



Factors Affecting Reluctance to Malaysian Adults' COVID-19 Vaccine Booster Doses

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Abstract

This study examines the factors that affect COVID-19 booster vaccine hesitancy among Malaysian adults, utilizing the 5C Vaccination Decision-Making Framework and a modified Theory of Planned Behavior (TPB). Malaysia's rollout of booster doses faces significant hesitancy, indicating a need to explore the underlying reasons. The research identifies key physical and psychological determinants influencing vaccine intentions, particularly emphasizing confidence, constraints, complacency, calculation, and collective responsibility, while highlighting the mediating role of attitude. Data from 100 Malaysian adults were collected through a cross-sectional web-based survey and analyzed using SPSS and structural equation modeling (SEM) with SmartPLS. The findings indicate that confidence in vaccine efficacy is a strong predictor of positive attitudes and intentions, while constraints have a moderate influence, and complacency exerts a negative impact on attitudes. Calculation does not significantly relate to attitudes, indicating that factual information has limited effects in the context of misinformation and trust issues. This research underscores the mediating influence of attitudes on the interplay between confidence, constraints, complacency, calculation, and collective responsibility concerning vaccination intentions, highlighting the importance of promoting positive vaccine perceptions. The study recommends comprehensive strategies to enhance confidence, reduce barriers, combat complacency, provide accurate information, and promote collective responsibility to improve COVID-19 booster vaccine uptake.

Keywords: 5C Vaccination, Attitude, COVID-19, Decision-Making, Theory Of Planned Behavior, Vaccination Intention, Vaccine Booster.

Introduction

The COVID-19 pandemic, caused by the SARS-CoV-2 virus, emerged in late 2019 and has resulted in a major global health crisis, impacting millions across the world. The virus, first detected in Wuhan, China, was declared a pandemic by the WHO on 11 March 2020. COVID-19 presents a wide range of symptoms, from mild to severe respiratory distress, resulting in over 774 million infections and 7 million deaths globally as of 28 January 2024. Malaysia has faced significant challenges in controlling the COVID-19 infection since 25 January 2020, undertaking various movement control orders to manage multiple waves of outbreaks. Measures to minimize human-to-human transmission have negatively impacted the physical and mental fitness of the population, social interactions, and global economic stability [1][2]. In response to the crisis, the global scientific community mobilized to develop vaccines, resulting in several

receiving emergency use authorization within one year of the outbreak and leading to widespread vaccination campaigns [3][4].

Malaysia launched its National COVID-19 Immunisation Programme (NIP) in February 2021 to achieve extensive vaccine coverage among adults, aiming for an 80% vaccination rate by February 2022 [3][4], as part of global efforts coordinated by the Special Committee on Ensuring Access to COVID-19 Vaccine Supply (JKJAV). This research highlights the personal significance of the COVID-19 pandemic's impact on Malaysia, emphasizing challenges in vaccine procurement amid global competition. It reveals vulnerabilities in the local healthcare system and the necessity for preparedness in future health crises, asserting that vaccine development and distribution are vital for societal health and sustainability. Malaysia exhibited strong initial vaccine acceptance; however, there is a concerning drop in the uptake of COVID-19 booster doses. This phenomenon indicates a complex dynamic in vaccine acceptance that is not yet fully understood. While existing literature often addresses hesitancy regarding the first two vaccine doses, there is a notable lack of studies focusing on booster dose hesitancy among Malaysian adults. This study aims to fill that gap by exploring the specific factors influencing reluctance toward booster vaccination, underlining the need to analyze perceptions of the benefits and risks associated with additional doses [5]. Understanding vaccine hesitancy is essential for public health. Malaysia's National Vaccine Development Roadmap aims to strengthen its vaccine production and distribution capabilities, crucial for future pandemic preparedness. Widespread vaccine acceptance is key to economic stability and public well-being, making this research vital for enhancing the national health infrastructure and readiness for future health challenges.

Material and Methods

As the study explores factors affecting COVID-19 booster vaccine acceptance or hesitancy, it employs a quantitative, cross-sectional web-based survey methodology. A quantitative survey methodology is used to effectively address research questions by collecting measurable data that can be statistically analyzed. The study utilizes a cross-sectional model to gather data at a single point in time, targeting adult Malaysians' behaviors and attitudes towards the COVID-19 vaccine booster dose. This approach captures current sentiments and factors contributing to vaccine hesitancy in a brief period [6][7]. Numerous studies indicate that convenience sampling, especially through online surveys, is effective for researching vaccine hesitancy. This approach enables efficient and accessible gathering of preliminary insights in pandemic settings through a web-based survey, allowing rapid dissemination and the collection of a large dataset in a short timeframe. The study analyzes individual Malaysian adults aged 18 and older who have internet access, as it is conducted through a web-based

survey. To investigate factors influencing booster hesitancy, the study will focus on individuals who have received at least one COVID-19 vaccine dose. A diverse group of participants from various demographic and socioeconomic backgrounds will be included to ensure representation and generalizability of findings across the Malaysian population through convenience sampling. Convenience sampling involves selecting participants based on their availability and willingness to participate. While it may introduce bias due to potential misrepresentation of the general population, it proves beneficial in exploratory research aimed at identifying emerging trends and relationships. Yamane's formula offers a simplified approach to determine the sample size from a population of 23 million adult Malaysians across various states, despite the challenge of targeting the entire population. The formula is expressed as follows:

$$n = \frac{N}{1+N.e^2} \quad (1)$$

Where:

- n is the sample size,
- N is the population size,
- e is the margin of error.

In understanding the trend of the adult Malaysian population, the estimated population size is approximately 23 million. For a sample size with a 10% margin of error, an ideal sample size of approximately 100 respondents is necessary. A preliminary sample size of at least 100 participants is adequate with a 10% margin of error, potentially increasing to 400 participants for a 5% margin of error [8], involving 117 and 385 respondents, respectively. The survey was conducted online via messaging apps like WhatsApp and Telegram, alongside social media platforms such as Twitter and Instagram. Promotional messages with the survey link were primarily shared among contacts within similar educational institutions, workplaces, and community groups. This research employs an online survey to assess factors influencing COVID-19 booster hesitancy in Malaysians, featuring two main sections: Demographic Information and Theoretical Constructs. The Demographic Information section collects essential background data including age, gender, ethnicity, education level, employment status, and vaccination status. This information is vital for understanding the sample's demographic characteristics and for conducting subgroup analyses within a population. The Theoretical Constructs section serves as the core of the survey, utilizing the 5C Vaccination Decision-Making Framework and a modified Theory of Planned Behaviour with validated scales. It employs five or more statements per construct, utilizing Likert-scale responses from strongly disagree to strongly agree. The selected scales are chosen for their validity and cultural relevance to the Malaysian context. The survey results will be imported into IBM SPSS Statistics and SmartPLS for detailed analysis, as these tools offer strong statistical capabilities and user-

friendly interfaces suitable for various types of survey data. The questionnaire's design is vital for the data assembly process, affecting data quality and reliability. This study's questionnaire focuses on measuring factors that contribute to COVID-19 booster vaccine hesitancy among Malaysians, utilizing validated scales and including elements from the 5C Vaccination Decision-Making Framework and other constructs. Measurement items (Table 1) in this study are tailored questions aimed at assessing COVID-19 booster vaccine hesitancy among Malaysian adults. They are based on validated scales from health behavior research, including the 5C Vaccination Decision-Making Framework, attitudes toward the booster vaccine, and intentions to receive the booster, ensuring their reliability and relevance.

Table 1. Measurement Items

Variables	Items	Sources	Scale
5C VDM Framework Confidence	- I am familiar with the term "vaccines". - I am completely confident that COVID-19 booster vaccines are safe. - COVID-19 booster vaccines are effective. - I am willing to take the COVID-19 booster vaccine even though many have not yet opted for it. - I am confident that public authorities decide in the best interest of the community about COVID-19 booster vaccines.	[9][10]	5-point Likert
Constraints	- Everyday stress hinders my ability to receive the booster vaccine. - Receiving the booster vaccine is inconvenient. - Distance to the medical facility and waiting time will hinder my ability to receive the vaccination. - I avoid booster immunization due to discomfort in visiting the doctor. - My negative experience with the first vaccination has made me hesitant to receive the booster.	[9][10]	5-point Likert
Complacency	- I believe booster vaccinations are unnecessary because they do not prevent COVID-19. - Booster vaccination is deemed unnecessary as COVID-19 is becoming less common. - The booster is deemed unnecessary due to the government's stringent COVID-19 prevention and control measures. - I believe my immune system is powerful; it will protect me from COVID-19. - The booster dose is deemed unnecessary since COVID-19 is not severe enough to warrant vaccination.	[9][10]	5-point Likert
Calculation	- Considering the COVID-19 booster vaccine involves evaluating its benefits and risks to make an informed decision. - For each vaccination, I closely consider whether it is effective or not. - For each vaccination, I need to know about this vaccine in detail.	[9][10]	5-point Likert

Variables	Items	Sources	Scale
	- I am aware of the reported side effects of the COVID-19 vaccines. - I am worried about the quality and validity of information being circulated in the media regarding the COVID-19 vaccine.		
Collective Responsibility	- Everyone needs to be vaccinated against COVID 19. - I know of friends/family members/others who have advised me to avoid taking the COVID-19 booster vaccine. - The opinions of my friends and family influence me against being vaccinated for COVID-19. - I get vaccinated because I can protect people with a weaker immune system. - I think vaccination against COVID-19 is a collective action to prevent the spread of diseases.	[9][10]	5-point Likert
Attitude towards COVID-19 booster vaccine	- I think the COVID-19 booster vaccine is likely to be effective. - I trust the COVID-19 booster vaccine. - I think the COVID-19 booster vaccine is necessary. - I think it is necessary to get a booster vaccine to protect people from COVID-19. - I think the COVID-19 booster vaccine is necessary even though I am healthy and at low risk for infection.	[11]	5-point Likert
Booster vaccination intention	- I am willing to receive the booster dose of COVID-19 vaccines. - I have received at least one COVID-19 booster vaccination. - The effectiveness of vaccination in controlling airborne viruses motivates the decision to receive the COVID-19 booster vaccination. - I have the intention to spend extra on COVID-19 booster vaccination. - I strongly recommend others to get COVID-19 booster vaccination.	[12][13]	5-point Likert

Results

A. Demographic analysis

The validity of a questionnaire is primarily indicated by its response rate, which also affects publication prospects [14]. Online questionnaires are convenient for educational research but are effective only when administered to a relevant audience. A well-defined target demographic enhances response rates and ensures the data accurately represents the population of interest. Table 2 presents a demographic analysis of study participants, detailing information such as gender, age, race, religion, occupation, education level, COVID-19 infection status, and vaccination completion. The study sample consisted of 41% males and 59% females, indicating a higher participation of women. Age-wise, 60% of participants were aged

30-45, 22% were 18-29, 14% were 46-59, and 4% were 60 and above, with the 30-45 age group representing the largest proportion. In Malaysia, the demographic composition reflects a Malay ethnicity of 80%, with Chinese and Indian at 5% each, and Bumiputera from Sabah or Sarawak or Others at 10%. Regarding religion, 90% of respondents are Islam, while Hinduism, Christianity, and Buddhism account for 2%, 5%, and 3%, respectively, highlighting Islam's predominance in the country. These statistics help understand the respondents' characteristics and their relevance to the Malaysian adult population, which is crucial for analyzing behavioral trends. This data is essential for understanding the sample population's characteristics. Table 2 presents the demographic distributions of the respondents derived from 100 usable questionnaires.

Table 2. Respondents Profile

Demographic	Category	Frequency	Percentage (%)
Gender	Male	41	41
	Female	59	59
Age	18-29	22	22
	30-45	60	60
	46-59	14	14
	60 and above	4	4
Race	Malay	80	80
	Chinese	5	5
	Indian	5	5
	Bumiputera Sabah / Sarawak / Others	10	10
Religion	Islam	90	90
	Hindu	2	2.0
	Christian	5	5.0
	Buddhist	3	3.0
Occupation	Medical Professional	9	9.0
	Non-Medical Professional	39	39
	Civil Servant (Government)	13	13
	Self-Employed	12	12
	Student	7	7.0
	Housewife/Retired/Unemployed/Others	20	20
Education	Secondary and below	3	3.0
	Undergraduate	44	44
	Postgraduate	53	53
Ever contracted COVID-19	Yes	73	73
	No	24	24
	Maybe	3	3.0
Completed primary COVID-19 vaccination	Yes	99	99
	No	-	-
	Unsure	1	1.0

B. Feelings toward their COVID-19 primary-dose vaccination

Fig. 1 illustrates participants' feelings toward their COVID-19 primary-dose vaccination experience. The distribution reflects varying emotional responses, ranging from positive to negative perceptions. Overall, the figure provides an overview of participants' vaccination

experiences and serves as a basis for understanding public acceptance and attitudes toward COVID-19 immunization.

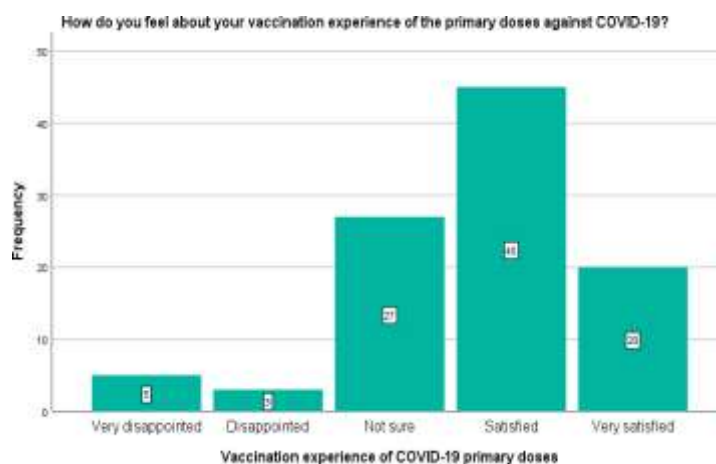


Fig. 1. Feelings towards vaccination experience of COVID-19 primary doses

C. Correlation Analysis

The correlation analysis examines relationships among perceptions, attitudes, and intentions related to COVID-19 booster vaccinations. Pearson's correlation coefficients and significance levels were calculated for pairs of constructs to assess the strength and direction of these relationships, with several significant results shown in Table 3. Referring to Table 3, a negative correlation was found between Confidence in COVID-19 vaccine boosters (CD) and Complacency (CT), with $r = -0.309$ and $p = 0.002$, indicating that as confidence in vaccine effectiveness and safety increases, complacency towards getting vaccinated decreases. Similarly, Complacency (CP) also negatively correlates with Collective Responsibility (CR), with a correlation of $r = -0.614$ and $p < 0.001$, suggesting that the collective responsibility component less influences individuals with higher confidence in the vaccine. The analysis reveals a strong positive correlation between Confidence (CD) and Attitude (AT) with $r = 0.837$ ($p < 0.001$), indicating that higher confidence in boosters correlates with a more positive vaccination attitude. Conversely, a negative correlation between Constraints (CT) and Attitude (AT) is present ($r = -0.232$, $p = 0.020$), suggesting that reducing barriers enhances favorable attitudes towards vaccination. Attitude towards the vaccine (AT) is strongly positively correlated with the Intention to receive the booster (IN), indicated by $r = 0.892$ and $p < 0.001$, suggesting that a positive attitude increases the likelihood of receiving the booster. Pearson correlation coefficients (r) quantify the strength and direction of a linear relationship between two variables, ranging from -1 to +1. A value of +1 indicates a perfect positive linear relationship, -1 a perfect negative relationship, and 0 signifies no linear relationship. The strength of the relationship between variables is classified by the absolute value of r ($|r|$): a

weak relationship is indicated by $0 \leq |r| < 0.3$, a moderate relationship by $0.3 \leq |r| < 0.5$, and a strong relationship by $0.5 \leq |r| \leq 1$.

Table 3. Correlation Analysis

CD	CT	CP	CL	CR	AT	IN
CD Pearson Correlation	1	-.309**	-.614**	.030	.360**	.837**
Sig. (2-tailed)		.002	.000	.771	.000	.000
CT Pearson Correlation	-.309**	1	.462**	.028	-.123	-.232*
Sig. (2-tailed)			.000	.779	.221	.020
CP Pearson Correlation	-.614**	.462**	1	.245*	-.162	-.669**
Sig. (2-tailed)				.014	.107	.000
CL Pearson Correlation	.030	.028	.245*	1	.461**	.077
Sig. (2-tailed)					.000	.447
CR Pearson Correlation	.360**	-.123	-.162	.461**	1	.449**
Sig. (2-tailed)						.000
AT Pearson Correlation	.837**	-.232*	-.669**	.077	.449**	1
Sig. (2-tailed)						.000
IN Pearson Correlation	.768**	-.216*	-.659**	.020	.367**	.892**
Sig. (2-tailed)						.000

*Confidence in COVID-19 vaccine boosters (CD), Complacency (CT), Complacency (CP), Collective Responsibility (CR), Calculation (CR), Attitude towards COVID-19 booster vaccine (AT), Booster vaccination intention (IN)

** Correlation is significant at the 0.01 level (2-tailed).

* Correlation is significant at the 0.05 level (2-tailed).

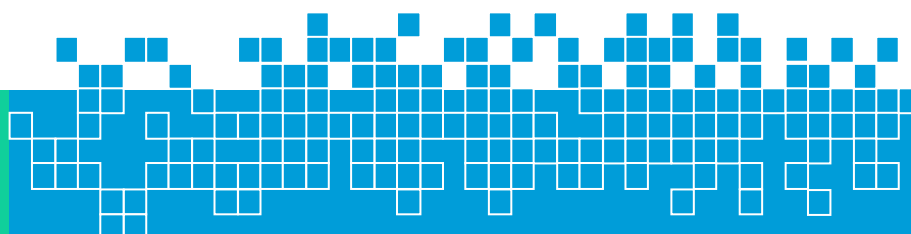
D. Construct Validity

The Fornell-Larcker Criterion is a widely used method for assessing discriminant validity in structural equation modeling. It measures how distinct a construct is from others, requiring that the square root of each construct's average variance extracted (AVE) exceeds the correlations with any other constructs in the model. The matrix provided below (Table 4) shows the Fornell-Larcker Criterion for the determinants Attitude (AT), Confidence (CD), Calculation (CL), Complacency (CP), Collective Responsibility (CR), Constraints (CT) and Intention (IN).

Table 4. Discriminant Validity – Fornell – Larcker Criterion

	AT	CD	CL	CP	CR	CT	IN
AT	0.864						
CD	0.844	0.861					
CL	0.436	0.393	0.428				
CP	-0.675	-0.630	-0.324	0.808			
CR	0.745	0.668	0.326	-0.520	0.664		
CT	-0.405	-0.478	-0.330	0.646	-0.504	0.666	
IN	0.898	0.782	0.379	-0.674	0.644	-0.390	0.836

The square root of AVE for AT (0.864) shows good discriminant validity, being greater than correlations with CD (0.844), CL (0.436), CP (-0.675), CR (0.745), and CT (-0.405). However, it is lower than the correlation with IN (0.898), suggesting a potential issue with discriminant validity between AT and IN. For other constructs, the square roots of their AVE exceed their



correlations with all other constructs, confirming good discriminant validity. Discriminant validity assessment via the Fornell-Larcker criterion shows that most constructs exhibit good validity, as the square root of AVE for each is generally higher than their correlations with other constructs. However, there are issues identified between Attitude towards Booster Vaccine (AT) and Booster Vaccination Intention (IN), indicating these constructs may not be distinct enough and may need further revision.

E. Path Coefficients

Based on Table 5, Attitude (AT) mediates the effect of Confidence (CD), Complacency (CP), Collective Responsibility (CR), and Constraints (CT) on the intention (IN) to receive the COVID-19 booster vaccine. The p-values represent the probability that the path coefficient differs significantly from zero. A p-value of less than 0.01 indicates strong evidence against the null hypothesis, marking results as highly statistically significant, while a p-value below 0.05 implies moderate evidence and is typically deemed statistically significant. A p-value under 0.10 suggests weak evidence, considered marginally significant. Conversely, a p-value of 0.10 or higher signifies insufficient evidence to reject the null hypothesis, indicating non-significant results. These thresholds aid researchers in evaluating hypotheses and assessing the reliability of their findings. For ease of reference, a structural model of the path coefficients for all the constructs is depicted in Fig. 2.

Table 5. Path Coefficients

Hypothesis	Path Coefficients (β)	Standard Deviation (STDEV)	T statistics ($ O/STDEV $)	p Values
H1 CD -> AT	0.495	0.091	5.449	0.000
H2 CT -> AT	0.234	0.076	3.077	0.002
H3 CP -> AT	-0.303	0.081	3.752	0.000
H4 CL -> AT	0.110	0.099	1.118	0.264
H5 CR -> AT	0.338	0.089	3.784	0.000
H6 CD -> IN	0.093	0.101	0.918	0.359
H7 CR -> IN	-0.066	0.081	0.811	0.417
H8 AT -> IN	0.869	0.097	8.915	0.000
H9 CD -> AT -> IN	0.430	0.085	5.066	0.000
H10 CT -> AT -> IN	0.203	0.068	2.978	0.003
H11 CP -> AT -> IN	-0.263	0.075	3.510	0.000
H12 CL -> AT -> IN	0.096	0.088	1.093	0.274
H13 CR -> AT -> IN	0.294	0.088	3.342	0.001

Fig. 2 presents the structural model with standardized path coefficients, illustrating the relationships among the latent variables examined in the study. The model highlights the direction and strength of the hypothesized paths, providing a visual representation of the structural equation modeling results and the overall framework used to test the proposed hypotheses.

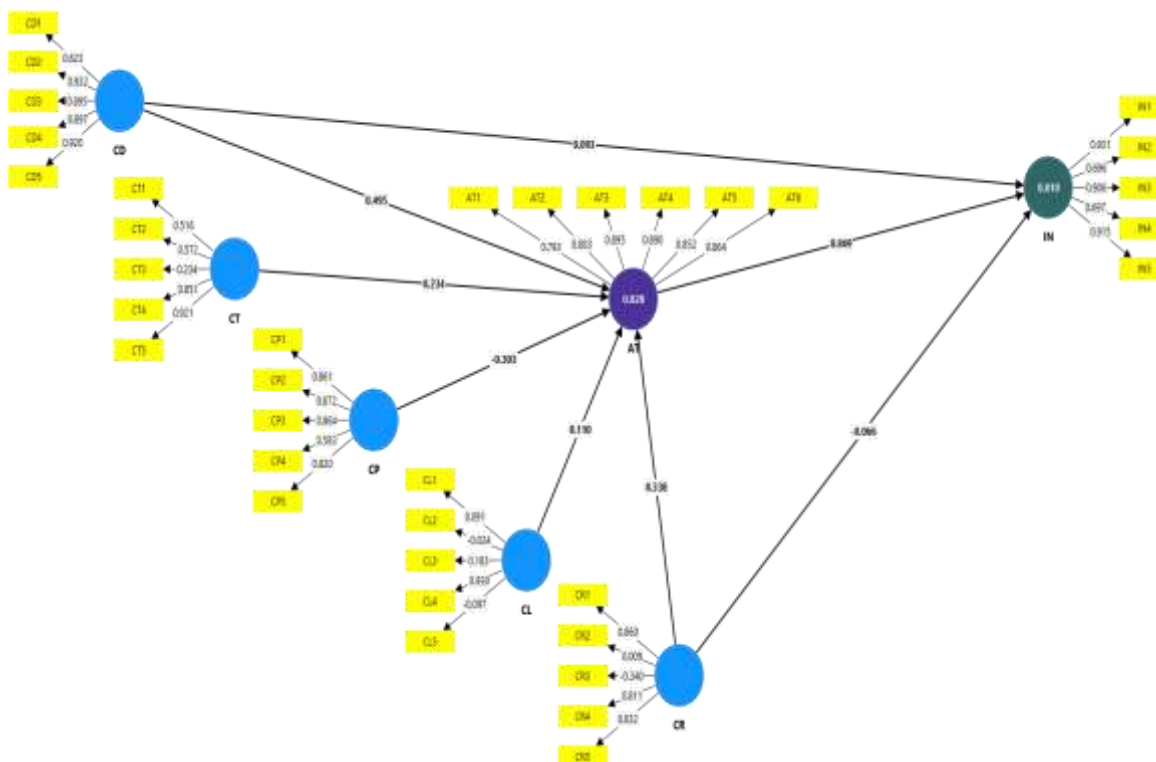


Fig. 2. The Structural Model – Path Coefficients

Discussion

Based on the tests conducted using SPSS and SmartPLS, the derived findings are presented. By utilizing structural equation modelling (SEM) through SmartPLS, the study discusses and concludes the research findings in Table 6, emphasizing the hypothesized relationships. It interprets the SEM scores in relation to existing literature on vaccine hesitancy and public health behavior.

Table 6. Summary of findings

Item	Hypothesis	Path Coefficients (β)	T statistics ($ O/STDEV $)	P-Values	Decision
H1	There is a significant relationship between confidence and attitude towards the COVID-19 booster vaccine	0.495	5.449	0.000	Accepted (Strong and positive relationship)
H2	There is a significant relationship between constraints and attitude towards the COVID-19 booster vaccine	0.234	3.077	0.002	Accepted (Moderate and positive relationship)
H3	There is a significant relationship between complacency and attitude towards the COVID-19 booster vaccine	-0.303	3.752	0.000	Accepted (Strong and negative relationship)
H4	There is a significant relationship between calculation and attitude towards the COVID-19 booster vaccine.	0.11	1.118	0.264	Not Accepted (Weak relationship)
H5	There is a significant relationship between collective responsibility	0.338	3.784	0.000	Accepted (Moderate and

Item	Hypothesis	Path Coefficients (β)	T statistics ($ O/STDEV $)	P-Values	Decision
	and attitude towards the COVID-19 booster vaccine.				positive relationship)
H6	There is a significant relationship between confidence and intention to receive the COVID-19 booster vaccine.	0.093	0.918	0.359	Not Accepted (Weak relationship)
H7	There is a significant relationship between collective responsibility and intention to receive the COVID-19 booster vaccine.	-0.066	0.811	0.417	Not Accepted (Weak relationship)
H8	There is a significant relationship between attitude towards the COVID-1S booster vaccine and intention to receive the COVID-19 booster vaccine.	0.869	8.915	0.000	Accepted (Strong and positive relationship)
H9	Attitude towards the COVID-19 booster vaccine mediates the relationship between confidence and intention to receive the COVID-19 booster vaccine.	0.430	5.066	0.000	Accepted (Strong and positive relationship)
H10	Attitude towards the COVID-19 booster vaccine mediates the relationship between constraints and intention to receive the booster vaccine.	0.203	2.978	0.001	Accepted (Moderate and positive relationship)
H11	Attitude towards the COVID-19 booster vaccine mediates the relationship between complacency and intention to receive the booster vaccine.	-0.263	3.510	0.000	Accepted (Strong and negative relationship)
H12	Attitude towards the COVID-19 booster vaccine mediates the relationship between calculation and intention to receive the booster vaccine.	0.096	1.093	0.274	Not Accepted (Weak relationship)
H13	Attitude towards the COVID-19 booster vaccine mediates the relationship between collective responsibility and intention to receive the booster vaccine.	0.294	3.342	0.001	Accepted (Moderate and positive relationship)

The hypothesis 1 indicates a strong positive correlation ($r = 0.837$, $p < 0.01$) between confidence and attitudes towards the COVID-19 booster vaccine, with a path coefficient of $\beta = 0.495$ ($p = 0.000$). This suggests that greater confidence in vaccine efficacy and safety, along with trust in public authorities, enhances the willingness to receive the booster dose. The result aligns with previous research indicating a significant positive relationship between confidence and vaccine hesitancy, suggesting that some respondents lack confidence in the COVID-19 vaccine's safety, potentially due to concerns over the rapid development process and unprecedented timeline for vaccine production [15]. The research by [16] emphasizes that trust in health authorities and vaccine information is essential for vaccine acceptance. [17] corroborate this by showing that individuals who view vaccines as safe and effective tend to

have more positive attitudes towards vaccination, highlighting the significance of confidence in increasing vaccine uptake.

The study found a moderate positive relationship between constraints and attitudes towards the COVID-19 booster vaccine, contradicting initial expectations. Preliminary results indicated a Pearson correlation coefficient of $r = -0.232$ ($p < 0.05$), but structural equation modeling (SEM) revealed a path coefficient of $\beta = 0.234$ ($p = 0.002$) for hypothesis 2. Individuals who recognize and overcome logistical and accessibility barriers may develop more positive attitudes towards vaccination. This aligns with health behavior theory, which posits that overcoming barriers can enhance self-efficacy and encourage positive health behaviors. Additionally, Gust et al. [18] demonstrated that addressing these barriers and providing clear information about vaccine access can improve attitudes towards vaccines. Literature indicates a negative relationship between constraints and vaccination attitudes, as shown by Schmid et al. [19] and Brewer et al. [20], who found that access and logistical issues often lead to negative sentiments towards vaccines. However, some individuals develop positive attitudes after overcoming barriers, while others may feel discouraged. Given the weak to moderate relationship, further research is needed to clarify the connections between constraints and hesitancy toward COVID-19 vaccine booster doses.

The hypothesis (H3, H5, H8, H9, H10, H11 and H13) are accepted in this study. The study finds a strong negative correlation ($r = -0.669$, $p < 0.01$) between complacency and attitudes towards the COVID-19 booster vaccine, with a path coefficient of $\beta = -0.303$ ($p = 0.000$). Complacency regarding COVID-19, defined as a low perceived risk of infection, leads to beliefs that vaccination is unnecessary [21]. Higher complacency levels correlate with negative attitudes towards booster shots due to beliefs in natural immunity. This aligns with previous studies indicating that individuals who underestimate their susceptibility or the benefits of vaccination are less likely to have favorable views on vaccines [22]. Huang et al. [23] also found that perceived susceptibility and severity are critical determinants of vaccine acceptance. Key findings highlight the importance of public health campaigns that effectively communicate COVID-19 risks and the benefits of booster vaccinations, particularly to populations that may underestimate these factors.

The analysis revealed a moderate positive correlation ($r = 0.449$, $p < 0.01$) between collective responsibility and attitudes towards the booster vaccine, with a path coefficient of $\beta = 0.338$ ($p = 0.000$). This indicates that individuals who feel a duty to protect others are more likely to positively view receiving the booster. Research shows that prosocial motives, such as protecting vulnerable groups and contributing to herd immunity, can significantly affect health behaviors like vaccination [24]. Furthermore, individuals who perceive a greater social

responsibility tend to have more positive attitudes toward vaccination [25]. The research by Fishbein and Ajzen [26] suggests that messages highlighting collective benefits and social responsibility can improve positive attitudes toward vaccination. Public health strategies that focus on vaccination's role in safeguarding community health and preventing disease spread may effectively promote positive attitudes and enhance vaccine uptake.

The study demonstrated a significant positive correlation ($r = 0.892$, $p < 0.01$) between attitudes towards the COVID-19 booster vaccine and the intention to receive it, with a path coefficient of $\beta = 0.869$ ($p = 0.000$). This indicates that favorable attitudes, shaped by beliefs regarding the vaccine's efficacy, safety, and benefits, are key determinants of vaccination intentions, aligning with the Theory of Planned Behaviour (TPB) which posits that attitudes influence intentions and behaviors. Numerous studies indicate that individuals with positive attitudes towards vaccines are more inclined to intend to vaccinate [27][28], as demonstrated by Mussetto et al. [29], which found a significant correlation between positive vaccination attitudes and higher vaccination intentions and behaviors.

The study of H9 indicates that confidence in COVID-19 booster vaccines significantly affects the intention to receive the booster doses, with attitude serving as a mediating factor. The path coefficient is 0.430 ($p = 0.000$), highlighting that greater confidence in vaccine safety and efficacy correlates with a stronger intention to get boosted, primarily through a positive attitude towards the vaccine. The hypothesis 10 investigates how constraints affect the intention to receive COVID-19 booster doses, with attitude towards the vaccine acting as a mediator. The findings reveal a moderate positive correlation, demonstrated by a path coefficient (β) of 0.203 and a p-value of 0.001 . The hypothesis 11 indicates that complacency negatively impacts the intention to receive COVID-19 booster doses, mediated by attitudes towards the booster vaccine. A path coefficient of -0.263 with a p-value of 0.000 shows a significant negative relationship. Higher complacency, characterized by a low perception of risk from COVID-19, results in negative attitudes towards the vaccine, subsequently leading to a reduced intention to receive booster doses. The findings of hypothesis 13 indicate a moderately positive relationship between collective responsibility and the intention to receive COVID-19 booster doses, with attitude acting as a mediator. Individuals viewing vaccination as a social duty are more inclined to hold favorable attitudes toward vaccines, thereby increasing their likelihood of getting booster doses.

Therefore, hypothesis (H4, H6, H7, and H12) are not supported in this study. The study found no significant correlation between calculation and attitudes toward the COVID-19 booster vaccine, with a Pearson correlation coefficient of $r = 0.077$ ($p < 0.05$) and a path coefficient of $\beta = 0.11$ ($p = 0.264$). This indicates that the process of weighing risks and benefits

of the booster vaccine does not notably impact attitudes towards it. Despite a strong link between confidence and attitude, the study found no direct relationship between confidence and the intention to receive the COVID-19 booster vaccine. With a path coefficient of $\beta = 0.093$ and $p = 0.359$, the results indicate that confidence enhances positive attitudes but does not directly lead to vaccination intention. Instead, confidence may influence vaccination intention through its effect on attitudes. The study revealed no significant direct relationship between collective responsibility and the intention to receive the COVID-19 booster vaccine, with a path coefficient of $\beta = -0.066$ and $p = 0.417$. Despite collective responsibility positively influencing attitudes, it does not directly impact vaccination intentions, suggesting that other personal factors may play a more critical role in the decision to vaccinate. The hypothesis examines the weak and statistically insignificant relationship ($\beta = 0.096$, $p = 0.274$) between risk-benefit calculation and the intention to receive booster doses, mediated by attitude towards the vaccine. The findings suggest that this relationship is influenced by the complexity of information available, as previous studies indicate that misinformation can adversely affect informed decision-making, underscoring the necessity for accurate information dissemination.

Conclusion

From a policymaking perspective, the findings provide actionable insights for planning and implementing vaccination programs. They highlight factors influencing vaccine acceptance and offer evidence-based recommendations to address vaccine hesitancy. The study underscores the importance of confidence and the mediating effect of attitudes, suggesting that policies should enhance trust in vaccines and health authorities through transparent communication and robust information dissemination. This study significantly contributes to various fields by enhancing the understanding of vaccine hesitancy through a strong theoretical and methodological framework. It provides practical insights for industry stakeholders to improve communication and intervention strategies, along with evidence-based recommendations for policymakers to boost vaccine uptake and public health outcomes. Ultimately, the findings are poised to inform and enhance public health strategies related to COVID-19 and other pandemics.

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Conflict of Interest

All authors declare no conflicts of interest.

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