The Relationship between Knowledge and Attitude toward COVID-19 Vaccine: Risk Perception & Confidence in Vaccine as Mediators

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ABSTRACT
Previous studies found mixed result regarding the effect of knowledge on attitude toward vaccine, however there were significant findings regarding the effect of risk perception and confidence in vaccine on attitude. This study was conducted to examine the impact of knowledge on attitude toward Covid-19 vaccine as mediated by risk perception and confidence in vaccine. We run mediation analysis to the data collected from N = 323 people using online survey. Participants are Indonesians aged >15 years, living in areas with relatively high cases of COVID-19, directly or indirectly affected by the pandemic, and never got the COVID-19 vaccination before. Results show that knowledge is positively predict attitude (B=.398, z=7.33, p<.001). Analyzing the indirect effects, results reveal significant mediation in the relationship between knowledge and attitude: risk perception (B=.108, z=3.85, p<.001, 95% CI, .0528 to .163) and confidence in vaccine (B=.174, z=4.65, p<.001, 95% CI, .10 to .247). Knowledge positively affects risk perception and confidence in vaccine. All mediators positively affect attitude toward Covid-19 vaccine. This partial mediation suggests that knowledge alone is an important factor that predicts attitude toward vaccine.

Keywords: *Knowledge; Attitude Toward Vaccine; Risk Perception; Confidence in Vaccine; Mediation Analysis; Covid-19 Vaccine; Covid-19 Pandemic*

1. INTRODUCTION

Since it was first detected in Wuhan, China, the COVID-19 pandemic has continued to sweep around the world for more than two years. It brings devastating impact on health, economic development, social life, and also people's mental health [1]. This emergency urges global mitigation strategies to slow down the spread of the novel coronavirus (SARS-CoV-2 virus) [2]. Many countries implement mass vaccination program against COVID-19 as a long-term solution to achieve herd immunity [3], [4]. COVID-19 mass vaccination is called the key to end pandemic, but its implementation faces many challenges.

One major factor that hinders acceptance to vaccine is negative attitude toward the vaccine that led to vaccine hesitancy and even refusal. Countries around the world show different rate of acceptance [5], [6]. A survey in 2020 involving more than 13.000 people in 19 countries show that vaccine acceptance rates ranged greatly from almost 90% (in China) to less than 55% (in Russia) [5]. Negative attitude toward vaccine is understandable because basically Covid-19 is a new disease, and its rapid vaccine development rises concerns on safety and efficacy issues [6]–[8]. Attitude has great influence on people's choices and actions and it mediates the impact of belief change on behavior change [9].

Attitude refers to a relatively general and enduring evaluation of an object or concept on a valence dimension ranging from positive to negative [10]. Thus, attitude toward vaccine is defined as a continuum that goes from an attitude of actively asking for vaccines (positive) to total opposition to vaccines (negative). Between the two poles, there is a middle ground in which people are showing hesitancy toward vaccine [11]. This attitudinal ambivalence is present when individual's evaluation of vaccine includes both positive and negative evaluations [12], [13]. They may agree to one vaccine but refuse another, choose to delay the vaccine, or receive the vaccine if certain conditions are met.

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The degree of vaccine hesitancy greatly influences the decision whether a person will accept or refuse vaccination [14]. To improve attitude, the nature of attitude change must be understood. Among many factors, information in the form of working knowledge plays a critical role in how attitude could be changed. Working knowledge is a subset of the full array of knowledge a person possesses regarding the attitude object, and it can be explored by asking people to report their level of knowledge [10]. Even though the relationship between attitude and behavior sometimes lacks consistency, the increased knowledge is found to be related to stronger attitude-behavior correlations [10]. In general, the better knowledge a person possesses, the better his/ her attitude toward an object.

In several studies, there are mixed findings regarding the relationship between knowledge about the disease and attitude toward vaccine. Pre-COVID-19 pandemic, people tend to be more willing to get vaccinated if they have limited knowledge of the disease and its vaccines. People who refuse vaccines are likely those who research a lot of information about vaccines and are aware of health issues [11], [15]. In the context of COVID-19 vaccination, there was no difference in knowledge about COVID-19 between people who received and hesitated with the vaccination [16]. This problem deserves further investigation to confirm the effect of knowledge on the attitude toward COVID-19 vaccine.

Based on the theory of planned behavior, knowledge is indirect predictor of attitude. Humans behave by considering beliefs about the consequences that may be obtained from certain behavior (behavioral beliefs) and beliefs about the presence of things that could potentially help or inhibit action (control beliefs). One of the control belief variables sourced internally is one's knowledge [17], [18]. We predict that a person is to have a negative attitude towards the COVID-19 vaccine if they believe that there could be negative consequences of vaccination and this perception of risk is influenced by the knowledge about the disease.

In the context of COVID-19, risk perception has two components: the perceived risk of COVID-19 as the disease and the perceived risk of COVID-19 vaccine itself [19]. Although a person perceives that COVID-19 is dangerous, fear or concern about the side effects of vaccine affects willingness to receive vaccinations more [19]–[21]. Vaccine hesitancy occurs when: the perception of the need for vaccination is low and the vaccine is considered unimportant and there are considerations of safety and efficacy of the vaccine [7]. Thus, along with COVID-19 risk perception, confidence to COVID-19 vaccine is an important variable to take into consideration as mediator of the relationship between knowledge and attitude.

Based on the research framework above, this research aims to determine the relationship between knowledge about COVID-19, risk perception, confidence in vaccine, and attitudes toward COVID-19 vaccine. We conduct a mediation analysis to explain the process whether the relation between the independent variable and the dependent variable is due, wholly or in part, to the mediating variable [22]. We use the single-level mediation model to test two hypotheses: (1) Knowledge affects attitude toward COVID-19 vaccine indirectly through the mediation of risk perception. (2) Knowledge affects attitude toward COVID-19 vaccine indirectly through the mediation of confidence in the vaccine as depicted.

2. METHOD

2.1. Participant

This survey involved 323 respondents from 15 cities in Indonesia: Banda Aceh, Padang, Karawang, Bogor, Semarang, Magelang, Purwokerto, Solo, Yogyakarta, Surabaya, Probolinggo, Jember, Makassar, Buton, and Bima. The criteria for respondents are > 15 years of age, do not work as health workers, have never received the Covid-19 vaccine before, and free from health conditions that are not allowing to receive vaccination. Respondents were obtained using online convenient sampling. Researchers spread online survey links on the internet with the help of research collaborators through social media. Before filling out the questionnaire, researchers explained the purpose of the study in the cover letter and respondents gave their consent or willingness to be involved in the research voluntarily. Researchers guarantee privacy to respondents' identity and data confidentiality.

2.2. Instrument

Attitude toward COVID-19 vaccine was measured using a scale adapted from the Oxford COVID-19 Vaccine Hesitancy Scale [7]. This scale consists of 7 questions. Each question is followed by response in five-options multiple-choice format, and each option from (A) to (E) reflects a continuum of attitudes as follow: Answer A indicates an active request action (score 5), answers B, C, and D indicate a gradation of the level of doubt, and answer E indicates a total rejection (score 1). The scale has α= .922.

Knowledge was measured using The Knowledge of COVID-19 Test. This test reveals the level of knowledge of COVID-19 in six domains: modes of transmission, symptoms, risk factors, preventive measures, treatment, and the vaccination. During the construction process, two doctors were involved to validate the content of items. This test consisted of 33 items and respondents were asked to judge whether the statements about COVID-19 is true, false, or don't know. This test has α KR-21 = .89.

Risk perception was measured using the COVID-19 Risk Perception Scale. This scale measures the risk perception of the outbreak (e.g., "How likely are you to be infected with COVID-19?"), and the risk perception if not vaccinated (e.g., "How likely are you to catch the virus if not vaccinated?") [23]. This scale consists of ten items with a five-point Likert response format (1 = very little, 5 = very great). The test showed α Cronbach = .89.

The Confidence in the COVID-19 Vaccine Scale was used to measure confidence in vaccine as a product (e.g., "The COVID-19 vaccine is safe."), confidence in vaccine service providers (e.g., "Healthcare workers (doctors, nurses) explained the side effects of the COVID-19 vaccine clearly and honestly."), and confidence in vaccination policy makers (e.g., "The government's COVID-19 vaccination program is for the good of the community.") [24]. This scale consists of 12 items with a five-point Likert response format (1 = very not confident, 5 = very confident). The test showed α Cronbach = .94. All scale was provided in Indonesian language.

2.3. Data Analysis

Descriptive analysis and tests of assumptions for regression analysis was conducted using SPSS 23. Meanwhile, the simple mediation analysis was conducted using JAMOVI *software*. To examine the impact of knowledge on attitude toward COVID-19 vaccine and to check mediation effect, regression analysis was used based on David and Kenny's mediation analysis procedure [22].

3. RESULT AND DISCUSSION

3.1. Results

3.1.1. Preliminary Analysis

Means, standard deviations, and correlation between all variables are reported in Table 1 below. There is a significant correlation between knowledge and attitude toward the COVID-19 vaccine (r = .378, p<.01) and this is a necessary condition for mediation analysis [22]. All variables were highly correlated with each other, raising the potential problem of multicollinearity. Therefore, variance inflation factor (VIF) was conducted, and it was found that they were all within the acceptable bounds. We conducted other assumption tests of homoscedasticity and linearity and we found there were no violations of the assumptions of regression analysis.

Table 1 Mean, standard deviation, & correlations between variables

Variables	Mean	SD	1	2	3	4
ACV	24.49	5.729	1.00			
K	23.50	5.438	0.378**	1.00		
RP	32.61	7.383	0.512**	0.227**	1.00	
CV	41.84	8.588	0.686**	0.262**	0.517**	1.00

Note: ACV = attitude toward COVID-19 vaccine, K = knowledge, RP = risk perception, CV = confidence in vaccine; ** p<.01

3.1.2. Test of Mediation

The results of the tests of Hypothesis 1 are in Table 2. The result of total effect shows that knowledge positively predict attitude toward COVID-19 vaccine (B=.398, z = 7.33, p<.001). Analyzing the indirect effect, results reveal that risk perception significantly mediates the relationship between knowledge and attitude (ab=.108, z= 3.85, p<.001, 95% CI, .0528 to .163). Knowledge positively affects risk perception (B=.309, z = 4.19, p<.001) and risk perception, in turn, positively affect attitude toward COVID-19 vaccine (B=.349, z=9.65, p<.001). Nevertheless, the results also suggest that even after accounting for the mediating role of risk perception, knowledge still has positive impact on attitude (B=.290, z=5.91, p<.001). Risk perception as mediator accounts for only 27.1% of the total effect. These finding suggests that people who have better knowledge about COVID-19 are more likely to have more positive attitude toward COVID-19 vaccine. Interestingly, this relationship is not greatly determined by perception of COVID-19 risk.

Table 2 Mediation estimates of Hypothesis 1

				95% CI				
Effect	Label	Estimate	SE	Lower	Upper	Z	p	% Mediation
Indirect	a × b	0.108	0.0280	0.0528	0.163	3.85	< .001	27.1
Direct	c	0.290	0.0491	0.1939	0.386	5.91	< .001	72.9
Total	c + a × b	0.398	0.0543	0.2915	0.504	7.33	< .001	100.0

The results of the tests of Hypothesis 2 are in Table 3. Analyzing the indirect effect, results reveal that confidence in vaccine significantly mediates the relationship (ab=.174, z= 4.65, p<.001, 95% CI, .100 to .247). Knowledge positively affects confidence in vaccine (B=.413, z = 4.87, p<.001) and confidence in vaccine, in turn, positively affect attitude toward COVID-19 vaccine (B=.420, z=15.64, p<.001).

Nevertheless, the results also suggest that even after accounting for the mediating role of confidence in vaccine, knowledge still has positive impact on attitude (B=.224, z=5.26, p<.001). Confidence in vaccine as mediator accounts for 43.6% of the total effect. These finding suggests that people who have better knowledge about COVID-19 are more likely to have more positive attitude toward COVID-19 vaccine because they tend to have higher confidence in the vaccine safety and efficacy.

Table 3 Mediation estimates of hypothesis 2

				95% CI				
Effect	**Label**	**Estimate**	**SE**	**Lower**	**Upper**	**Z**	**p**	**% Mediation**
Indirect	a × b	0.174	0.0373	0.100	0.247	4.65	< .001	43.6
Direct	c	0.224	0.0424	0.141	0.307	5.29	< .001	56.4
Total	c + a × b	0.398	0.0543	0.291	0.504	7.33	< .001	100.0

3.2. Discussion

This study seeks for the process model of attitude toward COVID-19 vaccine. We examined the relations among variables of study in two hypotheses of mediation. Both tests of hypothesis showed partial mediation, but with different power of mediation effect. In partial mediation, knowledge as independent variable has both direct and indirect effects on attitude as dependent variable. However, the mediation effects are found to be weaker than the total effect given by the independent variable alone. Risk perception only accounts for 27.1% of the total effect, while confidence in vaccine accounts for slightly greater percentage, 43.6%. Having knowledge about COVID-19 alone greatly determines a person judgement and evaluation about its vaccine. The better the knowledge, the more positive their attitude to accept vaccine. However, although the mediation effect is relatively low, both mediators still affect attitude significantly. Therefore, risk perception and confidence in vaccine cannot be ignored, especially the confidence in vaccine.

Why confidence in vaccine is more influential as mediator can be explained by the theory of attitude structure. Attitude is a type of knowledge structure stored in human's memory [10]; a simple object-evaluation associations that is linked with relevant information, i.e., the knowledge about vaccine. Risk perception regarding the progress of pandemic in society and how it negatively damages one's life is not directly related to the issue of vaccine. This research explains how the perceived risk about the vaccine itself is considered more impactful than the general perception of the pandemic. Although a person perceives that COVID-19 is dangerous, fear or concern about the side effects of vaccine affects willingness to receive vaccinations more [19]–[21]. To accept vaccination, concern about the vaccine outweighs the concern about the risk of the disease. Hesitancy to vaccine can be understood as the result of the low confidence in vaccine safety and efficacy due to the lack of knowledge about the disease that is prevented by the vaccine.

This study highlights the importance of knowledge regarding issue in health-related context. The role of knowledge in the formation of attitude toward COVID-19 vaccine is in line with previous research, e.g., influenza and pneumococcal vaccine [25], human papillomavirus vaccine [26], and dengue vaccine [27]. This research will broaden our view regarding how knowledge contributes to the formation of attitude and test the applicability of the theory of planned behavior to explain human behavior in the context of COVID-19 pandemic. Hopefully, this research also will inform a better strategy to communicate vaccine to public and increase acceptance.

4. CONCLUSION

This study conducted mediation analysis to explain the process by which knowledge affects attitude toward COVID-19. We tested risk perception and confidence in vaccine as moderators for the relationship. The partial mediation is statistically significant, but the effect of mediation is relatively weak. Having knowledge about COVID-19 alone greatly influences judgement and evaluation about COVID-19 vaccine. Even so, the role of risk perception and confidence in vaccine cannot be ignored and they can be integrated in the vaccine communication strategy. Vaccine communication strategy in the future needs to focus on increasing public knowledge about COVID-19 and public awareness about the safety, efficacy, and the importance of vaccination to mitigate the risk caused by the pandemic.

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