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Hepatitis B infection and vaccination in southern Vietnam: Knowledge, attitudes, and willingness to pay among the general population

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ABSTRACT

Objective: To assess the knowledge and attitudes of the general population regarding hepatitis B virus (HBV) infection, their association with sociodemographic factors, and the community's willingness to pay for hepatitis B vaccination.

Methods: This cross-sectional study was conducted from January to March 2025 in Ho Chi Minh City, Vietnam. A self-administered questionnaire was distributed to 1 098 adults who were recruited *via* nonprobability convenience sampling. Descriptive analysis was conducted to calculate the frequencies and percentages of the categorical variables. A *Chi*-square test was carried out to explore the association between the independent and categorical dependent variables.

Results: A total of 926 complete questionnaires were returned and included in the analysis. Among the participants, 524 (56.6%) exhibited good knowledge about HBV infection and vaccination, while 651 (70.3%) showed positive attitudes toward the issues of interest. The factors associated with knowledge and attitudes were household incomes, health insurance, family history of HBV infection, vaccination intention, reasons for nonvaccination, sources of HBV information, and awareness of immunization programs and vaccination sites.

Conclusions: Although most participants had limited knowledge of HBV symptoms and transmission, their attitudes toward vaccination remained positive. Targeted national strategies and intervention initiatives are needed since public awareness and attitudes toward the condition greatly impact intervention success.

KEYWORDS: Attitude; Hepatitis B virus; Knowledge; Willingness to pay; Vietnam

1. Introduction

Infections due to the hepatitis B virus (HBV) continue to be a significant global health issue that results in both acute and chronic hepatitis, which in turn, can bring about severe complications, such as liver cirrhosis, hepatitis-induced liver cancer, liver failure, and mortality[1]. Currently, an estimated 254 and 50 million people live with hepatitis B and C, respectively, with 58% of these cases involved men and half of burden occurring in individuals aged 30 to 54 years[2].

Vietnam grapples with a particularly high burden from viral hepatitis, with HBV and the hepatitis C virus being the main

Summary

Question: What are the knowledge, attitudes, and willingness to pay for hepatitis B vaccination among the general population in southern Vietnam?

Findings: In this cross-sectional study of 926 adults in Ho Chi Minh City, 56.6% had good knowledge of HBV, 70.3% showed positive attitudes toward vaccination, and several sociodemographic factors were significantly associated with these outcomes.

Meaning: Despite limited knowledge about HBV symptoms and transmission, positive attitudes and willingness to pay suggest that targeted national strategies could improve vaccination coverage.

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causative agents of cirrhosis, liver cancer, and liver-related deaths. In 2018, the country ranked sixth globally in liver cancer incidence and had the third-highest liver cancer mortality rate[3]. Furthermore, the prevalence of chronic HBV infection in Vietnam increased from an estimated 6.4 million cases in 1990 to approximately 8.4 million cases in 2005. This number, however, is expected to decrease to 8.0 million by 2025 under the expansion of HBV control measures[4].

Against this backdrop, the inadequacy of knowledge about hepatitis B varies widely across population groups. In Malaysia, for instance, 63% of households poorly understand the disease[5], while in Ethiopia, 48% of health science students lack sufficient knowledge of HBV infection[6]. Unfavorable attitudes were reported among 16.7% of pregnant women in China[7] and 13.6% of nurses and midwives in Sudan[8]. In Vietnam, research on HBV-related knowledge and attitudes has been conducted primarily among medical students, healthcare workers, or individuals identified as HBV-negative. Consequently, the results could not be precisely reflective of the whole population. It is imperative to conduct studies that evaluate knowledge and attitudes at the community level, given the critical role of individuals outside the healthcare sector and broader community members in the development of effective prevention and intervention strategies.

The widespread global use of HBV vaccines, coupled with continuous monitoring, reaffirms their safety and efficacy in preventing HBV infection and reducing the incidence of cirrhosis and hepatocellular carcinoma. Such efficacy nevertheless varies with age, as antibody responses diminish in older individuals, rendering immunization during childhood or adolescence the most effective preventive strategy[9].

In the healthcare sector, willingness to pay (WTP) is used as a way of measuring how much people are willing to pay for medical procedures, services, and packages[10,11]. Assessing the WTP for the HBV vaccine is particularly crucial since it reflects the perceived monetary value of the vaccine to individuals and society[12]. The data derived are, in turn, employed by policymakers to prioritize vaccine distribution, particularly in the early stages of development when shortage is a major global issue[13,14].

In consideration of the discussion above, the current study was aimed at reducing new HBV infections and HBV-related mortality in Vietnam by inquiring into knowledge and attitudes toward hepatitis B as well as people's WTP for the vaccine. The results are expected to raise public awareness, encourage self-defense practices, and highlight how important immunization is in halting the spread of the disease and its long-term consequences.

2. Methods

2.1. Setting and research design

This community-based, cross-sectional descriptive study was conducted in Ho Chi Minh City, one of the most populous metropolises in southern Vietnam. A knowledge, attitudes survey regarding HBV infection and vaccination was administered to adults from January to March 2025.

2.2. Sampling and participants

Participants were recruited *via* nonprobability convenience sampling based on the following inclusion criteria: individuals aged 18 years or older who consented to participate in the survey. Recruitment campaigns were launched in Ho Chi Minh City, organized specifically in central public spaces, including markets, major crossroads, hospitals, and sports halls. The recruitment initiatives were approved by local authorities.

2.3. Sample size

The minimum sample size required was calculated using a formula based on the WHO's guidelines[15]:

$$N = \frac{(Z_{\alpha/2})^2 \times P\,(1-P)}{d^2} = \frac{(1.96)^2 \times 0.5\,(1-0.5)}{0.05^2} = 385$$

where $Z_{\alpha/2}$ is the 95% confidence interval (*CI*) under the assumption of normal distribution ($Z_{\alpha/2}$=1.96), P denotes the proportion of individuals with expected awareness of, experience with HBV (hypothetically 50%), and d refers to the error margin corresponding to a 95% confidence level (d=0.05). To accommodate a potential 20% of participants submitting nonvalid questionnaires, a minimum sample of 460 participants was determined to be suitable.

2.4. Data collection

A self-administered structured questionnaire was distributed to the participants, who were assured of complete anonymity and to whom the study's objectives were clearly explained. Data collection took place over 60 days or until the target sample size was reached, at which point the process was concluded.

The invitation extended to the participants included the principal researcher's contact information for any inquiries that they may have. A written informed consent form detailing the research objectives and ethical considerations was provided to them. Before beginning the survey, the participants were required to signify consent through a tick-box mechanism, authorizing both their participation and the publication of the collected data.

2.5. Questionnaire

The questionnaire, which was intended to assess the key variables of interest in this study, was developed following a comprehensive review of the relevant literature[16-19]. The first draft was revised according to feedback from six senior experts who evaluated

the questionnaire's face, content, and convergent validity. A pilot evaluation (30 copies) of acceptability and consistency was performed, and a Cronbach's α of 0.862 was derived. After the pilot testing, a few minor adjustments were required, and ambiguities or issues with the questionnaire were identified and rectified on the basis of the feedback received during the pilot test. Importantly, the participants who took part in the pilot test were excluded from the final sample to avoid potential bias, and the questionnaire data collected during this stage were discarded. This rigorous approach to questionnaire development and testing was expected to enhance the reliability and validity of the instrument, ensuring that it effectively captured the intended constructs and facilitated meaningful data collection and analysis. The final self-administered questionnaire (41 items) was then translated into Vietnamese and comprised four sections: sociodemographic characteristics (11 items), knowledge (18 items) and attitudes (8 items) toward HBV infection and HBV vaccination, and WTP for HBV vaccines (4 items).

2.5.1. Sociodemographic characteristics

The sociodemographic factors of interest were age, sex, income, family history of HBV infection, the intention to get vaccinated, and reasons for nonvaccination.

2.5.2. Knowledge of HBV issues

Participants' knowledge of HBV was evaluated using two independent but related domains: knowledge of HBV transmission (10 items) and HBV complications (8 items). The response options were *yes*, *no*, and *don't know*. Each correct response received 1 point, whereas an incorrect or a don't know response was granted no points. The participants' overall HBV knowledge was evaluated on the grounds of Abdnur's threshold[18,20], wherein a score of 7 points or more (≥70%) is indicative of comprehensive knowledge, while a score below 7 points (<70%) is reflective of poor knowledge.

2.5.3. Attitudes toward HBV vaccination

Vaccination attitudes were assessed using 8 items, rated by the participants on a five-point Likert scale ranging from 1 (*strong disagreement*) to 5 (*strong agreement*). The statements were categorized into three groups: three items for assessing perceptions of the necessity and timing of hepatitis B vaccination, three items for evaluating views on the safety and effectiveness of the vaccine, and two intended to determine behaviors and recommendations related to hepatitis B vaccination.

2.5.4. Willingness to pay for HBV vaccines

The contingent valuation method (CVM) is used to obtain information about the maximum WTP for a specific good or service directly from respondents through a scenario. The CVM has been recognized as a reliable method for assessing the value of vaccines, particularly when the public is aware of their importance and effectiveness[21]. Its implementation entails the use of a wide range of methods (payment cards, open-ended questions, bidding games) to help respondents articulate their pricing preferences[22]. This study employed the payment card approach, wherein the respondents were provided with a range of reasonable WTP values from which to select their maximum WTP or the highest amount that they were willing to pay for a vaccine[23]. Each respondent was allowed only one choice.

The WTP for the HBV vaccine was determined under four scenarios, which varied in terms of vaccine efficacy (95% *vs*. 100%), duration of protection, and dosage scheme. Scenario 1 featured the currently available HBV vaccine, which is administered in three or four doses and has a 95% efficacy rate over the course of 10 to 20 years. Scenario 2 considered a single-dose vaccine with the same 95% efficacy and duration as that in the first scenario. Scenario 3 presented a single-dose vaccine with 100% efficacy for 20 to 30 years, while Scenario 4 offered a single-dose vaccine with 100% lifelong immunity. In Scenarios 1 and 2, the respondents were asked to choose from 14 price options ranging from $8 USD to $403 USD Scenarios 3 and 4 consisted of pricing starting at $20 USD and going up to $1 008 USD. If the participants could not select any of the predefined prices, they were asked to specify the maximum amount that they were willing to pay. Price levels were based on actual HBV vaccine prices registered with the Vietnamese FDA.

The proposed conceptual model (Figure 1) illustrates the hypothesized relationships between knowledge of and attitudes toward HBV infection and vaccination as well as the WTP for the HBV vaccine. In this framework, knowledge, attitudes, and WTP serve as key measurement domains, and attitudes are posited as a mediating variable in the association between prior knowledge and actual participation in HBV vaccination campaigns.

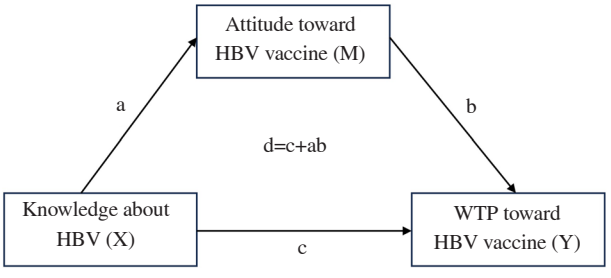

Figure 1. The proposed mediation model of knowledge, attitudes, and WTP for the HBV vaccine. WTP: Willingness to pay; X: Knowledge about HBV; M: Attitude toward HBV vaccine; Y: Willingness-to-pay for HBV vaccine; a: Effect of knowledge on attitude; b: Effect of attitude on willingness-to-pay; c: Direct effect of knowledge on willingness-to-pay; d: Total effect of knowledge on willingness-to-pay (d=c+ab).

2.6. Data processing and statistical analyses

2.6.1. Data processing

The data were processed using a systematic approach to maximize accuracy and reliability. Initially, the dataset was thoroughly cleaned, which involved the removal of incomplete responses and entries with missing values. Subsequently, outliers were identified and excluded to minimize potential bias in the analysis. This identification was carried out using box plots and verified using the Shapiro–Wilk test of normality.

2.6.2. Statistical analysis

The data were analyzed using SPSS for Windows (version 26.0, IBM). Descriptive statistics were reported as mean±standard deviation for continuous variables and as frequencies with percentages (%) for categorical variables. *T*-tests and ANOVA were performed to compare differences between binary and polytomous variables, while a *Chi*-square test was conducted to examine variations in vaccine use across categorical groups. Additionally, further analyses were carried out in SPSS (version 21) to identify factors associated with the key outcome variables (*e.g.*, knowledge and attitudes). Significance was set as a two-tailed P-value < 0.05. Mediation analysis was conducted using the PROCESS macro of SPSS (Model 4)[24] to explore whether attitudes mediated the relationship between health knowledge (independent variable) and WTP (dependent variable) across the four vaccine scenarios. Bootstrapping with 5000 resamples was applied to estimate indirect effects, and 95% bias-corrected *CI*s were used to assess statistical significance. Mediation was considered significant if the *CI* for the indirect effect excluded zero.

2.7. Ethical considerations

Involvement in this research was voluntary, and informed consent was obtained from the participants, who were instructed to mark a checkbox to signify their willingness to take part in the study. The consent form clearly stated their rights, obligations, risks, and benefits, along with the boundaries of the research. They were assured of the anonymity and confidentiality of their data and consent forms throughout the study. They were also informed of their right to withdraw at any time without the imposition of penalties. The participants' identities were protected through the use of initials.

Initial ethical approval was obtained (IRB No. 01/QD-HDDD on 30 December 2024) from the Institutional Review Board Committee at the University of Health Sciences of Vietnam National University Ho Chi Minh City.

Table 1. Sociodemographic variables.

Characteristic	*N* (%)	Characteristic	*N* (%)
Sex		Reasons for not vaccinating	
Male	458 (49.5)	Don't know where to get vaccinated	18 (8.4)
Female	466 (50.3)	Vaccine cost is high	58 (27.0)
Others	2 (0.2)	Afraid of side effects	55 (25.6)
Age, years		Afraid of injection	54 (25.1)
18-25	123 (13.3)	Not afraid of HBV transmission	15 (7.0)
26-35	274 (29.6)	Others	15 (7.0)
36-45	202 (21.8)	Sources of information about HBV	
46-55	158 (17.1)	Social media/Internet	551 (29.1)
56-65	105 (11.3)	Books, Newspapers, Magazines	308 (16.3)
>65	64 (6.9)	Television	292 (15.4)
Personal income, US dollar*/month		Friends and family	499 (26.4)
<403	454 (49.0)	Courses, programs	55 (2.9)
403 - <605	222 (24.0)	Schools	162 (8.6)
605 - <1 614	204 (22.0)	Others	24 (1.3)
≥1 614	46 (5.0)	Awareness of immunization program	
Household income, US dollar*/month		Yes	429 (46.3)
<403	131 (14.1)	No	497 (53.7)
403 - <605	160 (17.3)	Awareness of vaccination locations	
605 - <1 614	491 (53.0)	Yes	814 (87.9)
≥1 614	144 (15.6)	No	112 (12.1)
Health insurance		Family history of HBV infection	
Yes	675 (72.9)	No family members infected	705 (76.1)
No	251 (27.1)	Family member infected	184 (19.9)
Intention to vaccinate		No information	37 (4.0)
Yes	275 (29.7)		
No	108 (11.7)		

*$1 USD=VND 24 786 (Source: Vietnamese Ministry of Finance: Exchange rate for foreign currencies in March 2025).

2.8. Risk of bias assessment

The quality of this study was evaluated using the Appraisal Checklist for Cross-Sectional Studies (AXIS)[25].

3. Results

3.1. Sociodemographic characteristics

A total of 926 participants completed the questionnaire, with females, males, and others accounting for 50.3% (466), 49.5% (458), and 0.2% (2) of the sample, respectively (Table 1). The majority were aged 26 to 35 (29.6%) and 36 to 45 (21.8%) years. Nearly half (49.0%) earned less than $403 USD monthly, and 72.9% had health insurance. 76.1% reported no family history of hepatitis B, while 19.9% had at least one infected family member. The most commonly cited reasons for refusing vaccination were high cost (27.0%) and concerns about side effects (25.6%). Of the sample, 53.7% were unaware of free/low-cost immunization programs.

3.2. Knowledge of HBV issues

This study explored the knowledge and attitudes of Ho Chi Minh City residents toward HBV infection and vaccination using an 18-item questionnaire (Cronbach's α=0.851) (Table 2). The most common transmission routes were sexual contact, mother-to-child transmission, blood transfusion, and needle sharing. The respondents exhibited considerable knowledge of symptoms, but only 65.2% understood HBV's higher infectivity compared with HIV.

3.3. Attitudes regarding HBV vaccination

73.0% participants believed that the HBV vaccine should be included in the national immunization program, with vaccination for newborns recommended for administration within the first 24 hours after birth (Table 3). 53.5% disagreed with the statement that only children aged 0 to 10 years should be vaccinated against HBV. 72.9% were also convinced that the vaccine is safe for all subjects, with 77.8% and 79.4% of the participants supporting vaccination at their age and ensuring that everyone in the family is vaccinated, respectively.

3.4. Associations between knowledge and attitudes with sociodemographic variables

A statistically significant association was found between knowledge and attitudes toward HBV infection/vaccination and family

Table 2. Knowledge of hepatitis B [*n* (%)].

Items	Variables	Correct response	Incorrect response
K1	HBV can be transmitted through genetic inheritance.	519 (56.0)	407 (44.0)
K2	HBV can be transmitted through the air.	637 (68.8)	289 (31.2)
K3	HBV can be transmitted through sexual intercourse.	663 (71.6)	263 (28.4)
K4	HBV can be transmitted from mother to child.	719 (77.6)	207 (22.4)
K5	Sharing bowls and chopsticks can transmit HBV.	519 (56.0)	407 (44.0)
K6	HBV can be transmitted through blood transfusion.	668 (72.1)	258 (27.9)
K7	Sharing a toothbrush can lead to HBV transmission.	598 (64.6)	328 (35.4)
K8	Shaking hands with an HBV-infected person will cause infection.	449 (48.5)	477 (51.5)
K9	You will be infected if you share needles with an HBV-infected person.	720 (77.8)	206 (22.2)
K10	You can be infected if you eat food prepared by an HBV-infected person.	377 (40.7)	549 (59.3)
K11	Symptoms of HBV infection include fever, jaundice, and loss of appetite.	696 (75.2)	230 (24.8)
K12	Asymptomatic HBV-infected individuals can still transmit the virus.	642 (69.3)	284 (30.7)
K13	HBV can lead to cirrhosis and liver cancer.	745 (80.5)	181 (19.5)
K14	Adults with HBV are more likely to develop liver cancer than children.	636 (68.7)	290 (31.3)
K15	Exposure to alcohol and chemicals is a major factor in HBV progression.	724 (78.2)	202 (21.8)
K16	Co-infection with other hepatitis viruses (HCV, HDV) can worsen HBV progression.	716 (77.3)	210 (22.7)
K17	HBV should be treated as early as possible.	748 (80.8)	178 (19.2)
K18	Hepatitis B is 50-100 times more infectious than HIV.	604 (65.2)	322 (34.8)

Table 3. Attitudes toward HBV infection [*n* (%)].

Items	Variables	Positive attitude	Negative attitude
A1	Hepatitis B vaccination is only necessary for children aged 0-10 years.	431 (46.5)	495 (53.5)
A2	The inclusion of the hepatitis B vaccine in Vietnam's national immunization program is appropriate.	735 (79.4)	191 (20.6)
A3	Newborns should receive the hepatitis B vaccine within the first 0-24 hours after birth.	676 (73.0)	250 (27.0)
A4	Immunocompromised patients should not receive the hepatitis B vaccine.	577 (62.3)	349 (37.7)
A5	The hepatitis B vaccine is safe for all populations.	675 (72.9)	251 (27.1)
A6	You should receive the hepatitis B vaccine at the appropriate age.	720 (77.8)	206 (22.3)
A7	You intend to ensure that all members of your family are vaccinated against hepatitis B.	735 (79.4)	191 (20.6)
A8	Your doctor has recommended hepatitis B vaccination within the past two years.	341 (36.8)	585 (63.2)

Table 4. Analysis of factors associated with knowledge and attitudes toward hepatitis B [*n* (%)].

Characteristics	Knowledge of HBV			Attitude of HBV		
	Good	Not good	*P*-value	Positive	Negative	*P*-value
Sex			0.017			0.302
Male	242 (52.8)	216 (47.2)		332 (72.5)	126 (27.5)	
Female	282 (60.5)	184 (39.5)		318 (68.2)	148 (31.8)	
Others	-	2 (100.0)		1 (50.0)	1 (50.0)	
Age, years			0.132			0.069
18-25	66 (53.7)	57 (46.3)		77 (62.6)	46 (37.4)	
26-35	146 (53.3)	128 (46.7)		203 (74.1)	71 (25.9)	
36-45	121 (59.9)	81 (40.1)		140 (69.3)	62 (30.7)	
46-55	84 (53.2)	74 (46.8)		110 (69.6)	48 (30.4)	
56-65	62 (59.0)	43 (41.0)		69 (65.7)	36 (34.3)	
>65	45 (70.3)	19 (29.7)		52 (81.3)	12 (18.8)	
Personal income, US dollar*/month			<0.001			0.095
<403	220 (48.5)	234 (51.5)		329 (72.5)	125 (27.5)	
403 - <605	123 (55.4)	99 (44.6)		159 (71.6)	63 (28.4)	
605 - <1 614	144 (70.6)	60 (29.4)		129 (63.2)	75 (36.8)	
≥1 614	37 (80.4)	9 (19.6)		34 (73.9)	12 (26.1)	
Household income, US dollar*/month			<0.001			0.004
<403	87 (66.4)	44 (33.6)		103 (78.6)	28 (21.4)	
403 - <605	70 (43.8)	90 (56.3)		124 (77.5)	36 (22.5)	
605 - <1 614	261 (53.2)	230 (46.8)		333 (67.8)	158 (32.2)	
≥1 614	106 (73.6)	38 (26.4)		91 (63.2)	53 (36.8)	
Health insurance			<0.001			0.002
Yes	441 (65.3)	234 (34.7)		455 (67.4)	220 (32.6)	
No	83 (33.1)	168 (66.9)		196 (78.1)	55 (21.9)	
Family history of HBV infection			<0.001			<0.001
No family members infected	349 (49.5)	356 (50.5)		473 (67.1)	232 (32.9)	
Family member infected	156 (84.8)	28 (15.2)		155 (84.2)	29 (15.8)	
No information	19 (51.4)	18 (48.6)		23 (62.2)	14 (37.8)	
Intention to vaccinate			<0.001			<0.001
Yes	117 (42.5)	158 (57.5)		214 (77.8)	61 (22.2)	
No	27 (25.0)	81 (75.0)		54 (50.0)	54 (50.0)	
Sources of information about HBV			<0.001			<0.001
Social media/ Internet	312 (56.6)	239 (43.4)		387 (70.2)	164 (29.8)	
Books, newspapers, magazines	187 (60.7)	121 (39.3)		218 (70.8)	90 (29.2)	
Television	172 (58.9)	120 (41.1)		205 (70.2)	87 (29.8)	
Friends and family	292 (58.5)	207 (41.5)		357 (71.5)	142 (28.5)	
Courses, programs	41 (74.5)	14 (25.5)		43 (78.2)	12 (21.8)	
Schools	140 (86.4)	22 (13.6)		120 (74.1)	42 (25.9)	
Others	4 (16.7)	20 (83.3)		2 (8.3)	22 (91.7)	
Awareness of immunization program			<0.001			<0.001
Yes	311 (72.5)	118 (27.5)		346 (80.7)	83 (19.3)	
No	213 (42.9)	284 (57.1)		305 (61.4)	192 (38.6)	
Awareness of vaccination locations			<0.001			<0.001
Yes	498 (61.2)	316 (38.8)		594 (73.0)	220 (27.0)	
No	26 (23.2)	86 (76.8)		57 (50.9)	55 (49.1)	

*$1 USD=24 786 VND (Source: Vietnamese Ministry of Finance: Exchange rate for foreign currencies in March 2025).

income, health insurance, history of HBV infection, the intention to vaccinate, sources of information about HBV, immunization programs, and vaccination locations (P<0.05). Specifically, 56.6% (524/926) of individuals demonstrated good understanding about HBV, while 70.3% (651/926) of participants displayed a positive attitude. Furthermore, knowledge and both sex and personal income were significantly correlated (P<0.05), with the highest percentage of good knowledge found among those earning ≥1 614 USD/month (80.4%) and the lowest percentage among those earning less than $403 USD/month (48.5%). Positive attitudes were most prevalent among those over 65 (81.3%) and least prevalent among those between the ages of 18 and 25 (62.6%) (Table 4).

Of the 926 respondents, 6.3% said they would not be able to afford the vaccination. The majority of respondents in each scenario expressed a willingness to pay, with percentages ranging from 84.8% in Situation 1 to 92.2% in Situation 4 (Figure 2).

The parameters that have the biggest impact on the mean WTP for HBV vaccination across four scenarios are shown in Figure 3. With mean WTP values close to 1.4, those with a personal income (PI) of 605–<1 614 and those who were aware of vaccination locations (VL) showed the greatest financial commitment in Scenario 1. With both achieving the highest recorded mean WTP of 1.4, Scenario

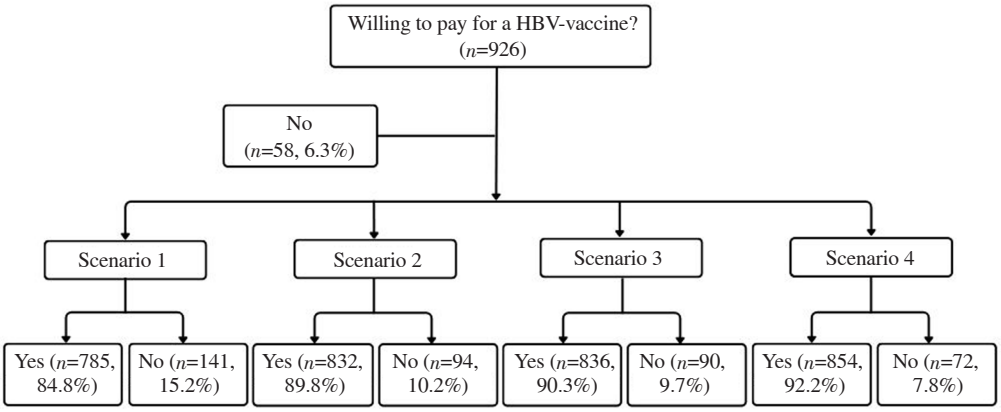

Figure 2. Summary of statistics for the four scenarios on the WTP for HBV vaccines. Data were expressed as *n* (%).

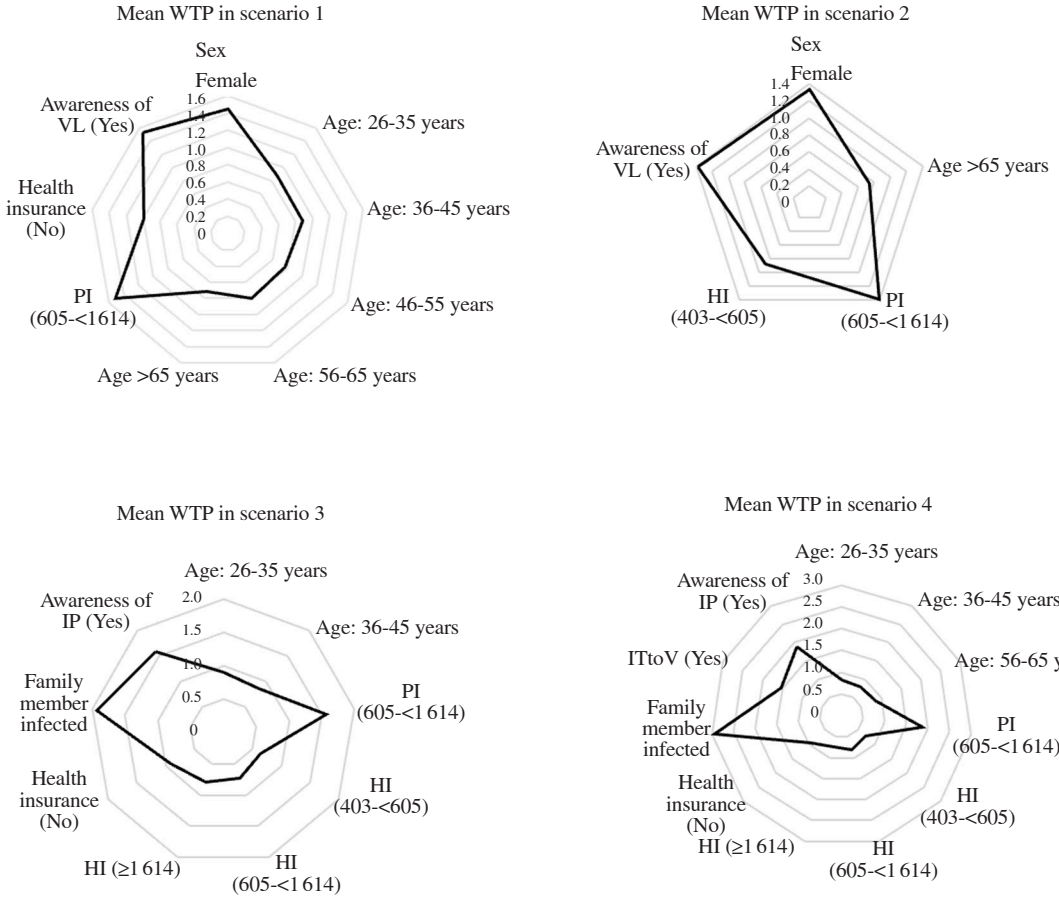

Figure 3. Mean percentage differences in WTP and demographic factors compared with reference categories. WTP: Willingness to pay, IP: Immunization program, HI: Household income, ItoV: Intention to vaccinate, VL: Vaccination locations, PI: Personal income.

2 demonstrates that being female and being aware of VL were the most significant drivers. As these factors drove mean WTP to its highest of 2.0 in Scenario 3, the significance of having an infected family member and knowledge of immunization programs (IP) is amply demonstrated. Notably, Scenario 4 finds that "family member infected" is the most important component overall, with the highest mean WTP of 3.0 while high-tier personal income and awareness of IP also remained highly influential.

Figure 4 illustrates the cumulative WTP across the scenarios (WTP1 to WTP4) and the overall average, which were based on payment thresholds ranging from $20 USD to nearly $400 USD. Generally, the WTP decreased sharply as the payment threshold increased. As expected, the percentage of respondents who were willing to pay was highest at the lowest payment threshold ($20 USD) across all the scenarios and declined as the payment threshold increased. Notably, the respondents choosing Scenario 2 exhibited the lowest WTP, with a steep decline that reached near-zero willingness at thresholds beyond $80 USD. In contrast, those who chose Scenario 4 accounted

for a relatively high proportion of respondents who were willing to pay even at greater thresholds, suggesting a more robust perceived value or affordability among this subgroup. The WTP_total line, representing the average across all the scenarios, lay between the individual curves, capturing the general trend.

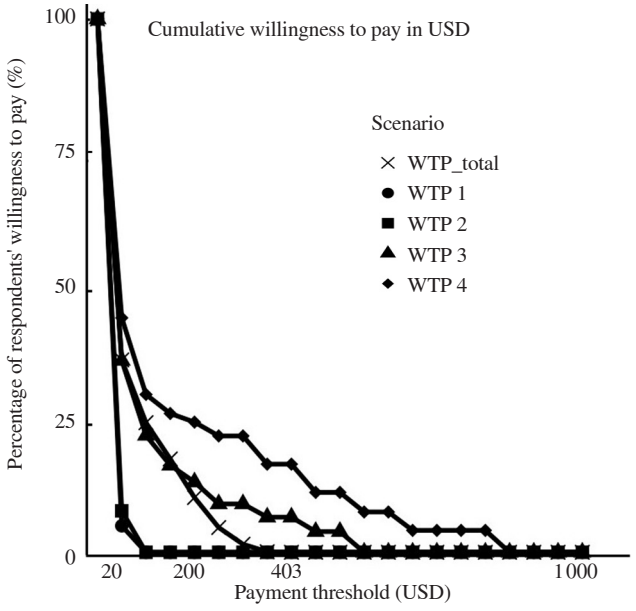

Figure 4. Cumulative WTP in US dollars.

3.5. The mediating role of attitudes in the relationship between knowledge and WTP

The study uncovered that knowledge about HBV influenced WTP both directly and indirectly through attitudes (Table 5). The direct effect of knowledge on WTP ranged from 0.7 to 16.34, accounting for 92.0% to 122.8% of the total effect. The total effect was also significant, with a large mediation effect in cases involving WTP3 and WTP4. These findings suggest partial mediation under HBV knowledge.

4. Discussion

The survey revealed that 56.6% of the participants had a strong understanding of HBV—a percentage greater than those reported for Cameroon (41.1%)[26] and Malaysia (37%)[27] but lower than those found in Ethiopia (58.1% and 89.6%)[20,28] and Vietnam (90%)[29]. Additionally, a study conducted among Vietnamese American adults exhibited elevated awareness of the symptoms and transmission of HBV, consistent with other studies conducted in Vietnam, where 91.5% of women of reproductive age are aware that the HBV vaccine is available; however, only 19.9% know where to acquire vaccination, and a mere 18.3% are aware of free programs[30]. Similarly, research conducted in Ho Chi Minh City revealed that more than 90% of the participants are aware of HBV's preventability via vaccination; its connection to serious liver diseases, including cirrhosis and cancer; and its detection through blood tests; nevertheless, there remain gaps in knowledge about chronicity and transmission[29]. Studies conducted in other developing nations revealed a lack of awareness of HBV issues. In Gujarat, India, for example, only 34% of the population know about pathways of transmission, and 40% are aware of vaccination, but fewer people have received it[31]. Among Ghanaian market women, only 11.1% demonstrate high knowledge of HBV[32]. Out of the 61.6% with poor awareness, 66.5% are unaware of transmission *via* shared sharp objects, and 67.0% are uninformed about treatments[33]. These comparisons underscore the necessity of tailored, context-specific strategies for enhancing public awareness and comprehension of

Table 5. Mediation effect of attitudes on the link between knowledge and WTP.

Variable	Effect	SE	*t*	*P*	95% *CI*
Situation 1					
Total effect of X on Y	0.57	0.13	4.39	<0.001	0.31-0.83
Direct effect of X on Y	0.70	0.13	5.35	<0.001	0.44-0.96
Indirect effect (s) of X on Y	-0.13	0.33	-	-	(−0.20)-(−0.07)
Situation 2					
Total effect of X on Y	1.08	0.13	8.29	<0.001	0.82-1.34
Direct effect of X on Y	1.03	0.13	7.74	<0.001	0.77-1.30
Indirect effect (s) of X on Y	0.05	0.03	-	-	(−0.01)-0.11
Situation 3					
Total effect of X on Y	8.87	0.85	10.40	<0.001	7.19-10.54
Direct effect of X on Y	8.22	0.87	9.49	<0.001	6.52-9.92
Indirect effect (s) of X on Y	0.65	0.18	-	-	0.34-1.02
Situation 4					
Total effect of X on Y	17.67	1.48	11.93	<0.001	14.77-20.58
Direct effect of X on Y	16.34	1.50	10.89	<0.001	13.39-19.28
Indirect effect (s) of X on Y	1.33	0.31	-	-	0.77-1.99

WTP: Willingness to pay, X: Knowledge about HBV, M: Attitudes toward the HBV vaccine, Y: WTP for the HBV vaccine.

HBV. Variations in knowledge levels across regions likely arise from differences in socioeconomic conditions, educational attainment, cultural beliefs, and the timing of data collection. Elevated awareness in certain populations is frequently associated with sustained public health initiatives and improved access to information. This is particularly evident in developed countries, where formal education, media, and healthcare systems provide greater exposure to accurate information, fostering a deeper understanding of diseases such as HBV. The findings in the current work emphasize the critical role of education, information accessibility, and cultural context in shaping HBV awareness across diverse populations.

The results indicated that 70.3% of the participants held positive attitudes toward HBV vaccination, reflecting significant trust and willingness within the community to receive the vaccine. However, 29.7% expressed negative attitudes, pointing to persistent barriers related to perceptions, beliefs, or concerns about vaccine safety and efficacy. Compared with global findings, those derived here are relatively favorable, but they still fall short of ideal targets. For instance, a 2024 study in Gamo Zone, Ethiopia reported a low favorable attitudinal rate of 60.5%[34]. Conversely, substantially greater positivity was found by studies in Jimma, Ethiopia (88.7%)[35], Khartoum, Sudan (86.4%)[8], and Guangdong Province, China (83.3%)[7]. The elevated figures in Sudan and China are likely due to the study populations comprising mainly healthcare professionals, who benefit from greater access to information and a deeper understanding of vaccination benefits. Meanwhile, a study in Lubumbashi of the Democratic Republic of Congo found a negative attitudinal rate (28.6%) similar to that found in the present study for Ho Chi Minh City, with cultural reliance on traditional healers and financial constraints cited as primary deterrents to modern healthcare access[36].

Although attitudes toward HBV vaccination among the Ho Chi Minh City residents were generally positive, nearly one-third of the population remained hesitant or unwilling to vaccinate. This highlights the need for sustained health communication efforts to enhance awareness of HBV vaccine safety and effectiveness, particularly targeting low-income groups and those with limited healthcare access. Such initiatives are crucial for optimizing the outcomes of immunization programs and reducing the burdens stemming from hepatitis B in the community. Income level emerged as a critical determinant of attitudes toward HBV vaccination. This study found that income level was a major factor in people's views towards vaccination (P=0.004). The affluent group (income ≥ $1 614 USD) demonstrated the highest percentage of good knowledge (80.4%, P<0.001), enabling improved access to health information and preventive measures. However, the percentage of positive attitudes fluctuated among various income levels, peaking at 63.2% in the highest income group. Individuals with greater financial resources are better positioned to access accurate health information and services, fostering heightened awareness and trust in preventive measures such as vaccination. To mitigate income-related disparities, public health interventions should focus on accessible and affordable strategies, such as community-based education campaigns, mobile health units, and free or subsidized vaccination programs for low-income populations. Additionally, collaborating with local leaders and employing culturally tailored messaging can help address trust and knowledge gaps, improving vaccination attitudes across economic strata.

In this research, family history of HBV infection also significantly influenced vaccination attitudes. Personal exposure to the consequences of HBV appears to heighten risk perception, motivating individuals to adopt preventive behaviors. Witnessing how HBV affects the health and social lives of people that one cares about can underscore the severity of the disease and the benefits of vaccination. Public health programs can capitalize on this reality by sharing real-life stories and testimonies to personalize HBV risks, particularly for populations underestimating the disease's seriousness. Integrating such community-based storytelling into vaccination campaigns can resonate considerably with people and drive higher vaccine uptake, enhancing overall public health outcomes.

The findings showed a relatively higher WTP for the hepatitis B vaccine among the Vietnamese respondents compared with participants in previous domestic and international studies. At commonly proposed price points, approximately 82% of the participants were willing to pay 500 000 VND (~$20 USD), and about 43% were willing to pay 1 000 000 VND (~$40 USD). These levels are slightly higher than those reported in a 2019 Vietnamese investigation, where 80.8% of reproductive-age women expressed a WTP for HBV vaccination at an average of approximately $4.70 USD[30]. The higher WTP in the current study may reflect an increased awareness of HBV risks or the perceived value of longer protection offered by newer vaccines. This trend is further highlighted in international comparisons. A recent study in Ethiopia found an average WTP of Ethiopian Birr (ETB) 174.24 ($5.25±$4.38) USD[37], which is substantially lower than both the market price of the vaccine ($65-$134 USD)[38] and the WTP levels observed in the current Vietnamese sample. An earlier Ethiopian study involving healthcare professionals reported a higher mean WTP of ETB 325.83 ($14.39 USD)[39], suggesting that factors such as stable income and professional knowledge positively influence WTP. The amount of money that the households were willing to pay in the present study was lower than the $596 USD that the population group with the worst health status in Iran was willing to pay for health care[40].

In a comparison of current HBV vaccine prices in Vietnam, the

findings revealed even more nuanced insights. Monovalent vaccines are priced between 210 000 and 275 000 VND ($8-$11 USD), falling within the WTP range of approximately 60% to 80% of respondents. Conversely, combination vaccines (*e.g.*, 6-in-1 formulations) are priced significantly higher, ranging from 655 000 to 996 000 VND ($26-$40 USD), which exceeds the WTP range of the majority of the participants[41]. This discrepancy implies that while combination vaccines offer added benefits in terms of broader protection and convenience, they may remain financially inaccessible for many individuals without government subsidies or insurance coverage. This possibility corresponds with the findings of the current work, which demonstrated that the participants were generally willing to pay more for vaccines perceived to be more effective or to offer longer-term protection. This highlights the importance of perceived value in shaping vaccine affordability and acceptance.

The mediation analysis revealed distinct patterns in how knowledge (X) and attitudes (M) influenced WTP (Y) across the four vaccine scenarios. For Scenarios 1 and 2 (95% efficacy, 10-20 years protection), knowledge had a significant indirect effect on WTP through attitudes, with no direct effect detected. This suggests that knowledge enhances favorable attitudes, which in turn increase WTP, but on its own is insufficient to influence payment behavior when vaccine attributes are moderately favorable. In contrast, Scenarios 3 and 4 (100% efficacy, long-term or lifetime protection) exerted both direct and indirect effects of knowledge on WTP. These findings imply that a high perceived vaccine value enables knowledge to independently motivate payment decisions, even without attitudinal mediation. These results align with those of previous studies demonstrating the mediating role of attitudes in health behaviors. For example, research in India during the COVID-19 pandemic and studies on diabetes self-management in China found that attitudes partially or fully mediate the effect of knowledge on health-related behaviors[42,43]. Together, these outcomes support a cognitive–affective model of health decision-making, emphasizing the dual roles of knowledge and attitudes in shaping WTP. Public health strategies should therefore address both cognitive and affective drivers, tailoring communication to the specific characteristics of each vaccine. Emphasizing efficacy, convenience, and long-term protection may strengthen the direct influence of knowledge, while attitudinal reinforcement remains essential for less compelling vaccine profiles.

A number of shortcomings are acknowledged in this study. First, the resource-constrained cross-sectional design enabled us to record relationships only at a certain moment in time, preventing causal inferences. Second, using self-reported data may have placed the researchers at risk of social desirability bias because the participants could have underreported unfavorable behaviors and overreported desirable ones. Third, anchoring effects from the predetermined monetary range may have brought bias into the contingent valuation under the payment card approach, potentially leading to an overestimation or underestimation of genuine WTP. The accuracy of the results is affected when respondents believe the figures presented to be unreasonable or out of proportion with their financial situations.

Future studies should use experimental or longitudinal designs to assess the changes occurring after an intervention and establish causal relationships between health knowledge, attitudes, and WTP. Alternative valuation techniques, such as open-ended questions or discrete choice experiments, may reduce anchoring bias. Generalizability would be enhanced, and the sociodemographic and cultural determinants of vaccine choices would be revealed by extending coverage to larger, more varied populations. For focused communication campaigns, qualitative approaches may also help clarify how vaccine features are perceived.

In conclusion, successfully eliminating HBV infection at both the national and global levels hinges considerably on public awareness and attitudes toward the disease. This underscores the importance of assessing how such initiatives are perceived in Ho Chi Minh City, one of Vietnam's major metropolitan areas. Although most of the participants had limited knowledge about HBV symptoms and transmission, their attitudes regarding vaccination remained positive. Consequently, there is a pressing need for targeted national strategies and intervention programs. These should include education on pathogens and their harmful effects, training, awareness campaigns on HBV and vaccination, and efforts to enhance public understanding of food safety and the importance of seeking appropriate treatment.

Conflict of interest statement

The authors of this work declare that they have no competing interests with the publication of this work.

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Authors' contributions

T.N. developed the theoretical formalism, N.H performed the analytic calculations and performed the numerical simulations. Both B.V. and C.L. authors contributed to the final version of the manuscript. T.N. supervised the project.

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