs to communicate effectively

with the population, for example, through public health providers and other information media to address the lack of information, worries, and vaccination-related anxiety in the population. Other interventions intended to educate individuals about the safety, effectiveness, and halalness of vaccines could help reduce hesitancy.

## Data Sharing Statement

The datasets analysed in this study are available, based on reasonable request. Please contact the corresponding author aras.utami@gmail.com.

## Ethical Consideration

This study has obtained permission from the Ethics Committee of the Faculty of Medicine, Universitas Diponegoro (Number 111/EC/KEPK/FK-UNDIP/III/2021). We also had the approval from the National and Political Unity Board, Research and Development Planning Board, Health Office in Central Java. This study was conducted in accordance with the ethical principles of the Declaration of Helsinki. The written informed consent form was presented on the first page of the questionnaire and filled in before the respondents completed the questionnaire.

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## Author Contributions

All authors made a significant contribution to the work reported, whether that is in the conception, study design, execution, acquisition of data, analysis, and interpretation, or in all these areas; took part in drafting, revising, or critically reviewing the article; gave final approval of the version to be published; have agreed on the journal to which the article has been submitted; and agree to be accountable for all aspects of the work.

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## Disclosure

The authors declare no conflicts of interest in this work.

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