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The Role of Risk Perception and Big Five Personality Traits in COVID-19 Vaccine Hesitancy in Indonesia

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Abstract. Even when the COVID-19 global health emergency is declared over, vaccine hesitancy is a relevant topic that needs to be studied to ensure effective intervention when such cases arise again in the future. Vaccine hesitancy is a phenomenon of public doubt about whether to accept or reject vaccination. This study aims to determine the characteristics of vaccine hesitancy in Indonesian society and its relationship with the risk perception of COVID-19 and the Big Five personality traits. We also discuss how the present findings can inform future decision making on pandemic interventions. This multimethod cross-sectional study incorporated both quantitative and qualitative analyses through self-report measures and an open question. We distributed the questionnaire online through convenience sampling technique and involved 390 Indonesian citizens aged 18 - 62 years (M_{age} = 30.68, SD = +13.17). Through regression analyses, we found that risk perception of COVID-19, Extraversion, Conscientiousness, and Intellect were significant predictors of vaccine hesitancy. Thematic analysis showed that themes of lack of confidence, convenience, and complacency were present in participants' attitudes toward COVID-19 vaccines. Demographic analysis also showed a correlation between vaccine hesitancy and economic status. Vaccination campaigns should focus on extensive education on vaccine safety that is backed by factual data, education on the risk of preventable diseases with vaccination, and increasing public confidence in government and health authorities.

Keywords: health attitude; multimethod; vaccination

COVID-19 disease caused by severe acute respiratory syndrome coronavirus 2 (SARS- CoV-2) was declared a pandemic on March 11, 2020, and struck millions of casualties worldwide. In dealing with the pandemic, the Indonesian government had launched a vaccination program. Although, as of 29th of February 2024, 86% of the vaccination target had received at least the first dose of vaccination (Tanoto, 2023), the initial response by the community regarding the procurement of this vaccine had a mixed reception. Before the vaccination program was launched, several national newspapers had reported reluctance and doubts from the public about vaccination (Satra, 2021; Susilo, 2021). One government

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figure was also widely reported for expressing distrust of vaccines (Prabowo, 2021).

In addition, the results of a national survey conducted by the Ministry of Health (2020) in September 2020 showed that only 65% of respondents expressed willingness to accept the COVID-19 vaccine if provided by the government, another 8% refused, and the remaining 27% expressed doubt. The reasons for the rejection of the COVID-19 vaccine were related to vaccine safety, doubts about the effectiveness of vaccines, distrust of vaccines, concerns about side effects, and religious reasons (Ministry of Health, 2020). The results showed that the vaccine acceptance rate in Indonesia is similar to the findings of Lazarus et al. (2021) in their study in 19 countries, which showed 71.5% of the respondents were willing to accept the COVID-19 vaccine, while almost a third still had doubts. In another study, the reason for doubts about the COVID-19 vaccine was also found to be similar, namely concerns about the safety of vaccines that were developed so quickly (Dror et al., 2020).

The phenomenon of public doubt and reluctance to the vaccine can be explained through the concept of vaccine hesitancy, which is the delay in accepting or refusing vaccination even though access to vaccines is available, described through the 3C Model, which covers dimensions of lack of confidence, convenience, and complacency (MacDonald, 2015). Vaccine hesitancy is a complex phenomenon; it varies by time, place, and type of vaccine (Dubé et al., 2013; Yaqub et al., 2014). This phenomenon has been a matter of concern for epidemiologists, researchers, and public health observers for the past decade (Betsch et al., 2015; Henrich & Holmes, 2010; Peretti-Watel et al., 2015).

Many studies have uncovered correlated factors that may predict vaccine hesitancy. At the community level, a past study has found that vaccine hesitancy is related to the growing lack of public trust in the government and health authorities (Yaqub et al., 2014). This is also confirmed by recent research in the context of COVID-19 that observes distrust of the credibility of the government and health authorities as the reason for doubts about receiving vaccines (Murphy et al., 2021). In addition, lifestyle changes in the post-modern era also play a role in vaccine hesitancy. The lifestyle of consumerism and the easy access to alternative information have made decision-making related to vaccinations switch from decisions made by following health authorities to decisions made by individuals from self-collected information (Chan, 2017; Dubé et al., 2013).

At the individual level, a meta-analysis study by Brewer et al. (2007) showed that perceptions of risk for vaccinated diseases had a strong association with vaccination behavior. Numerous studies in previous pandemics have confirmed this, for example in influenza pandemics (Barr et al., 2008), SARS (Hong & Collins, 2006), avian flu (Lau et al., 2008), and swine flu (Quinn et al., 2009). This is also in accordance with the latest findings by Dror et al. (2020), which state that the high perception of risk of being infected with COVID-19 can predict acceptance of vaccines in the future.

In addition, risk perception has been shown to have a strong association with general health-protective behavior (Brug et al., 2009; Ibuka et al., 2010), and this is also found in the context of the COVID-19 pandemic e.g., handwashing and masking behavior (Abdelrahman, 2022; Zainurrahman et al., 2020). In conclusion, the relationship between risk perception and protective behavior has strong empirical evidence. The higher a person perceives a disease as a risk, the higher the likelihood of a person adopting protective health behaviors. In this case, this includes vaccination.

Further in the context of the COVID-19 vaccine hesitancy, research by Murphy et al. (2021) identified factors influencing COVID-19 vaccine hesitancy, including lower cognitive reflection, altruism, certain personality traits, social dominance, conspiracy beliefs, religious beliefs, and internal locus of control. Other personality traits are also associated, including lower levels of Agreeableness, Conscientiousness, and Emotional Stability (Lin & Wang, 2020; Murphy et al., 2021). This suggests personality traits as a recently discovered dispositional factor that has a correlation with vaccine hesitancy. However, the number and scope of research on the subject is still limited, as underlined by Lin and Wang (2020).

In conclusion, previous studies have shown a variety of factors that play a role in vaccine hesitancy. On an individual level, risk perception of disease has a strong empirical basis for predicting a person's reluctance to be vaccinated. However, there have not been many studies in the context of the COVID-19 pandemic in Indonesia. Given that vaccine hesitancy is closely related to socio-cultural aspects (Dubé et al., 2013; MacDonald, 2015), it is especially important to conduct vaccine hesitancy research that considers the socio-demographic aspects of Indonesian society. For example, a recent study by Sinuraya et al. (2024) argued that Indonesia's decentralized healthcare governance and vast geography create challenges in distributing vaccines, especially to remote areas with inadequate transportation networks. This results in delays, risks to cold chain integrity, and disparities in vaccination accessibility, highlighting the need for improved infrastructure and logistics to ensure equitable vaccine distribution across the country.

Even when WHO has declared the COVID-19 global health emergency as being over (Duff, 2023), vaccine hesitancy remains a relevant topic post-pandemic due to its significant implications for public health, social impact, and health psychology. Addressing vaccine hesitancy requires tailored strategies that consider the diverse reasons behind individuals' reluctance to vaccinate (Wiysonge et al., 2021) and must be context- and issue-specific (Zhou et al., 2023); thus, learning from past pandemics within a specific context is essential to lower vaccine hesitancy if other pandemics arise in the future.

This study aims to a) find the characteristics of vaccine hesitancy of Indonesians to the COVID-19 vaccine, b) explore the reasons behind vaccine hesitancy of Indonesian people, and c) explore the roles of COVID-19 risk perception and Big Five personality traits towards vaccine hesitancy of Indonesian people. In addition, this study proposes two hypotheses, namely 1) the higher the risk perception of COVID-19, the lower the vaccine hesitancy rate of the COVID-19 vaccine; and 2) there is a relationship between the Big Five personality traits Agreeableness, Conscientiousness, and Emotional Stability and the COVID-19 vaccine hesitancy.

Methods

The present study is multimethod cross-sectional research using self-report measures and an open question. We used the convenience sampling technique through an online questionnaire for gathering the data, considering the risks of offline data gathering during the COVID-19 pandemic.

We recruited participants through a non-random sampling with the following criteria: being

Indonesian citizens aged 18 or more (therefore eligible for getting the vaccine), having never contracted COVID-19, and not having received the COVID-19 vaccine at the time of this study. This study also collected demographics of gender, age, regional origin, economic status (poor, vulnerable, aspiring – middle, middle, and upper classes), and education levels (elementary, junior high school, senior high school, and higher-level education). Economic status is based on monthly per capita consumption and is categorized according to The World Bank (2019), i.e., Rp354,000 and below for Poor Class, Rp354,000 – Rp532,000 for Vulnerable, Rp532,000 – Rp1,2 million for Aspiring - Middle, Rp1,2 million - Rp6 million for Middle, and more than Rp6 million for Upper Class. Participants were informed of the nature of this study and had given informed consent before participating. This research and all procedures therein have received ethical approval from the Research Ethics Committee of Faculty of Psychology, Universitas Gadjah Mada (number 1586/UN1/FPSi.1.3/SD/PT.01.04/2021).

Participants of the study numbered 390 people with the age of 18-62 years (M_{age} = 30.68, *SD* = $\pm$ 13.17). A total of 281 (72.1%) participants were female, while 109 (27.9%) were male. Most participants had completed higher education (57.2%), and plenty others were high school graduates (42.3%). They came from 21 provinces in Indonesia, with the majority coming from the Special Region of Yogyakarta (54.3%) and Central Java (19.6%). When categorized by economic status, 22.8% of participants belonged to the poor, 20% to the vulnerable, 35% to the aspiring middle class, 21% to the middle class, and the remaining 1% to the upper class.

Data retrieval took place on March 17 – 24, 2021, through social media. Firstly, participants were given a brief explanation of the research, including the reasons for the research, the benefits and risks of participating in the study, the nature of data confidentiality, and how to obtain more information about the study. After reading the explanation, participants were given an informed consent form and were asked to express willingness or unwillingness to participate in the research through a checkbox. If participants showed agreement, participants would then be asked to fill out a series of questionnaires that included personal data, three self-report scales, and an open question.

Risk Perception of COVID-19. We measured the perception of risk to COVID-19 disease using the COVID-19 Risk Perception Scale (C-19-RPS), which has been adapted by Zainurrahman et al. (2020) from Iorfa et al. (2020). The adapted scale has a coefficient of reliability Cronbach's α = .864 and consists of ten items. This scale measures an individual's risk perception, which includes worry and risky views of COVID-19 (for example, "What level of threat do you think the Coronavirus pandemic poses to your job or studies?" and "How worried are you about contracting the coronavirus?"). The scale is measured using a seven-point Likert with varying labels at both extremes, adjusted to each statement (e.g., very low – very high, and absolutely no threat – very high threat).

Personality traits. To measure personality traits, we used the Indonesian version of the International Personality Item Pool Big Five Factor Marker with 25 items (IPIP-BFM-25), which was adapted by Akhtar and Azwar (2019). This scale measures the Big Five personality traits according to Goldberg (1993), namely Extraversion (e.g., "Am the life of the party"), Agreeableness (e.g., "Am interested in people"), Conscientiousness (e.g., "Am always prepared"), Emotional Stability (e.g., "Get stressed out easily" that is reverse scored), and Intellect (e.g., "Have a vivid imagination"). The

subscales for each trait have coefficients of reliability ranging from Cronbach's α = .709 (Intellect) to α = .797 (Conscientiousness).

Vaccine hesitancy. We adapted the Vaccine Hesitancy Scale (VHS) Larson et al. (2015), which was modified for general use by Luyten et al. (2019). This scale consists of two aspects, namely Lack of Confidence (n = 7) and Risks (n = 2), and covers the first dimension of the 3C Model of vaccine hesitancy. Other than adapting to the Indonesian language and the context of the COVID-19 vaccination, we also changed some items to be reverse scored and added three new items under the Risks aspect. These changes were based on recommendations from previous adaptations of the scale (Luyten et al., 2019; Shapiro et al., 2018).

After the professional judgement stage, the items with Aiken's V value above 0.8 were selected for pre-testing. The scale pre-testing was conducted on 109 college students of Universitas Gadjah Mada and showed that the scale was reliable for use (α = .886). The result of this adaptation process is the COVID-19 Vaccine Hesitancy Scale (C-19-VHS), with a total of 13 items consisting of 7 items in the Lack of Confidence aspect (e.g., "Vaccines can effectively prevent COVID-19," which is reverse-scored) and 6 items in the Risks aspect (e.g., "The newly discovered COVID-19 vaccine has a greater risk than the previously available vaccine"). The finished items for the scale are shown in Appendix A.

Open question. To explore the dimensions of Convenience and Complacency of the 3C Model that are not measured by the C-19 VHS scale, we also added one open question that reads, "If you feel doubtful or reluctant to be vaccinated, what are the reasons that make you doubtful or reluctant?" This open question is optional; participants can choose to opt out of answering this question.

We then analyzed all quantitative data collected using descriptive statistical analysis (frequency, mean, standard deviation) and inferential statistics. The present study used simple regression analysis techniques to test the first hypothesis and multiple regression analysis to test the second hypothesis. We also conducted additional analysis of demographic variables to obtain an understanding of vaccine hesitancy characteristics in Indonesian society. This demographic analysis is conducted through a t-test and analysis of variance (ANOVA). All analysis was done through IBM Statistics SPSS version 22.

In addition, we conducted qualitative analysis through thematic analysis of respondents' answers to the open question. Thematic analysis followed the procedure according to Braun and Clarke (2006) and used the multiple-coding technique. The steps were as follows: data familiarization, generating initial codes, searching for themes, reviewing themes, then defining and naming the themes, The coding process only involved one person, one of the authors. Since answering the open question was made optional, only 167 participants out of 390 total answered the question.

Results

Before testing the hypotheses, we conducted a series of assumption verifications. First, we conducted a Kolmogorov-Smirnov normality test against variables depending on vaccine hesitancy. Normality test results showed a value of D (390) = 0.047 (p = .035), which means that the sample of this study did not follow the normal distribution. However, analysis with multiple regression parametric statistics,

ANOVA, independent-samples t-test, and Pearson correlation test can still be performed based on robust to violation principles of these analytical techniques (Knief & Forstmeier, 2018; Rasch & Guiard, 2004).

In addition, the number of samples in this study (N = 390) meets the minimum number of samples with a moderate effect size according to Miles and Shevlin (2001). Before testing the hypotheses, we conducted a series of assumption verifications. First, we conducted a Kolmogorov-Smirnov normality test against variables depending on vaccine hesitancy. Normality test results showed a value of D (390) = 0.047 (p = .035), which means that the sample of this study did not follow the normal distribution. However, analysis with multiple regression parametric statistics, ANOVA, independent-samples t-test, and Pearson correlation test can still be performed based on robust to violation principles of these analytical techniques (Knief & Forstmeier, 2018; Rasch & Guiard, 2004).

In addition, the number of samples in this study (N = 390) meets the minimum number of samples with a moderate effect size according to Miles and Shevlin (2001). We then conducted a series of verification assumptions for simple and multiple regression analysis, including multicollinearity, heteroskedastisity, autocorrelation, residual normality, and linearity (Berry, 1993; Field, 2009). First, a multicollinearity test is performed to ensure there is no linear relationship between two or more free variables. Multicollinearity test results show tolerance > 0.10 and VIF < 10 for all independent variables, so there is no multicollinearity in the regression model. Second, Heteroskedastisity tests are conducted to ensure the same tended variance of residual free variables. The Heteroskedasticity test through the Glejser test and residual scatterplot showed that no symptoms of heteroskedasticity occurred. For the third assumption, we ensured that there was no autocorrelation in residues through the DurbinWatson test. The DurbinWatson test results showed a figure of 1.97.

This figure is close to 2.00, so the third assumption is met. Furthermore, KolmogorovSmirnov's normality test of residues yielded D (390) = 0.029 (p = .200), which means the residue of the regression model followed the normal distribution. For the final assumption, linearity tests are performed on each free variable against the dependent variable. The linearity test results show an insignificant deviation of linearity (p > 0.05) on all variables, so the linearity assumptions are met. Thus, all assumptions for multiple regression analysis have been fulfilled.

Regression Analysis

To test the first hypothesis, we conducted a simple regression analysis with risk perception of COVID-19 as the predictor variable. The analysis shows R-squared value of .048 (F =19.65, p = .000), which is displayed in Table 1. The risk perception of COVID-19 was shown to have a significant negative role towards vaccine hesitancy, with a 4.8% effective contribution. Thus, the first null-hypothesis was rejected.

Table 1

Simple Regression Analysis With Covid-19 Risk Perception As Predictor

	Unstandardized Coefficient		Standardized Coefficient	R^2	F
	B	*SE*			
Model				.048	19.65**
(Constant)	39.11	1.86			
COVID-19 risk perception	−0.17	0.04	−.22		

Description: N = 390; *SE*, standard error; *p < .05; **p < .01

We then performed multiple regression analysis with the stepwise-backwards method to determine the best model that predicts vaccine hesitancy based on the risk perception of COVID-19 and the Big Five personality traits. The analysis yielded three models shown in Table 2. Model 1 shows the contribution of all predictor variables in explaining vaccine hesitancy, with a value of R^2 = .100 (F = 7.13, p = .000), which means that this model simultaneously has an effective contribution of 10%. In addition, Model 1 shows that risk perceptions of COVID-19, Extraversion, Conscientiousness, and Intellect significantly predict vaccine hesitancy. Meanwhile, Agreeableness and Emotional Stability do not play a significant role. Multiple regression analyses gradually eliminate these two variables. Thus, the results of the analysis showed not all personality traits play a role and are related to vaccine hesitancy, so the second hypothesis was rejected.

Table 2

Multiple Regression Analysis with Stepwise-Backwards Method with Vaccine Hesitancy as Dependent Variable

	Unstandardized Coefficient		Standardized Coefficient	R^2	F
	B	*SE*			
Model 1				.100	7.13**
(Constant)	48.88	3.82			
COVID-19 risk perception	−0.16	0.04	−.21		
Extraversion	0.29	0.11	.14		
Agreeableness	−0.22	0.17	−.08		
Conscientiousness	−0.27	0.12	−.12		
Emotional Stability	−0.08	0.09	−.05		
Intellect	−0.23	0.12	−.10		
Model 2				.099	8.40**
(Constant)	48.02	3.70			
COVID-19 risk perception	−0.15	0.04	−.20		
Extraversion	0.29	0.11	.14		
Agreeableness	−0.21	0.17	−.08		
Conscientiousness	−0.29	0.12	−.13		
Intellect	−0.25	0.12	−.11		
Model 3				.095	10.07**
(Constant)	46.22	3.42			

Table 2 (Continued)

Multiple Regression Analysis with Stepwise-Backwards Method with Vaccine Hesitancy as Dependent Variable

	Unstandardized Coefficient		Standardized Coefficient	R^2	F
	B	*SE*			
COVID-19 risk perception	−0.16	0.04	−.21		
Extraversion	0.25	0.10	.12		
Conscientiousness	−0.36	0.11	−.17		
Intellect	−0.25	0.11	−.11		

Note: N = 390; *SE*, standard error; *p < .05; **p < .01

Simultaneously, the Model 3 has an R-squared value of .095, which means it explains 9.5% of the variability in vaccine hesitancy. Although the value of R^2 decreased compared to the previous two models, the ratio of F in Model 3 has increased significantly at the level of .001 (F = 10.07, p = .000). This suggests that the variables in Model 3 are simultaneously better at predicting vaccine hesitancy than the previous two models. The equation for this regression model is as follows:

$Y = 46.22 - 0.16\ X_1 + 0.25\ X_2 - 0.36\ X_3 - 0.25\ X_4$

Note: Y = vaccine hesitancy

X_1 = risk perception of COVID-19

X_2 = Extraversion

X_3 = Conscientiousness

X_2 = Intellect

After getting the best model, the role of each predictor variable can be observed further. The value B in Table 2 and the regression equation above indicate the role of each predictor variable in vaccine hesitancy. Effective contributions from each predictor are shown in Table 3. The perception of COVID-19 risk has the most effective contribution compared to other variables. In addition, only Extraversion variables have a positive relationship with vaccine hesitancy (for the complete correlation matrix, see Appendix B).

Table 3

Standardized Coefficient Beta, Pearson-Correlation Coefficient, and Contribution of Independent Variables

	B	*r*	Contribution
Risk perception of COVID-19	−.21	−.220	4.6%
Extraversion	.12	.084	1.0%
Conscientiousness	−.17	−.180	3.1%
Intellect	−.11	−.085	0.9%

Demographic Data Analysis

Based on gender and marital status, we found no significant difference in vaccine hesitancy between men and women (t[388] = 0.31, p = .757) or between the married and the unmarried or divorced (t[388] = 1.65, p = .099). ANOVA analysis based on education level did not show any significant differences

between groups, with F (5, 384) = 0.974, p = .433. Meanwhile, ANOVA results based on economic status showed significant differences in the .001 level, with F (4, 385) = 6.433, p = .000. Poor class economic status (M = 34.08, SD = ±6.94) has the highest vaccine hesitancy rate, while the highest economic status (M = 24.75, SD = ±2.22) has the lowest vaccine hesitancy rate. In addition, the average vaccine hesitancy increases as economic status decreases.

Thematic Analysis

Of the 167 participants' answers collected, the reasons for vaccine hesitancy were concerns about the side effects of vaccination (such as fever and pain, 37.7%), uncertainty of the vaccines effectiveness (11.4%), doubts about vaccine safety (10.8%), lack of knowledge about vaccines (7.2%), comorbidity (such as asthma and diabetes, 6.0%), feeling able to take care of themselves (5.4%), distrust of the government (5.4%), and other reasons (such as unwillingness to pay for vaccinations and fear of being injected, for a total of 13.2%). Example quotes from each theme are shown in Table 4.

Of the various themes, reasons that express confidence to take care of COVID-19 by themselves are included in the dimension of complacency in the 3C model. Reasons related to trust in the quality and safety of vaccines fall into the dimension of lack of confidence and have been represented by the C19-VHS scale.

Table 4

Thematic Analysis of Participants Answers

Theme	Percentage	Translated Answer Sample
Worries about the side effects of vaccination	37.7%	"Doubt because of the side effects obtained in people who have been vaccinated. The side effects tend to vary depending on each individual, so I don't think it can be determined exactly what kind of side effects will occur in my body if it has been vaccinated."
Uncertainty about the effectiveness of the vaccine	11.4%	"Because as far as I understand, so far, the available COVID vaccine varies, the source varies, and the effectiveness is also different. I tend to doubt if the vaccine given is the one that is rumored to be less effective."
Doubts about vaccine safety	10.8%	"Being vaccinated is not necessarily safe. Although the distribution is allowed, many people are skeptical of the vaccine."
Lack of knowledge on vaccines	7.2%	"What makes me doubt about vaccination is the news containing facts about the impact of vaccines, and I think the government hasn't done enough describing the facts about the vaccine that will be given to the public so that a hoax or the discovery of new facts that the public finds itself that results in the emergence of speculation and distrust of the public to the government. However, on the other hand, of course I support vaccination in Indonesia."
Comorbidity	6.0%	"I have congenital diseases of hypertension, vertigo, and stomach acid."
Feeling able to take care of self	5.4%	"Feeling reluctant because I feel that we can still take care of ourselves through health protocols and have never been in direct contact with covid-19 sufferers."
Distrust towards the government	5.4%	"The possibility that the data provided by the government is invalid or there are cases of death after vaccination."
Other reasons	13.2%	"Why I'm reluctant to do it is because I'm afraid of syringes."

Discussion

The Roles of Risk Perception and Big Five Personality Traits

The study found a model that can explain vaccine hesitancy through risk perceptions of COVID-19 and three personality traits. Although we showed that this model can predict vaccine hesitancy significantly, the magnitude of the effect is small, which at only 9.5%. This low effect can be explained by the possibility of mediator relationships in this study. In accordance with the Health-Belief Model (HBM), personality traits not only affect vaccine hesitancy through individual beliefs related to treatment but also affect the perception of COVID-19 risk as an individual belief related to disease. This indicates that the risk perception of COVID-19 is a mediating variable between personality traits

and vaccine hesitancy. This relationship was not explored in this study and needs to be examined by subsequent research.

Furthermore, the results showed a partial effect of COVID-19 risk perception on vaccine hesitancy, confirming many previous findings (for meta-analysis studies, see Brewer et al. (2007)). The relationship between these two variables is negative. In other words, the higher a person perceives COVID-19 as a threatening disease, the lower their degree of doubt about being vaccinated.

The psychological mechanism in these findings can be explained through the HBM. In HBM theory, a person's health behavior is determined by two main factors: namely perception of health risks and confidence in certain treatment's effectiveness in reducing said risks. In this study, the risk perception of COVID-19 already includes aspects of perceived likelihood, perceived susceptibility, and perceived severity of COVID-19 disease, and this variable explains the first factor of HBM theory. On the other hand, vaccine hesitancy provides an overview of health behaviors that can be explained by HBM itself, namely vaccination behavior. Not only that, vaccine hesitancy also represents the second factor of HBM because this variable describes the lack of confidence in the COVID-19 vaccine.

In addition, among the five personality traits of the Big Five model (Goldberg, 1993), we found Extraversion, Conscientiousness, and Intellect to play significant roles. There is novelty in these findings when compared to previous studies, such as Murphy et al. (2021) and (Lin & Wang, 2020), both of which found Agreeableness, Emotional Stability, and Conscientiousness as personality traits associated with vaccine hesitancy. The relationship of the three personality traits found in this study can be explained through the Big Five model itself.

Conscientiousness describes a person's tendency to apply discipline and obey the rules, so that individuals with high Conscientiousness tend to adhere to social norms (John & Srivastava, 1999; Zajenkowski et al., 2020). Given that vaccine hesitancy itself has been widely proven to be related to social norms (Dubé et al., 2013; MacDonald, 2015), the tendency of individuals with high Conscientiousness to follow these social norms is further strengthened. These findings are also in accordance with previous studies that state that individuals who are high in Conscientiousness in general have good health behaviors (Bogg & Roberts, 2004) and tend to adopt COVID-19 protective behaviors, such as washing hands and wearing masks (Zainurrahman et al., 2020).

Meanwhile, the positive relationship of Extraversion with vaccine hesitancy is the novelty of this study and has not been explained by research on related topics before. Some studies have found that individuals with high Extraversion are more likely to share misinformation on social media (Chen & Sin, 2013) and less able to distinguish fake news from real news (Wolverton & Stevens, 2019). This may indicate Extraversion levels are also associated with susceptibility to vaccination-related misinformation. Given that vaccine hesitancy is strongly related to the consumption of factual information (Dubé et al., 2013), the trend may be indirectly related to the study's findings. However, the researchers' knowledge of both findings has not been supported by many other studies. Therefore, more research needs to be done related to this.

The third personality trait associated with vaccine hesitancy is Intellect, otherwise known as openness to experience, according to McCrae and Jr. (1999). Intellect characterizes imaginative traits,

is open to experience, and likes to learn new things (Goldberg, 1993; Ramdhani, 2012). Low rates of vaccine hesitancy in people with high Intellect are because they tend to think of vaccination as a novelty they can accept. In addition, the nature of openness to learning new things can be related to a prominent level of information-seeking. If this information-seeking is supported by the availability of factual information about vaccination, attitudes towards vaccination can change to be more positive.

However, unlike previous findings by Murphy et al. (2021) and (Lin & Wang, 2020), this study did not find Agreeableness to be a factor that affects vaccine hesitancy. It is possible that the relationship between Agreeableness and vaccine hesitancy is moderated by other variables not considered in this research. For example, factors like trust in healthcare institutions and misinformation might interact with Agreeableness to influence vaccine hesitancy.

Reasons Behind Vaccine Hesitancy

There are a few themes related to the convenience dimension of the 3C model in participants' answers. This may be based on the COVID-19 vaccination being made free of charge by the Indonesian government so that physical and financial affordability are not a problem for the community. On the other hand, we found themes within the complacency dimension. Some people feel no need to be vaccinated for reasons such as feeling able to protect themselves from COVID-19 with health protocols, as well as confidence in having strong enough immunity. Based on HBM theory, these answers show low susceptibility and perceived severity to COVID-19.

Although this study found some themes of convenience and complacency, compared to both dimensions, the themes in the dimension lack of confidence appeared more prominently. This indicates that the lack of confidence in COVID-19 vaccines better describes vaccine hesitancy in the context of COVID-19 vaccination in Indonesia. Using the HBM theory explanation, this may occur because the risk perception of vaccination (whether real or not) for the public is more visible than the perception of vaccination effectiveness and threat perception from COVID-19 itself. Research shows that individuals tend to avoid the risks associated with taking an action (i.e., getting an 'unsafe' vaccine), rather than the risk associated with not taking any action (i.e., the risk of contracting COVID-19). This tendency is called omission bias (Ritov & Baron, 1992).

Characteristics of Vaccine Hesitancy Within Indonesian Context

Our subsequent findings were related to the sociodemographic characteristics of vaccine hesitancy. We found the rate of vaccine hesitancy is highest in those with poor economies and decreases as the economy class goes higher. This finding is in accordance with a national survey conducted by the Ministry of Health and WHO (Ministry of Health, 2020) that divides economic status by the same classification as this study, as well as in accordance with many other vaccine hesitancy studies (Lin & Wang, 2020; Murphy et al., 2021; Quinn et al., 2009; Shapiro et al., 2018). The negative relationship between economic status and vaccine hesitancy may be moderated by a degree of trust in health authorities and governments, a factor closely related to vaccine hesitancy (Dubé et al., 2013). Studies show the level of trust in health authorities will increase as economic status increases (Jackson et al.,

2019). In addition, the tendency of people with low economic status to doubt vaccines may also be due to the experience felt when getting health services from the government during this time, although health service fees are partially covered by the Social Security Agency on Health (BPJS).

Further on sociodemographic characteristics, the absence of differences in vaccine hesitancy based on gender, education level, and marital status may be attributed to the uneven distribution of samples in each group, given that previous studies have documented differences based on those demographics (Lin & Wang, 2020; Murphy et al., 2021).

Overall, this study has provided an extensive picture of the role of attitudes and personalities at the individual level in vaccine hesitancy. Although the effect of risk perception and personality traits is only responsible for about 10% of vaccine hesitancy variance, this effect is quite consistent with similar studies that also involve dispositional factors (Lin & Wang, 2020; Zajenkowski et al., 2020). Further research needs to explore other predictors that can explain vaccine hesitancy more comprehensively, both at the individual level (such as locus of control, dark triads, and information-seeking) as well as at the group and community level (such as social norms and religious beliefs).

Given that past vaccination behavior is shown to predict future vaccinations (Betsch et al., 2015), the implications of this study are to portray the vaccine hesitancy phenomenon in Indonesia in the future. The results of this study have helped deepen the understanding of vaccination attitudes and behaviors and can be beneficial for the fields of health psychology, public health, and epidemiology.

On the other hand, this study certainly has advantages and disadvantages that may affect its generalizability. The advantages of the study include, among others, that the samples used in this study are quite large and balanced, especially in terms of economic status and sociodemographic factors that determine vaccine hesitancy. In addition, data retrieval is carried out when the phase II vaccination program has just started to run. This timing was ideal because, on one hand, information about vaccination was being vigorously reported by mainstream media and access to vaccination had also begun to be affordable, and on the other, most of the population has not been vaccinated. As a result, this study provides a good picture, considering vaccine hesitancy should be measured when access to vaccines is easily available.

Among the limitations of our study is the sampling technique, which was non-random. Thus, the data obtained may be limited to the community around the researchers. In addition, online data collection may indirectly have limited the participation of elderly individuals or people with certain disabilities. Future research could address this issue by incorporating diverse sampling methods, such as stratified sampling, to ensure representation from elderly individuals and those with disabilities, enhancing the inclusivity and validity of the study results. Additionally, utilizing mixed-mode data collection approaches that combine online and offline methods could help reach a more diverse participant pool, improving the overall representativeness of the study.

Conclusion

We have confirmed and outlined the relationship between risk perception of COVID-19 and personality traits with COVID-19 vaccine hesitancy in Indonesia. Risk perceptions of COVID-19, Conscientiousness, and Intellect were shown to be negatively related to vaccine hesitancy. The findings of this study can be used as a basis for recommendations for various parties. For researchers in the fields of health psychology and public health, we recommend conducting further research by exploring other variables, both at the individual and community level. Further research may also consider a longitudinal approach to finding out changes in attitudes towards vaccination after a certain period, as well as conducting nation-wide research with stratified sampling.

Recommendation

Our study results show recommendations for the government and health authorities. Vaccination campaigns should focus on extensive education on vaccine safety and vaccination with factual data, education on the risk of preventable diseases with vaccination, and increasing public confidence in governments and health authorities. In addition, vaccination promotion should be prioritized for people with lower economic status.

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Appendix A

COVID-19 Vaccine Hesitancy Scales

No.	Aspects	Original	Adaptation
1.	Lack of confidence	Vaccines are important for my health	*Vaksin COVID-19 penting bagi kesehatan saya*
2.		Vaccines are effective	*Vaksin dapat mencegah COVID-19 secara efektif.*
3.		Being vaccinated is important for the health of others in my community	*Penting bagi saya untuk divaksin COVID-19 demi kesehatan orang lain di sekitar saya.*
4.		All vaccines offered by the government programme in my community are beneficial	*Semua vaksin COVID-19 yang ditawarkan oleh pemerintah kepada masyarakat itu bermanfaat.*
5.		The information I receive about vaccines from the vaccine program is reliable and trustworthy	*Informasi yang saya terima mengenai vaksin COVID-19 dari program vaksinasi dapat diandalkan dan dipercaya.*
6.		Getting vaccines is a good way to protect myself from disease	*Divaksin merupakan cara yang baik untuk melindungi saya dari COVID-19.*
7.		Generally I do what my doctor or health care provider recommends about vaccines	*Pada umumnya saya mematuhi anjuran mengenai vaksin COVID-19 dari dokter atau tenaga kesehatan yang menangani saya.*
8.	Risks	New vaccines carry more risks than older vaccines (R)	*Vaksin COVID-19 yang baru ditemukan memiliki risiko yang lebih besar daripada vaksin yang telah ada sebelumnya.* (R)
9.		I am concerned about serious adverse effects of vaccines (R)	*Saya khawatir terhadap efek samping serius yang ditimbulkan vaksin COVID-19.* (R)
10.		COVID-19 vaccine does not have any negative impact on my health	*Vaksin COVID-19 tidak menimbulkan dampak buruk bagi kesehatan saya*
11.		COVID-19 vaccine is completely safe for my health	*Vaksin COVID-19 sepenuhnya aman bagi kesehatan saya*
12.		COVID-19 vaccine contains harmful substance	*Vaksin COVID-19 mengandung bahan yang membahayakan* (R).
13.		COVID-19 vaccine has minimal side effects	*Vaksin COVID-19 memiliki efek samping minimal*

Note: New Items Italicized

Appendix B

Correlation Matrix of all Research Variables

	Variable	VH	RP	E	A	C	ES	I
Vaccine hesitancy								
Covid-19 risk perception	-.22**							
Extraversion	.08*	.02						
Agreeableness	-.14**	.17**	.31**					
Conscientiousness	-.18**	.10*	.07	.50**				
Emotional Stability	-.04	-.19**	.02	.04	.14**			
Intellect	-.08**	-.01	.19**	.10*	.00	.15**		
Mean	31.02	47.95	15.51	20.79	19.49	13.71	17.31	
SD	7.45	9.69	3.63	2.66	3.44	4.45	3.22	

Note: VH, Vaccine hesitancy; RP, Risk Perception of COVID-19; E, Extraversion; A, Agreeableness; C, Conscientiousness ; ES, Emotional Stability; I, Intellect. *$p < .05$ **$p < .01$