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Explaining the intention to uptake COVID-19 vaccination using the behavioral and social drivers of vaccination (BeSD) model

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ABSTRACT

Background: The World Health Organization (WHO) has proposed a tool to measure behavioral and social drivers (BeSD) of vaccination uptake intentions of people across all countries. This study tests BeSD model to predict people's intentions to uptake COVID-19 vaccination in rural India.
Methods: An online cross-sectional survey was developed for the purpose based on the components of the BeSD model, i.e., confidence, motivation, and behavioral intention. A convenient sampling technique was used to collect samples, amounting to a total of 625, from rural Bengaluru, in the Karnataka state of India. Structural equation modelling (SEM) was applied to examine the proposed model. All respondents for the survey were in the age category of 18–68 years with a mean age of 35 years.
Findings: The results showed that 85% of COVID-19 vaccine uptake intentions can directly or indirectly be attributed to the government's vaccine communication strategy, perceived threats about the vaccine, and their trust in the healthcare sector. The dimensions of the vaccine acceptance scale (motivation factors) act as a mediator between these factors and COVID-19 vaccination uptake (the behavioral factor).
Conclusion: The study demonstrates that the BeSD framework is an efficient model for predicting the COVID-19 vaccination uptake in India.

Introduction

India is home to the world's second largest population, amounting to 1.4 billion people. Needless to say, containing the pandemic in the country is a mammoth task. The central and state governments have announced several lockdowns since March 2020 to contain the virus, bringing all economic activity and movement to a halt. Pharmaceutical companies have been racing against time to develop the necessary medicines and vaccines to counter the virus. The COVID-19 vaccination program began on January 16, 2021, with the Covishield (AZD1222) adenovirus vector vaccine from AstraZeneca and the Covaxin (BBV152) whole inactivated virus vaccine from Bharat Biotech. Further, in June 2021, the Indian government gave the go ahead for the Russian vaccine Sputnik V (Gam-COVID-Vac; adenovirus viral vector vaccine) and further to other international players like Pfizer (mRNA), Johnson & Johnson (vector vaccine), and Moderna (mRNA). As of July 6, 2021, vaccination drives across the country have covered 357 million people [1]. However, the government is tasked with addressing a major concern and that is vaccination hesitancy, or in other words, hesitancy on the part of the people to voluntary take the vaccine. The hesitancy can be attributed to several reasons, primarily, lack of awareness and trust in the safety of the vaccines and misinformation about COVID-19 vaccine and its technological approach. Due to poor knowledge between populations about types of vaccine, its dosing recommendations, and the poor commitment to hygiene practices, the national and international health organizations are organizing campaigns to increase the public awareness level about the COVID-19 vaccines [2]. The vaccination program campaigns include advertisements on social media and television to increase the population's awareness of COVID-19 vaccines and show the importance of public vaccination to limit the spread of coronavirus infections [2,3]. The initial lack of trust can be attributed to the lack of vaccine trials. Vaccine hesitancy and refusal to accept vaccines are common in India, even for routine immunization [4]. As a result, vaccine hesitancy linked to COVID-19 vaccines is nothing new or surprising. Even before the COVID-19 pandemic, the overall vaccination hesitancy to routine childhood vaccines in India was on the rise [5]. When the Measles-Rubella vaccination was first offered in India in 2016, there were several cases of hesitancy

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[6,7]. When the COVID-19 vaccination campaign began in India on January 16, 2021, there was considerable skepticism among health care providers, who were the target group to be covered at the time [4]. At the time, COVID 19′s first wave had just ended, and the second had not yet begun. A prominent South Indian film actor and comedian who strongly supported the state government's COVID 19 vaccination effort was vaccinated in a public event. The following day, on April 17, he suffered a sudden cardiac arrest and died from causes unrelated to the vaccination. His death, however, sparked a flurry of conspiracy claims about COVID 19 vaccine-related deaths. This exacerbated the vaccine hesitation in Indian, mainly in south India [4]. While the vaccine uptake intention amongst Indians is gradually increasing, the hesitancy still remains a cause of concern in the rural areas.

In a vaccine market that continues to see a demand–supply mismatch, the revised vaccine procurement process builds in a skew against smaller hospitals in cities and towns in comparison to their bigger counterparts in simply getting access to the shots, and a more disconcerting urban–rural divide in terms of where healthcare facilities are vis-à-vis the already-established supply-chain map [8,9]. In the guidelines for the "Liberalised and Accelerated Phase 3 Strategy of Covid-19 Vaccination", the Centre mandated prior online registration on the CoWin portal for the 18–44 years age group. Mandatory online registration introduces a skew in favor of urban centres, given that a little over half of India's population has access to broadband Internet, while rural teledensity is under 60%— with states including Bihar, Uttar Pradesh, Chhattisgarh, Jharkhand, and Madhya Pradesh having among the country's lowest teledensity [8,10]. These are the main reasons which affect the availability and accessibility of vaccination services in rural areas in India. However, no matter how convincing and irrefutable the science and the data about the COVID-19 vaccines are, misinformation spreads so easily and quickly—that it has become a significant barrier stopping India from reaching higher levels of vaccination. The main myth is that COVID-19vaccines were not rigorously tested, which is why they have only emergency authorization approval by country. The second common myth was that the technology used to create the COVID-19 vaccines was too new to be safe. The following common myth is that getting the COVID-19 vaccine gives COVID-19 [11]. The aim of the study is to highlight the reasons for the hesitancy in rural areas. Our findings will help decision-makers address this hesitancy, and consequently improve vaccination intention in these areas.

With no "one-size-fits-all" solution to vaccine hesitancy and vaccine acceptance, there is need for contextualized and curated approaches. The WHO working group experts have developed the Behavioural And Social Drivers (BeSD) vaccination model, which emphasizes "motivation" as the vanguard of human psychology during a vaccination drive [12]. Country like Israel have successfully inoculated a significant percentage of citizens using incentives and motivation [13]. Unfortunately, in India, misinformation, and misplaced beliefs have led to fears about the potentially harmful effects of vaccines [14]. In light of this situation, this study aims to use the "BeSD" vaccination model (Fig. 1) as a theoretical stance to map the relationship between vaccination confidence, motivation, behaviour and the practical issues that affect vaccine uptake among rural Indians.

Literature review

Research model

BeSD of vaccination uptake model consists of three stages, i.e., confidence, motivation and behavior [12,15]. The motivation stage is explained from two perspectives, i.e., vaccination demand and hesitancy among people. Demand is a complex concept and its estimations are based on human interaction with the system, government structure and dynamics, and so it best serves as an external variable [16]. Hesitancy is another means to explain the motivation stage. It refers "Vaccine hesitancy refers to delay in acceptance or refusal of vaccines despite availability of vaccine services. Vaccine hesitancy is complex and context specific, varying across time, place and vaccines. It is influenced by factors such as complacency, convenience and confidence" [17]. Vaccine hesitancy manifests itself in delay in acceptance or complete refusal to get vaccinated [16]. Hence, this study measures motivation towards vaccine uptake on a Vaccine Acceptance Scale and behavior based on the vaccine intake intention. The motivation stage is always built on the confidence people have towards an initiative [18]. In this study, people's confidence in vaccine is built around three factors, i.e., COVID-19 communication strategy of the Indian government, threats posed by the COVID-19 vaccinations, and trust in India's healthcare sector.

Vaccine acceptance scale

While vaccinations have been successfully developed in several countries, the major success depends on the willingness of the people to actually take the jab [19,20]. "The Drivers of COVID-19 vaccination Acceptance Scale (DrVac-COVID19S)" appears to be a well-constructed and validated instrument to measure an individual's intention, attitude, and thoughts to take the COVID-19 vaccine [21,22]. This scale was developed and adapted from a well-established scale, the MoVac-Flu Scale- Motors of Influenza Vaccination Acceptance Scale, which was developed to assess influenza vaccination acceptance [23,24]. Like the MoVac-Flu Scale, the DrVac COVID-19S scale is also developed on the Cognitive Model of Empowerment assuming that intrinsic motivation is required to engage in purposeful behavior.

Dimensions of vaccine acceptance scale

Value: Purposeful behavior or task is assessed based on a person's standards and concern towards performing the behavior [21].

Impact: A person's awareness and knowledge about the benefits of the action to undertake can ensure a successful launch of any new initiative. If people feel that their actions would contribute to the general welfare of the society, they are more likely to adopt a change in behavior [14,25].

Autonomy: Studies have explained autonomy as an individual's control over their decision, independence, and freedom to schedule their tasks at any point in time [19,23]. Many studies represent this variable as choice. If autonomy is high, then individuals are more empowered, and acceptance is high [22,26].

Knowledge: Knowledge about a new initiative or goal increases a person's confidence and self-esteem, which further increases their trust in the initiative and benefits the organization. Accordingly, when people have more knowledge about the vaccine, the different types of vaccines available, and their benefits and their side-effects, they are more likely to make an informed choice [14,27].

The threat posed by the COVID-19 vaccine

Vaccine hesitancy is one of the top 10 threats to global health [28] and anti-vaccine or anti-vaccination movements become common amidst any pandemic situation [29] and anti-vaccination campaigns have gathered more stream than ever due to the social media and encourage vaccine hesitancy. The reasons for vaccine denial vary from one region to another. However, a common cause remains the misinformation caused on the Internet which has sev-

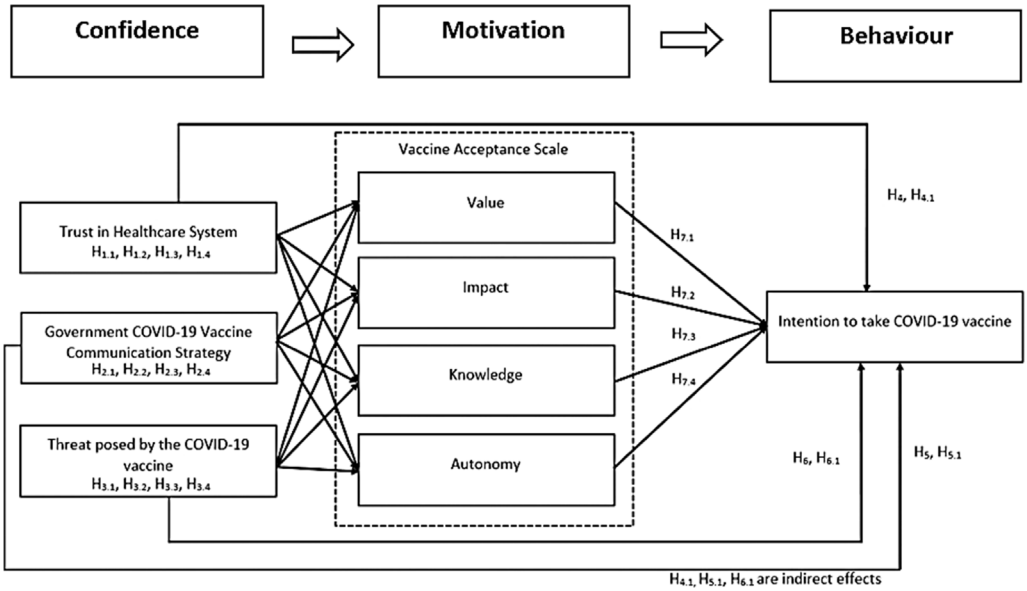

Fig. 1. Conceptual Model.

erally impacted vaccination drives worldwide [30]. The constant stream of misinformation has caused fear among the general populations with regards to the side-effects and the after-effects of taking the COVID-19 vaccination [26]. Threats negatively influence peoples' belief systems; push them to question their own knowledge about the disease; induce fear; and affect autonomous decision-taking in the context of the vaccine [31]. These studies show that subjective perceptions of the threat posed by the COVID-19 vaccine will negatively influence its acceptance and uptake intentions [32].

Trust in the healthcare system

It is important for policymakers and administrators to build trust about the vaccine amongst the people to successfully tackle the pandemic and prevent further loss of life. For this, trust has to be studied from all perspectives, especially in the context of the healthcare industry [33,34] including trust in the vaccine brand and effectiveness, the health care providers [35], and the government and healthcare departments [34,36]. Existing studies show that intention to take vaccines is highly associated with people's trust in the government and their perceived vulnerability to the disease [37]. Trust is also governed by other factors such as the country of origin [38].

Government communication strategy

Evidence-based health communication strategies are required to address vaccination hesitancy and successfully build vaccine trust [39]. The government has to consider appropriate communication strategies to counter misinformation and reduce mistrust, xenophobia, misinformation exposure and endorsement [40], along with other strategies to build awareness, educate people and build an environment of trust in order to induce people to get vaccinated.

Timely and updated communication can improve confidence, which in turn, will enable people to take autonomous decisions with regards to taking the jab. Therefore, people's vaccine hesitancy can be addressed with timely available information [21,27]. Fig. 1 shows the hypothesised links in detail.

Methods

Measures

The quantitative method was used to test the hypotheses, and the cross-sectional survey method was used to collect data using the convenient sampling technique. The questionnaire was developed based on extensive literature review. However, construct such as the government COVID-19 Vaccine communication strategy was self-developed based on various COVID-19 vaccine communication strategies by the Ministry of Health and Family Welfare, India. The final instrument was developed with 5 constructs and 28 items. Information on the source of constructs and items is provided in Appendix I. The questionnaire was administered among respondents who were eligible for the vaccination. They were explained about the research objectives in the online survey link. The participation of the respondents in the survey was voluntary and they were assured full confidentiality. They had the liberty to withdraw from the survey at any point of time. Responses completed in<6 min (baseline was set) were removed to arrive at a valid sample. The data collection instrument was designed with five-point Likert-type scale ranging from 1 (Strongly disagree) to 5 (Strongly Agree). Besides, there were some questions that aimed to collect the demographic details of the participants.

The questionnaire was administered in the local language, and we followed the procedures prescribed by Brislin (1986) for developing the translated version of the instrument [41]. First, two Kannada native-speaking professors translated the English version into the local language and then back-translated it into English. We administered the survey to 100 respondents and checked the initial reliability. The initial Cronbach alpha values for all research constructs are greater than 0.7 and conclude instruments internal consistency. It was added to the original sample since no items were removed from the survey based on a pilot study. Content validity describes whether an instrument is systematically and comprehensively representative of the trait it is measuring [42]. For this purpose, Community Health Workers were contacted and asked to validate the research instrument. Since community health workers play a significant role during the COVID-19 pandemic, their feedback was taken to check the relevance of the research instrument.

Ethical considerations

Ethical approval for this study was submitted and approved by the Research Conduct and Ethics Committee (CU: RCEC/37/04/21), Center for Research, CHRIST (Deemed to be University), Bengaluru-560029, India.

Sample and Data collection

In cross-sectional studies, the aim is to estimate the prevalence of unknown parameter(s) from the target population using a random sample. So, an adequate sample size is needed to estimate the population prevalence with good precision. The following simple formula would calculate the adequate sample size [$n = \frac{Z^2P(1-P)}{d^2}$] in prevalence study [43,44]. Where n is the sample size, Z is the statistic corresponding to confidence level (most researchers present their results with a 95% confidence interval; Z = 1.96), P is expected prevalence, and d is precision (corresponding to effect size). Studies recommended selecting a precision (d) of 5% if the prevalence is between 10% and 90% [43,44]. The pilot study results yielded that 42% of the rural respondents are agreed and strongly agreed to uptake the COVID-19 vaccine. The prevalence of COVID-19 vaccine uptake is (P) 42%. Based on the above formula, the adequate sample size = 374.

In the face of the ongoing COVID-19 pandemic, online survey method has emerged as the preferred means to collect data [45]. It also works well with the respondents as they can keep their identity anonymous. Accordingly, we prepared the E-questionnaire on Survey Monkey and shared the link to the respondents through official e-mails, LinkedIn, WhatsApp, and Facebook. Conscious follow-up was done, and reminders were sent through emails and messages on social media sites.

It is not easy to calculate the response rate of an online survey because it is difficult to trace the number of people who have read the questionnaire on different social media platforms. To resolve this issue, filter questions such as age and location were used to select participants. Only respondents above 18 years of age and from rural Bengaluru were allowed to participate. We received 710 responses, out of which 12 were withdrawn by the participants; and 73 responses were removed from the sample based on base timeline and missing data calculations. The final sample size comprised of 625 respondents; however, the present study sample was more than adequate.

According to the Ministry of Electronics & Information Technology, Government of India, Bengaluru Urban occupies the fifth position in the list of total vaccination uptakes in the country. It is observed that people's perception towards the vaccination is gradually improving in Bengaluru Urban. However, many people still remain hesitant to take the COVID-19 vaccination in Bengaluru Rural and this is the reason why it was chosen as a base for this research. This area also hosts a diverse population, thus, providing an adequate representation of the robust Indian population. Further, Bengaluru is the third most populous city in India, accommodating people from different socioeconomic backgrounds [46].

Results

The data were collected between March 2021 and June 2021, at a time when India had launched its COVID-19 vaccination drive for all people above the 18 + years' group. The study sample consisted of 625 participants in the age category of 18–68 years with a mean age of 35 years. The male and female composition was 52% and 48%, respectively. Respondents had an average of four family members, with numbers ranging between 1 and 22. They all had a diverse educational background comprising of 43.8% post-graduate, 42.4% graduate, 11.8% with school-level education, and 1.9% completely uneducated. From the employment perspective, 34.2% were private employees, 12.6% government officials, 12.5% had their own business, 2.9% were retired, and 37.8% were unemployed, students and homemakers. Based on financial background analysis, 16.2% of respondents had less than INR 29,999 as monthly income, 17% earned between INR 30,000 to 49,999, 25.9% between INR 50,000–74999, 17.8% between 75,000–99,999 and 23.2% more than INR100,000.

Measurement model

As the sample was large and had uneven distribution, partial least square structure equational modeling (PLS-SEM) was used for data analysis, and SmartPLS3 to test the measurement and structural models. The measurement model was measured using the indicators, reliability, internal consistency reliability, and construct validity [47]. Indicator reliability was achieved by checking the outer loading of each indicator. In all cases, it should be greater than 0.7. The internal consistency reliability was checked using Cronbach Reliability (Cronbach's α) and Composite Reliability (CR). For both, the cut-off value should be greater than 0.7. Construct validity can be achieved by testing convergent validity and discriminant validity. Convergent validity is generally considered adequate if the average variance extracted (AVE) is greater than 0.5. Discriminant Validity can be tested using the Fornell-Larcker criterion.

Fig. 2 shows that all the indicators in this study met the thresholds and so were retained. CR, AVE and Cronbach's α values are presented in Table 1. Thus, the measurement model had both convergent validity and internal consistency. Finally, the Fornell-Larcker criterion was evaluated by comparing the construct AVE values with the shared variances between the constructs [48]. The square root of AVE was higher than the inter-constructed correlations [47], supporting the discriminant validity of the constructs, as shown in Table 1. In the second step, the significance of the path coefficient (β) between the independent and dependent constructs was tested. The path coefficients are shown in Table 2 and Fig. 2. The statistical significance level at 5% ($p < 0.05$) shows that hypotheses were accepted.

In the third step, the predictive accuracy of the model was tested using f^2 and R^2 [47]. The model's predictive accuracy was tested using effect size (f^2). R^2 was used to assess the level of the variance in the dependent variable predictable from the independent variables. Studies recommends the interpretations of f^2 values 0.02 as small effect; 0.15 as medium effect; and 0.35 as a large effect [49] and recommend the acceptable R^2 values as 0.190 weak; 0.333 moderate; and 0.670 substantial [47]. Table 2 explains the effect size for all hypotheses.

In the fourth step, the predictive relevance of the model (Q^2) was measured using the blindfolding technique. Q^2 values should ideally be larger than 0 (Q^2 greater than 0) in order to have predictive relevance. Accordingly, all Q^2 values were larger than zero suggesting that our model has considerable predictive power (see Table 2).

Hypothesis testing

Finally, the structural model was assessed. The direct relations between independent and mediators are explained below. 57% of the value of the COVID-19 vaccine was explained by the respondents' trust in the country's healthcare systems ($\beta = 0.375$; $p < 0.01$), government vaccine communication strategy ($\beta = 0.255$; $p < 0.01$), and perceived threat about the vaccine ($\beta = -0.192$; $p < 0.01$). These results support H1.1, H2.1 and H3.1. 65% of COVID-19 vaccine importance was predicted by trust in the country's healthcare systems ($\beta = 0.453$; $p < 0.01$), government

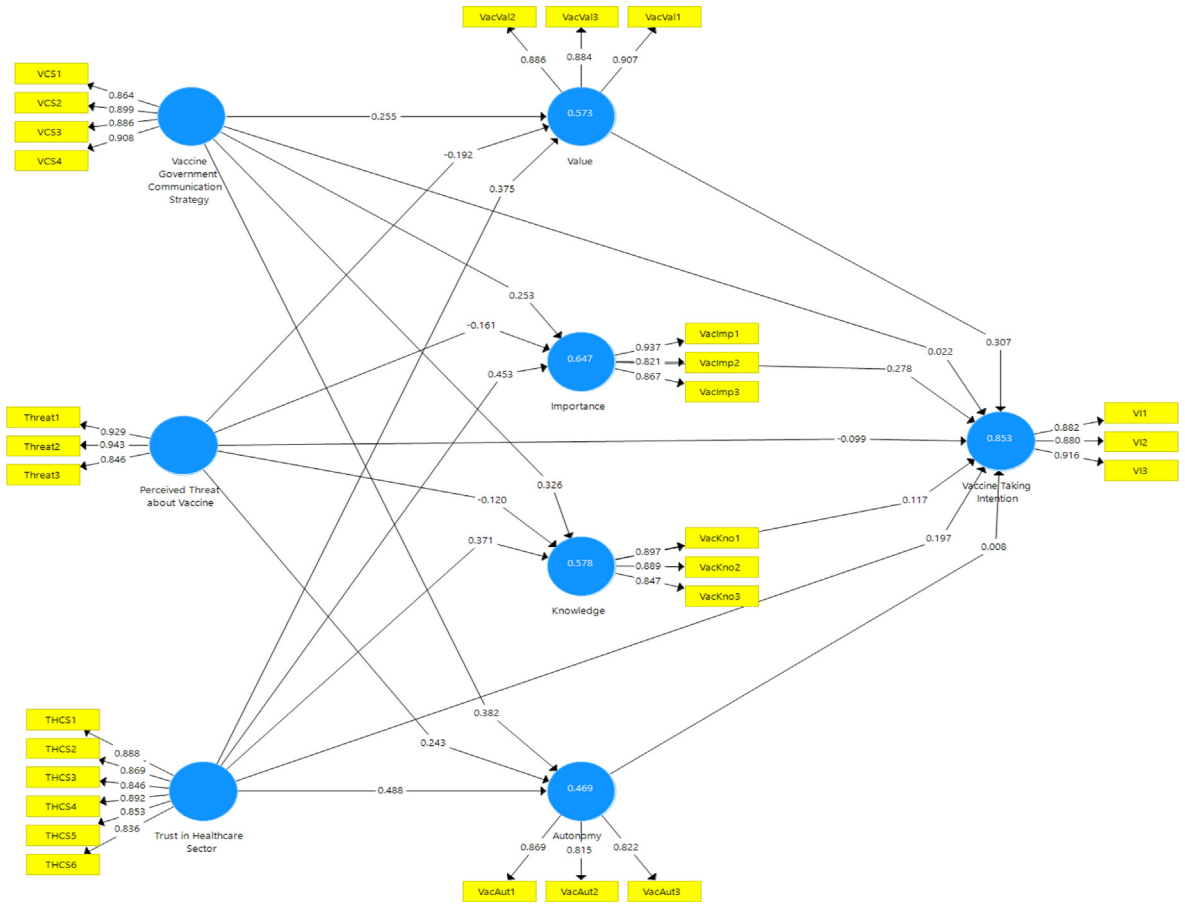

Fig. 2. Structural Model.

Table 1
Validity and Reliability Statistics.

Constructs	Convergent Validity			Discriminant Validity							
	α	CR	AVE	1	2	3	4	5	6	7	8
1. Autonomy	0.874	0.874	0.699	**0.836**							
2. Impact	0.908	0.908	0.768	0.536	**0.876**						
3. Knowledge	0.910	0.910	0.771	0.525	0.815	**0.878**					
4. Perceived Threat about Vaccine	0.932	0.933	0.822	−0.357	−0.651	−0.599	**0.907**				
5. Trust in Healthcare Sector	0.946	0.946	0.747	0.639	0.782	0.733	−0.714	**0.864**			
6. Vaccine Government Communication Strategy	0.938	0.938	0.791	0.637	0.743	0.720	−0.658	0.849	**0.889**		
7. Vaccine Uptake Intention	0.919	0.922	0.798	0.508	0.872	0.811	−0.701	0.819	0.766	**0.893**	
8. Value	0.921	0.922	0.797	0.370	0.844	0.791	−0.628	0.729	0.700	0.859	**0.893**

Note: Diagonal value shows square root of AVE

vaccine communication strategy (β = 0.253; p < 0.01), and perceived threat about the vaccine (β = -0.161; p < 0.01); these results support H1.2, H2.2 and H3.2. 58% of COVID-19 vaccine knowledge was explained by trust in the country's healthcare systems (β = 0.371; p < 0.01), government vaccine communication strategy (β = 0.326; p < 0.01), and perceived threat about the vaccine (β = -0.120; p < 0.05); these results support H1.3, H2.3 and H3.3. 47% of COVID-19 vaccine autonomy was explained by trust in the country's healthcare systems (β = 0.488; p < 0.01), government vaccine communication strategy (β = 0.382; p < 0.01), and perceived threat about the vaccine (β = 0.243; p < 0.01); these results support H1.4, H2.4 and H3.4. For predicting all four vaccine acceptance dimensions, trust in the country's healthcare systems plays a significant role with the highest beta values.

Next, the direct relations between mediators and dependent variables, and between independent and dependent variables are explained below. The value of the vaccine is significantly positively influencing the COVID-19 vaccine uptake intentions (β = 0.307; p < 0.01). Similar results are recorded between impact → vaccine uptake intention (β = 0.278; p < 0.01) and knowledge → vaccine uptake intention (β = 0.117; p < 0.05). However, the impact of autonomy on vaccine uptake intention is not significant (β = 0.008; p greater than 0.05) — these results support H7.1, H7.2 and H7.3 but not H7.4. Trust in the healthcare sector positively influences the vaccine uptake intention (β = 0.197; p < 0.01), and perceived threat about vaccine negatively influences the vaccine uptake intention (β = -0.099; p < 0.01). However, the vaccine government communication strategy does not directly

Table 2
Hypotheses Testing.

Hypotheses	Direct Effect	Indirect Effect	Total Effect	R^2	f^2	Q^2	Result
Trust in Healthcare Sector → Value	0.375**		0.375**	0.573	0.078	0.416	$H_{1.1}$ Supported
Vaccine Government Communication Strategy → Value	0.255**		0.255**		0.042		$H_{2.1}$ Supported
Perceived Threat about Vaccine → Value	−0.192**		−0.192**		0.041		$H_{3.1}$ Supported
Trust in Healthcare Sector → Impact	0.453**		0.453**	0.647	0.138	0.454	$H_{1.2}$ Supported
Vaccine Government Communication Strategy → Impact	0.253**		0.253**		0.049		$H_{2.2}$ Supported
Perceived Threat about Vaccine → Impact	−0.161**		−0.161**		0.035		$H_{3.2}$ Supported
Trust in Healthcare Sector → Knowledge	0.371**		0.371**	0.578	0.077	0.406	$H_{1.3}$ Supported
Vaccine Government Communication Strategy → Knowledge	0.326**		0.326**		0.069		$H_{2.3}$ Supported
Perceived Threat about Vaccine → Knowledge	−0.120*		−0.120*		0.016		$H_{3.3}$ Supported
Trust in Healthcare Sector → Autonomy	0.488**		0.488**	0.469	0.106	0.293	$H_{1.4}$ Supported
Vaccine Government Communication Strategy → Autonomy	0.382**		0.382**		0.075		$H_{2.4}$ Supported
Perceived Threat about Vaccine → Autonomy	0.243**		0.243**		0.053		$H_{3.4}$ Supported
Trust in Healthcare Sector → Vaccine Uptake Intention	0.197**	0.289**	0.486**	0.853	0.050	0.622	H_4 & $H_{4.1}$ Supported
Vaccine Government Communication Strategy → Vaccine Uptake Intention	0.022	0.190**	0.212**		0.001		H_5 Not Supported & $H_{5.1}$ Supported
Perceived Threat about Vaccine → Vaccine Uptake Intention	−0.099**	−0.116**	−0.214**		0.029		H_6 & $H_{6.1}$ Supported
Value → Vaccine Uptake Intention	0.307**		0.307**		0.141		$H_{7.1}$ Supported
Impact → Vaccine Uptake Intention	0.278**		0.278**		0.101		$H_{7.2}$ Supported
Knowledge → Vaccine Uptake Intention	0.117*		0.117*		0.025		$H_{7.3}$ Supported
Autonomy → Vaccine Uptake Intention	0.008		0.008		0.000		$H_{7.4}$ Not supported

**$p < 0.01$; *$p < 0.05$

impact the vaccine uptake intention (β = 0.022; p greater than 0.05); this result supports H4 and H6 but rejects H5.

The indirect relationship between trust in the healthcare sector and vaccine uptake intention via all the four vaccine acceptance scale dimensions were significant (β = 0.289; $p < 0.01$). Interestingly, the indirect relationship between the vaccine government communication strategy and vaccine uptake intention (β = 0.190; $p < 0.01$), and perceived threat about vaccine and vaccine uptake intention via all the four vaccine acceptance scale dimensions are significant (β = -0.116; $p < 0.01$); these results support H4.1, H5.1 and H6.1. As there is a direct and indirect effect between trust in the healthcare sector and the vaccine uptake intention, we can conclude that vaccine acceptance dimensions act as a partial mediator. Similarly, there is a direct and indirect effect on the perceived threat about the vaccine and vaccine uptake intention; therefore, we conclude that vaccine acceptance dimensions act as a partial mediator. However, the direct effect of the government communication strategy on vaccine uptake intention is insignificant. Only an indirect relationship exists, which forms full mediation between the government communication strategy and the vaccine uptake intention. Further, the vaccine acceptance dimensions act as a full mediator. 85% of the COVID-19 vaccine uptake intentions are explained directly and indirectly by the government communication strategy, perceived threat about the vaccine, and trust in the healthcare sector.

Discussions

To our knowledge, very few studies have been published on the COVID-19 vaccine uptake intention in the backdrop of India's rural population. The results support the hypothesis that vaccine government communication strategy and trust in the healthcare sector significantly positively affect all the four dimensions of vaccine acceptance, in concurrence with other studies [21,34–36,39,40]. The Indian government, in the year 2021–22 budget allocated the healthcare sector with significant investments, with an aim to improve the COVID-19 infrastructure and facility. Trust of people in India towards COVID-19 vaccination infrastructure is influenced by factors, such as the capability and reputation of the Indian pharmaceutical and research companies, the number and frequency of trials run they conduct, the number of lives saved and lost by the healthcare system during the pandemic time and the past history of the pharma companies [50]. The level of trust predicts people's acceptance level of the vaccination [38]. This discussion brings to light why trust in the healthcare system positively influences vaccine acceptance and vaccine uptake intentions in India.

However, the perceived threat about the vaccine is seen to negatively affect all vaccine acceptance dimensions except autonomy. Somewhat similar findings were reported for different populations [16,20,26]. One of the primary reasons for this is that citizens have access to all types of information on various social media platforms. Most people generally believe what is shared without validating the authenticity of the information [51,52]. This misinformation leads to conflicts and confusion, which then trigger skepticism and distrust in some groups and communities. Therefore, there is need for the government to develop better vaccine communication strategies to reduce the perceived fear about the vaccines.

In predicting the COVID-19 vaccine uptake intentions, vaccine acceptance dimensions, such as value, impact, and the knowledge dimension significantly positively influence vaccine uptake intentions. These results are consistent with previous studies [14,16,27]. The BeSD model makes it clear that motivational factors influence behavioural intentions. However, the autonomy dimension is not significant. In the Indian population, vaccine uptake is not mandated and is voluntary. Even though vaccines are safe and effective, many people remain hesitant to take the jab. Moreover, the difference between demand and availability of vaccines is another factor that affects an individual's intention to get vaccinated. The Indian Health Ministry has developed a CoWin digital platform for real-time monitoring of COVID-19 vaccine delivery and enabling people to register for the vaccination. While this is a good initiative taken by the government, it is not much to the rural population, primarily devoid of the Internet and smartphones. Even if they have, they are not tech-savvy enough to use the platform. The COVID-19 vaccination centres in many parts of the country have witnessed large crowds, long queues, and large congregations. Health experts have also raised concern about COVID-19 spread through vaccine centres. These factors too have contributed to vaccine hesitancy amongst the rural population.

Trust in the healthcare sector positively influences vaccine uptake intentions, and the perceived threat about the vaccine is seen to negatively affect the vaccine uptake intentions. However,

intentions are not influenced by the government communication strategy. The Indian government's COVID-19 communication strategy 2020 is mainly designed and focused on circulating timely, accurate and transparent information about the vaccine to ease apprehensive minds, ensure vaccines acceptance and encourage citizens to uptake the vaccine [53]. Experts have raised concerns over India's emergency approval of a locally produced COVID-19 vaccine even before it has completed the necessary trials. This itself has raised significant concerns over vaccine confidence and intention. In the face of this, it can be concluded that the government's communication strategy can be further improved to generate trust in the Indian healthcare system.

Limitations

The study, like other studies, has its limitations. First, the study considers 625 rural samples from India, with samples selected through convenience sampling, and respondents participating voluntarily. Hence, the generalizability of the results is restricted. The study uses the BeSD framework as a theoretical stance. However, a few researchers have used the extended theory of planned behaviour and the health belief model to predict vaccine intention. Future research can use different theoretical models, such as protection motivation theory, novel behavioural reasoning theory and self-determination theory to glean deeper insights. Next, we used a cross-sectional design with no long-term follow-up. The Indian government's communication strategy is continuously evolving, providing fodder for more research. Future research can also use data triangulation techniques to reduce response bias; mixed-method research needs to be done to understand other potential variables that influence an individual's vaccine intentions.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Appendix A. Supplementary material

Supplementary data to this article can be found online at https://doi.org/10.1016/j.jvacx.2021.100140.

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