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Serological Evidence of Hepatitis B Virus Vaccination Among University Students in Lafia, Nigeria

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Abstract

Background

Hepatitis B virus (HBV) vaccination is highly effective, yet protection is not guaranteed to be lifelong, and evidence on how long vaccine-induced immunity persists among Nigerian university students remains limited. This study assessed serological evidence of protection against HBV among vaccinated students of the Federal University of Lafia (FULAFIA) and examined the factors associated with its persistence.

Methods

A descriptive cross-sectional study was conducted among 120 students with a documented or self-reported history of HBV vaccination. Structured questionnaires captured demographic, vaccination, and lifestyle data, and venous blood samples were screened using an HBV rapid diagnostic test (RDT) combo panel (HBsAg, anti-HBs, HBeAg, HBeAb, HBcAb). Associations between anti-HBs status and selected variables were tested using chi-square and Fisher's exact tests ($\alpha = 0.05$).

Results

Detectable anti-HBs was found in 51.7% (62/120) of participants; 48.3% (58/120) showed no serological evidence of protection. One participant (0.8%) was HBsAg-positive with a marker profile consistent with chronic HBeAg-negative phase infection. Time since last vaccination was the strongest correlate of protection ($\chi^2 = 56.92$, df = 4, $p < 0.001$), with protection falling from 87.9% in those vaccinated under 5 years ago to 0.0% beyond 15 years. Age at vaccination was also significant ($\chi^2 = 39.19$, df = 3, $p < 0.001$), whereas current age group ($p = 0.272$), sex ($p = 0.417$), and number of doses received ($p = 0.052$) were not.

Conclusions

Nearly half of vaccinated students at this Nigerian university no longer show serological evidence of protection against HBV, driven principally by time elapsed since vaccination rather than by demographic characteristics. These findings support the introduction of post-vaccination serological screening and targeted booster vaccination in university health services, and add university-level evidence to the ongoing debate over WHO's no-routine-booster guidance in high-endemicity settings.

Trial registration:

Not applicable.

Background

Hepatitis B virus (HBV) remains a major global public health problem, with more than 250 million people living with chronic infection and substantial mortality from its long-term hepatic sequelae [1, 2]. Sub-Saharan Africa is among the most heavily affected regions, with prevalence estimates of 5–10% in some populations [3], and Nigeria in particular continues to report high rates of both acute and chronic infection [4]. Localised data from Lafia, Nasarawa State, place community HBV prevalence at 6–9% [5], underscoring the ongoing local relevance of the infection.

Vaccination remains the most effective tool for HBV prevention, conferring protection in more than 90% of healthy individuals who complete the standard three-dose series [6], mediated by production of hepatitis B surface antibody (anti-HBs) at or above the internationally recognised protective threshold of 10 mIU/mL [7]. However, this protection is not universally durable. Antibody titres can decline over time even among individuals who mounted an adequate initial response, and a subset of vaccinees never seroconvert at all — so-called non-responders [8]. Reported determinants of variable and waning vaccine-induced immunity include host factors (age, genetic background, nutritional status, co-existing illness), vaccine-related factors (dosing completeness, cold-chain integrity), and, importantly, time elapsed since vaccination itself [8, 9]. Age at the time of vaccination also appears to matter independently: individuals vaccinated in infancy have been reported to show lower long-term antibody persistence than those vaccinated later in life, plausibly reflecting the relative immaturity of the neonatal immune system [10].

Nigeria incorporated HBV vaccine into its National Programme on Immunization in 2004 [11], meaning the first cohorts to have received a complete, programme-delivered HBV vaccination series are now of university age. This creates a timely opportunity — and, from a health-systems perspective, a pressing need — to determine whether documented childhood vaccination still translates into measurable protection as this cohort enters an environment associated with elevated blood- and body-fluid exposure risk. Yet published evidence specifically addressing the durability of vaccine-induced anti-HBs among vaccinated young adults in Lafia is lacking [5], which limits the ability of university health services and state policymakers to design evidence-based interventions such as catch-up vaccination, targeted boosters, or routine post-vaccination screening.

This question also intersects with an unresolved point of global policy. The World Health Organization (WHO) does not currently recommend universal HBV booster doses, on the basis that immune memory is generally assumed to provide durable protection even after measurable antibody decline [2]. This position, however, is derived largely from data generated in lower-endemicity, higher-resource settings, and it remains unclear whether it is equally applicable in a hyperendemic country such as Nigeria, where the consequences of an undetected immunity gap may be more consequential.

This study therefore assessed the proportion of HBV-vaccinated FULAFIA students with detectable anti-HBs antibodies using RDT-based screening, examined the factors — age, sex, and time since vaccination

in particular — associated with variation in antibody detection, and estimated the proportion of vaccinated students who may require booster vaccination.

Methods

Study design and setting

A descriptive cross-sectional study was conducted among vaccinated students at the Federal University of Lafia (FULAFIA), Nasarawa State, north-central Nigeria. Geographically, Lafia lies between latitude 8.49°N and longitude 8.52°E. FULAFIA is a tertiary institution with a diverse, nationally drawn student population and an on-campus health centre providing preventive and curative services, including vaccination and laboratory investigations.

Study population and eligibility

The target population comprised FULAFIA students with a documented or self-reported history of at least one dose of HBV vaccine. Students who had received one or more vaccine doses and who provided informed consent were eligible for inclusion; students who had never received an HBV vaccine, or who declined consent, were excluded.

Sample size and sampling technique

The minimum required sample size was calculated using Fisher's formula for cross-sectional prevalence studies [12, 13]: $n = Z^2pq/d^2$, where $Z = 1.96$ (95% confidence level), $p = 0.067$, $q = 1 - p$, and $d = 0.05$ (margin of error). No local estimate of the proportion of vaccinated students with protective anti-HBs was available at the planning stage, so p was taken from the prevalence of HBV infection (6.7%) reported among students of a Nigerian tertiary institution [14]. This yielded a minimum sample size of 96. A total of 120 students were recruited to improve precision. Because the observed proportion with detectable anti-HBs (51.7%) was higher than the value assumed at planning, the study is interpreted as an exploratory baseline, and the precision actually achieved is reported as a 95% confidence interval [12, 13]. Participants were selected using purposive sampling, as documented HBV vaccination history, rather than membership of the general student population, was the defining eligibility criterion.

Data collection

Demographic characteristics, vaccination history, lifestyle and behavioural factors, and medical and exposure history were collected using a structured, interviewer-administered questionnaire covering socio-demographic information, HBV vaccination history, lifestyle and behavioural factors, medical and immunological history, risk and exposure history, and HBV-related knowledge and awareness. The questionnaire and screening protocol were reviewed by experts in immunology, public health, and

medical laboratory science prior to use, and a pilot study was conducted among students outside the eligible sample to assess consistency of responses and RDT performance.

Approximately 2–3 mL of venous blood was collected by venipuncture from the antecubital fossa under aseptic conditions using sterile disposable needles and syringes, in accordance with standard phlebotomy practice [15]. Samples were labelled with a unique participant identifier and transported to the Medical Laboratory Science teaching laboratory, FULAFIA, for same-day analysis.

Serological screening

Serological evidence of protection was assessed using an HBV rapid diagnostic test (RDT) combo panel targeting hepatitis B surface antigen (HBsAg), hepatitis B surface antibody (anti-HBs), hepatitis B e-antigen (HBeAg), hepatitis B e-antibody (HBeAb), and total hepatitis B core antibody (HBcAb), following manufacturer instructions and WHO guidance on lateral-flow immunochromatographic HBV testing [7, 16, 35]. A drop of whole blood was applied to the sample well of each cassette, followed by the manufacturer-specified volume of assay buffer; results were read at 10–15 minutes and considered invalid if read after 20 minutes. Anti-HBs positivity (test line present alongside a valid control line) was taken as serological evidence of protection; anti-HBs negativity was interpreted as absence of detectable protection, prompting recommendation for a booster dose.

Statistical analysis

Data were analysed descriptively (frequencies and percentages, presented in tables and charts) and by chi-square tests of independence to examine the association between anti-HBs status and each explanatory variable, with Fisher's exact test used as a robustness check where more than 20% of expected cell counts were below 5. Statistical significance was set at $\alpha = 0.05$.

Ethical considerations

Ethical approval

was obtained from the Federal University of Lafia Directorate of Research and Creative Thoughts Ethical Review Committee (Ref: FUL/DIRECT/ECC/2026/HU:008). Written informed consent was obtained from adult participants while minors among them had parental consent to join the study after the purpose, procedures, risks, and benefits of the study were explained; participation was voluntary, and participants could withdraw at any time without consequence in line with the Declaration of Helsinki to ensure responsible conduct of research. Participant identity was protected throughout, and results were reported in de-identified, coded form. A copy of the research questionnaire and consent form developed and used for this study have been supplied in the supplementary files accompanying this manuscript

Results

Socio-demographic and vaccination characteristics

Of the 120 participants, the majority (72.5%) were aged 20–24 years, 59.2% were male, and 99.2% were single. Academic level was broadly evenly distributed across the five undergraduate years (13.3–24.2% per level) (Table 1). Most participants (73.3%) had completed the full three-dose vaccination series, and 55.0% had been vaccinated during adolescence rather than infancy (8.3%) or childhood (16.7%), a pattern consistent with catch-up immunization in settings where birth-dose coverage has historically been incomplete [11, 17]. A substantial majority (59.2%) had received their last dose more than 10 years previously, consistent with this cohort corresponding to the early years of Nigeria's National Programme on Immunization [11]. Only 2.5% reported ever having received a booster dose (Table 2).

Table 1
Socio-demographic characteristics of participants (n = 120)

Characteristic	Category	n	%
Age group (years)	15–19	14	11.7
	20–24	87	72.5
	25–29	17	14.2
	> 30	2	1.7
Sex	Male	71	59.2
	Female	49	40.8
Academic level	100	16	13.3
	200	29	24.2
	300	29	24.2
	400	23	19.2
	500	23	19.2
Marital status	Single	119	99.2
	Married	1	0.8

Table 2
Vaccination history of participants (n = 120)

Characteristic	Category	n	%
Doses received	1 dose	12	10.0
	2 doses	20	16.7
	3 doses	88	73.3
Age at vaccination	At birth/infancy	10	8.3
	Childhood	20	16.7
	Adolescence	66	55.0
	Adulthood	24	20.0
Time since last vaccination	< 5 years	33	27.5
	5–10 years	37	30.8
	10–15 years	34	28.3
	15–20 years	6	5.0
	> 20 years	10	8.3
Received booster dose	Yes	3	2.5
	No	117	97.5

Lifestyle and behavioural characteristics

No participant reported current smoking. Sharing of sharp objects (40.0%) and exposure to blood or body fluids during clinical training or otherwise (40.8%) were the most commonly reported risk behaviours, consistent with previously documented HBV exposure routes among Nigerian university students [29, 30]; tattoos or piercings were reported by 30.8%, and 10.0% reported being sexually active (Table 3). Only 42.5% of participants were aware that HBV vaccination does not guarantee lifelong protection.

Table 3
Lifestyle and behavioural risk distribution (n = 120)

Risk factor	Yes, n (%)	No, n (%)
Drinks alcohol	13 (10.8)	107 (89.2)
History of blood transfusion	3 (2.5)	117 (97.5)
History of surgery	7 (5.8)	113 (94.2)
Has tattoos/piercings	37 (30.8)	83 (69.2)
Shares sharp objects	48 (40.0)	72 (60.0)
Sexually active	12 (10.0)	108 (90.0)
Exposed to blood/body fluids	49 (40.8)	71 (59.2)
Aware vaccination ≠ lifelong protection	51 (42.5)	69 (57.5)

Serological findings

Detectable anti-HBs was found in 51.7% (62/120) of participants, while 48.3% (58/120) had no serological evidence of protection. One participant (0.8%) tested HBsAg-positive; this individual was also HBeAg-negative, HBeAb-positive, and HBcAb-positive, a profile consistent with chronic HBV infection in the HBeAg-negative phase rather than a resolved past infection, and was HBsAb-negative (Tables 4 and 5).

Table 4
Distribution of serological markers and final clinical interpretation (n = 120)

Marker/status	Category	n	%
HBsAg	Positive	1	0.8
	Negative	119	99.2
Anti-HBs (HBsAb)	Positive (protected)	62	51.7
	Negative (susceptible)	58	48.3
HBeAg	Negative	120	100.0
HBeAb	Positive	1	0.8
	Negative	119	99.2
HBcAb (total)	Positive	1	0.8
	Negative	119	99.2
Final interpretation	Protected	62	51.7
	Booster recommended	57	47.5
	Infected (active/chronic)	1	0.8

Table 5
Extended serological profile of the HBsAg-positive participant

Marker	Result	Standard interpretation
HBsAg	Positive	Virus currently present
HBsAb (anti-HBs)	Negative	No protective surface antibody detected
HBeAg	Negative	Not in the high-replicative phase
HBeAb	Positive	Seroconversion from HBeAg to HBeAb
HBcAb (total)	Positive	Confirms current or past viral exposure

Factors associated with anti-HBs status

Chi-square analysis of the three factors specified in the study hypothesis showed no significant association between anti-HBs status and current age group ($\chi^2 = 3.91$, df = 3, $p = 0.272$) — unsurprising given the cohort's narrow age range, since immunosenescence is typically described as a phenomenon of adulthood beyond 40 years [31] — or sex ($\chi^2 = 0.66$, df = 1, $p = 0.417$; Fisher's exact $p = 0.356$), but a highly significant association with time since last vaccination ($\chi^2 = 56.92$, df = 4, $p < 0.001$), with protection declining from 87.9% among those vaccinated under 5 years previously to 73.0% (5–10 years), 17.6% (10–15 years), and 0.0% beyond 15 years (Table 6).

Supplementary analyses examining additional variables relevant to Objective 2 showed a significant association between anti-HBs status and age at vaccination ($\chi^2 = 39.19$, df = 3, $p < 0.001$; 0.0% protected among those vaccinated at birth/infancy versus 79.2% among those vaccinated in adulthood) and academic level ($\chi^2 = 17.31$, df = 4, $p = 0.002$, a non-monotonic pattern most plausibly reflecting mixed age and vaccination-cohort effects across levels rather than a direct effect of academic level itself [32]). A visible dose-response gradient was observed across number of vaccine doses received (25.0% for one dose, 40.0% for two doses, 58.0% for three doses) that approached but did not reach conventional significance ($\chi^2 = 5.90$, df = 2, $p = 0.052$). Sharing of sharp objects showed a significant but counter-intuitive inverse association with protection ($\chi^2 = 3.91$, df = 1, $p = 0.048$; Fisher's exact $p = 0.040$), most plausibly confounded by age or vaccination-cohort effects rather than reflecting a direct causal relationship. No significant association was found between anti-HBs status and alcohol consumption, tattoos/piercings, sexual activity, or blood/body-fluid exposure (all $p > 0.05$) (Table 6).

Table 6
Summary of chi-square tests of association with anti-HBs status

Factor	χ^2	df	p-value	Verdict
Age group*	3.91	3	0.272	Not significant
Sex*	0.66	1	0.417	Not significant
Time since vaccination*	56.92	4	< 0.001	Significant
Doses received	5.90	2	0.052	Borderline (NS)
Age at vaccination	39.19	3	< 0.001	Significant
Academic level	17.31	4	0.002	Significant
Shares sharp objects†	3.91	1	0.048	Significant
Alcohol consumption	0.02	1	0.899	Not significant
Tattoos/piercings	0.41	1	0.523	Not significant
Sexually active	0.03	1	0.855	Not significant
Exposure to blood/fluids	0.09	1	0.762	Not significant

**Denotes the three factors tested directly under the study's stated hypothesis.*

†Exploratory finding, possibly confounded (see Discussion).

Overall, the pattern of results supported rejection of the null hypothesis, driven specifically by time since vaccination: current demographic profile (age, sex) did not explain variation in seroprotection, whereas the temporal process of antibody waning did.

Discussion

This study set out to determine whether documented HBV vaccination history among FULAFIA students still translates into measurable serological protection, and found that it does not do so reliably. Just over half (51.7%) of the vaccinated cohort had detectable anti-HBs, meaning nearly half no longer showed serological evidence of immunity. This is below the retention reported among South Korean adults with well-documented, complete vaccination schedules [18], but is broadly consistent with the time-dependent decline described among Ethiopian adults [19] and with other Nigerian university cohorts [5, 20].

The most striking finding was the strength of time since vaccination as a predictor of current serostatus, with protection falling from 87.9% within five years of vaccination to 0.0% beyond fifteen years, a decline consistent with the trajectories reported in South Korean, Italian, and Turkish cohorts and in a global meta-analysis of vaccinees, and with the 20-year decline documented among healthcare workers vaccinated in childhood [5, 6, 18, 21, 22, 23]. Age at vaccination was independently significant, consistent with reports that vaccine timing relative to age can influence the durability of the antibody response, plausibly reflecting the relative immaturity of the neonatal immune system [10, 24]. By contrast, current age group, sex, and number of doses received showed no significant association with protection — a pattern arguing against the use of easily observable demographic traits as a proxy for protection status. In practice, this means a university health service cannot assume that “fully vaccinated,” “female,” or “younger” students are protected; time elapsed since vaccination is the variable that matters.

The identification of one HBsAg-positive participant, with a marker profile consistent with a low replicating chronic HBeAg-negative phase infection (not resolved). The participant is infected but not currently infectious, as the negative HBeAg reflects minimal viral replication however, HBV-DNA viral load, liver enzyme testing, and long-term hepatology follow-up are still warranted. This case is numerically small but clinically and programmatically meaningful. It demonstrates that active infection can persist undetected even within a population presumed to be at comparatively lower risk by virtue of vaccination history, echoing the rationale behind RDT-based screening programmes elsewhere in Africa that have similarly surfaced infections not identifiable through symptom-based case-finding alone [25]. This finding illustrates that documented vaccination history alone cannot substitute for serological confirmation [26], and reinforces the case for screening having clinical value independent of its research value.

Viewed through a health-behaviour lens, these findings highlight the potential influence of perceived susceptibility and awareness on hepatitis B prevention practices. Students vaccinated during early childhood may have limited recollection of their vaccination history and may therefore be less inclined to seek post-vaccination screening or reassess their immune status. Research among health sciences students in Somalia has demonstrated suboptimal completion of hepatitis B vaccination, with vaccine availability, cost, attitudes and practices identified as relevant factors [27, 28]. These findings underscore the importance of targeted health education, accessible screening services and interventions that strengthen students' understanding of hepatitis B prevention. Fewer than half of participants (42.5%) were aware that vaccination does not guarantee lifelong protection, even though sharing of sharp

objects and exposure to blood or body fluids remained common in this population — suggesting that the biological gap in protection and the psychological gap in perceived risk are widening in parallel rather than being independently managed.

Taken together, these findings challenge the implicit assumption, reflected in the absence of any routine post-vaccination screening policy in Nigeria, that childhood HBV vaccination is a “set and forget” intervention. They add Nigerian university-specific evidence to the broader debate over WHO's no-routine-booster guidance [2], suggesting that in high-endemicity settings the guidance may warrant more localised scrutiny rather than uniform global application.

Limitations

This study is limited by its cross-sectional design, which precludes causal inference; its modest, single-institution sample, which limits generalisability and statistical power for some subgroup comparisons (for example, the borderline dose-response association); and its reliance on self-reported vaccination and behavioural history, which is subject to recall bias. Larger, multi-centre studies incorporating molecular confirmation would strengthen these findings.

Conclusions

Among vaccinated students at this Nigerian university, detectable protection against HBV was present in only just over half of participants, and its principal correlate was time elapsed since vaccination rather than current age, sex, or dose completeness. In a country where HBV prevalence consistently exceeds 8% in many communities [33], this immunity gap constitutes a genuine public health concern. These findings indicate that childhood HBV immunization under Nigeria's National Programme on Immunization, while essential for reducing early-life transmission, cannot be assumed to confer durable protection through the high-exposure university years. They support incorporating anti-HBs screening into university health service protocols — using RDT platforms that are inexpensive and field-validated enough to support routine, on-the-spot use [34] — prioritising booster vaccination for students without detectable protection, particularly those in health-science disciplines with occupational exposure risk, and revisiting, at a national policy level, whether the current no-routine-booster guidance remains appropriate for a hyperendemic setting such as Nigeria.

Abbreviations

HBV
Hepatitis B virus
HBsAg
Hepatitis B surface antigen
HBsAb/anti-HBs
Hepatitis B surface antibody

HBeAg
Hepatitis B e-antigen
HBeAb
Hepatitis B e-antibody
HBcAb
Hepatitis B core antibody (total)
RDT
Rapid diagnostic test
WHO
World Health Organization
NPI
National Programme on Immunization
NPHCDA
National Primary Health Care Development Agency
FULAFIA
Federal University of Lafia
CLSI
Clinical and Laboratory Standards Institute
mIU/mL
milli-international units per millilitre.

Declarations

Ethics approval and consent to participate

Ethical approval was obtained from the Federal University of Lafia Directorate of Research and Creative Thoughts Ethical Review Committee (Ref: FUL/DIRECT/ECC/2026/HU:008). Written informed consent to participate was obtained from all participants.

Consent for publication

Not applicable.

Availability of data and materials

The dataset generated and/or analysed during the current study is available from the corresponding author on reasonable request.

Competing interests

The authors declare that they have no competing interests.

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Authors' contributions

Emmanuel Ojoka Eleojo designed the study, collected and analysed the data, and drafted the manuscript. Dr. Solomon S. Chollom supervised the study and critically revised the manuscript. All authors read and approved the final manuscript.

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Authors' information

Not applicable.

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