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Factors associated with hepatitis B vaccination among nursing and midwifery students at the university for development studies, Ghana: an analytical cross-sectional study

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Abstract

Background: Hepatitis B virus (HBV) remains an important occupational health concern for healthcare workers, including nursing and midwifery students who may be exposed to blood and body fluids during clinical training. This study aims to assess the associations of attitude, HBV testing and socioeconomic conditions with hepatitis B vaccination among nursing and midwifery students at the University for Development Studies (UDS), Ghana.

Methods: An analytical cross-sectional study was conducted among nursing and midwifery students at UDS, Tamale, in June 2023. Of 350 students approached, 306 completed a structured questionnaire. Data were analyzed using partial least squares structural equation modelling (PLS-SEM) in SmartPLS 4.3.1 and complementary ordinary least-squares regression in SPSS. The measurement model was assessed using indicator loadings, Cronbach's alpha, composite reliability, average variance extracted (AVE), and the Fornell-Larcker criterion.

Results: Of the 306 respondents, 85.0% had ever tested for HBV, 79.4% reported receiving at least one vaccine dose, and 62.7% reported completing three doses. The PLS-SEM model showed positive associations of attitude (β=0.353, $p<0.001$), HBV testing (β=0.301, $p<0.001$), and socioeconomic conditions (β=0.291, $p<0.001$) with the HBV vaccination construct and explained 76.2% of its variance (R^2=0.762). In the complementary regression analysis, the main-effects model explained 72.5% of the variance in vaccination (R^2=0.725). Adding interaction terms increased R^2 to 0.728 (ΔR^2=0.003); both HBV testing×socioeconomic conditions (β=0.213, $p<0.001$) and attitude×HBV testing (β=0.311, $p<0.001$) were positively associated with vaccination.

Conclusion: Attitude, HBV testing and socioeconomic conditions were positively associated with hepatitis B vaccination among the participating students. Interventions that improve access to HBV testing and vaccination and strengthen occupational-risk awareness may support higher vaccination uptake. Because of the cross-sectional design, these associations should not be interpreted as causal effects.

Keywords: Hepatitis B, Vaccination, Nursing Students, Midwifery Students, Socioeconomic Factors, Ghana

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Background

Hepatitis B virus (HBV) infection remains an important global public-health problem because chronic infection can lead to cirrhosis and hepatocellular carcinoma. The World Health Organization (WHO) estimated that about 240 million people were living with chronic HBV infection in 2024 contributed approximately to 1.1 million deaths in the same year. The WHO African Region accounted for 68% of new chronic HBV infections in 2024, underscoring the continuing need to strengthen prevention, testing and linkage to care in African settings [1,2]. Healthcare workers and students in clinical training are an occupationally relevant population because exposure to blood and body fluids can occur through sharps injuries and other percutaneous or mucosal exposures. HBV vaccination is an effective preventive intervention, while testing provides an entry point for prevention, care and treatment [3,4,5]. WHO guidance also supports hepatitis B immunization for healthcare workers who may be exposed to blood or blood products [2]. Ghana remains an endemic setting for HBV. A systematic review of studies published between 2015 and 2019 estimated HBV prevalence at 8.36% among adults in Ghana, with higher prevalence among some occupational groups [6]. Earlier evidence estimated an overall national HBsAg prevalence of 12.3% [7]. Studies among Ghanaian students and healthcare workers have also documented gaps in testing and completion of

vaccination. Among public-health students in Ghana, 50.4% had never been tested and only 30.5% had completed the three-dose vaccination schedule [8,9]. Among nursing training students in Ho, 60.1% had been tested, 66.8% had received at least one vaccine dose and 49.4% of those vaccinated reported completing the recommended doses [10]. More recent studies among Ghanaian healthcare workers similarly show incomplete adherence to the three-dose schedule and low uptake of post-vaccination serological testing [11-14]. Although these studies provide important evidence, less is known about how attitude, HBV testing and socioeconomic conditions are jointly associated with vaccination among nursing and midwifery students. In particular, evidence from the University for Development Studies (UDS) is limited, despite their transition from classroom learning to clinical practice. This study therefore assessed the associations of attitude towards HBV, HBV testing and socioeconomic conditions with hepatitis B vaccination among nursing and midwifery students at UDS, Tamale. The specific hypotheses were: (H1) more favorable attitudes towards HBV are positively associated with hepatitis B vaccination; (H2) HBV testing is positively associated with hepatitis B vaccination; and (H3) more favorable socioeconomic conditions are positively associated with hepatitis B vaccination.

Methods

Study Design

An analytical cross-sectional study was conducted at the School of Nursing and Midwifery, University for Development Studies (UDS), Tamale, Ghana, in June 2023. The study was reported in accordance with the STROBE recommendations for cross-sectional studies [15].

Study population and eligibility

The study population comprised students enrolled in the UDS School of Nursing and Midwifery. University records indicated a population of 1,555 BSc nursing and midwifery students in levels 100–400. Students were eligible if they were direct nursing or midwifery students, were present on campus during data collection, and provided informed consent. Students who were not direct nursing or midwifery students, were not available during data collection, or did not consent were not included.

Sample size

A classroom-based, non-probability recruitment approach was used. Eligible students present during the data-collection period were approached in their classes and invited to participate. The minimum sample size was estimated using Yamane's formula for a finite population [16]:

$n = N / [1 + N(e^2)]$

where N = 1,555 and e = 0.05.

Thus, $n = 1,555 / [1 + 1,555(0.05^2)] = 318$ students.

A total of 350 students were approached, approximately 10% above the minimum calculated sample. Of these, 306 completed the questionnaire and were included in the analysis, giving a response rate of 87.4% (306/350).

Study instrument, validity and reliability

Data were collected using a structured, closed-ended questionnaire developed from the study objectives. The instrument contained four sections: (A) demographic characteristics; (B) HBV testing and vaccination history; (C) socioeconomic conditions/barriers; and (D) attitudes towards HBV vaccination. Sections A and B contained multiple-choice and dichotomous items. Sections C and D used a five-point Likert response format ranging from 1 (strongly agree) to 5 (strongly disagree). The questionnaire was administered electronically through Google Forms after informed consent. The original study documentation did not provide a formal pilot-testing procedure; accordingly, no unsupported claim of a pilot study has been added in this revision. Measurement quality was assessed empirically in the analytical sample using indicator loadings, Cronbach's alpha, composite reliability (CR), average variance extracted (AVE), and the Fornell-Larcker criterion. Retained reflective indicators had loadings above 0.70, Cronbach's alpha and CR exceeded 0.70, and AVE exceeded 0.50.

Operationalization of socioeconomic conditions

The socioeconomic construct (SCS) was operationalized as an asset/access-based index using reported access to or ownership of household and personal resources, including a smartphone, washing machine, television, refrigerator, microwave, piped water, room-sharing status, and adequacy of monthly pocket money. These indicators were retained as a pragmatic measure of socioeconomic conditions rather than a validated household wealth index. This distinction is important because ownership of individual assets is not, by itself, a validated measure of socioeconomic status. The items were analyzed as reflective indicators within the PLS-SEM measurement model.

Outcome definition

For descriptive reporting, 'ever vaccinated' was defined as self-reported receipt of at least one hepatitis B vaccine dose. 'Complete vaccination' was defined as self-reported receipt of the three-dose primary series. For the PLS-SEM analysis, hepatitis B vaccination was represented as a reflective latent construct using the six retained indicators shown in the measurement model (HBV1, HBV3, HBV4, HBV6, HBV8 and HBV9). HBV testing was based on self-reported history of having been tested for HBV.

Data collection

The questionnaire was distributed through Google Forms. Participants were approached in their classes, provided with information about the study, and invited to provide informed consent before completing the questionnaire. Responses were exported to Microsoft Excel for data management and subsequently analyzed using SmartPLS and SPSS.

Statistical analysis

Descriptive statistics were used to summarize participant characteristics, HBV testing, vaccination status and questionnaire responses. PLS-SEM was conducted using SmartPLS 4.3.1 to evaluate the reflective measurement model and estimate associations among the latent constructs. PLS-SEM was selected because the analytical objective was prediction-oriented and involved multiple latent constructs and indicators [17]. Bootstrapping was used to assess the statistical significance of indicator loadings and structural path coefficients. The measurement model was evaluated using outer loadings,

Cronbach's alpha, composite reliability, AVE and the Fornell-Larcker criterion. A complementary OLS multiple regression analysis was conducted in SPSS to provide a robustness analysis using the composite constructs. Model 1 included HBV testing (HBT), socioeconomic conditions (SCS) and attitude towards HBV (AHB) as predictors of the vaccination outcome. Model 2 added two theoretically specified interaction terms, HBT×SCS and HBT×AHB, to assess moderation. Residual-centering was used before forming the interaction terms. The purpose of the OLS analysis was therefore complementary: PLS-SEM assessed the measurement and latent-variable structural model, whereas OLS assessed the robustness of the associations and whether the relationship between HBV testing and vaccination varied according to socioeconomic conditions and attitude. Interaction terms were interpreted as moderation effects, not mediation or indirect effects. For the regression table, the values in parentheses were treated as standard errors, consistent with the original table footnote. Approximate 95% confidence intervals were calculated as coefficient ±1.96×SE. Statistical significance was considered at $p<0.05$.

Results

Of the 350 students approached, 306 completed the questionnaire and were analyzed (response rate 87.4%). The participants were aged 15–41 years; 190 (62.1%) were female and 116 (37.9%) were male (Table 1).

Table 1. Age and sex distribution of respondents (n = 306)

Characteristic		Frequency (n)%
Age grouping	15–20	51(16.7)
	21–25	86(28.1)
	26–30	80(26.1)
	31–35	67(21.9)
	36–40	21(6.9)
	≥ 41	1(0.3)
Sex of respondents	Female	190(62.1)
	Male	116(37.9)

Attitudes towards HBV vaccination

The attitude responses showed generally favorable views towards HBV vaccination. As reported in the original survey, 80.4% disagreed that they did not need HBV vaccination because of natural immunity; 89.9% agreed that HBV vaccination should be mandatory for health workers and students; 92.5% indicated that religious or traditional beliefs did not prevent vaccination; 76.8% agreed that the vaccine provides adequate protection; 67.0% agreed that students were at risk during practical placement; 92.1% agreed that students should receive HBV vaccination before practical placement; 97.3% agreed that vaccination teams should have adequate supplies; 57.2% agreed that UDS students were keen to receive vaccination; 56.2% disagreed that fear of injection pain would prevent vaccination; and 68.7% agreed that cost was a barrier (Table 2).

Table 2. Respondents attitude toward HBV (n=306)

Attitude statement	Direction reported	Approx. n	Percent (%)
No need for vaccine because of natural immunity	Disagreeing	246	80.4
HBV vaccination should be mandatory for health workers/students	Agreeing	275	89.9
Religious/traditional beliefs do not prevent vaccination	Agreeing	283	92.5
HBV vaccine provides adequate protection	Agreeing	235	76.8
Students are at risk during practical placement	Agreeing	205	67.0
Vaccination before practical placement	Agreeing	282	92.1
Vaccination team should have adequate supplies	Agreeing	298	97.3
Students are keen to receive HBV vaccination	Agreeing	175	57.2
Injection pain would deter vaccination	Disagreeing	172	56.2
Cost is a barrier to vaccination	Agreeing	210	68.7

HBV testing and vaccination status

A total of 260 (85.0%) respondents reported having ever been tested for HBV, while 46 (15.0%) had never been tested. Among those tested, 195 (63.7% of all respondents) reported that their most recent test was more than 6 months earlier, 23 (7.5%) reported testing 1–3 months earlier, 29 (9.5%) 4–6 months earlier, and 13 (4.2%) less than 1 month earlier (Table 3).

Table 3. HBV testing status among respondents (n=306)

Most recent HBV test	n (%)
Never tested	46 (15.0)
Total ever tested:	260 (85.0)
>6 months ago.	195 (63.7)
1–3 months ago.	23 (7.5)
4–6 months ago.	29 (9.5)
<1 month ago.	13 (4.2)

Regarding the reasons for hepatitis B testing, most participants 214 (69.9%) reported that they wanted to know their hepatitis B status, testing due to sickness (19, 6.2%), workplace requirements (15, 4.9%), and admission requirements (12, 3.9%) (Fig.1). Among the 46 respondents who had never tested, reported barriers were lack of money (4.9% of the total sample; approximately 15 respondents), not knowing where to test (3.6%; approximately 11), not wanting to know their status (2.0%; approximately 6), fear of a positive result (2.6%; approximately 8), fear of stigma (1.3%; approximately 4), and not seeing the need to test (0.7%; approximately 2) (Fig.2). Regarding hepatitis B vaccination status, 192 participants (62.7%) reported receiving the complete three-dose primary series, while 51 (16.7%) had received only one or two doses. Notably, 63 participants (20.6%) reported never receiving hepatitis B vaccination (Table 4).

Table 4. Self-reported hepatitis B vaccination status (n=306)

Vaccination status	Frequency (n)%
Never vaccinated	63 (20.6)
1–2 doses	51(16.7)
3 doses (complete primary series)	192(62.7)

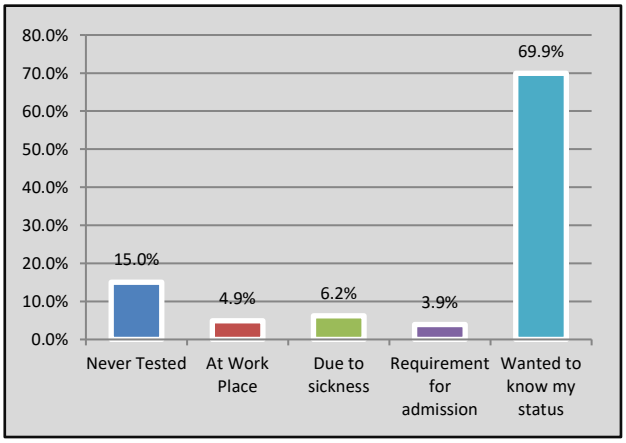


Figure 1. Reasons for Testing for HBV.

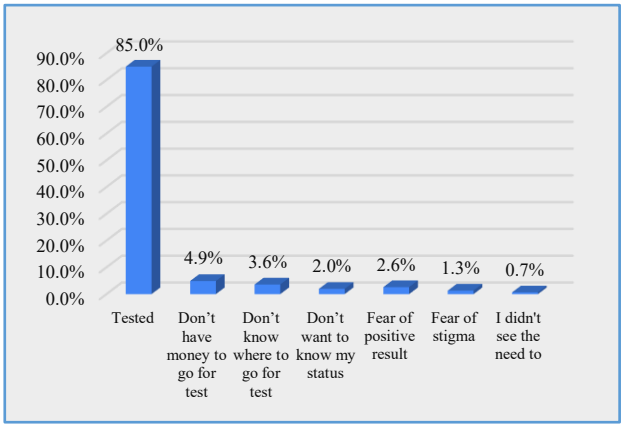


Figure 2. Reasons for Not Testing for HBV.

Socioeconomic conditions

The asset/access responses indicated that 81.7% reported using a smartphone, 16.3% using a washing machine, 73.9% having a television in the room, 71.2% having a refrigerator, 24.8% having a microwave, 77.5% having family access to piped water, 36.9% having no roommate, and 25.2% receiving enough monthly pocket money from parents. These indicators were used as components of the SCS construct; they are not presented as a validated wealth index.

Table 5. Selected socioeconomic/access indicators reported in the original survey (n=306).

Asset/access indicator	Approx. n (%)
Smartphone use	250 (81.7)
Washing machine	50 (16.3)
Television in room	226 (73.9)
Refrigerator in room	218 (71.2)
Microwave in room	76 (24.8)
Family access to piped water	237 (77.5)
No roommate	113 (36.9)
Enough monthly pocket money	77 (25.2)

PLS-SEM measurement model

The PLS-SEM measurement model showed acceptable internal consistency and convergent validity. Cronbach's alpha ranged from 0.746 to 0.895, composite reliability from 0.855 to 0.916, and AVE from 0.576 to 0.663. All retained outer loadings shown in Table 6 exceeded 0.70. The Fornell-Larcker matrix showed the square root of AVE on the diagonal exceeding the corresponding inter-construct correlations (Table 6,7,8).

Table 6. Retained reflective indicator loadings from the PLS-SEM model (n=306).

Construct	Indicator	Outer loading
AHB	AHB1	0.753
AHB	AHB5	0.760
AHB	AHB6	0.713
AHB	AHB7	0.748
AHB	AHB8	0.735
AHB	AHB9	0.732
HBT	HBT3	0.771
HBT	HBT5	0.737
HBT	HBT6	0.701
HBT	HBT7	0.709
HBT	HBT8	0.712
HBT	HBT9	0.724
SCS	SCS3	0.723
SCS	SCS4	0.730
SCS	SCS5	0.714
SCS	SCS6	0.729
SCS	SCS7	0.725
SCS	SCS8	0.714
HBV	HBV4	0.736
HBV	HBV1	0.733
HBV	HBV3	0.739
HBV	HBV6	0.737
HBV	HBV8	0.712
HBV	HBV9	0.712

Table 7. Internal consistency and convergent validity

Construct	Cronbach's α	Composite reliability	AVE
AHB	0.895	0.916	0.576
HBT	0.746	0.855	0.663
SCS	0.884	0.910	0.590
HBV	0.891	0.914	0.604

Table 8. Fornell-Larcker discriminant validity matrix

Construct	AHB	HBT	SCS	HBV
AHB	0.894			
HBT	0.678	0.814		
SCS	0.532	0.615	0.940	
HBV	0.776	0.535	0.544	0.890

Structural model and hypotheses

The structural model showed positive associations between the three explanatory constructs and HBV vaccination. Attitude towards HBV was positively associated with vaccination (β=0.353, p<0.001), HBV testing was positively associated with vaccination (β=0.301, p<0.001), and socioeconomic conditions were positively associated with vaccination (β=0.291, p<0.001) (Table 9). The model explained 76.2% of the variance in the HBV vaccination construct (R^2=0.762). These values correspond to the path coefficients and p-values displayed in the retained PLS-SEM model (Figure 3).

Table 9. PLS-SEM structural path results (n=306).

Hypothesis	Path	β	p-value	Decision
H1	AHB → HBV	0.353	<0.001	Supported
H2	HBT → HBV	0.301	<0.001	Supported
H3	SCS → HBV	0.291	<0.001	Supported

Note: The path coefficients and p-values were harmonized to the values displayed in the retained PLS-SEM path model; the internally inconsistent t-statistics in the original hypothesis table were not carried forward.

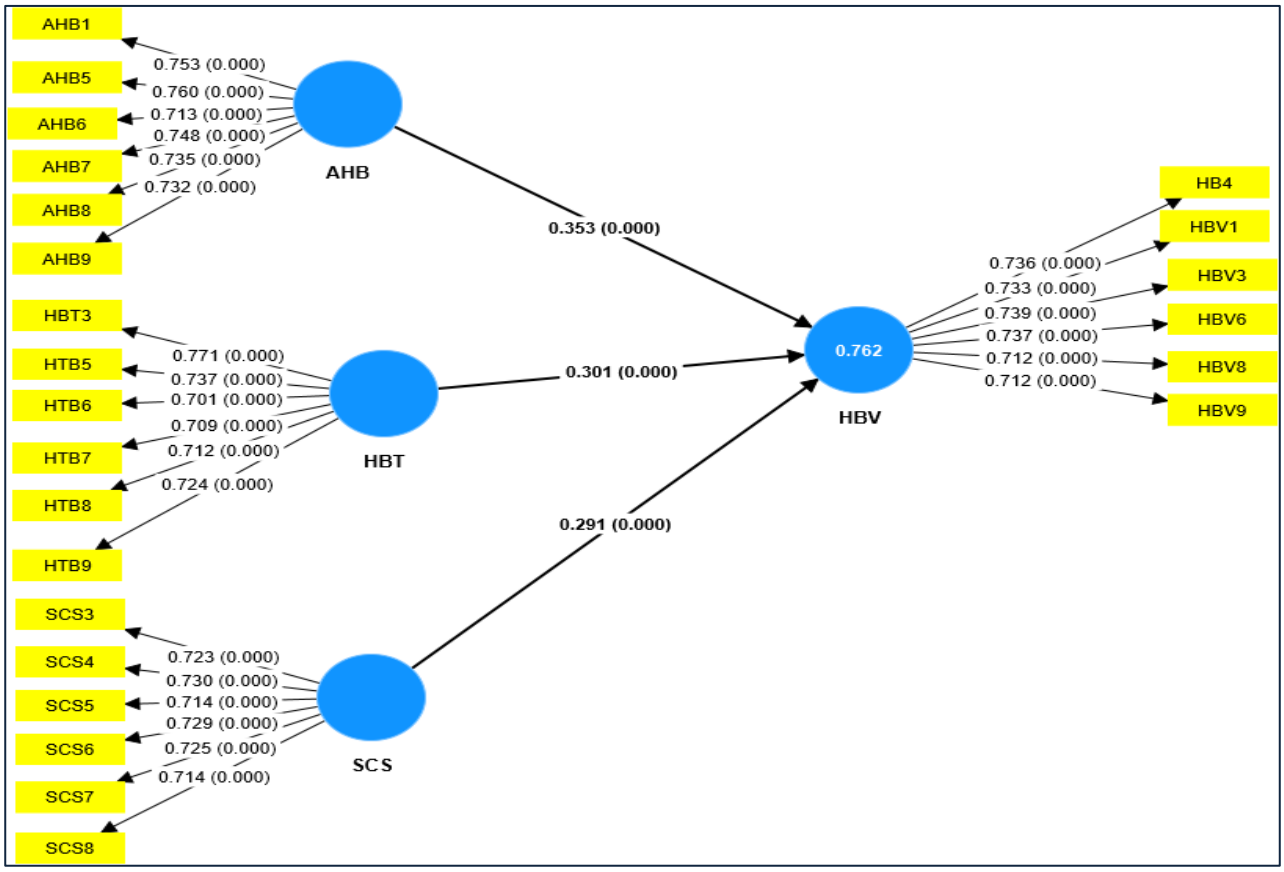


Figure 3. PLS-SEM structural model showing retained indicator loadings, path coefficients and R^2 for the HBV vaccination construct

Complementary OLS regression and moderation analysis

In the complementary OLS analysis, Model 1 explained 72.5% of the variance in vaccination (R^2=0.725; adjusted R^2=0.723; F=330.85). Model 2 explained 72.8% (R^2=0.728; adjusted R^2=0.725; F=208.18), representing an R^2 increase of 0.003 (0.3 percentage points). The HBT×SCS interaction was positive (β=0.213, SE=0.001, approximate 95% CI 0.211–0.215, p<0.001), as was the AHB×HBT interaction (β=0.311, SE=0.003, approximate 95% CI 0.305–0.317, p<0.001). The main effects in Model 2 were also positive for HBT (β=0.510, SE=0.060), SCS (β=0.136, SE=0.006) and AHB (β=0.152, SE=0.023). The interaction terms were interpreted as moderation effects (Table 10).

Table 10. Complementary OLS regression and moderation analysis (n=306).

Predictor/statistic	Model 1	Model 2
Constant	0.325 (0.236)	0.462 (0.472)
HBT	0.277 (0.021)	0.510 (0.060)
SCS	0.175 (0.022)	0.136 (0.006)
AHB	0.317 (0.022)	0.152 (0.023)
HBT × SCS		0.213 (0.001); 95% CI 0.211–0.215
AHB × HBT		0.311 (0.003); 95% CI 0.305–0.317
R^2	0.725	0.728
Adjusted R^2	0.723	0.725
F	330.85	208.18
N	306	306

Discussion

The present study found high self-reported HBV testing and vaccination uptake among nursing and midwifery students at UDS. The 85.0% testing prevalence is higher than the 49.6% testing prevalence reported among undergraduate public-health students in Ghana by Osei et al. [8] and the 60.1% reported among nursing training students in Ho by Aniaku et al. [10]. The difference may reflect the clinical orientation of the UDS sample, differences in institutional requirements, access to testing, or differences in study period and population. The present findings therefore extend earlier Ghanaian evidence by showing that high testing uptake can coexist with incomplete vaccination among nursing and midwifery students. The vaccination findings also differ from earlier Ghanaian student studies. In the present study, 79.4% reported at least one dose and 62.7% reported completing three doses. By comparison, Osei et al. [8] reported 44.2% receiving at least one dose and 30.5% completing the three-dose series among public-health students, while Aniaku et al. [10] reported 66.8% ever vaccinated and 49.4% complete vaccination among nursing training students in Ho, Ghana. A multi-university Ghanaian study reported that only 38.2% of students had been vaccinated and 57.3% had not completed the full three-dose series [9]. The higher uptake observed at UDS may reflect the study population's clinical exposure, institutional context or differences in access to vaccination, although these explanations were not directly tested in this study. The role of cost remains important. In the current study, 68.7% of respondents agreed that cost was a barrier, yet 62.7% reported completing the three-dose series. This suggests that perceived cost barriers do not necessarily translate into non-vaccination when other enabling

conditions are present. Ghanaian studies among nursing students and healthcare workers have similarly identified cost as a barrier [10,11]. More recent Ghanaian healthcare-worker studies have also demonstrated incomplete three-dose adherence, reinforcing the need for convenient and affordable vaccination services for clinical personnel and students [12,13]. The PLS-SEM results showed positive associations of attitude, HBV testing and socioeconomic conditions with vaccination. These findings are consistent with the broader Ghanaian literature in which knowledge, risk perception, training and access-related factors have been associated with HBV prevention behaviors [10-14]. However, the magnitude of the associations should be interpreted as model-based relationships rather than causal effects. The complementary OLS analysis produced a small increase in explained variance after adding the interaction terms (ΔR^2=0.003), although both interaction coefficients were positive. The moderation analysis therefore suggests that the relationship between HBV testing and vaccination may vary with socioeconomic conditions and attitude; it does not demonstrate an indirect pathway or mediation. The findings have practical implications for universities and clinical training programmes. WHO identifies vaccination and improved access to testing as central components of the hepatitis response, and current guidance supports hepatitis B immunization for healthcare workers at risk of blood exposure [1,2]. Ghanaian evidence further indicates that adherence to the complete vaccination protocol and post-vaccination serological testing remains suboptimal among healthcare workers [12-14]. Universities can therefore strengthen pre-clinical-placement education, facilitate access to HBV testing and vaccination, maintain documentation of vaccine doses, and link students who test positive to appropriate clinical care. Such approaches are more directly supported by the present data than making testing or vaccination a universal admission condition. The findings indicate that improving access to HBV testing and vaccination, alongside strengthening risk awareness and reducing financial and logistical barriers, may be useful components of occupational-health programmes for nursing and midwifery students. The study also provides local evidence for universities and health-training institutions to monitor vaccination completion rather than relying only on whether a student has received any dose. The study contributes to the evidence base on HBV prevention among Ghanaian health-professional students by examining attitude, testing and socioeconomic conditions within a single analytical framework. The results support institutional planning for accessible HBV prevention services and reinforce the importance of documenting completion of the three-dose vaccination series. This study has several limitations. First, the cross-sectional design does not establish temporality or causality; the observed associations should not be interpreted as evidence that attitude, testing or socioeconomic conditions caused vaccination. Second, HBV testing and vaccination histories were self-reported and may be affected by recall and social-desirability bias. Third, the study was conducted at a single university and used classroom-based non-probability recruitment, which may limit generalizability. Fourth, the socioeconomic construct was based on selected assets and access indicators rather than a validated household wealth scale. Fifth, vaccination and testing were not independently verified from clinical records or laboratory results. Finally, the original study documentation did not retain the external source spreadsheet used to generate the Likert charts; therefore, exact item-level frequencies for every Likert response category could not be independently reconstructed and no unsupported values have been inserted into this revision.

Conclusion

Among nursing and midwifery students at UDS, HBV testing, favorable attitudes towards HBV vaccination and more favorable socioeconomic conditions were positively associated with the HBV vaccination construct. Most respondents reported having been tested and having received at least one vaccine dose, but complete three-dose vaccination remained lower than ever vaccination. The cross-sectional design and self-reported measures mean that the observed relationships should be interpreted as associations rather than causal effects. Universities and clinical training institutions should facilitate affordable, convenient HBV testing and vaccination for students before and during clinical training, consistent with applicable national and institutional policy. Institutions should strengthen pre-clinical-placement education on occupational HBV risk, vaccination schedules, and the importance of completing the three-dose series. Vaccination records should be maintained to distinguish students who have received any dose from those who have completed the recommended primary series. Post-vaccination anti-HBs assessment should be considered for healthcare personnel and students according to applicable occupational-health guidance rather than being recommended indiscriminately for every vaccinated person. Future multicentre studies should use probability sampling and validated socioeconomic measures, and should verify vaccination, testing and serological outcomes from clinical records or laboratory results.

Abbreviation

HBV: Hepatitis B Virus; UDS: University for Development Studies; PLS-SEM: Partial Least Squares Structural Equation Modelling; AVE: Average Variance Extracted; WHO: World Health Organization; CR: Composite Reliability; SCS: Socioeconomic Construct.

Declaration

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None.

Availability of data and materials

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request by emailing sabina.wireko@cug.edu.gh.

Authors' contributions

All authors contributed equally to design the study, collected the data, performed the statistical analyses, the interpretation of the data, critically revised the manuscript, and approved the final version. All authors read and approved the final manuscript.

Ethics approval and consent to participate

We conducted the research in accordance with the Declaration of Helsinki. Ethical approval was obtained from the University for Development Studies Institutional Review Board before data collection (approval no. UDS/RB/025/23). Participation was voluntary and based on informed consent. All participants provided informed consent prior to participation. The survey did not require participants to provide identifying information in the questionnaire.

Consent for publication

Not applicable

Competing interest

The authors declare that they have no competing interests.

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