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Jakarta, 27 Juli 2023

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The use of Health Belief Model (HBM) to explain factors underlying people to take the COVID-19 vaccine in Indonesia

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Introduction

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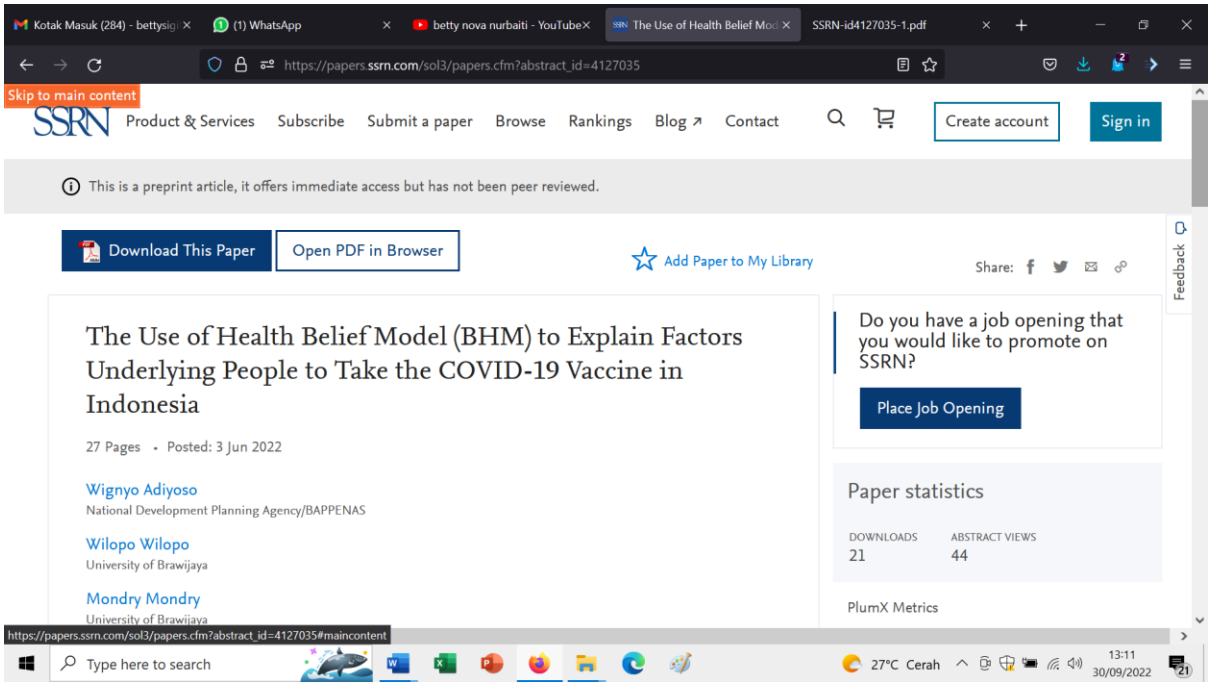
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The Use of Health Belief Model (BHM) to Explain Factors Underlying People to Take the COVID-19 Vaccine in Indonesia
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National Development Planning Agency/BAPPENAS
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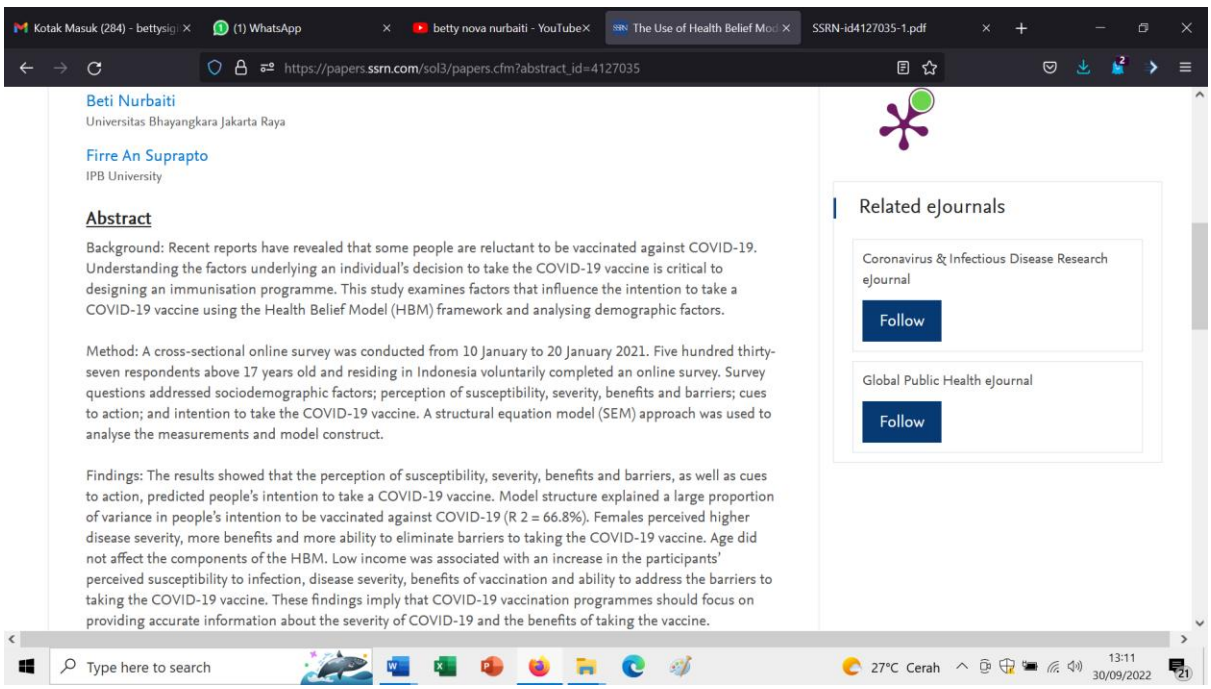
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Findings: The results showed that the perception of susceptibility, severity, benefits and barriers, as well as cues to action, predicted people's intention to take a COVID-19 vaccine. Model structure explained a large proportion of variance in people's intention to be vaccinated against COVID-19 (R 2 = 66.8%). Females perceived higher disease severity, more benefits and more ability to eliminate barriers to taking the COVID-19 vaccine. Age did not affect the components of the HBM. Low income was associated with an increase in the participants' perceived susceptibility to infection, disease severity, benefits of vaccination and ability to address the barriers to taking the COVID-19 vaccine. These findings imply that COVID-19 vaccination programmes should focus on providing accurate information about the severity of COVID-19 and the benefits of taking the vaccine.
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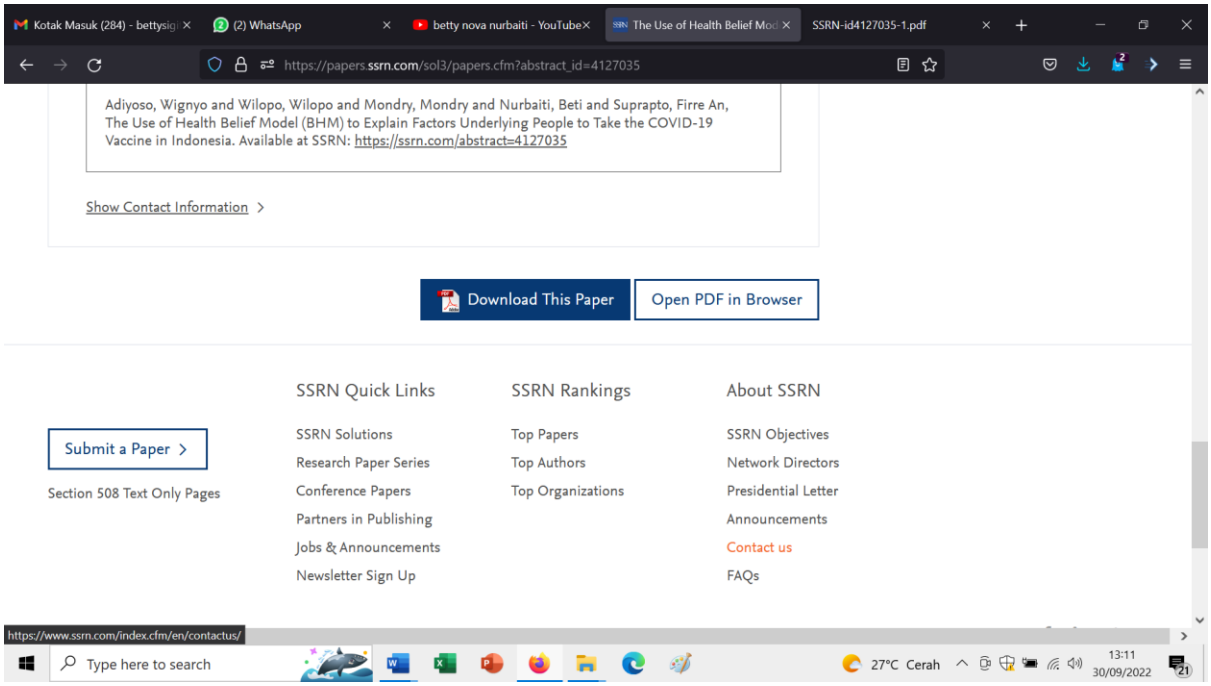
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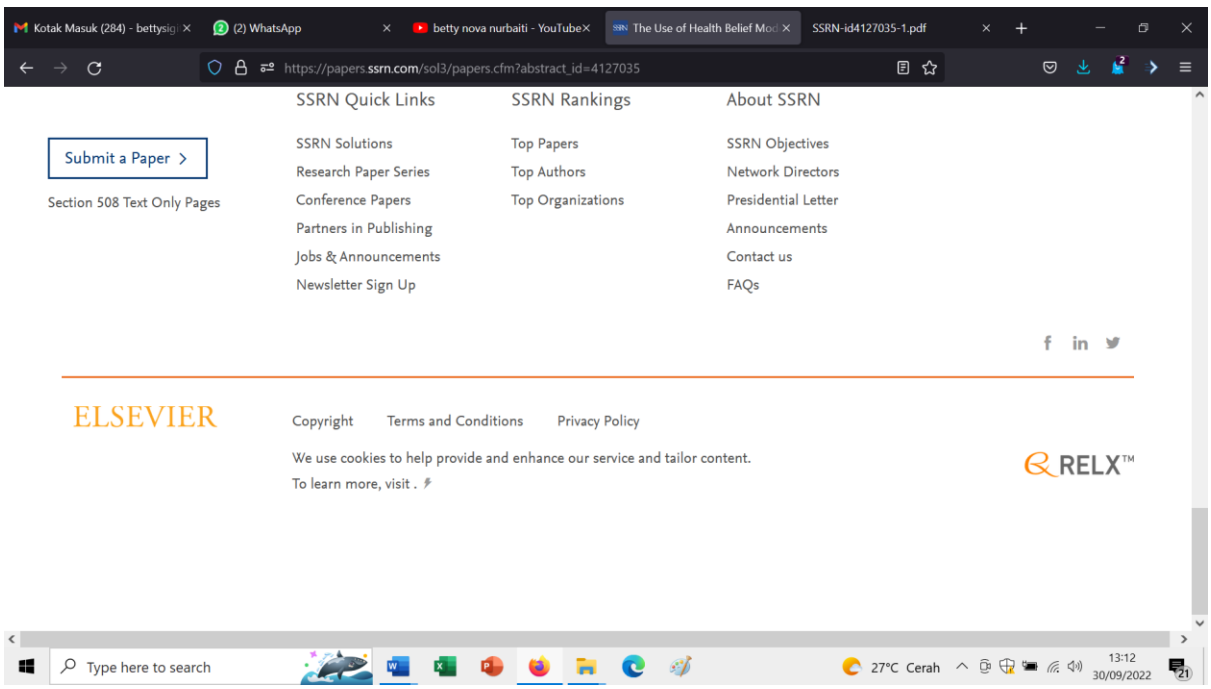
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The use of Health Belief Model (HBM) to explain factors underlying people to take the COVID-19 vaccine in Indonesia

by BETI NURBAITI

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Introduction

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COVID-19 infection [11]. Although COVID-19 vaccines have been available since the end of 2020, providing new hope to reduce spreading the COVID-19, some people reject the vaccine for various reasons [22]. Recent reports have revealed that 25 % of citizens in France, Germany, and the United States [43] and 20 % of citizens in Canada were reluctant to take COVID–19 vaccination [55].

Since the availability of the COVID-19 vaccine, some studies have been conducted to assess the acceptance of such a vaccine including in Indonesia. Most of them trying to identify factor determinants in influencing acceptance of a COVID-19 vaccine such as the effectiveness of the vaccine [29], cognitive reflection, trust in social leaders, and personality traits [64], and basic components of the Health Belief Model (HBM) [24]. Since Indonesia is a diverse community in terms of social economic, race, religion, and culture it is necessary to conduct a comprehensive study on vaccine acceptance. To the author's knowledge, no study has been conducted on COVID-19 vaccine acceptance using demographic integrated with the HBM model in Indonesia.

Indonesia is one of the countries hardest hit by COVID-19. As of 24 February 2022, there were 5,350,902 total cases, 4,632,355 recovered cases and 147,025 deaths because of COVID-19 in Indonesia [49]. As the vaccine became available in early January 2021, the Government of Indonesia provided a free COVID-19 vaccine to all members of the population meeting certain health requirements [59]. Vaccination was prioritised for frontline health workers, essential workers, older adults and public officers before it was offered to the general public.

Arifin and Anas [9] reported that in preparing for the implementation of the vaccine program, the government of Indonesia has used massively public and private places as well as door-to-door strategies to attract the public in accessing the vaccination program. Even, the government institution, the state-owned enterprises, police and army institutions as well as private sectors have supported the Indonesian government to facilitate the national vaccine program. Governments have made efforts to promote the benefits of taking a COVID-19 vaccine, yet some people have refused vaccination. The opposed people, often influenced by conspiracy theories, believe that COVID-19 vaccines have not been tested properly, negatively impact health or do not comply with religious teachings, amongst other reasons [13]. In addition, some communities raised doubt about the effectiveness of vaccines from China [53].

Although the COVID-19 vaccine acceptance rate in Indonesia was reported high, with 93 % of adults intending to receive the vaccine, vaccine refusal leads to difficulties in achieving herd immunity [55]. It is therefore critical to investigate the factors that influence people to be voluntarily vaccinated against COVID-19 and to understand the root problems of vaccine refusal using the HBM framework. The HBM has been confirmed as a strong model for establishing effective interventions in research toward health-related behavior [8]. Previous studies found that using the HBM model on COVID-19 resulted in predicting COVID-19 vaccine acceptance [34,45]. A systematic review concluded that 87.5 % of the studies involving HBM can predict a better factor in influencing COVID-19-related-behavior [66]. Another advantage of using HBM is that there is no strict standard on how to develop variables in predicting behavior [41].

The HBM has been largely used to predict health behaviour in a variety of specific contexts [18]. Previous studies have employed the HBM to successfully explain health behaviours relating to specific populations or activities such as female sex workers [67], Korean medical tourism [12], women screening for breast cancer [21], self-care with diabetes [10], meningitis [57], cardiovascular disease prevention, dietary patterns [7], and driving safety [19].

A group of psychologists in the U.S. Public Health Service developed the HBM framework to identify why people partake in healthy behaviour [52]. The HBM is a psychological model that explains and predicts specific health behaviours. The model describes that before taking certain behavior, people will evaluate the advantages and disadvantages of such behavior [27]. For example, if they perceive that taking the vaccine is more beneficial, they will make effort to do it. In contrast, if people think that taking a vaccine is not useful, they may be reluctant to do that. The HBM model consists of two variables that reflect the evaluation of barriers and benefit in taking behavior. The HBM predicts that people's behaviour is determined by their perceived susceptibility to risk, severity of risk, benefits to action, and barriers to action [17]. Later, other factors were added to the HBM, including cues to action [50], efficacy [31], confidence [32] and health motivation [20]. One of the standard models is depicted in Fig. 1 [47].

The goal of the HBM is to predict future health-related behaviour of individuals. Several studies have found that application intention can significantly foster the performance of the actual health behaviour [47]. The perceived susceptibility refers to an individual's perception of the threat posed by a disease or illness, and the perceived severity refers to their perception of the seriousness of the disease. The perceived benefit is an individual's belief that a certain health behaviour will likely reduce the harmful impact of the illness. Similarly, the perceived barrier is an individual's perception of being able to take action to reduce the threat of illness [47].

Cues to action refer to the motivations that trigger an individual to partake in health-related behaviour. This concept is similar to the concept of the subjective norm, which is a component of the Theory of Planned Behaviour (TPB) [2]. The subjective norm in the TPB refers to "persons' beliefs that specific individual or group think we should or should not take a certain behavior" [27]. Specific individuals or groups can be a wife, a husband, sons, parents, community or religious leaders, government officers, and others. While cues action of this study focused on social pressures from family, religious leaders, media, and government officers (Kim & Kim, [66]; Salazar, [67]). Social acceptance and the history of local outbreaks' variables are sometimes included in the HMB model, yet this study did not include them. Cues can be internal or external factors that encourage or discourage people to partake in healthy behaviour [36]. In the social context, people's behaviour is influenced by parents, religious leaders, community leaders, government officers and doctors [58]. The public acceptance of a COVID-19 vaccine may be affected by the social context [16].

The HBM components are affected by demographic factors [28]. Previous studies using the HBM model have reported that socioeconomic status and age are related to vaccination intention [38]; men older than 55 years have a greater willingness to be vaccinated, but younger men refused vaccination [42]. Another study has revealed that vaccine properties such as national origin, side effects, and effectiveness influence people to take vaccines [39].

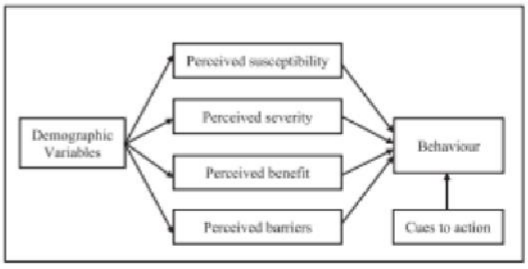

Fig 1. The Health Belief Model (HBM).

Additional indicators of COVID-19 vaccination adoption include the existence of conspiracy theories [15] and government confidence [48]. The majority of HBM applications to public health and disaster risk have been carried out in Western nations [23]. Given that Eastern nations, like Indonesia, have distinct cultural traits from Western nations, it is beneficial to examine Indonesians' readiness to get the COVID19 vaccine using the HBM framework. During a health crisis, cultural identity affects the psychological and social facets of an individual's characteristics [3].

A cultural theory distinguishes between the traits of individualism and collectivism. Western countries are characterized by individualism, whereas Eastern societies—including Indonesia—regard collectivism. Individual motivations and attitudes are viewed as belonging to the society in a collectivist setting [54].

Methods

Participants and survey design

Data collection was place between January 10 and 20, 2021, using an online survey created with Google Forms. President Joko Widodo received a dose of imported COVID-19 vaccine on January 13, 2021, marking the beginning of the first vaccination program. As a result, participants in this study who intend to receive the vaccine are those who are receiving it for the first time. The survey was disseminated by email, Facebook, WhatsApp, and other social media sites. The survey was only open to Indonesian citizens who were at least 17 years old. An adult in Indonesia is defined by law as someone who is 17 years of age or older. General information about the survey, including its goal, the confidentiality and protection of personal data, the option to withdraw from the survey before it is analyzed, and the names of the authors, was included on the first page of the questionnaire. Prior to completing the survey, respondents were required to fill out a consent form by selecting whether or not to participate by clicking "agree."

Five hundred and eighty-nine people answered the questionnaire; 537 participants' answers were examined. A total of 38 individuals were disqualified for providing incomplete or erroneous responses, while 14 people expressed that they would "not agree" to participate. An invalid response indicates that the respondent did not fill out the form completely or that one or more of the elements that made up the HBM variables were missing from the answers.

The questions on the questionnaire dealt withSex (male or female), age (45 or older), rural/urban classification (rural or urban), education (graduate degree or high school), marital status (married or single/divorced), and income were among the demographic data. (three income levels: low, middle, and high). The components that made up the extended HBM variables were: intention to get the COVID-19 vaccine; signals to action; perceived vulnerability, severity, benefits, and barriers.

Variables and measurements

The modified HBM served as the model for the HBM variable item measurements [17]. On a scale ranging from 1 (strongly disagree) to 4 (strongly agree), participants indicated their responses. drawn upon the Health Assessment Questionnaire [40] for adaptation. Categorical data, which

were handled as dummy variables, were used to measure demographic factors. Only sex, marital status, income, and living area were included in the model analysis because education data samples were unequal.

The intention was measured by four survey items: (1) "I plan to take the COVID-19 vaccine," (2) "I am willing to take the COVID-19 vaccine," (3) "I will take the vaccine even if it is difficult to do," and (4) "I will try to take the COVID-19 vaccine even if I have to pay for it and get it." Four things were measured.

Statistical methods

Data cleaning was done using an Excel spreadsheet prior to analysis. Descriptive statistics like frequency are calculated. The IBM SPSS Statistics 23.0 software package (IBM Corp., Armonk, NY, USA) was used to define dummy variables and calculate the mean and standard deviation. PLS-SEM, or partial least squares structural equation modeling, was the method employed in this investigation. Small sample sizes, non-normal data, latent variables, and predictions involving numerous independent variables are all being analyzed using PLSSEM more and more. Since SmartPLS 3.3.2 (SmartPLS GmbH, Boenningstedt, Germany) is more user-friendly and can be downloaded for free, data were processed using this program.

The measurement model's validity and construct reliability were confirmed before the structural model was put to the test. Setting outside loadings above 0.7 was the goal. Generally speaking, a composite reliability (CR) score over 6 and a Cronbach's alpha (CA) score above Good dependability is indicated by a 0.7. By looking at the average variance extracted (AVE) value, the convergent validity (CV) was evaluated. The AVE must be more than 0.5 in order to meet the CV criteria.

An additional test that was employed to confirm the validity of the measurements is discriminant validity (DV). The DC criteria, according to Wong, is "the square root of AVE of each latent variable." tought to exceed the correlations between the latent variables.

The SmartPLS bootstrapping process was conducted using 500 subsamples and 5000 iterations. The significance level for the p-value testing of the hypotheses was set at 0.05. The structural model's explanation and prediction of the dependent variables is quantified by the adjusted R-squared (R2). According to Cohen, used by Ringle et al, a minor effect is defined as one with an R2 of less than 2%.

Results

Respondent profile

The responses of 537 participants were analysed (Table 1). There was a greater proportion of females (58.5 %) than males (41.5 %). The sample was thus slightly over-representative of women compared to the general Indonesian population, which is 50.2 % males and 49.8 % females (Indonesia [30]. In terms of age, participants 45 years old and under made up 66.5 % of the sample, and participants over 45 years old made up 33.5 %. The proportions of rural and urban respondents were 36.9 % and 63.1 %, respectively. More participants were married (67.8 %) than single or divorced (32.2 %). The majority of the respondents (84.5 %) had completed undergraduate or graduate programme degrees, and only 15.5 % had secondary or primary school as their highest level of education. Most participants (42.3 %) had a monthly income of Rp 7 million (1 USD = Rp 15,000) or greater, followed by Rp 1 million or below (31.1 %), and between Rp 3–4 million (26.6 %).

The mean, standard deviation (SD), CA and CR, as well as the AVE value of the variables and items tested have been assessed (Table 2). As demographic variables were categorical, their factor loadings, CA, CR and AVE were 1. All the HBM variables and cues to action variables had a factor loading of more than 0.7. The values of CA and CR were also more than 0.7. AVE also met the criteria that all variables of HBM and cues to action variables were greater than 0.5. The DV test resulted that for all variables the square root of AVE was greater than the correlation among latent variables (Table 3). Overall, data measurements had good reliability and validity, as required by the structural model.

Table 1
Characteristic of Respondents.

Varibles/Items	Frequency	%
Sex (537)		
Female	314	58.5 %
Male	223	41.5 %
Age (537)		
45 and below	357	66.5 %
46 and above	180	33.5 %
Education (537)		
High School and below	83	15.5 %
Graduate and above	454	84.5 %
Living Area (537)		
Rural	198	36.9 %
Urban	339	63.1 %
Marital Status (537)		
Single	173	32.2 %
Married	364	67.8 %
Income (537)		
Rp3 million & below	167	31.1 %
Rp.3–7 million	143	26.6 %
Rp.7 million & above	227	42.3 %

$p < 0.000$) and barriers ($\beta = 0.272$, $t = 8.763$, $p < 0.000$), as well as cues to action ($\beta = 0.319$, $t = 8.029$, $p < 0.000$), predicted the intention to take the COVID-19 vaccine.

Demographic factors such as sex, age, marriage, and living areas did not affect the components of the HBM, except for sex influenced severity ($b = 0.143$, $t = 3.305$, $p < 0.001$) and people living areas affected benefit variables ($b = -0.092$, $t = 2.161$, $p < 0.031$). Low and middle income had significant effect on all variables of the HBM except for the middle income had not significant on susceptibility. The effect of low income on perceived susceptibility was $\beta = -0.187$, $t = 3.413$, $p = 0.001$, severity ($\beta = -0.208$, $t = 3.576$, $p < 0.001$), benefits ($\beta = -0.188$, $t = 3.280$, $p = 0.001$) and barriers ($\beta = -0.359$, $t = 6.279$, $p < 0.000$). The effect of middle income on perceived severity ($\beta = -0.089$, $t = 1.977$, $p < 0.049$), benefits ($\beta = -0.093$, $t = 2.048$, $p = 0.041$) and barriers ($\beta = -0.133$, $t = 3.060$, $p < 0.002$).

Discussion

The present study assesses factors determining an individual's decision to be vaccinated against COVID-19 vaccine using a modified HBM constructs, including demographic and cues to action variables. All components of the HBM and cues to action had a significant effect on the intention to take the COVID-19 vaccine. The more that people believed they could contact COVID-19, become severely ill when infected, benefit from taking the COVID-19 vaccine or overcome barriers to taking a COVID-19 vaccine and the more they perceived that their social network approved of the vaccine, the more likely they were to intend to be vaccinated. These findings demonstrate the usefulness of the HBM constructs in understanding COVID-19 vaccine uptake. The result of present study was not supported by the previous findings that not all of the key components of the HBM and cues to action factors predicted the intention to prevent against COVID-19 [5,65,21]. These results indicated that a high intention to take the COVID-19 vaccine fitting to the HBM models is advantageous for a massive immunization to the general population. Public health campaigns need to focus on the five components of the HBM including perceived susceptibility, severity, benefit, barriers, and involvement of the family and social groups.

This structural model accounts for a larger proportion of variance in intention to take a COVID-19 vaccine (66.8 %) [44]than a previous related study (28 %) [8]. This finding suggests that the modified HBM framework is useful for identifying the root factors that drive vaccine decision-making and designing intervention programmes to increase the uptake of COVID-19 vaccines in this population [18]. To address the susceptibility and severity factors, the design of intervention programmes should focus on increasing awareness of the transmissibility of COVID-19 and its severe health impacts. The public should be provided with accurate information concerning the elevated risk of spreading the COVID-19 virus and

Table 2
Mean, SD, Factor Loading, Cronbach's Alpha, Composite Reliability and AVE.

Variable and Items	Mean (1–4)	SD	Factor Loading	VIF	Cronbach's α	CR	AVE
Demographic (dummy)							
Sex (female)	–	0.493	1.000	1.000	1.000	1.000	1.000
Age (45 and below)	–	0.494	1.000	1.000	1.000	1.000	1.000
Marriage (Not married)	–	0.468	1.000	1.000	1.000	1.000	1.000
Living (Urban)	–	0.483	1.000	1.000	1.000	1.000	1.000
L-Income (under Rp3 million)	–	0.463	1.000	1.000	1.000	1.000	1.000
H-Income (Rp3-7 million)	–	0.442	1.000	1.000	1.000	1.000	1.000
Susceptibility					**0.789**	**0.861**	**0.607**
I have chance to be infected	3.1229	0.73795	0.742	1.582			
Likely to be infected than others	2.4655	0.74012	0.748	1.691			
If no vaccine it will worse	3.1248	0.82931	0.836	1.877			
No vaccine it will uncontrollable	2.8101	0.82930	0.788	1.453			
Severity					**0.837**	**0.890**	**0.669**
Family will be disturbed	3.5438	0.63660	0.801	1.873			
Feeling worried	3.3110	0.71114	0.834	2.018			
Disrupting my life	3.4488	0.67310	0.826	2.006			
My life become worse	3.0354	0.80614	0.812	1.575			
Benefit					**0.922**	**0.944**	**0.809**
Vaccine can reduce COVID-19	3.0726	0.70203	0.891	3.061			
Vaccine reduce infection	2.8547	0.73387	0.864	2.628			
Vaccine will protect me	3.1322	0.72226	0.933	4.402			
Vaccine can reduce worries	3.1676	0.72908	0.909	3.530			
Barrier					**0.783**	**0.873**	**0.697**
Vaccine is not effective	2.1657	0.82887	0.846	1.651			
Vaccine against my religion	2.9851	0.74046	0.798	1.515			
I don't trust vaccine from China	2.5252	0.93156	0.859	1.864			
Cues					**0.855**	**0.900**	**0.693**
My family agree with vaccine	3.0354	0.77787	0.831	1.713			
Religious leaders agree with vaccine	2.9106	0.79611	0.828	1.973			
Government facilitate vaccine	3.1825	0.73570	0.826	2.494			
Mass media provides information	3.0670	0.75507	0.844	2.652			
Intention					**0.944**	**0.960**	**0.857**
I plan to take vaccine	3.0037	0.78701	0.953	8.356			
I will be ready to take vaccine	3.0186	0.79153	0.945	7.701			
I push to get vaccine	2.8417	0.81674	0.939	4.839			
I would pay vaccine if necessary	2.6778	0.88654	0.862	2.778			

Note: SD: Standard Deviation, VIF: Variance Inflation Factor, CR: Composite Reliability, AVE: Average Variance Extracted, Measurement: Demographic variables used dummy variables and Modified HBM variables used 1–4 scales. Demographic Variables: male (sex), 46 and above (Age), married (Marriage), rural (Living area), High-income (Rp7 million and above) are as a reference for variables dummy.

Table 3
Discriminant validity tests results.

VARIABLES	SEX	AGE	LIVING	MARRIAGE	L-INCOME	M–INCOME	SUSCEP	SEVER	BENEF	BARR	CUES	INT
SEX	**1.000**											
AGE	0.190	**1.000**										
LIVING	0.057	−0.109	**1.000**									
MARRIAGE	0.252	0.363	−0.134	**1.000**								
L-INCOME	0.193	0.375	−0.195	−0.613	**1.000**							
M–INCOME	**0.039***	−0.164	**0.006***	−0.172	−0.405	**1.000**						
SUSCEP	−0.079	**−0.044***	**0.029***	−0.173	−0.192	**0.022****	0.779					
SEVER	0.079	**−0.059****	**0.026***	−0.156	−0.186	**0.018****	0.589	0.818				
BENEF	**0.019****	−0.069	**−0.045****	−0.115	−0.147	**−0.007****	0.581	0.652	0.900			
BARR	**0.024****	−0.053	**0.036***	−0.091	−0.227	**0.004****	0.276	0.302	0.408	0.835		
CUES	**0.024***	−0.103	**0.027***	−0.139	−0.175	**0.049***	0.562	0.568	0.636	0.395	0.832	
INT	**−0.047***	−0.088	**0.058****	−0.162	−0.279	**0.009****	0.577	0.579	0.689	0.559	0.702	0.926

Note: L-INCOME: Lower Income, M–INCOME: Middle Income, SUSCEP: Susceptibility, SEVER: Severity, BENEF: Benefit, BARR: Barrier, CUES: Cues to Action and INT: Intention. Significance level: * $p < 0.001$, ** $p < 0.05$. Demographic variables used dummy variables and Modified HBM variables used 1–4 scales. Demographic Variables: male (sex), 46 and above (Age), married (Marriage), rural (Living area), High-income (Rp7 million and above) are as a reference for variables dummy.

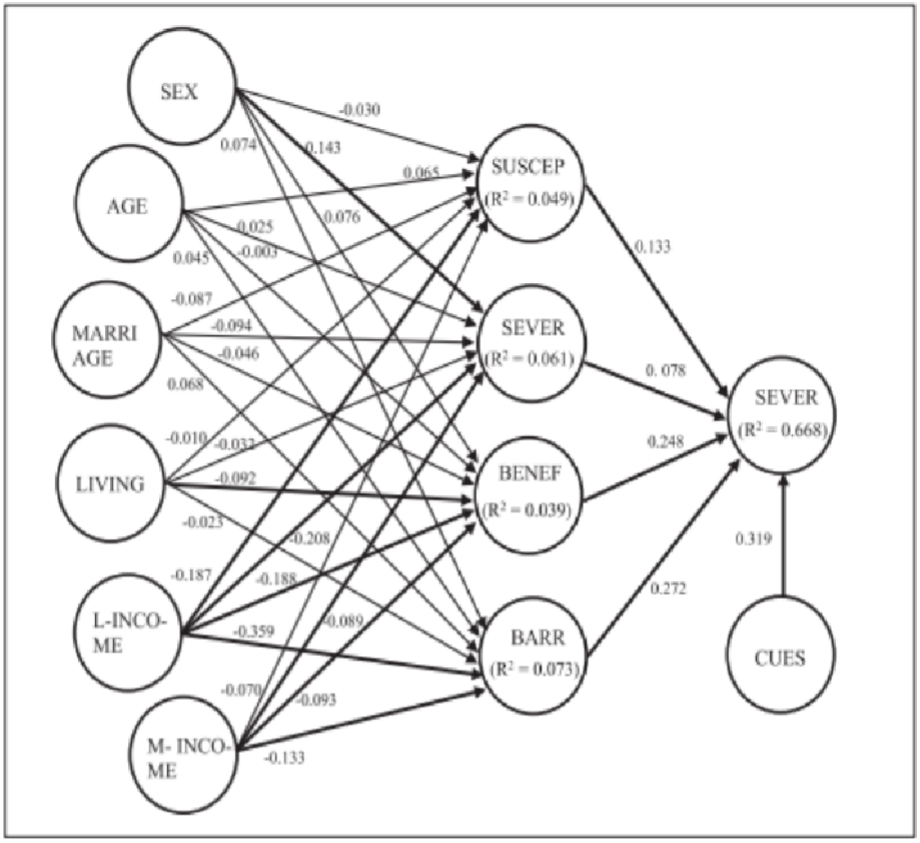

Fig 2. Structural Model ResultsNote: Thin lines = no significant and **thick lines** = significant.

experiencing severe illness for unvaccinated individuals. A previous study found that individuals who received misinformation were more likely to reject COVID-19 vaccination [38].

Perceived susceptibility and severity are predictors of the intention to be vaccinated COVID-19. This finding contrasts with past studies that concluded the perception of susceptibility and severity had no link to the intention to vaccinate against COVID-19 or the willingness to pay for vaccination [35] (M. C. S. [62]. As information technology advances, the internet and social media contribute to the spread of the COVID-19 pandemic globally and results in worldwide public concern [4]. This feeling of anxiety motivates the public to be aware of the consequence of COVID-19 for themselves and their family members. The rapid and massive information regarding COVID-19 amplifies people's perceiving the danger and severe impact of COVID-19. The more people perceive their vulnerability and the severity of the illness, the more they will decide to take precautions [56].

The present study also reveals that perceived benefits and barriers are other predictors of the intention to get vaccinated against COVID-19. These findings support previous findings that perceived benefits and obstacles to vaccination were important predictors of the intention to seek COVID-19 vaccination [35] and mammography [20]. Research indicates that vaccination campaign messages should address and decrease barriers to vaccination. These findings imply that intervention programmes can address negative perceptions of the vaccine by counterbalancing conspiracies and perceptions such as the vaccine being ineffective or contrary to religious teachings. As COVID-19 has spread, conspiracy theory issues have become widespread, influencing people to reject preventive behaviour, including vaccination [15].

Cues to action are effective predictors of the intention to take a COVID-19 vaccine. The current study supports previous findings that the more influential people accept the COVID-19 vaccine, the more others are convinced to be vaccinated [60]. Influential or trusted people can include family members, religious leaders, community leaders and government officers. In developing countries such as Indonesia, social-cultural factors may play an important role in determining individuals' behaviour [33]. As we hypothesize that Indonesian represents collectivistic people, the roles of family member and social groups are critical factors for people to take COVID-19 vaccines [54]. The present findings suggest the importance of involving key family members and other influential people in designing campaigns for vaccination programmes. It is also recommended that governments provide publicly-funded vaccines and facilitate easy access to vaccination.

Demographic variables have a partly significant effect on key components of the HBM model. In the present works, perceived susceptibility, severity, benefits, and barriers mediated the low-income group's diminished intention to take the COVID-19 vaccine compared to the high income group. Middle income status had also

Table 4
Structural Model Results.

Hypotheses	Path Coefficient (β)	t-statistic	p-value	Results
SEX → SUSCEP	−0.030	0.462	0.521	Not Supported
SEX → SEVER	0.143	3.305	**0.001***	**Supported**
SEX → BENEF	0.076	1.570	0.117	Not Supported
SEX → BARR	0.074	1.749	0.081	Not Supported
AGE → SUSCEP	0.065	1.396	0.163	Not Supported
AGE → SEVER	0.025	0.574	0.566	Not Supported
AGE → BENEF	−0.003	0.068	0.946	Not Supported
AGE → BARR	0.045	1.048	0.295	Not Supported
MARRIAGE → SUSCEPT	−0.087	1.626	0.105	Not Supported
MARRIAGE → SEVER	−0.094	1.631	0.103	Not Supported
MARRIAGE → BENEF	−0.046	0.783	0.434	Not Supported
MARRIAGE → BARR	0.068	1.224	0.222	Not Supported
LIVING → SUSCEPT	−0.010	0.222	0.825	Not Supported
LIVING → SEVER	−0.032	0.749	0.454	Not Supported
LIVING → BENEF	−0.092	2.161	**0.031****	**Supported**
LIVING → BARR	−0.023	0.504	0.615	Not Supported
L-INCOME → SUSCEP	−0.187	3.313	**0.001***	**Supported**
L-INCOME → SEVER	−0.208	3.576	**0.000***	**Supported**
L-INCOME → BENEF	−0.188	3.280	**0.001***	**Supported**
L-INCOME → BARR	−0.359	6.279	**0.000***	**Supported**
M−INCOME → SUSCEP	−0.070	1.534	0.126	Not Supported
M−INCOME → SEVER	−0.089	1.977	**0.049****	**Supported**
M−INCOME → BENEF	−0.093	2.048	**0.041****	**Supported**
M−INCOME → BARR	−0.133	3.060	**0.002****	**Supported**
SUSCEPT → INT	0.133	3.448	**0.001***	**Supported**
SEVER → INT	0.076	2.000	**0.046****	**Supported**
BENEF → INT	0.248	5.629	**0.000***	**Supported**
BARR → INT	0.272	8.763	**0.000***	**Supported**
CUES → INT	0.319	8.029	**0.000***	**Supported**

Note: L-INCOME: Lower Income, M−INCOME: Middle Income, SUSCEP: Susceptibility, SEVER: Severity, BENEF: Benefit, BARR: Barrier, CUES: Cues to Action and INT: Intention. Significance level: * $p < 0.001$, ** $p < 0.05$. Demographic variables used dummy variables and Modified HBM variables used 1–4 scales. Demographic Variables: male (sex), 46 and above (Age), married (Marriage), rural (Living area), High-income (Rp7 million and above) are as a reference for variables dummy.

less perceived severity, benefits, and barriers in intending to take the vaccine. This finding supports previous studies that found that people of lower income take fewer protective measures in handling hospital wastes in Bangladesh [6]. These findings are concerning because people with lower incomes cannot easily access the COVID-19 vaccine compared to people with higher incomes. Our findings emphasise the importance of increasing the perception of susceptibility, severity, benefits and the ability to overcome barriers among the lower and middle-income populations.

The non-significant of the major demographic factors such as sex, age, marriage and living areas in the models were critical findings. These results of the study contrast with previous studies that intention to take vaccine were influenced by sex, age, marital status and living areas [26,34]. Females perceived lower severity compared the man. People living in urban did not perceive the benefit of taking vaccines. The findings suggest that vaccination campaign programs should focus on females and people in urban particularly on informing them about their risk of infection with COVID-19, perceived severity, and perceived benefits.

Limitations of the study

This study assessing individuals' intentions to take the COVID-19 vaccine has some limitations. The unrepresentative demographic variables such as respondent's education were not included in the analyses that might lead to different findings. The disproportion of males and females implies that the results might not be generalizable to all Indonesian populations. Another limitation is that because the data collection took place over only two weeks, it could not capture changes in respondents' attitudes and behaviours as the vaccination campaign progressed. As intention does not always translate into real behaviour, future work is needed to investigate whether people follow through in their intentions regarding the COVID-19 vaccine. To overcome these limitations, future studies should focus on observing the real COVID-19 vaccination behaviour in a representative and balanced demographic sample. Information plays an important role in influencing people's health-related attitudes and behaviours, so it is suggested that future studies consider the role of information in determining the factors driving people's decisions to take the COVID-19 vaccine.

Conclusion

This study confirms that the perception of susceptibility, severity, benefits and barriers, as well as cues to action, predict an individual's intention to take a COVID-19 vaccine. Model structure explains a large proportion of variance in the intention to be vaccinated against COVID-19 (66.8 %). Based on the present findings indicate that the HBM model is useful to predict people to take the COVID-19 vaccine in the collectivist society. Not all demographic variables influenced variables of the HBM model including sex, age, marital status, and living areas. Factors such as susceptibility, severity, benefits, and barriers mediated the low-income intention to take the COVID-19 vaccine. Middle income influenced lower severity, benefits, and ability to eliminate barriers to COVID-19 vaccine uptake. Males were more perceived severity compared to females and people living in rural areas were more feeling benefit in taking vaccines. This finding implies that vaccination programmes should focus on providing accurate information about the health impacts of COVID-19 and the benefits of taking the vaccine. Building individuals' confidence in their ability to eliminate barriers to vaccination and involving family and social or religious leaders will increase the proportion of the population accepting

COVID-19 immunization. In developing nations, people's intentions to receive the COVID-19 vaccine are explained and predicted by the current study. Notwithstanding these drawbacks, the study offers insightful suggestions for public health policy that can help develop immunization programs that work.COVID-19 immunization. This study elucidates and forecasts people's intentions to receive the COVID-19 vaccine in emerging nations. Notwithstanding these drawbacks, the study offers insightful suggestions for public health policy that can help develop immunization programs that work.

Declarations

Ethics approval and consent to participate

The Brawijaya University Research Center has concluded that no ethics approval is needed for this project. (1) Indonesia Laws No. 18 Year was followed in conducting this investigation. (3) Indonesia Government Regulation No. 39 of 1995 on Health Research and Development; (2) Indonesia Government Regulation No. 48 of 2009 on Permission for Conducting Activities, Developing, and the Implementation of the Science and Technology with the High Risk and Dangerous; and (3) National System of Research, Development, and Application of Natural Science, established in 2002. It is not required to get ethics committee approval for this study because it is not considered high-risk or harmful. Every study participant received information regarding the study's objectives, voluntary participation, information confidentiality, anonymity, and age over.

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The use of Health Belief Model (HBM) to explain factors underlying people to take the COVID-19 vaccine in Indonesia

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