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Adherence to the three-component Hepatitis B virus vaccination protocol among healthcare workers in hepatitis B virus endemic settings in Ghana

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ABSTRACT

Background: The WHO and CDC recommend that HCWs who are at risk of HBV infection should vaccinate as adults early in their career by receiving 3 doses of HB vaccine at a schedule of months 0,1,6 and perform post-vaccination serological testing 1–2 months after vaccination. This study assessed adherence to all three components of the HBV vaccination program.

Methods: The study was a hospital-based analytical cross-sectional study involving 340 HCWs who were randomly selected. A pretested questionnaire was used to collect data which was analyzed using SPSS version 21. The proportion of HCWs adhering to the three components of the HBV vaccination protocol was computed. The multivariable analysis procedure identified the factors associated with overall adherence. Odds ratios were estimated with corresponding confidence intervals with the level of significance set at 0.05.

Results: HBV vaccination coverage was 60.9 % and adherence to 3-doses, 0,1,6 vaccination schedules and post-vaccination serological testing were 46.8 %, 38 % and 13 % respectively. Overall adherence was intermediate at the population level with only 6.2 % of the study participants adhering to all three components of the HBV vaccination protocol. HCWs who had low-risk perception for HBV had the lowest odds of completely adhering to all three indicators recommended for HBV vaccination (aOR = 0.15; 95 %CI = 0.04–0.58). Also, male HCWs have lower odds of adhering to all three components of HBV vaccination compared to their female counterparts (aOR = 0.65; 95 %CI = 1.17–2.50).

Conclusion: Adherence to the three components of HBV vaccination recommended for HCWs is low in this study. Failure to receive the recommended three-dose series of HBV vaccine at the recommended 0,1,6 schedule has implications for achieving seroprotection or development of antibodies against HBV. Failure to perform post-vaccination testing 1–2 months after HBV vaccination has implications for timely PEP management following occupational exposures. All three components of an ideal HBV vaccination program are important and should be used collectively to guide facility led HCW vaccination programs. Occupational health and safety programs, Infection prevention and control, as well as health promotion campaigns in health facilities, should promote adherence to all three components of HBV vaccination programs.

Background

Hepatitis B Virus (HBV) infection is a liver disease which can present in acute or chronic forms with liver cirrhosis and hepatocellular carcinoma being its major complications [1]. The World Health Organization (WHO) in 2019 estimated that close to 296 million individuals were living with HBV with 820,000 deaths. Further, the WHO projected 1.5 million new infections to occur every year [2]. Apart from mother-to-child transmission of HBV which is the predominant mechanism of spread in highly endemic regions of the world, contact with blood and body fluids is another important mechanism of HBV disease transmission [3] This is the basis for considering HBV as an important occupational hazard for Health Care Workers (HCWs) all over the world [4] Among people who are at significant risk of infection, HBV is highly infectious and transmissible than Hepatitis C virus and Human Immunodeficiency virus [5]. Also, it has been documented that HCWs' risk of

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acquiring HBV infection is four times higher than the general population [5]. Africa and the West Pacific regions of the world where the disease is highly endemic are the areas that bear the greatest burden of the global HBV problem [3]. Since HBV infection in HCWs mirrors closely the prevalence in the general population, the prevalence of HBV is very high among HCWs in Africa [6]. A recent systematic review of studies done in Africa among HCWs estimated the HBV infection rate at 6.81 % [7]. Further 40–60 % of HBV infection in HCWs have been linked to exposure to professional hazards in developing countries [8].

In Ghana, the prevalence of HBV infection is high and has been estimated at 12.3 % among the general population. The risk of infection among Ghanaian HCWs is high as there are increasing incidents of blood and body fluids exposure through percutaneous injuries [10,11]. HBV prevalence rates ranging from 1 to 5.9 % have been reported among Ghanaian HCWs [12,13,14] and this is an indication of risk translating into actual infections.

HBV is preventable through the efficient use of a potent and safe vaccine which has been available since the 1980 s. Correct use of the vaccine produces seroprotection in 90–95 % of immunocompetent individuals [15,16]. The availability of the vaccine has contributed significantly to the reduction of the global burden of HBV infection [17]. Specifically, for HCWs who are at high risk of the infection, the WHO, CDC, Occupational Safety and Health Administration (OSHA) and country-specific organizations have recommended the use of the HB vaccine as the mainstay and cost-effective strategy for HBV prevention [18,19]. Per the recommendations, every HCW vaccination program targeted at preventing occupational transmission of HBV should mandatorily include three components or indicators. These indicators or components include (a) receipt of three doses of the HB vaccine on the deltoid muscle (b) using a vaccination schedule of 0,1,6 and (c) undertaking post-vaccination serological testing 1–2 months after the vaccination. This recommendation according to the CDC, WHO is the ideal vaccination program for HCWs who are at high risk of HBV infection.

The three-dose vaccination regimen at the correct vaccination schedule of 0,1,6 is essential in building adequate antibodies to achieve seroprotection against the virus [20] The post-vaccination serological testing and documentation of antibody levels following HB vaccination in HCWs is also essential in deciding on the post-exposure-prophylaxis regimen to use for a HCWs who suffers an exposure to blood and body fluid contaminated with HBV in line of duty [21].

Most studies used three-dose vaccination (complete vaccination) as an indicator to describe adherence to HBV vaccination [22–25]. Others used a combination of three doses with post-vaccination serological testing as an indicator for measuring adherence to HB vaccination [5,26] There is a paucity of information on the **use** of three indicators (3 doses, correct schedule of 0, 1, 6 and post-vaccination serological testing) to measure an ideal vaccination in other word referred to in this study as overall adherence to HB vaccination specifically among HCWs. This study perhaps, maybe the first to have combined the three indicators (receipt of 3 doses of vaccine at month 0,1,6 schedule and post-vaccination serological testing) to measure an overall adherence to HB vaccination recommendations among Ghanaian HCWs.

Materials and methods

Study area

This study was carried out in five selected districts within the Greater Accra Region of Ghana. The region is one of sixteen administrative regions in the country with a total of 1297 health institutions or facilities. The study area has the highest population of healthcare workers who perform varying degrees of patient care activities due to the concentration of highly skilled health force and availability of modern state-of-the-art health facilities and infrastructure. The Greater Accra Region is located in the south-central part of the country, bordering the Central Region to the west, the Volta Region to the east, the Eastern Region to the north, and the Gulf of Guinea to the south [27,28].

Study design

This study was a hospital-based analytical cross-sectional study.

Study population and inclusion criteria

This study recruited health professionals belonging to the six (6) cadres or categories including medical doctors, laboratory professionals, hospital sanitation workers (orderlies), anaesthetists, physician assistants, nurses, and midwives. These cadres of staff were chosen on purpose since they provide direct patient care services and therefore have direct contact with the blood and body fluids of patients and are at significantly higher risk of exposure to HBV. The study participants were adults of 20 years and above who had over one year of work experience. For those who had been vaccinated against HBV, the possession of vaccination cards to validate the number of HBV vaccine doses received and the vaccination schedule followed was an added requirement.

Sample size estimation

We utilized the formula for estimating proportions in cross-sectional studies proposed by Cochran, to estimate the sample size $n = (Z^2pq)/d^2$ [29] where: n = sample size, Z = the z-score that corresponds with a 95 % confidence interval (1.96), p = estimated proportion of health workers who received all the three doses of HBV vaccine at the correct vaccination schedule and performed post-vaccination serological testing (29 %, = 0.29) [22,30], q = 1-p, d = margin of error set at 5 % (0.05). After making allocations for non-response, a sample size of 340 was estimated to be adequate for the determination of factors associated with adherence to the three components of the HBV vaccination protocol among the selected HCWs.

Sampling procedure

The Greater Accra Regional Health Directorate has five levels of health facilities. These levels include Regional hospitals, District hospitals, Polyclinics, Health centres, and CHPS compounds. We used the lottery method to randomly select five facilities from each level except the regional hospital which was purposively chosen since it is the only regional hospital in the study Region. We proportionally allocated the samples to each of the five selected facilities to ensure that facilities contribute study participants proportionally based on their human resource strength. The number of respondents per cadre per facility was also proportional to size. We made use of systematic random sampling procedures to select individual participants from among eligible cadre of staff using a predetermined sampling interval for each cadre. The sampling interval (*k*) was obtained by dividing the total number of healthcare workers in that specific professional category by the allocated number of samples per professional category. We identified a random starting point and every K^{th} element in the sampling frame was selected. This procedure was repeated for all the cadres or professional categories in all the 5 study sites where participants were recruited from.

Research instrument and data collection procedure

The study made use of a structured data collection instrument with 29 items to collect data. Most of the questions were dichotomous questions. Apart from the standard risk perception sub-scale, the questions in the instrument were based on available literature on the practice of ideal vaccination against HBV among at-risk populations. The instrument was subjected to validity tests through pre-testing and expert review. In all, our research instrument had three sections. Section one had questions on sociodemographic variables, Section Two had questions on HBV vaccination uptake, number of doses received, vaccination

schedule followed and performance of post-vaccination serological testing. The third section of the instrument was the adapted risk perception sub-scale called the Champion's health belief model risk perception subscale [31] which had 5 5-point Likert scale and was utilized to assess the HBV risk perception among participants.

Information about the study was placed on notice boards and circulated on facility social media platforms. The participants were informed of the aims and procedures of the study. They were informed that only those systematically selected would be allowed to participate in the study. The consenting processes were equally explained. Potential participants were informed to also report with their HBV vaccination cards for the research team to validate the number of HBV vaccine doses received and the schedule that was followed.

We employed self-administered interviews since most of the study participants could read and write. In very few instances the questionnaires were administered in a face-to-face interaction moderated by the authors. The study participants answered the questionnaires at the nurses' station, consulting rooms, staff rest rooms in the laboratory operating theatre etc. It took 25–30 min on average for the participants to answer the questions in the research instrument.

Data processing and analysis

Data entry, cleaning, and analysis were done using Statistical Package for Social Scientists (SPSS) version 21 software. Both investigators did the data entry independently and comparisons were made. Frequency distributions were run for all variables to check for omissions and errors.

Age and duration of employment were classified based on information from related studies and median years of work duration for the study participants respectively [32,33]. Composite risk perception scores were dichotomized into good (≥50) and poor risk perception (<50) [34]. A three-level interval scoring scheme ranging from low, (≤50 %) intermediate (51–74 %) and high (≥75-100 %) was used to categorize overall adherence scores [35,36].

HBV vaccination adherence scores were obtained by scoring a positive response as '1′ and an incorrect response as '0′ for the three indicators (3 doses of HBV vaccination, correct schedule of 0,1,6 and post-vaccination serological testing). The scores under overall adherence were summed up to obtain a composite score which was referred to as overall adherence. The total attainable or expected score of overall adherence is '3′ (100 %). A score of 100 % was considered as complete adherence. Analysis of Variance (ANOVA) procedure was undertaken to compare the mean overall vaccination adherence scores among the six categories of HCWs and also to examine whether overall vaccination adherence is the same across the categories of HCWs.

Results were presented as counts (proportions) for categorical variables and mean with Standard Deviations (SD) for quantitative variables. Odds Ratios (OR) with their 95 % Confidence Intervals (CI) were computed whilst investigating the influence of various personal and occupational factors on the overall adherence to HBV vaccination protocol. These estimates were obtained through both univariate and multivariate logistic regression analyses while adjusting for potential confounders. A p-value of < 0.05 was considered significant.

Ethical considerations

We obtained ethical approval for this study from the Institutional Review Board of the Noguchi Memorial Institute for Medical Research, University of Ghana (*No: NMIMR-IRB-CPN 005/17-18*. We insisted on the provision of written, signed, informed consent from each study participant after the nature, purpose, and procedures of the study were thoroughly explained to them. We also ensured anonymity by de-identifying the data by using serial numbers or codes for each participant. We ensured participants' privacy by saving the research data in a password-protected computer which was accessible to only the principal investigator.

Results

Background characteristics of study participants

As presented in Table 1 Most of the HCWs who participated in the study were females (74.1 %, 252/340). The participants were aged between 22 and 58 years with a mean age of 34.5 years and a standard deviation of SD ± 7.7. The majority of the participants 70.6 %, (240/340) had attained tertiary-level education. Nurses and midwives formed 47.6 % (162/340) of the participants with doctors forming 20.3 % (69/340) and anesthetists being the least professional group 4.4 %, (15/340). The majority representing 76 % (260/340) of the Health Care Workers had less than 10 years of working experience. A total of 155/340 (45.6 %) worked as providers in critical units (e.g., Labor ward, theatre) where blood and body fluid exposures are much more likely,

Table 1
Sociodemographic Characteristics of Respondents (N = 340).

Variable	No.	%
Age group (years)		
21–30	127	37.4
31–40	153	45.0
41–50	43	12.6
51–60	17	5.0
Sex		
Male	88	25.9
Female	252	74.1
Cadre of staff		
Doctor	69	20.3
Nurse/Midwife	162	47.6
Anaesthetist	15	4.4
Laboratory Professionals	40	11.8
Orderly/Sanitation workers	35	10.3
Physician Assistant	19	5.6
Educational level		
No formal Education	6	1.8
Primary	17	5.0
Secondary	36	10.6
Tertiary	240	70.6
Post Tertiary	41	12.1
Duration of employment		
<10 Years	260	76.5
≥10 Years	80	23.5
Work unit*		
Unit with High Exposure	155	45.6
Unit with low to moderate exposure	185	54.4
Facility Type		
CHPs compound	19	5.6
Health Centre	28	8.2
Polyclinic	56	16.5
District Hospital	80	23.5
Regional Hospital	157	46.2
Training in infection prevention and control		
Received Training	274	80.6
Not Trained	66	19.4
Perception of Risk of Infection		
High	295	86.8
Low	45	13.2

* Working Unit refers to HCW's Work department.

whilst 54.4 % (185) provided care at less critical units or departments. The majority of the study participants (46.2 %) were recruited from the regional hospital. Receipt of training in the prevention of blood-borne infections was widespread with almost 80.6 %, (274/340) of the respondents admitting ever attending such training workshops.

Adherence to three components of HB vaccination protocol

From Table 2, 60.9 % of participants admitted having received at least one dose of the HB vaccine, 46.8 % completed the three-dose vaccination series, 38.0 % also adhered to the 0,1,6 months vaccination schedule whilst only 13.0 % adhered to the post-vaccination serological testing recommendation and that majority representing 91.3 % had anti-HBs levels above 10mlU/mL indicating seroprotection against HBV.

Overall adherence to HBV vaccination recommendations among HCWs

Overall adherence to HBV vaccination (3 doses, 0, 1, 6 schedules and post-vaccination testing) was assessed among the population. As illustrated in Fig. 1**,** out of 340 HCWs whose data were analyzed, 6.2 % (21/340) completely followed all the steps regarding HB vaccination (3 doses, correct schedule, post-serological testing) by obtaining scores of 100 %. The majority of 54.7 % (186/340) had scores below 100 % indicating partial or incomplete adherence to all three recommendations. However, a total of 133(39.1 %) did not vaccinate at all. More females than males, HCWs with less than 10 years of work experience, and those who were 30 years and above and working in critical units adhered more to the three components of HB vaccination compared to their counterparts. However, none of these observations showed any statistical significance at the bivariate level.

From Table 3**,** (which shows the overall adherence scores of only HCWs who received at least one dose of HB vaccine [N = 207]) the overall mean vaccination adherence score was 53.46 (95 %CI = 49.86–57.05) indicating overall intermediate adherence to all three recommendations regarding HBV vaccination (3-doses, 0, 1, 6 vaccination schedule& post-vaccination serological testing) at the population level. Orderlies were the least adhering group with scores of 51.28 % followed by nurses and midwives as well as anaesthetists. Laboratory staff had the highest mean score of 58.06. An analysis of variance (ANOVA) procedure did not show any statistically significant difference between the various categories of HCWs (F = 0.357, P = 0.877) indicating that the intermediate level of adherence to recommended HBV vaccination adherence was similar across all the six categories of HCWs examined and therefore the assertion that overall HBV vaccination practice is the same across the six categories of HCWs is upheld whilst rejecting the hypothesis that there are variations in level of overall adherence among the six categories of HCWs.

Table 2
Adherence to Three Components of HBV Vaccination Protocol (N = 340).

Variable	Frequency	Percent (%)
HBV Vaccination uptake (at least one dose)		
Vaccinated	207	60.90
Unvaccinated	133	39.10
Three doses of HBV vaccine		
Adhered	159	46.80
Did not adhere	181	53.30
0,1,6 vaccination schedule		
Adhered	129	38.00
Did not adhere	211	62.00
Post-Vaccination Serological Testing		
Performed serological testing	44	13.00
Did not perform serological testing	296	87.00

Factors associated with overall adherence to HBV vaccination recommendations (3 doses, 0, 1, 6 schedules & post-vaccination testing)

Both occupational and personal factors that are likely to influence overall adherence to vaccination recommendations were assessed using binary logistic regression procedures. The results as presented in Table 4 revealed that those HCWs who had low-risk perception for HBV had the lowest odds of completely adhering to all the three indicators recommended for HBV vaccination (aOR = 0.15; 95 %CI = 0.04–0.58). Also, male HCWs have lower odds of adhering to all three components of HBV vaccination compared to their female counterparts (aOR = 0.65; 95 %CI = 1.17–2.50).

Discussion

The CDC, WHO, NCIRS and many other health organizations have strongly recommended that HCWs who are at risk of exposure to blood and body fluids receive early in their career, 3 doses of HBV vaccine at a schedule of 0,1,6 months and perform post-vaccination serological testing 1–2 months after vaccination [16,18,19]. Adherence to these three important components of the HB vaccination protocol is considered the ideal vaccination program for pre-exposure prophylaxis for HCWs. To assess this practice among Ghanaian HCWs, this study was undertaken to determine adherence to the three components of HBV vaccination protocol (receipt of 3 doses of vaccine at 0,1,6 schedule and performance of post-vaccination serological testing 1–2 months after vaccination) among HCWs.

According to the Hepatitis B Foundation, [37] complete vaccination refers to the receipt of three doses of HB vaccine. This study found complete vaccination coverage to be 46.80 % which is similar to 46.6 % and 44.4 % reported from two other regions of Ghana [38,39]. The vaccination coverage reported in this study still shows that a lot more HCWs in Ghana do not adhere to the 3-dose vaccine schedule in the face of high disease prevalence among the general population and continuous exposures to blood and body fluids [9,10,11].

Adherence to the three-dose vaccination regimen is particularly important for people who are at high risk of contracting HBV such as HCWs [20]. Evidence across multiple studies show that following the standard 3-dose schedule of HBV Vaccination in immunocompetent populations, close to 90–95 % of vaccinees who are < 40 years at the time of vaccination develop neutralizing antibodies against HBV to the levels of ≥ 10mlU/mL, therefore adherence to the 3-dose regimen is vital for the attainment of full seroprotection [15].

Most HB vaccine manufacturers have recommended 0, 1, 6 schedules for adult immunocompetent men and women and this forms the basis for recommendations in most international and country-specific HBV prevention guidelines for HCWs vaccinating as adults [40,41]. This study found that only 38 % of the respondents followed the recommended 0,1,6 vaccination schedule. This is not surprising because in Ghana, and many African countries, HCWs arrange for their own HBV vaccination and bear the cost of the vaccines. Onsite or facility-led HBV vaccination programs are not always available [50] hence HCWs follow erratic vaccination schedules which are contrary to the recommended 0,1,6 vaccination schedules which have implications for the development of antibodies and immunity against HBV. The CDC observed that longer intervals between the last two HBV vaccine doses might affect antibody levels and therefore increase the risk of acquisition of HBV infection among persons who have a delayed response to the HBV vaccination [41].

Testing for anti-HBs levels 1–2 months post-vaccination has been strongly suggested to be the objective method of measuring the effectiveness of HBV vaccination at both the individual and population levels [42]. This study found only 13 % of study participants performed post-vaccination serological testing. This finding is lower than the 33.6 % and

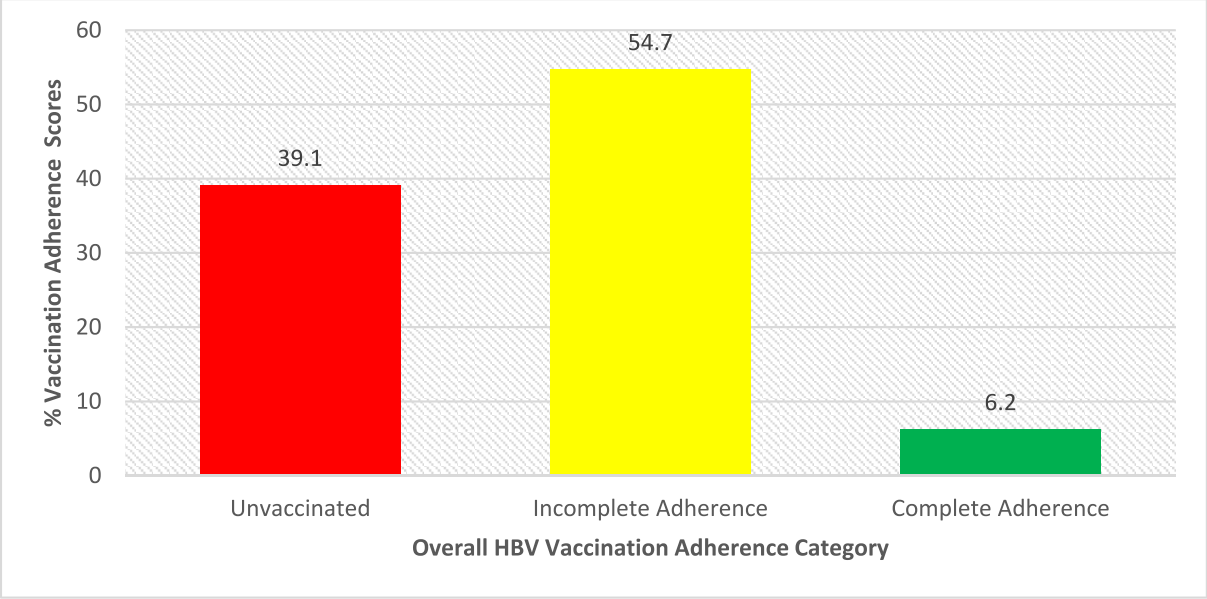

Fig. 1. Overall HBV vaccination adherence categories.

Table 3
Comparison of Overall Vaccination Adherence Scores among the Various Categories (N = 207) **.

Cadre of Staff	N**	Mean	Std. Deviation	Std. Error	95 % CI for Mean	
					Lower Bound	Upper Bound
Doctor	44	55.303	26.844	4.047	47.142	63.464
Nurse/ Midwife	95	51.579	26.970	2.767	46.085	57.073
Anaesthetist	11	51.515	31.140	9.389	30.595	72.435
Laboratory Staff	31	58.065	22.718	4.080	49.731	66.398
Orderly	13	51.282	22.008	6.104	37.983	64.581
Physician Assistant (PA)	13	53.846	28.991	8.041	36.327	71.365
Total	**207**	**53.462**	**26.226**	**1.823**	**49.868**	**57.056**
				F = 0.357 P = 0.877.		

Levene's test = 0.344; p = 0.886 Classical One-way ANOVA performed.
** N = Vaccinated HCWs only.

29 % reported by other studies in Africa [22,43]. Lack of knowledge of the importance of immunity testing and the cost of performing the tests may be responsible for this poor adherence to this individual-level indicator.

Post-vaccination serological testing is important since adequate Post Exposure Prophylaxis (PEP) management for HCWs exposed to HBV requires knowledge and documentation of immune status to determine whether HBV Immunoglobulin (HBIG) should be administered after occupational exposure to blood and body fluids, hence, knowledge and documentation of immune status is important in at 'risk' populations [21].

Per the WHO and CDC recommendations for HCWs regarding HBV prevention, we combined the adherence to all three components of HB vaccination to obtain a composite score that we named or referred to as overall adherence. We observed an intermediate or sub-optimal level of overall adherence among the participants with only 6.2 % of the entire study population complying completely with all the three recommended components of the HBV vaccination protocol. Even though vaccine uptake was 60.9 %, not all the HCWs (1) took the compulsory three doses (2) followed the recommended 0,1,6 schedule and (3) performed post-vaccination serological testing to confirm immunity against HBV.

Previous studies done in Africa and elsewhere have equally reported poor adherence to HBV vaccination recommendations among HCWs. However, none of these studies used the three components in measuring adherence. For example, three studies relied on only one indicator (three doses) to measure adherence [24,44–46] whereas two others used two indicators (3 doses and post-vaccination serological testing) to measure vaccination adherence [22,43].

The overall adherence (6.2 %) obtained (by combining the three indicators) in this study is perhaps new and depicts a considerably far lower level of adherence compared to what the other studies using either one or two indicators have reported. It is obvious that the scale applied in this present study in measuring adherence is much more rigid and this could have contributed to the very low level of adherence observed.

We found in this study that gender was associated with high adherence to all three indicators or components of HBV vaccination. A similar study that used adherence to 3 doses as the only indicator also found the odds of adherence to be higher in females than male participants [47]. Specifically in Ghana, a study reported a high loss to follow-up for the continuation of the HBV vaccination series among male participants of a voluntary HBV vaccination program [48]. Reports from previous studies have indicated that females engage more in positive health behaviours regarding disease prevention and health service utilization than their male counterparts and this could have contributed to the lower odds of adherence observed in the male participants in this study [49]. Based on this observation there is a need to target male HCWs frequently in facility-led vaccination programs.

To the best of our knowledge, this is the first time that all three vaccination indicators or components were combined to measure adherence to HBV vaccination protocol. This study has established the fact that when combining all three vaccination indicators as a scale, a very low level of adherence to HBV vaccination protocol would be observed among HCWs.

Implications for public health practice

There is a need for on-site or facility-led HBV vaccination programs to be organized in health facilities. These programs should be coordinated by occupational health and safety coordinators with constant reminders to the HCWs to complete the vaccination series at the recommended 0,1,6 schedule. Facility-level vaccination programs can

Table 4
Factors Associated with Overall Adherence to HBV Vaccination Recommendations.

	Unadjusted Estimates		Adjusted Estimates	
Variables	uOR (95 % CI)	P-value	aOR (95 % CI)	P-value
Facility Type				
CHPS	1.00		1.00	
Health Center	0.4(0.03–5.25)	0.485	0.34(0.02–6.12)	0.465
Polyclinic	0.52(0.08–3.34)	0.487	0.59(0.06–5.36)	0.637
District Hospital	0.62(0.1–3.62)	0.591	0.46(0.06–3.90)	0.480
Regional Hospital	0.33(0.06–1.8)	0.199	0.35(0.05–2.47)	0.289
Educational level				
No Formal	1.00		1.00	
Primary	1***		1***	
Secondary	0.46(0.03–6.93)	0.576	0.11(0.01–2.87)	0.187
Tertiary	0.32(0.03–3.31)	0.342	0.13(0.01–1.84)	0.132
Post Tertiary	0.33(0.03–4.3)	0.4	0.16(0.01–2.96)	0.218
Cadre of staff				
Doctor	1.00		1.00	
Nurse/Midwife	0.58(0.19–1.79)	0.346	0.37(0.10–1.47)	0.159
Anesthetist	0.63(0.07–5.88)	0.688	1.77(0.12–25.81)	0.675
Laboratory	0.68(0.16–2.95)	0.605	1.10(0.13–9.09)	0.928
Orderly	0.53(0.06–4.83)	0.572	0.41(0.04–4.55)	0.465
PA	1.15(0.2–6.53)	0.873	1.24(0.14–10.72)	0.847
Age category				
21–30	1.00		1.00	
31–40	0.88(0.34–2.28)	0.786	0.87(0.29–2.60)	0.800
41–50	0.29(0.03–2.37)	0.246	0.12(0.01–1.51)	0.101
51–60	0.93(0.1–8.33)	0.949	1.20(0.08–17.19)	0.895
Risk perception				
High	1.00		1.00	
Low	0.25(0.09–0.73)	0.011	0.15(0.04–0.58)	**0.006**
Duration of employment				
<10	1.00		1.00	
≥10	0.95(0.33–2.74)	0.926	1.47(0.34–6.40)	0.606
Work unit				
Noncritical	1.00		1.00	
Critical	0.54(0.21–1.37)	0.194	0.40(0.11–1.51)	0.176
Receipt of training				
Not Trained	1.00		1.00	
Received training	0.79(0.25–2.5)	0.682	1.25(0.32–4.82)	0.750
Sex				
Female	1.00		1.00	
Male	0.62(0.21–1.94)	0.414	0.65(1.17–2.50)	**0.035**

*** *No count or observations in this category.*

utilize existing laboratory structures to ensure that vaccinated HCWs perform post-vaccination serological testing.

Conclusion

Adherence to the three components of HB vaccination protocol recommended for HCWs is low in this study. Failure to receive the recommended three-dose series of HBV vaccine at the recommended 0,1,6 schedule has implications for achieving seroprotection or development of antibodies against HBV. Failure to perform post-vaccination testing 1–2 months after HBV vaccination has implications for timely PEP management following occupational exposures. All three components of an ideal HBV vaccination program are important and should be used collectively to guide facility-led HCW vaccination programs. Occupational health and safety programs, infection prevention and control as well as health promotion campaigns in health facilities should promote adherence to all three components of HB vaccination programs.

Limitations

The study being quantitative was unable to explore HCWs' personal experiences and perceptions that influenced their adherence to the vaccination recommendations. In addition, this study being an observational study specifically cross-sectional was unable to provide information on the changes in facility-level infrastructure, governance programs and policies and their corresponding impact on HCW adherence to the three-component ideal HB vaccination program.

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Ethics statement

Ethical approval for the conduct of this study was obtained from the Institutional Review Board of the Noguchi Memorial Institute for Medical Research, University of Ghana (Study number: 005/17-18). Permission was also obtained from all the facility heads. Written informed consent was obtained from each study participant after the nature, purpose, and procedures of the study were thoroughly explained to them.

CRediT authorship contribution statement

Senoo-Dogbey Vivian Efua: Conceptualization, Methodology, Software, Data curation, Writing – original draft, Visualization, Investigation, Validation. **Wuaku Delali Adwoa:** Writing – original draft, Writing – review & editing. **Mumuni Adiza Atoko:** Writing – original draft, Writing – review & editing.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

Data will be made available on request.

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Appendix A. Supplementary material

Supplementary data to this article can be found online at https://doi.org/10.1016/j.jvacx.2023.100421.

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