

Psychometric evaluation of the Malay Health Belief Model for COVID-19 booster dose vaccination intention scale among Malaysians

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ABSTRACT

Introduction: The COVID-19 pandemic has highlighted the importance of vaccination, with booster doses now integral to public health strategies. However, there is a lack of validated tools to assess vaccine intention for booster doses, despite the Health Belief Model (HBM) being widely used for primary doses. This study aims to address this gap by validating a Malay version of the HBM-based COVID-19 booster dose vaccine intention scale to measure factors influencing booster vaccination decisions in Malaysia.

Materials and Methods: The study was conducted in three phases. Phase 1 involved translation, content, and face validity. The translation process employed a forward-backward method, utilising two bilingual translators and an independent back-translator. Content validity was assessed by five experts from psychology, public health, and medicine, and face validity was evaluated through a pre-test with 40 laypersons. Phase 2 used Exploratory Factor Analysis (EFA) with 160 participants to identify the tool's underlying factor structure. Phase 3 employed Confirmatory Factor Analysis (CFA) with 556 participants to assess construct validity and reliability. Internal consistency was measured using Cronbach's alpha and Composite Reliability (CR). Participants aged 18 and above were recruited via online platforms, with eligibility determined by receipt of primary doses of the COVID-19 vaccine.

Results: The translation process resulted in a 16-item Malay COVID-19 HBM-Booster Dose Intention Scale (HBM-BDIS). Phase 1 confirmed content and face validity, with the Content Validity Index (CVI) for all items exceeding 3.0, and a satisfactory Face Validity Index (FVI). EFA in Phase 2 revealed a clear factor structure with factor loadings meeting the 0.33 threshold, and internal consistency was confirmed with Cronbach's alpha of 0.82. CFA in Phase 3 confirmed the scale's construct validity, with improved fit indices after revision (CFI = 0.926, TLI = 0.909, RMSEA = 0.084). The final model showed strong internal consistency, with CR values above 0.80 for all factors.

Conclusion: The 16-item Malay COVID-19 HBM-BDIS is a valid and reliable measure for assessing COVID-19 booster

dose vaccination intention in Malaysia, providing a solid foundation for future research and public health interventions.

KEYWORDS:

COVID-19 vaccination, Booster dose, Health Belief Model, Vaccine Intention, Public Health Intervention

INTRODUCTION

The COVID-19 pandemic has underscored the importance of vaccination as a vital public health measure, yet vaccine hesitancy remains an obstacle, including in Malaysia, where sociocultural and behavioural factors shape vaccine attitudes.¹ While primary doses have generally been well-accepted², the uptake of booster doses presents unique challenge. These doses are crucial for maintaining immunity as the effectiveness of the initial vaccine wanes, yet they face resistance driven by hesitancy and misinformation.³ A meta-analysis of eight studies involving 12,995 participants revealed that while 79% intended to receive a booster dose, only 31% actually did, indicating a substantial gap in uptake.⁴ This highlights the need for increased efforts to promote booster dose uptake and underscores the importance of exploring the psychological factors that influence decisions to receive COVID-19 booster doses.

A significant gap in the literature exists regarding the development of psychometrically sound tools to assess vaccine intention in the specific context of booster doses. While the Health Belief Model (HBM) has been widely applied to primary vaccine doses⁵, there is a paucity of validated tools designed to capture the unique psychological and behavioural factors influencing decisions about booster doses. Several HBM-based questionnaires have been developed to assess COVID-19 vaccination intention, but most focus solely on the primary dose.

Ren et al. developed the COVID-19 Vaccine Beliefs Scale, which demonstrated strong reliability and validity in assessing vaccine beliefs within the Chinese population.⁶ However, its applicability to Malaysia is uncertain due to

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cultural differences. Similarly, Huynh et al. developed an HBM-based 15-item scale to assess vaccine intention among Vietnamese adults with chronic conditions, focusing on perceived threat, benefits, barriers, and cues to action.⁷ Although the scale showed good reliability and effectively identified vaccine intention in high-risk groups, its relevance to the broader Malaysian population, especially regarding booster doses, is limited. In Malaysia, Wong et al. used a 15-item HBM-derived questionnaire to identify predictors of COVID-19 vaccine intention, finding perceived susceptibility, severity, benefits, and cues to action to be significant determinants.⁸ However, their study primarily focused on the primary dose, and no validity information for the tool was provided.

These studies underscore the need for context-specific, psychometrically sound tools to assess vaccine intentions for COVID-19 booster doses in Malaysia. Developing such a tool would deepen our understanding of vaccine behaviours and inform targeted public health interventions to address hesitancy and improve vaccine uptake.

Therefore, the present study seeks to provide a comprehensive development and validation of a contextually appropriate tool for Malaysians, in the specific context of COVID-19 booster dose vaccination intention. The results will provide empirical support for the scale's utilisation in public health interventions aimed at increasing vaccine uptake.

MATERIALS AND METHODS

The study was conducted in three distinct phases. Phase 1 focused on the translation, content validity, and face validity of the HBM questionnaire. Phase 2 involved Exploratory Factor Analysis (EFA) to identify the underlying factor structure of the questionnaire, while Phase 3 employed Confirmatory Factor Analysis (CFA) to assess the construct validity of the instrument.

Phase 1: Translation, Content Validity, and Face Validity

In Phase 1, a 15-item HBM questionnaire⁸ was translated into Bahasa Malaysia using the forward-backward translation method to ensure both linguistic and conceptual equivalence. Two bilingual translators, one with expertise in psychological medicine and the other a professional translator, performed the forward translation. An independent translator conducted the back translation, and discrepancies were resolved by a panel of researchers and translators to ensure consistency.

To assess content validity, a panel of five experts in psychology, public health, and medicine evaluated the clarity, simplicity, ambiguity, and relevance of each item. The feedback provided was incorporated into the final version of the questionnaire, and the Content Validity Index (CVI) was used to quantify the results.⁹ Face validity was evaluated through a pre-test involving 40 laypersons who assessed the clarity and relevance of the items using the Face Validity Index (FVI).

Phase 2: Exploratory Factor Analysis and Internal Reliability

Phase 2 involved a cross-sectional study design, with data collected from 160 participants using online platforms, including WhatsApp, Facebook, Twitter, Telegram, Instagram, and email. Inclusion criteria required participants to be Malaysian citizens aged 18 years and above who had received the first and second doses of the COVID-19 vaccine. Individuals who were illiterate or had been advised by medical professionals not to receive the COVID-19 booster dose were excluded.

Participants completed the questionnaire independently on Google Forms after providing informed consent. Data were analysed using RStudio statistical software. Descriptive statistics summarized the sociodemographic characteristics. The EFA was conducted to explore the underlying factor structure of the HBM questionnaire.⁸ The Kaiser-Meyer-Olkin (KMO) Measure of Sampling Adequacy was employed to evaluate the adequacy of the sample for factor analysis, with a threshold value of >0.50 considered acceptable.¹⁰ Additionally, Bartlett's Test of Sphericity was performed to test the hypothesis that the correlation matrix is an identity matrix, with a p-value <0.05 indicating that the data are suitable for factor analysis.¹¹ Factor retention was determined using Cattell's Scree Test and Horn's Parallel Analysis, and factor loadings ≥ 0.32 were considered significant.¹² Cronbach's alpha was used to evaluate the internal consistency of the constructs, with a value ≥ 0.60 indicating acceptable reliability.¹³

Phase 3: Confirmatory Factor Analysis and Composite Reliability

In Phase 3, a cross-sectional survey was conducted with 556 participants recruited via online platforms. Stratified quota sampling was employed to ensure representation from all 14 states in Malaysia, based on population proportions reported by the Department of Statistics Malaysia.¹⁴ Field enumerators from each state recruited participants.

Descriptive statistics were used to summarise the demographic data, with age reported as the mean and standard deviation, and other sociodemographic variables presented as percentages. CFA was performed to assess the factor structure, with parameters for model specification set to include factor loadings >0.50 and inter-factor correlations <0.85 , in accordance with established guidelines for structural equation modelling.¹⁵⁻¹⁶ Model fit was evaluated using the Comparative Fit Index (CFI >0.95), Tucker-Lewis Index (TLI >0.95), and Root Mean Square Error of Approximation (RMSEA <0.07), based on the recommendations of Hu and Bentler.¹⁷ The internal consistency of the constructs was assessed through Composite Reliability (CR), with a CR value ≥ 0.60 considered indicative of adequate reliability for each construct.¹⁸

RESULTS

The 15-item HBM questionnaire⁸ underwent forward and backward translation to ensure linguistic and conceptual equivalence. Forward translation was done by an expert in psychological medicine and a professional translator, while

Table I: Demographic information of the participants for Phase 1: Exploratory Factor Analysis (n = 160)

Criteria	%
Gender	
Female	73.1
Male	26.9
Race	
Malay	93.1
Chinese	04.4
Indian	00.6
Other Races	01.9
Employment Status	
Students	20.0
Unemployed	06.2
Employed	71.9
Retirees	01.9
Level of Education	
High School Diploma	03.1
College diploma	34.4
Bachelor's Degree	45.6
Master / Doctorate	16.9
Marital Status	
Single	48.1
Married	51.3
Divorced/Widowed	00.6

Table II: Factor loadings and internal consistency of the 19-item Malay COVID-19 HBM-Booster Dose Intention Scale from Exploratory Factor Analysis

No.	Item	Factor Loading	Cronbach's Alpha (a)
Perceived Benefits			
1.	Booster vaccination is a good idea because it makes me feel less worried about catching COVID-19. (Item 7)	0.94	0.93
2.	The COVID-19 booster vaccine can protect my family from COVID-19. (Item 20)	0.85	
3.	Booster vaccination decreases my chance of experiencing complications from COVID-19. (Item 9)	0.83	
4.	Booster vaccination decreases my chance of getting COVID-19. (Item 8)	0.81	
5.	I believe that the booster dose can control the spread of the COVID-19 pandemic. (Item 18)	0.78	
Perceived Barriers			
6.	I am concern about the safety of the COVID-19 booster dose vaccination. (Item 12)	0.90	0.90
7.	I am concern about the efficacy of the COVID-19 booster dose vaccination. (Item 11)	0.87	
8.	Worry the possible side effects of COVID-19 booster dose. (Item 10)	0.75	
9.	I am concern of the affordability (high cost) of getting the COVID-19 booster dose. (Item 13)	0.73	
Perceived Threat			
10.	I am worried about the likelihood of getting COVID-19. (Item 2)	0.87	0.83
11.	I am afraid of getting COVID-19. (Item 6)	0.79	
12.	My chance of getting COVID-19 in the next few months is great. (Item 1)	0.55	
13.	Getting COVID-19 is currently a possibility for me. (Item 3)	0.55	
14.	I will be very sick if I get COVID-19. (Item 5)	0.46	
15.	Complications from COVID-19 are serious. (Item 4)	0.46	
Cues to Action			
16.	I believe that the booster dose is a planned conspiracy. (Item 17)	0.76	0.77
17.	I will only take the COVID-19 booster dose if the vaccine is taken by many in the public. (Item 16)	0.52	
18.	I am concerned if the new COVID-19 booster dose vaccine is halal. (Item 14)	0.47	
19.	I believe that the booster dose is a futile effort in protecting me from COVID-19. (Item 19)	0.42	

Table III: Demographic information of the participants for Confirmatory Factor Analysis (n = 556)

Criteria	%
Gender	
Female	61.6
Male	38.4
Race	
Malay	69.5
Chinese	08.1
Indian	12.5
Other Races	09.9
Level of Education	
Primary School	0.3
Secondary School	09.8
College Diploma	18.5
Bachelor's Degree	48.6
Master's / Doctorate	02.9
Employment Status	
Students	56.1
Unemployed	06.1
Employed	35.5
Retirees	02.2
Marital Status	
Single	69.3
Married	27.3
Divorced	00.7
Widowed	00.4
Front liner Status	
Not Applicable	92.5
Healthcare Workers	07.0
Police / Military	00.5

Table IV: Factor loadings and composite reliability of the 16-item Malay COVID-19 HBM-Booster Dose Intention Scale from Confirmatory Factor Analysis

No.	Item	Factor Loading	Composite Reliability (CR)
Perceived Benefits			
1.	Booster vaccination is a good idea because it makes me feel less worried about catching COVID-19. (Item 7)	0.92	0.88
2.	Booster vaccination decreases my chance of getting COVID-19. (Item 8)	0.89	
3.	Booster vaccination decreases my chance of experiencing complications from COVID-19. (Item 9)	0.89	
4.	The COVID-19 booster vaccine can protect my family from COVID-19. (Item 20)	0.81	
5.	I believe that the booster dose can control the spread of the COVID-19 pandemic. (Item 18)	0.76	
Perceived Barriers			
6.	I am concerned about the safety of the COVID-19 booster dose vaccine. (Item 12)	0.88	0.89
7.	I am concerned about the efficacy of the COVID-19 booster dose vaccine. (Item 11)	0.86	
8.	Worry about the possible side effects of COVID-19 booster dose vaccine. (Item 10)	0.66	
9.	I am concerned about the affordability (high cost) of getting the COVID-19 booster dose vaccine. (Item 13)	0.60	
Perceived Threat			
10.	I am afraid of getting COVID-19. (Item 6)	0.81	0.84
11.	I am worried about the likelihood of getting COVID-19. (Item 2)	0.79	
12.	Complications from COVID-19 are serious. (Item 4)	0.76	
13.	I will be very sick if I get COVID-19. (Item 5)	0.60	
Cues to Action			
14.	I believe that the booster dose is a planned conspiracy. (Item 17)	0.64	0.82
15.	I am concerned if the new COVID-19 booster dose vaccine is halal. (Item 14)	0.66	
16.	I believe that the booster dose is a futile effort in protecting me from COVID-19. (Item 19)	0.60	

backward translation was performed independently by another bilingual translator. The translated version, which was subsequently labelled as the 15-item Malay HBM-Booster, was harmonised by the translators and study authors.

Phase 1: Content and Face Validity

Content validity was assessed by a panel of five experts in psychology, medicine, and public health, using the CVI. All 15 original items received CVI scores above 3.0, indicating strong agreement on their relevance. The panel recommended adding five new items to broaden the scope of the questionnaire. These included Item 17, "I believe that

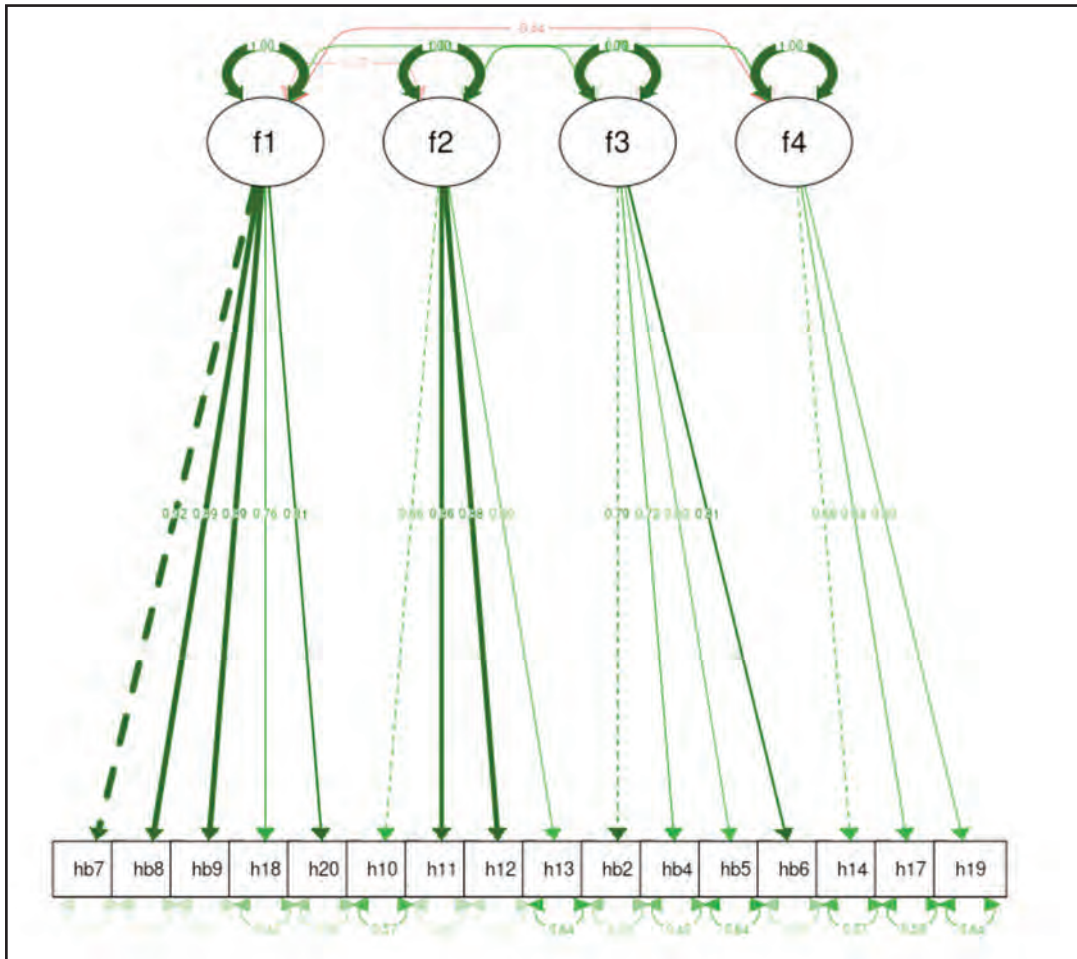


Fig. 1: Confirmatory Factor Analysis of 16-item Malay COVID-19 HBM-Booster Dose Intention Scale (n = 556)

booster doses are a planned conspiracy," Item 18, "I believe that booster doses are capable of controlling the spread of the COVID-19 pandemic," Item 19, "I believe that booster doses are a futile effort in protecting me from COVID-19," and Item 20, "The COVID-19 booster vaccine can protect my family from COVID-19." Additionally, Item 8 was split into two separate questions for clarity. The revised 20-item questionnaire was subsequently labelled as the 20-item Malay HBM-Booster Dose.

Face validity was evaluated with 40 participants (mean age=30.52 years, SD=5.22). The sample was 55% female and 45% male, all of whom were Malay. The FVI for each item showed scores above 3.0, confirming that the questionnaire was comprehensible and suitable for the target population.

Phase 2: Exploratory Factor Analysis

The demographic characteristics of the participants in Phase 2 included 160 participants (mean age = 31.3 years, SD = 8.9 years), with additional details provided in Table I. EFA was conducted on the 20-item Malay HBM-Booster Dose using oblique factor rotation. Preliminary analyses, including inter-item correlation checks, revealed several correlations above 0.30, confirming the suitability of the data for factor analysis. Item 15, with a correlation below 0.30, was excluded from further analysis, leaving 19 items for the subsequent EFA.

The Kaiser-Meyer-Olkin Measure of Sampling Adequacy (KMO=0.85) and Bartlett's Test of Sphericity ($p < .001$) confirmed the suitability of the dataset for factor analysis. The retention of factors was determined using multiple criteria, including Cattell's Scree Plot, Horn's Parallel Analysis, factor loadings exceeding 0.33, and the interpretability of the extracted factors. The EFA yielded a well-defined factor structure for the 19-item Malay HBM-Booster, with factor loadings summarised in Table II. Internal consistency was evaluated using Cronbach's alpha, with an overall value of 0.82 indicating good reliability. The individual factors had alpha values of 0.93, 0.90, 0.83, and 0.77, further supporting the reliability of the tool.

Phase 3: Confirmatory Factor Analysis (CFA)

Phase 3 involved a CFA of the pre-finalised 19-item Malay HBM tool to assess construct validity. This phase involved 556 participants (mean age = 29.4 years, SD = 12.0 years), with demographic details provided in Table III. The initial CFA model showed poor fit, with several items (Item 1, Item 3, and Item 16) exhibiting low factor loadings below the 0.60 threshold. The model's fit indices were $\chi^2=871.472$, CFI=0.873, TLI=0.852, RMSEA=0.095, and BIC=28,961.231, all suggesting inadequate model fit.

Consequently, Items 1, 3, and 16 were removed, resulting in a revised 16-item model. This revised model demonstrated significant improvements in fit indices: $\chi^2=475.165$, CFI=0.926, TLI=0.909, RMSEA=0.084, and BIC=23,889.076, indicating a good fit to the data. In the structural model, latent factors were represented by large circles, and measured variables by rectangles, with statistically significant parameter estimates ($p<0.05$). Three notable correlations were observed between the latent factors: $r=0.74$ between Factor 1 (f1) and Factor 3 (f3), $r=-0.49$ between Factor 1 (f1) and Factor 4 (f4), and $r=0.572$ between Factor 4 (f4) and Factor 2 (f2). The results of the CFA are illustrated in Figure 1. The internal consistency of the revised 16-item model was evaluated using CR. The overall CR was 0.86, and the individual factors showed CR values of 0.88, 0.89, 0.84, and 0.82, demonstrating strong reliability across the tool. The factor loadings and construct reliability for the 16-item model are summarised in Table IV.

DISCUSSION

The validation of the Malay version of the Health Belief Model COVID-19 booster dose vaccine intention scale (HBM-BDIS) was carried out in three phases to ensure its linguistic, content, and construct validity. In Phase 1, the translation and pre-testing procedures confirmed that the Malay HBM-BDIS was suitable for the Malaysian context, with content and face validity scores surpassing the recommended thresholds. Furthermore, EFA and CFA demonstrated a clear structure, highlighting the tool's reliability in measuring vaccination intention according to the HBM constructs. These results support the construct validity and internal consistency of the final 16-item Malay HBM-Booster Dose model, confirming its readiness for future research and practical use. Ren et al. developed and validated a reliable and valid HBM-based scale to assess COVID-19 vaccine beliefs in China, highlighting the need for cultural adaptation in vaccine belief measures.⁶ However, their study was limited to the Chinese population, and its applicability to Malaysia, with its distinct sociocultural context, remains unclear. The present study addresses this gap by providing a validated tool for assessing vaccine intentions in Malaysia, where sociocultural factors significantly influence vaccine attitudes.¹

Huynh et al. developed an HBM-based scale to assess vaccine intention among Vietnamese adults with chronic conditions, providing insights into vaccine hesitancy in high-risk groups.⁷ However, their tool's applicability to the broader Malaysian population is limited due to its lack of cross-cultural focus. The present study addresses this by ensuring the tool's relevance across diverse demographic groups in Malaysia, including those with and without pre-existing health conditions.

Wong et al. applied the HBM to assess COVID-19 vaccine intention in Malaysia, identifying key predictors such as perceived susceptibility, severity, and benefits.⁸ However, the study did not develop and validate a comprehensive scale specifically targeting booster dose vaccine intention, which limits its applicability in future research. The current study addresses this gap by offering a psychometrically validated,

context-specific scale for booster doses, which can be utilised in subsequent public health interventions and studies targeting Malaysian adults.

Despite the robustness of the present study, some limitations must be acknowledged. One limitation is the focus on the Malaysian adult population, which may restrict the generalizability of the findings to other demographic groups, such as children and elderly individuals. Future studies should consider expanding the scope to include these populations for a more comprehensive understanding of vaccine intentions across different demographic groups. Another limitation is the cross-sectional design of this study, which prevents the examination of changes in vaccine intention over time. Longitudinal studies could provide further insights into how attitudes toward booster doses evolve and inform ongoing vaccination strategies.

Moreover, while the tool has been validated in the Malaysian context, its applicability in other Southeast Asian countries with similar sociocultural contexts remains to be explored. Future research should test the scale's applicability and psychometric properties in these settings to ensure broader utility.

CONCLUSION

In conclusion, the 16-item Malay COVID-19 HBM-Booster Dose Intention Scale (HBM-BDIS) is a valid and reliable measure for assessing vaccination intention among Malaysian adults, particularly regarding booster doses. This study addresses key gaps in the literature by providing a culturally appropriate, psychometrically sound instrument, laying a strong foundation for future research and public health interventions.

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