ORIGINAL RESEARCH

Validity and Reliability Assessment of Attitude Scales for Hepatitis B Vaccination Among Parents in Ho Chi Minh City, Vietnam

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Background: Attitudes and beliefs could be associated with the low number of vaccinations in low- to middle-income countries such as Vietnam. This study aims to describe ways to develop and assess the attitudes towards Hepatitis B vaccination.

Methods: A mixed-method study was carried out between April 2015 and July 2017. Qualitative data were gathered via semi-structured interviews and focus group discussions. The data were then analyzed thematically into four domains of the Health Belief Model (HBM) in order to design the structured questionnaire. The quantitative strand was followed by the evaluation of the reliability and the construct validity, for which data were obtained after interviewing 768 parents whose children aged from 12 to 24 months, who were receiving the vaccines as part of the Expanded Programme on Immunization (EPI) schedules at the Commune Health Centers.

Results: The findings showed the content validity index value of 13 items ranged from 0.86 to 1.00. The factor analyses showed that 11 items remained in the final questionnaire after deleting 2 problematic items due to no relation to the total scales and revealed four factors (perceived susceptibility, perceived severity, perceived benefits, perceived barriers) that jointly accounted for 62.1% of the observed variances. All four factors have good internal consistency with a total Cronbach's alpha of 0.735. A confirmatory factor analysis demonstrated the proposed factor model which fits well in four domains of HBM.

Conclusion: Attitude scales for Hepatitis B vaccination based on HBM have been developed. This has confirmed to be a valid and reliable instrument that might be useful in assessing parents' attitudes regarding Hepatitis B vaccination and may be used to promote interventions within the increasing vaccination coverage for Vietnamese children.

Keywords: Hepatitis B, vaccination, children, reliability, Health Belief Model

Background

The World Health Organization (WHO) reported that approximately 257 million people around the world have chronic Hepatitis B (with Hepatitis B surface antigen-positive), and 887,000 deaths associated with cirrhosis and hepatocellular carcinoma occurred in 2015.[1] Hepatitis B infection is considered one of the major health problems in Vietnam, with 8.4 million people having an HBV infection resulting in 23,300 HBV-related deaths in 2005.[2] The high rate of HBsAg in children (9.3% to 14.1%), suggests that the main transmission channel is from mother to infant (MTCT).[3] The risk of chronic Hepatitis B infection directly related to age, whereby 80–90% of children infected at birth will also become infected with chronic

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Hepatitis B, while the probability will be only 5%–10% if they are infected occurs after 5-years of age.[4] The vaccine is a key factor to HBV protection, with 98–100% protection from contracting Hepatitis B when a child is vaccinated.[1] Presently, the Hepatitis B vaccine is available and free of charge for Vietnamese children under 12 months of age on the Expanded Program on Immunization (EPI). However, the previous studies found that the percentage of Hepatitis B birth dose vaccinations were still low, at only 46.6% and 62.8%.[5,6] Also, the birth dose coverage declined to 55% in 2013 and 2014 by the Adverse Events Following Immunization (AEFI). Several AEFIs occurred involving both the hepatitis B monovalent vaccine used for the birth dose and the pentavalent vaccine used for the 3-dose series in 2013.[7] Nevertheless, the importance of the Hepatitis B birth dose vaccine, followed by three additional doses of the pentavalent vaccine (including Diphtheria, Pertussis, Tetanus, Hepatitis B, Hib) at 2, 3 and 4 months, is still important because it will protect from vertical (mother to child at birth) and horizontal transmission during early childhood. Little is known about Hepatitis B vaccination acceptance among parents, on which this study could guide future interventions.[8] To explain the differences in Hepatitis B vaccination behavior, such as unimmunized or delayed or timely immunized children, the Health Belief Model (HBM) is used as a social cognition model and includes factors that may support determining health-related behaviors and the probability of behavior change. According to HBM, in order to accept the vaccination, people must believe that: (i) they have a probability of contracting HBV (perceived susceptibility), (ii) HBV infection would have a negative influence on their lives (perceived severity), which is a concept of perceived threat including combination susceptibility and severity, (iii) The likelihood of a positive result from Hepatitis B vaccination (perceived benefits), and (iv) barriers related to inconvenience of being vaccinated or side effects, in decision-making (perceived barriers).[9] Previous studies have made standardized measures of HBM constructs but most of the target groups were high-risk groups (men having sex with men, and immigrant groups) and groups with specific illnesses (chronic Hepatitis B infection and HBV carriers), as highlighted in Ma GX's study with HBV vaccination behavior among Chinese and Vietnamese immigrants, and Rhodes S.D's study for men having sex with men,[10,11] Bigham's study assessed the Hepatitis B immunization behavior of British Columbian mothers, however, this study used a questionnaire of the Immunization Health Belief Model scale with the target group being university students immunized and not immunized for measles,[12] the Kim Y.O's study assessed attitude and HBV vaccination behavior of Korean immigrants that used the instrument in Bates et al which found factors related to pediatric health service use,[13,14] Smith P.J. evaluated parental delay or refusal to vaccinate children aged 24 months of age,[15] and recent research was performed by Hae Won Kim, assessing the HBM scales toward Human Papilloma Virus (HPV) vaccination.[13] All have been shown that the HBM was a good fit in interpreting the vaccination behavior (All Cronbach's alpha >0.70). However, there were no reliable and valid instruments to measure the attitudes of parents towards the Hepatitis B vaccination, especially when the coverage of vaccination seriously declined by the Adverse Events Following Immunization. This study aims to develop an attitude measurement instrument for parents with reference to Hepatitis B vaccination in Ho Chi Minh City, based on HBM, in order to conduct interventions resulting in increasing vaccination coverage for children.
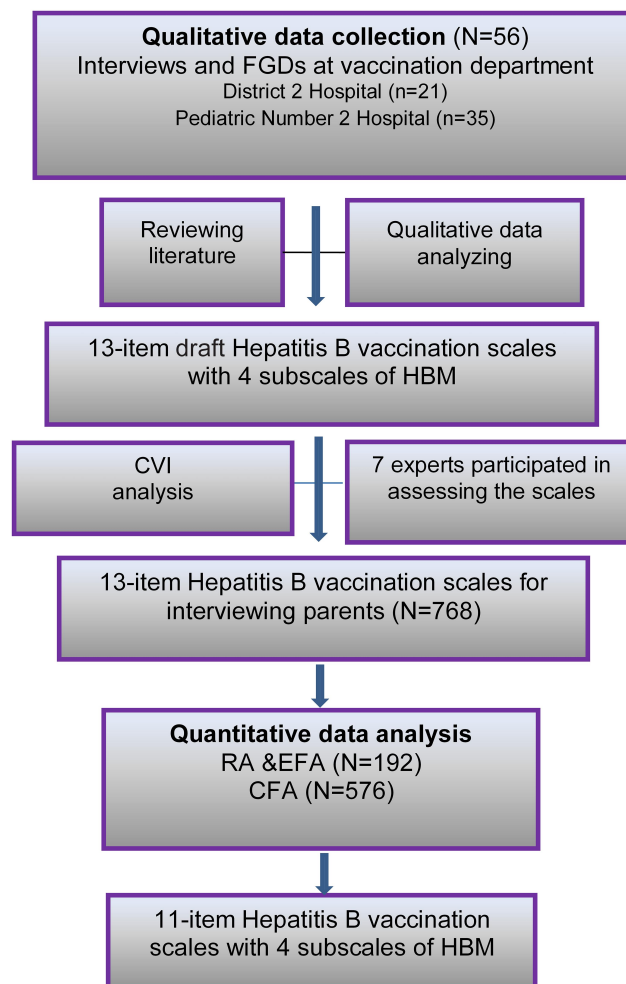
Methods
Design and Context
A total of 824 participants including 56 parents were included in the qualitative strand (N=56) and 768 in the quantitative strand (N=768), performed between April 2015 and July 2017 (Figure 1). A mixed-methods study was performed with the context being that the coverage of the Hepatitis B vaccine was low by AEFIs in 2013. There was a dramatic decline in the coverage of the birth dose HBV being administered to newborn babies (76% to 56%), followed by a decrease in the coverage of three-dose vaccine (97% to 59%) in 2012–2013, which led to a reduction in parents' belief in vaccination.[16]

Qualitative Strand to Find the Insight Key Words for HBM in the Vietnamese Context
A purposeful sampling strategy was carried out on 56 parents whose children were receiving vaccines in the EPI at two immunization centers in Ho Chi Minh City. The participants were invited to an interview or focus group discussion towards Hepatitis B vaccination. To understand insight into the context of parents' decisions to immunize, the semi-structured questionnaire was

Figure 1 Mixed methods design: Qualitative (N= 56) and quantitative (N=768) strands with data collection and analysis procedures.
Abbreviations: FGDs, Focus Group Discussions; HBM, Health Belief Model; CVI, Content Validity Index; RA, Reliability Analysis; EFA, Exploratory Factor Analysis; CFA, Confirmatory Factor Analysis.

classified based on four domains of the HBM concepts: (i) Perceived susceptibility to HBV infection including the item: Who can get HBV? (ii) Perceived severity of HBV infection including the item: How dangerous is HBV? (iii) Perceived benefits including the item: What do you know about the benefits of receiving the Hepatitis B vaccination? (iv) Barriers of vaccination including the items: Which factors make it difficult for you to obtain an HBV vaccination for your child? and, "What are the barriers influencing your decision to get your child vaccinated". Data that was collected from the transcripts were coded using Nvivo10, which was used to record our theme, and the extracted codes were used to design the instrument. After that, items of the scale were obtained by reviewing the literature on hepatitis B vaccination and investigating HBM scales. The resources of reviewing comprehensive data included

Pubmed and Google scholar. Some of the keywords used for the search were including Hepatitis B, validity, vaccination, HBM scales, reliability, and Health Belief Model. A process of the adaptation of HBM scales of Champion[17,18] and the HBM scales toward immunization of Bigham[12] were selected, primarily, for developing our scale. Then, analyses of the qualitative research regarding parents' perception about Hepatitis B disease and vaccine, and barriers causing a refusal or delay in HBV vaccination for their children were described in our previous study.[19] The keyword findings in this qualitative strand assisted by contributing valuable content to our study's scale that matches HBM with the design and assessment of the questionnaire in the quantitative strand. The mixed-methods study was considered to ensure the validity and accuracy of our study results (Figure 1). Finally, 13-item draft scales with 4 subscales were created after combining the literature and the findings in the qualitative research obtained using the HBM scales.[19,20]

Adaptation Procedures

In the next stage, the 13-item draft scales were sent to seven experts specializing in multidisciplinary areas relevant to the study, who were the leaders of the fields such as infectious diseases (2 persons), epidemiologists (2 persons), and community medicine (3 persons). They were asked to rate the clarity and full content of the items using a four-point Likert scale ranged from 1 point (cannot be used, not relevant) to 4 points (very relevant). Additionally, the experts were also invited to suggest modifications to improve the content of items, if needed, which is to ensure the content validity of the questionnaire. According to the findings, no items were removed from the scale, most experts agreed with the subject "I" and removed the words "believed that" to form simple questions but still ensures the clarity of the questionnaire. However, some items needed to change such as the terms "risk" (item 1), and "need to get Hepatitis B vaccination" (item 7) should also include the words "high risk", and "need to get Hepatitis B vaccination on schedule", respectively, to ensure comprehension of the participants. Other items with some grammatical and spelling errors were corrected. After modifying words and sentences, the final version was achieved.

Quantitative Strand

A cross-sectional study was conducted with a simple random sample of 768 parents whose children were receiving

the vaccination in the Vietnam EPI for children from 12–24 months at 16 CHCs in Ho Chi Minh City, including delaying or refusing the Hepatitis B vaccine or timely immunized children. All were interviewed with a structured questionnaire that consisted of the demographic characteristics, and 13- item attitude scales focused on the Hepatitis B vaccination.

Method of Analysis

Data was analyzed by using STATA software 13.0. We used frequencies and percentages to describe the demographics of participants. According to the concurrence of experts, the content validity of items were confirmed using the content validity index for items (CVI). The CVI was calculated as the number of experts giving rating 3 or 4 to an item divided by the total number of experts. Because there were more than five experts in the expert panel, the CVI must have achieved 0.83 or more.[21] The 13-item attitude scales included perceived susceptibility (2 items), perceived severity (3 items), perceived benefits (3 items), perceived barriers (5 items). Each item was evaluated on a 5-point Likert format ranged from 1 (strongly agree) to 5 (strongly disagree). Data of the 768 participants were divided randomly into two samples. For the first sample, split into a quarter sample (N=192), consistency reliability analysis (CRA), an exploratory factor analysis (EFA) was performed. Cronbach's alpha was determined for estimating the internal consistency of the scales, a value of Cronbach's alpha ≥0.7 was considered acceptable.[22] Kaiser-Meyer-Olkin (KMO) measure of sampling adequation and Bartlett's test of sphericity were realized (the KMO measure value more than 0.7 and p<0.05 is accepted). EFA extracted factors based on the Eigenvalues of more than 1 and used procedures of principal component extraction (PCA) and varimax rotation. A cut-off level for factor loading on each factor was defined at a value of 0.3 or more.[23] The remaining split of the three-quarters sample (N=576) was used for CFA analysis to assess the sufficiency of a proposed factor structure. A single factor index is not considered as adequate to report the good fit between an assessed model and a theoretical model.[11] The following indices were used for CFA to estimate the fit of the model: χ2 statistic, the root mean square error of approximation (RMSEA), the comparative fit index (CFI), Tucker-Lewis index (TLI), Standardized root mean squared residual (SRMR), Coefficient of Determination (CD).

A good fit of the model was considered sufficient when a value of CFI and TLI were greater than 0.90, RMSEA and SRMR were from 0.06 to 0.08.[24,25]

Ethics Approval

Our research complied with the Declaration of Helsinki. All the participants gave consent to engage in the study by signing the informed consent forms, as well as being aware they could withdraw from the study at any time without penalties. The study was approved by the Ethical Committee, University of Medicine and Pharmacy at Ho Chi Minh City, Vietnam (protocol number 125/UMP-BOARD).

Results
Qualitative Strand

A total of 56 parents participated in an age range from 18 to 40 years old. Most reported secondary school as their highest level of education and the majority of them identified as housewives (an accepted term in Vietnam for homemakers with children).

Experts Review About Content Validity

The 13-item draft scales with 4 subscales of HBM was developed as an outcome of combining the findings in the qualitative strand and reviewing the literature. Following assessment by the experts' opinions were offered and CVI analysis was used. The CVI value of 13 items ranged from 0.86–1.00, which was defined as good clarity and content.

Participant Characteristics in Quantitative Strand

Our results showed the similarities between sex, age, and education in RA and EFA, and the CFA sample. The test of significance did not show the difference between RA and EFA and CFA sample (p>0.05). Most participants were female (81%) and had a mean age of 30.8 ± 5.1 years. About 85% of them reached secondary education level (Table 1).

Consistency Reliability Analysis

The 13-item draft scales were used to interview the 768 participants. After performing the internal consistency reliability analysis, two items were removed from the scales due to no relation to the total scales (item-test correlation <0.3). The remaining 11-item scales were shown in Appendix 1,

Table 1 Sex, Age, and Education of Participants (N=768)

	Total (N=768)	RA and EFA (n=192)	CFA (n=576)	p
Sex				
Male	146 (19.0)	43 (22.4)	103 (17.9)	0.171*
Female	621 (81.0)	149 (77.6)	472 (82.1)	
Education				
Pre-primary education	20 (2.6)	3 (1.6)	17 (3.0)	Reference
Primary education	96 (12.5)	30 (16.6)	66 (11.5)	0.154[#]
Secondary education	592 (77.2)	141 (73.4)	451 (78.4)	0.367[#]
Post-secondary education	59 (7.7)	18 (9.4)	41 (7.1)	0.185[#]
Age (Mean ± SD)	30.8 ± 5.1	30.5 ± 4.7	30.9 ± 5.2	0.370[#]

Notes: *Chi-square test; [#]Logistic regression.

Table 2 Internal Consistency Reliability of the Attitude Scales Towards Hepatitis B Vaccination (N=192)

Item	Sign	Original Scale			Modified Scale		
		Item-Test Corr.	Item-Rest Corr.	Alpha	Item-Test Corr.	Item-Rest Corr.	Alpha
1. My child is at high risk for Hepatitis B	+	0.508	0.330	0.693	0.553	0.367	0.721
2. I think my child will get Hepatitis B in future	+	0.621	0.498	0.667	0.656	0.529	0.694
3. My child could be very sick if she/he got HBV	+	0.603	0.499	0.671	0.610	0.497	0.702
4. I am afraid to even think about my child getting sick with HBV	+	0.531	0.403	0.682	0.543	0.405	0.713
5. Immunization will prevent my child from catching HBV	+	0.603	0.519	0.674	0.631	0.544	0.701
6. By being immunized and not getting HBV, my child will be protecting others from HBV	+	0.475	0.324	0.692	0.475	0.311	0.727
7. Need to get the Hepatitis B vaccination on schedule to prevent my child from getting HBV	+	0.491	0.376	0.686	0.519	0.398	0.715
8. The Hepatitis B vaccine can cause AEFIs	-	0.436	0.287	0.697	0.455	0.294	0.728
9. The Hepatitis B shot can be painful	-	0.383	0.190	0.715	0.381	0.172	0.754
10. It is an inconvenient time to take my child in for vaccines	-	0.537	0.433	0.681	0.523	0.408	0.714
11. That is an inconvenient location to take my child in for vaccines	-	0.573	0.476	0.677	0.578	0.473	0.707
12. Hepatitis B is a dangerous disease	+	0.289	0.167	0.709	Excluded		
13. Watching my child get needles frightens me	+	0.288	0.082	0.733	Excluded		
Total				**0.708**	**0.735**		

which demonstrated acceptable internal consistency with Cronbach's alpha of 0.735. The correlation of each item to the scales ranged from moderate to strong (item-test correlation from 0.381 to 0.656) (Table 2).

Factor Analysis

In the factor of the post-estimation of the HBM scales, KMO measure value was 0.738, and p<0.001 of Bartlett's test of sphericity demonstrated satisfactory suitability of

Table 3 Exploratory Factor Analysis for Attitude Scales Towards Hepatitis B Vaccination (N=192)

| Item	Factors			
	1	2	3	4
1. My child is at high risk for Hepatitis B	0.880	−0.091	0.064	−0.106
2. I think my child will get Hepatitis B in future	0.573	0.282	0.035	−0.063
3. My child could be very sick if she/he got HBV	0.653	0.130	0.117	0.121
4. I am afraid to even think about my child getting sick with HBV	0.683	−0.211	−0.176	0.083
5. Immunization will prevent my child from catching HBV	0.182	0.332	−0.095	0.266
6. By being immunized and not getting HBV, my child will be protecting others from HBV	−0.037	0.890	0.082	−0.148
7. Need to get the Hepatitis B vaccination on schedule to prevent my child from getting HBV	−0.113	0.605	−0.023	0.282
8. The Hepatitis B vaccine can cause AEFIs	−0.046	−0.288	0.626	0.164
9. The Hepatitis B shot can be painful	0.078	0.158	0.874	−0.069
10. It is an inconvenient time to take my child in for vaccines	−0.063	−0.050	0.038	0.927
11. That is an inconvenient location to take my child in for vaccines	0.021	−0.064	−0.029	0.886
Eigenvalue	3.34	1.42	1.05	1.01
Explained variance	30.4%	13.0%	9.5%	9.2%
Cumulative of explained variance	62.1%			

the data to factor analysis, which showed that our variables are associated to and appropriate for structure detection.

Exploratory Factor Analysis

A loading cut-off level of 0.3 or more was used with the findings resulting in 11 items being approved, numbered from 1 to 11, and 2 items were deleted. Most of the items had factor loadings ranging from 0.573 to 0.927, with item 5 being a moderate loading on the perceived benefits factor (0.332). Following the Scree plot made by the method of principle-component factor, the number of the consisted factor was reported as four. The EFA found four factors of HBM scales were extracted including the perceived threat of disease, which was determined by a combination of perceived susceptibility and perceived severity (item 1 to 4), perceived benefits (item 5 to 7), while the barriers were divided into 2 subscales covering barriers of side effects (item 8 and 9), and inconvenience of being vaccinated (item 10 and 11). The factor analyses revealed four factors (perceived susceptibility, perceived severity, perceived benefits, perceived barriers) containing 11 items that jointly accounted for 62.1% of the observed variance (Table 3).

Construct and Concurrent Validity

Figure 2 revealed the standardized solution for the four-factor measurement model, that observed variables were described by rectangles, and latent variables were enclosed in ellipses, 4-items served as indicators of perceived threat, 3-items served as indices of perceived benefits, 2- items of perceived barriers of side effects and 2-items of the inconvenience of being vaccinated. The CFA revealed a model of the strong correlation of each factor with another with standardized covariances ranging from 0.32 to 0.63. Factor loadings of 9 items were good (ranging from 0.50 to 0.92), and of two remaining factors were acceptable (0.32 and 0.34). Multiple-squared correlation coefficients ranged from 0.15 to 0.90. These results indicated an acceptable to good ability to explain factors relating to the variation of items in the model (Figure 2). Fit statistics for the CFA model showed an unfit 4-factor model using LR test (Likelihood Ratio test) for model or baseline versus saturated comparison, corresponding to $X^2(38) = 114.33$, p <0.001, $X^2(55) = 1025.4$, p<0.001, which indicated the expected model and the observed model are significantly different. This can be explained by the large sample size that can affect these statistics leading to rejects in the model. However, all of other fit statistics revealed a good
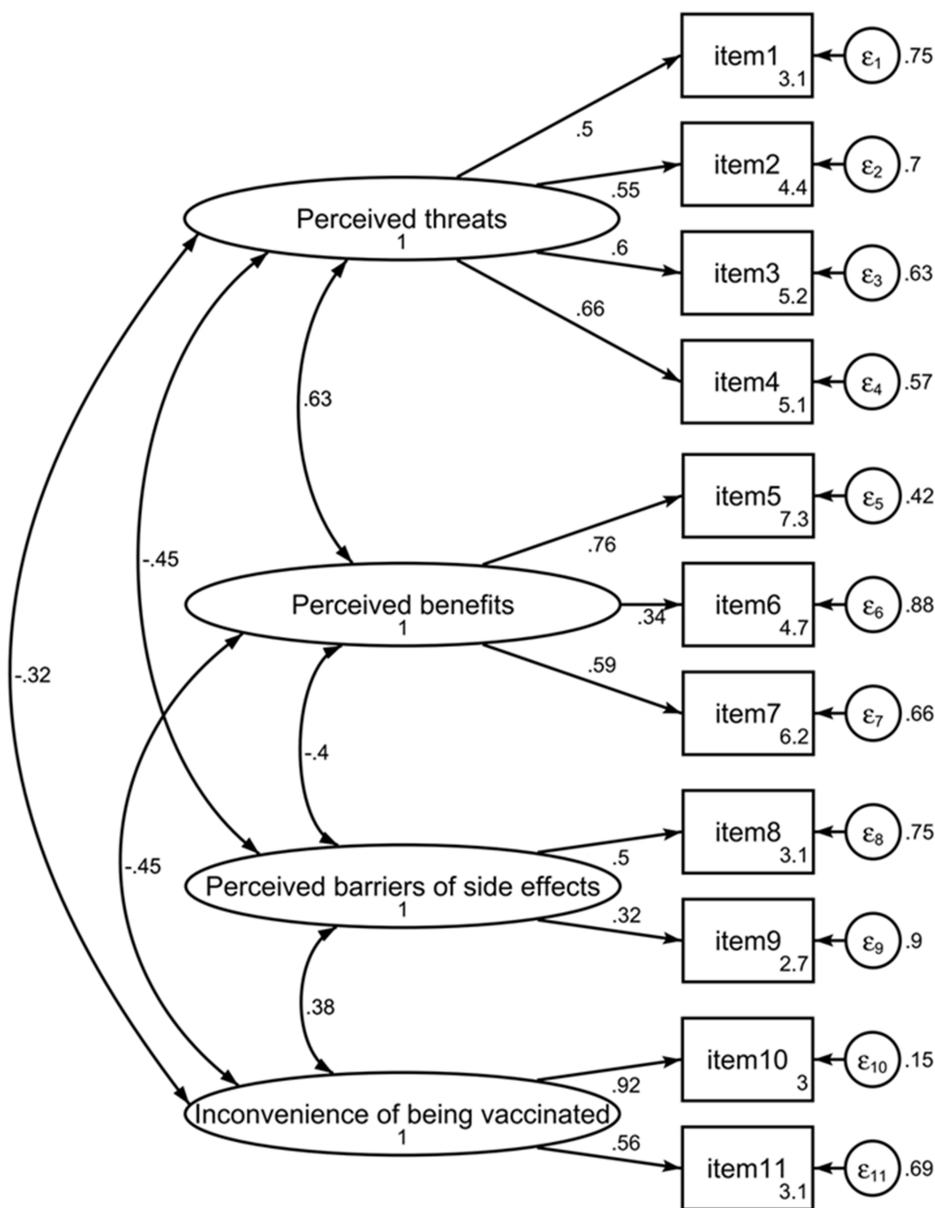
Figure 2 Confirm factor analysis for Attitude Scales towards Hepatitis B Vaccination (N=576).
Notes: Oval, Endogenous variable; Value in oval, Standardized variance; Rectangle, Exogenous variables; Value in rectangle, intercept; ε, random errors; Value on one-way arrows are standardized factor loading; Value on two-way arrows show Covariances.

fit of the model specified such as CFI (0.921), TLI (0.886), SRMR (0.039), CD (0.984), RMSEA (0.059, 90% CI = 0.04–0.072) (Table 4). Overall, the data showed that the scales had adequate factorial validity.

Discussion

Developing interventions to achieve behavioral change is the main goal to increase the coverage of HBV vaccination, especially following AEFIs in 2013, which significantly reduced parents' belief in vaccination and increased the rate of vaccine refusal and delays in take up. Also, there was no reliable and valid instrument to assess patients' attitudes towards Hepatitis B vaccination. The HBM showed vaccination behavior is affected by perceived sensibility, the severity of the disease, perceived benefits, and barriers to vaccination,[26] which were demonstrated by previous studies of Bigham[12] and Rhodes[11] about attitudes and beliefs toward Hepatitis B vaccination. However, it is necessary to have a suitable instrument for assessing the attitudes of parents toward their children's vaccination that will allow planned interventions to be more

Table 4 Fit Statistic for CFA Model (N=576)

Fit Statistic	Value	Expected Value
Likelihood ratio test for model vs saturated comparison		
$X^2_{(38)}$	114.33	
p-value	<0.001	>0.05
Likelihood ratio test for baseline vs saturated comparison		
$X^2_{(55)}$	1025.40	
p-value	<0.001	>0.05
Population error		
Root mean square error of approximation (RMSEA)	0.059	<0.08
RMSEA 90% CI, lower bound	0.047	
RMSEA 90% CI, upper bound	0.072	<0.08
pclose	0.109	
Baseline comparison		
Comparative fit index (CFI)	0.921	>0.9
Tucker-Lewis index (TLI)	0.886	Close to 1
Size of residuals		
Standardized root mean squared residual (SRMR)	0.039	<0.08
Coefficient of determination (CD)	0.984	Close to 1

effective. In our study, using the mixed methods study including qualitative and quantitative strands on a sample of parents whose children receiving the vaccination at CHCs based on items of the HBM scales, showed the instrument was suitably developed for this subject. Additionally, the final scales were also modified according to the opinions of experts. Therefore, it would ensure the comprehensiveness of the results. The content of all items was validated by experts and adapted after minor changes, such as editing of words with corresponding synonyms. The 13-item attitude scales for HBV vaccination in our study were structured into four factors as the theoretical framework of HBM.[26] Most items achieved the agreement of experts, which resulted in good content validity, followed by the results construct validity, which was provided through exploratory factor analysis. The primary scales initially consisted of 13-items, however, two items, which are "HBV is a serious disease ", and "The Hepatitis B shot can be painful", were deleted from the scales because they were seen as having no relation to the total scale (item-test correlation <0.3). This was based on the recommendation that the researchers should remove the items with a factor loading under 0.32.[23] The final scales of 11-items showed good internal

consistency with Cronbach's alpha of more than 0.7, its value was similar to Rhodes's study about HBV vaccination[11] and scale of Champion,[17] but higher-level than that of Pielak KL's study about the HBM scale of measles immunization,[27] and HBM scale for HPV vaccination of Kim (0.71–0.78).[13] The CFA supplied for the construct validity of HBM scales which consisted of a perceived threat; perceived benefits to vaccination; barriers related to side effects and inconvenience of being vaccinated, also CFA showed four stable subscales with comparative model fits, all the observed variables except for item 5 were strong measures of their latent factors, with factor loadings ranging from 0.573 to 0.890. These findings showed to be higher than those reported on the scale of Champion, which had factor loadings ranging from 0.40 to 0.83.[17,18] The scales revealed a good fit for a four-factor model using CFI, TLI, SRMR, CD, and RMSEA, although LR showed to be unfit. This might be because the X^2 was impacted by the sample size.[28] These results were similar to Sun's study[29] where the 5-factor model was not satisfactory for the X^2 test but had good fit indices, including CFI, TLI, and SRMR, RMSEA, CD. Overall, it is interpreted that the HBM scales of Hepatitis B vaccination may be considered to have sufficient factor validity. Most of the psychometric tests of the scales were found to have satisfactory results.

Strengths and Limitations

This was a new study to assess the immunization scales based on the HBM. This contribution is good for future studies in the context that Vietnam was an endemic area for Hepatitis B and the rate of taking up of the hepatitis birth dose was low. Some limitations included that information was collected from parents whose children were aged from 12 to 24 months old, which can result in recall bias, and the sample was collected in a large city, which might not reflect attitudes and trends across all of Vietnam, especially the regional areas.

Conclusions

Attitude Scales for Hepatitis B Vaccination is a valid and reliable instrument that might be useful in assessing parents' attitudes regarding vaccination and assist in identifying ways to conduct interventions promoting ways of increasing vaccination coverage for children.

Data Sharing Statement

Available upon request to the first author.

Acknowledgments

Author Contributions

All authors made substantial contributions to conception and design, acquisition of data, analysis, and interpretation of data, took part in revising the article critically for important intellectual content, gave final approval of the version to be published, and agree to be accountable for all aspects of the work.

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Disclosure

The authors declare that they have no competing interests.

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