BMC Infectious Diseases

RESEARCH

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Self-reported exposure to blood and body fluids and serological evidence of lifetime exposure to hepatitis B virus among health care workers in Ghana: a cross-sectional study

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Abstract

Introduction In Sub-Saharan Africa alone, about 40–65% of Hepatitis B Virus infections among HCWs were a result of percutaneous occupational exposures to contaminated blood and body fluids of patients. Occupational exposure to blood and body fluids among healthcare workers is on the rise in Ghana. However, the relationship between self-reported exposures to blood and body fluids suspected to be contaminated with the hepatitis B virus and actual serological evidence of exposure remains unknown. The aim of the study however was to assess the self-reported exposure to HBV as against the serological evidence of lifetime exposure to HBV and associated factors among Ghanaian HCWs.

Methods The study was a cross-sectional analytical survey that involved 340 HCWs who were recruited using a simple random sampling procedure from six cadres of staff from five districts in Greater Accra. The participants were surveyed using a validated instrument and 5mls of venous blood was aseptically withdrawn for qualitative detection of Anti-HBc. SPSS version 23.0 was used to analyze the data to obtain proportions, odds ratios and their corresponding confidence intervals with the level of significance set at 0.05.

Results The response rate was 94% with Nurses and Doctors in the majority with a mean age of 35.6 ± 7.2. Self-reported exposure to HBV was 63% whereas lifetime exposure to HBV (Anti-HBc) prevalence was 8.2% (95% CI = 5.0-11.0%). Females were 60% less likely to be exposed to HBV (aOR = 0.4; 95% CI = 0.1–0.9) than their male counterparts. HCWs without training in the prevention of blood-borne infections had almost three times higher odds of being exposed to HBV in their lifetime (aOR = 2.6; 95% CI = 1.0-6.4).

Conclusions The findings of this study suggest that self-reported exposure to HBV-contaminated biological materials was high with a corresponding high lifetime exposure to HBV. The female gender was protective of anti-HBc acquisition. Apart from direct interventions for preventing occupational exposures to HBV in the healthcare setting, periodic training of all categories of healthcare workers in infection prevention techniques could significantly reduce exposure to the Hepatitis B virus.

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Keywords Health care worker, Hepatitis B virus infection, Lifetime exposure, Self-reported, Serological evidence

Background to the study

Hepatitis B virus (HBV) infection is a major public health problem which is associated with severe complications namely, liver cancer and cirrhosis [1]. According to experts, HBV infection is ranked among the top health challenges of the world and was declared the tenth leading cause of mortality (786,000 deaths per year) [2]. These data necessitated its inclusion in the major global health priorities requiring urgent global action [1]. Healthcare workers are at risk of HBV as studies have reported a higher risk of infection in this population compared to the general population [3]. Reports available indicate that the risk of HBV infection among HCWs in Sub-Saharan Africa and Ghana specifically is greater due to the high prevalence of the disease in the general population [4].

In the healthcare setting, transmission of HBV may occur via several routes, but the most frequent route leading to the establishment of HBV infection is needlestick injury or sharp injury, collectively called percutaneous exposures [5]. The occurrence of this exposure form is high especially in Africa as a recent meta-analysis of studies done among HCWs revealed a pooled prevalence of 36% [6]. In Ghana, specifically, researchers have reported a higher prevalence of percutaneous exposures among HCWs. For example, In the middle belt of Ghana, Obirikorang et al., (2018), Appiagyei et al., (2021) and Lori et al., (2016) reported percutaneous exposure rates of 47%, 29% and 30% respectively [7–9] and in the Northern sector of Ghana, an exposure prevalence as high as 87.2% was reported [10]. In the Greater Accra region which represents the southern zone of the country, an exposure prevalence of 53.4% was recently reported among HCWs [11]. All these figures are indicative of the increasing risk of HBV infection among Ghanaian HCWs. Surprisingly, in the face of this high exposure rate to HBV and other bloodborne pathogens, HBV vaccination coverage, Post post-exposure prophylaxis (PEP) uptake and the practice of standard precautions which are all life-saving HBV prevention interventions are suboptimal in this population [12–18]. Perhaps this is one factor that has contributed to the reported high prevalence of HBV among HCWs in Ghana [19].

Given the high rate of percutaneous exposures among Ghanaian HCWs, we contend that a lot more Ghanaian healthcare workers who suffer from these exposures have encountered HBV which can eventually translate to actual HBV infections given the sub-optimal HBV preventive behaviour among this population. We, therefore, sought to assess the self-reported percutaneous exposure to biological products suspected to be contaminated with HBV vis avi the serological evidence of exposure to HBV (Anti-HBc) among HCWs who performed direct patient care activities in selected health facilities in Southern Ghana.

Study methods

Design

The study was a cross-sectional study conducted in the Greater Accra Region of Ghana. The study assessed self-reported exposure to biological materials suspected to be contaminated with HB (in the past 12 months) and lifetime exposure to HBV (Anti-HBs) among healthcare workers who were recruited from five health institutions in the Greater Accra Region.

Study setting

The study was conducted in the Greater Accra Region which is the capital of Ghana. The Region has the highest number of health facilities and healthcare workers. Health services in the region are provided by a network of health facilities comprising 707 Community-Based Health Planning Services (CHPS) facilities, 299 clinics, 101 maternity homes, 32 health centres, 22 polyclinics, and 111 hospitals. In addition, there is one Regional Hospital, one Teaching Hospital and one University Hospital as well as two psychiatry hospitals located within the region. The health facilities in the region are owned by the government, the Christian Health Association of Ghana (CHAG), private individuals and organizations and some are also quasi-governmental in terms of ownership. The health facilities in the capital city appear to be better equipped than those in the other parts of the country and the HCWs working in these facilities are exposed to blood and body fluids due to their constant care and interaction with clients. Studies have reported a high rate of exposure to blood and body fluids of 53.4% [11] and a high HBV prevalence of 5.9% [19] among HCWs working in the region.

Study population

Participants of this study belong to professional groups namely Doctors, Nurses, Laboratory staff, Anesthetists, Physician Assistants and Sanitation workers (Orderlies). These categories of HCWs were recruited from 5 health facilities which were selected randomly from the list of facilities in the Region. The participants were those who volunteered to answer the questions in the research instrument and also consented for their blood samples to be taken and analyzed for lifetime exposure to HBV, otherwise referred to as the presence of Anti-HBc. The inclusion criteria include being a permanent employee of the facility, belonging to a professional category with

direct involvement in patient care and being at the post for the past 12 months. Students and those on internships were excluded from the study.

Sample size estimation

Researchers elsewhere established that the HBV infection rate can be four times higher in HCWs compared to the general population [20]. Given that the prevalence of HBV in the general Ghanaian population has been estimated at 12.3% [21], we anticipated an Anti-HBc prevalence of 50% which is four times the 12.3% estimated for the general Ghanaian population (12.3*4=50%). We used the 50% as anticipated prevalence *(p)* to estimate the sample size. With a margin of error of 5% and, a z-value of 1.96, a minimum sample size of 340 was deemed adequate for the study.

Sampling procedure

Allocation of HCWs to the selected study sites was done proportionate to size (staff strength) in each selected facility, HCWs were again stratified into six cadres of staff (Doctors, Nurses/Midwives, Laboratory Staff, Physician Assistants, Anesthetists, and orderlies) proportionate to size. The category-specific staff list for each of the study sites served as a sampling frame for the simple random sampling procedure. The lottery method, which is a probability sampling technique was employed to randomly select eligible participants for the study.

Data collection instrument

The data collection instrument utilized in this study was a structured questionnaire which was developed based on occupational exposure and HBV infection risk variables obtained from related literature. The questions ranged from socio-demographic characteristics such as age, sex, level of education etc. The tool also had questions on occupational exposures (percutaneous and mucocutaneous exposures). The third section of the instrument had questions on behavioural factors that have the potential to increase the risk of encounters with HBV. These include lifetime surgery, dental procedures etc. The tool was subjected to expert review as well as pretesting which was done in a Health Center in the study Region, and the pretesting procedure involved 20 participants. The questionnaire was revised per the comments and suggestions of the experts and the outcome of the pretesting procedure. The scale utilized for the assessment of risk perception for HBV had a Cronbach's alpha (α) of >7 when subjected to reliability testing.

Data collection and laboratory procedure

The research instrument was self-administered to all consenting HCWs in this case participants indicated their responses by answering the questions directly on the questionnaires. As indicated in an already published related study [22] 5 ml of venous blood was aseptically collected under a strict WHO-recommended phlebotomy procedure. The blood sample was centrifuged and transported under cold chain conditions to a central laboratory. Qualitative detection of the serological marker denoting lifetime exposure to HBV (HBcAb or Anti-HBc) was done using a Hepatitis B Virus Profile Kit called Advanced Quality TM One Step multi-HBV Test Device Cassette (In Tec Products, Inc.). The recommended volume of serum samples was dropped into the wells designated on the test device. The results were read in 15 min. Identification of Anti-HBc from test results was done as recommended by the manufacturer.

Data analysis

Study variables

One independent variable in this study which represents a risk of exposure to HBV other than an occupational hazard is 'behavioural risk'. These factors included blood transfusion, intimate contact with a known HBV carrier, dental procedure, lifetime surgery tattoo or scarification etc. Individuals with none of the behavioural risk factors were classified as having no risk, those with 1–3 factors as intermediate risk and those with 4 or more risk factors as being at high risk of exposure and infection with HBV [23].

Facility factor was another important independent variable which was assessed in this study. HCWs from health facilities with HBV logistics, HBV prevention systems, protocols and programs are considered to have good facility factors. Health facilities below the secondary level were classified as being in the lower facility category whereas those at and above the secondary level were classified as higher-level facilities.

Data analysis procedure

Data entry and analysis were done using SPSS version 23 software. Data was presented in tables. Analysis of categorical variables was presented in proportions. Pearson's chi-square test and Fisher's exact tests were performed to assess associations between Lifetime exposure (Anti-HBs) and the personal and occupational characteristics of study participants. Variables that showed statistical significance at the bivariate level were marked for the next stage where simple logistic regression was performed to estimate the strength of the association between lifetime exposure and the independent variables. Using the rule of thumb, all the variables whose p-value<0.25 were included in the model for multivariable logistic regression analysis [24] which was subsequently undertaken to adjust for behavioural and personal factors that could influence Anti-HBs acquisition. Some important clinical variables were included in the model irrespective of their

statistical performance [24]. The first category under each categorical variable by default was used as a reference group in the logistic analysis procedure. The logistic regression assumptions of no multicollinearity and independent observations were respected. Hosmer-Lemeshow goodness of fit test was used to measure or evaluate model fit.

Ethical considerations

The Institutional Review Board of the Noguchi Memorial Institute of Medical Research approved the study protocol (005/17–18). Permission was obtained from both the regional and the district/municipal health directorates within which the five health facilities were located. Heads of the five health institutions were duly informed. The nature, purpose and procedures associated with the study were communicated to all participants after which they filled a consent form as a way of demonstrating their willingness to participate in the study. Confidentiality was ensured regarding test results. The principal investigator was the only one responsible for communicating the test results to the participants. Those who tested positive for Anti-HBc were counselled and given referral letters to be adequately evaluated for other serological tests (HBsAg) to ascertain their HBV infection status. All source documents were de-identified by use of serial numbers to ensure anonymity.

Results

Sociodemographic profile of the healthcare workers

The majority of the participants were females, (n=252; 74.1%) who were aged 34.5 (SD±7.7). Close to 70% of the participants worked in secondary-level health facilities with corresponding high Outpatient attendance and varying degrees of exposure-prone procedures. The majority of the HCWs (n=299; 88.0%) were educated up to tertiary level and beyond. Doctors, Nurses/ and midwives dominated the sample (n=231; 68%). Most of the participants (n=260;76.5%) had less than 10 years of professional experience. Close to half (n=155; 45.6%) worked in hospital departments or work areas considered high-risk areas where blood-borne pathogen exposure risk is high. Three-fourths of the participants (n=274; 80.6%) had attended training in the prevention of hospital-acquired infection in the last 12 months. The majority of the HCWs who participated in the study (n=237;70%) work in health facilities with an abundance of the needed logistics, programs and systems to protect HCWs from HBV hence they were considered as working in supportive health facilities. Behavioural exposure to HBV risk was assessed to be high in the minority of the study participants (44;12.9%). The majority of the HCWs (295; 86.6%) perceive HBV to be highly infectious, with serious health consequences.

Self-reported exposure to blood and body fluids suspected to be contaminated with HBV

As presented in Fig. 1, the majority of the study participants (63%) admitted ever being exposed to blood and body fluid they suspect to have been contaminated with HBV. These exposures were mainly through percutaneous exposures (n=112; 33%) and other mechanisms. Body fluid that was predominantly mentioned was blood (n=200;58.9%) (Table 1).

Serological evidence of Anti-HBc positivity among HCWs

In all, 28 participants had serological evidence of HBV exposure giving an Anti-HBc positivity rate of 8.2%, 95%

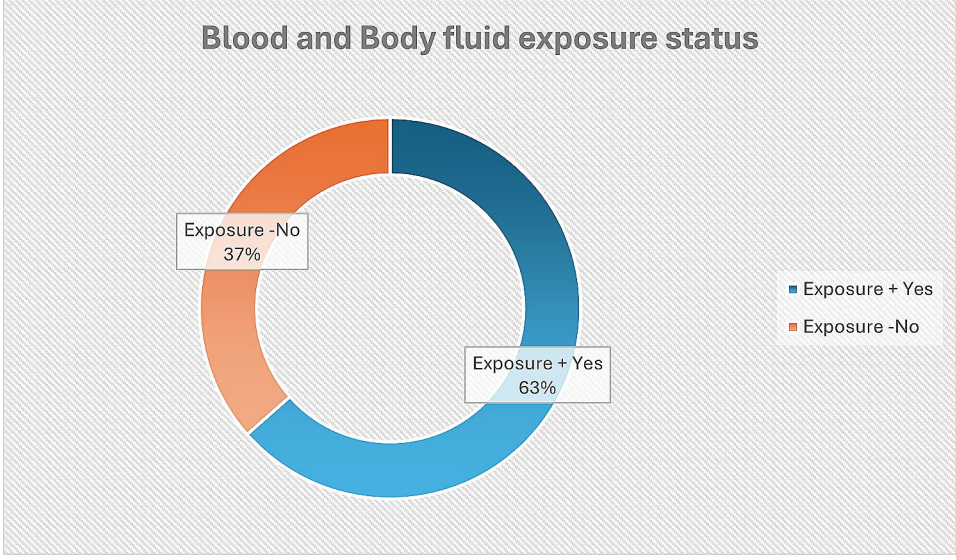

Fig. 1 Self-reported blood and body fluid exposure status among participants

Table 1 Sociodemographic profile of participants

Variables	*N*(340)	Percent (100%)
Age of Category of Participants		
Less than 30 years	127	37.4
Age 30 Years or More	213	62.6
Sex of study participants		
Male HCWs	88	25.9
Female HCWs	252	74.1
Level of education		
Tertiary and above.	41	12.0
Below Tertiary	299	88.0
Professional Group		
Doctors, Nurses & Midwives	231	68.0
Other Categories	109	32.0
HBV acquisition Risk criteria		
No risk of HBV acquisition	44	12.9
Medium to moderate risk	269	79.1
High risk of acquisition	27	8.0
Perception of susceptibility, severity of HBV*		
Good risk perception	295	86.8
Poor risk perception	45	13.2
Length of professional experience		
Less than 10 years	260	76.5
10 years and above	80	23.5
Level of Healthcare Delivery		
Secondary and Tertiary	237	69.7
Primary level	103	30.3
Health Facility support indicator		
Very supportive	237	69.7
Less supportive	103	30.3
Work Department**		
Critical or high-risk unit	155	45.6
Non-critical or medium to low-risk unit	185	54.4
Training in blood-borne infection prevention		
Trained in infection prevention	274	80.6
Not Trained in infection prevention	66	19.4
Type of exposure		
Other forms	104	30.6
Percutaneous	112	32.9
None	124	36.4
Type of biological material exposed to		
Blood	200	58.8
Other body fluids	16	4.7
No Exposure	124	36.5

* Perception of susceptibility and severity refers to having the perception that HBV is a serious disease, one is at risk of the disease and the benefits of preventing outweigh the cost

** Work unit refers to the department of work with critical units having a higher risk of blood and body fluid exposure

CI (5-11%). Results presented in Table 2 show that HCWs who were below 30 years of age had a higher frequency of exposure giving a proportion of 9.4%. The frequency of lifetime exposure to HBV was higher (15.2%) in HCWs who received no training in infection prevention and control compared to their trained counterparts and this observation was significant at the bivariate level *($p=0.023$).*

The study also observed higher rates of HBV exposure among male HCWs (13.6%) than their female counterparts and this relationship was also significant ($p=0.032$) at the bivariate level. Participants belonging to categories other than the nurse/doctor category had a higher prevalence of 11.0%.

A higher Anti-HBs prevalence was observed among HCWs working in lower-level settings, 13 (12.6%), and those working in critical units were much more exposed to blood and body fluid (10.3%). Again, a higher exposure rate was observed among individuals working in settings where facility levels systems and structures for HBV prevention were observed to be poor 13 (12.6%) and HCWs who had worked for less than 10 years (8.8%) in their various professions (Table 2).

After controlling for behavioural and occupational factors, the results presented in Table 3. show that not receiving training in the prevention of blood-borne infections increased the odds of lifetime exposure to HBV (aOR=2.6; 95% CI=1.0-6.4). Also, the female gender was protective of Anti-HBc and therefore reduced the odds of lifetime exposure (aOR=0.4; 95%CI=0.1–0.9). (Table 3).

Discussion

This present study sought to estimate the prevalence of self-reported exposure to HBV and the prevalence of Anti-HBc antibodies denoting lifetime exposure to hepatitis B virus. These two indicators are related in that one is from the HCW perspective or experiences of exposures to blood and body fluids suspected to be contaminated with HBV and the other is serological evidence of having a lifetime encounter with HBV.

In this study, self-reported exposure to biological materials or products suspected to be contaminated with HBV was as high as 63% which is higher than the global prevalence of 44.5% reported in a systematic review [25]. The finding of this study is also higher than the 53.4% reported among HCWs who were surveyed in the same region [11] but lower than the 87.2% reported by Alaru et al., (2023) from the Northern belt of Ghana [10]. The Northern belt of Ghana is less developed compared to the southern sector where this present study was done. There is evidence to show that, healthcare settings in resource-endowed regions have policies that are directed at protecting HCWs from occupational exposures compared to resource-poor settings [26]. Occupational health experts believe that HCWs' safety behaviours appear to be optimal in urban and highly developed settings compared to rural settings [4]. This may probably be the reason for the remarkable difference in the exposure prevalence in the study region and the northern belt

Table 2 Serological evidence of Anti-HBc positivity in healthcare workers

Variables	*N*(340)	(Anti-HBc positivity)			
		n(28)	Percent (95% CI)	Chi	*P*-value
Age category of HCWs				0.40	0.530
Less or equal to 30 years	127	12	9.4(5-15.9)		
Age 30 years or more	213	16	7.5(4.4–11.9)		
Sex of Study Participants				4.58	0.032
Male HCWs	88	12	13.6(7.2–22.6)		
Female HCWs	252	16	6.3(3.7–10.1)		
Level of Education				***	0.760
Tertiary and above.	41	24	9.8(2.7–23.1)		
Below Tertiary	299	4	8.0(5.2–11.7)		
Professional Group				1.60	0.201
Doctors/Nurses	231	16	6.9(4–11)		
Others	109	12	11.0(5.8–18.4)		
HBV acquisition risk criteria				2.00	0.377
No risk of HBV acquisition	44	6	13.6(5.2–27.4)		
Medium to moderate risk of HBV acquisition	269	20	7.4(4.6–11.2)		
High risk of HBV acquisition	27	2	7.4(9.1–24.3)		
Perception of susceptibility, severity of HBV				1.78	0.182
Good risk perception	295	6	7.5(4.7–11.1)		
Poor risk perception	45	22	13.3(5.1–26.8)		
Length of professional experience				0.54	0.460
Less than10 years	260	23	8.8(5.7–13)		
10 years and above	80	5	6.3(2.1–14)		
Level of healthcare delivery				3.76	0.052
Secondary and Tertiary level	237	15	6.3(3.6–10.2)		
Primary level	103	13	12.6(6.9–20.6)		
Health facility support indicator				3.76	0.052
Very supportive	237	15	6.3(3.6–10.2)		
Less supportive	103	13	12.6(6.9–20.6)		
Work Department				1.64	0.200
Critical or high-risk unit	155	16	10.3(6-16.2)		
Non-critical or medium to low-risk unit	185	12	6.5(3.4–11.1)		
Training in IPC€				5.18	0.023
Trained	274	18	6.6(3.9–10.2)		
Not Trained	66	10	15.2(7.5–26.1)		
Self-reported exposure				0.82	0.365
Exposure	216	20	9.3(5.7–13.9)		
No exposure	124	8	6.5(2.8–12.3)		
Type of exposure				0.68	0.410
Other forms	104	20	19.2(14.7–21.5)		
Percutaneous	112	5	4.5(4.7–19.7)		
None	124	3	2.4 (3.1–7.8)		
Type of biological material exposed to				0.44	0.231
Blood	200	18	9.0(7.4–14.1)		
Other body fluids	16	7	43.7(37.1–48.4)		
None	124	3	2.4 (3.1–7.8)		

* Risk perception refers to having the perception that HBV is a serious disease, one is at risk of the disease and the benefits of preventing outweigh the cost

** Work department refers to the department of work with critical units having a higher risk of blood and body fluid exposure

*** Estimates from Fishers' Exact Test. NSIs¥= Needle stick injury, €Infection prevention and control

Table 3 Factors associated with Anti-HBc acquisition among HCWs (Data has previously be published in [19])

Variables	*N*(340)	Anti-HBc	Crude Estimates		Adjusted Estimates	
		n(28)	uOR (95% CI)	*P*-value	aOR (95% CI)	*P*-value
Age category of HCWs				0.530		0.836
Less than 30 years	127	12	1.0		1.0	
Age 30 years or more	213	16	0.8(0.4–1.7)		0.9(0.4–2.3)	
Sex of study participants				0.036		0.026
Male HCWs	88	12	1.0		1.0	
Female HCWs	252	16	0.4(0.2–0.9)		0.4(0.1–0.9)	
Level of Education				0.706		0.185
Tertiary and above.	41	24	1.0		1.0	
Below tertiary	299	4	0.8(0.3–2.5)		0.4(0.1–1.5)	
Professional Group				0.205		0.661
Doctors/Nurses	231	16	1.0		1.0	
Other categories	109	12	0.6(0.3–1.3)		0.8(0.3–2.1)	
HBV acquisition Risk criteria						
No risk of HBV acquisition	44	6	1.0		1.0	
Medium to moderate risk	269	20	0.5(0.2–1.3)	0.174	0.5(0.2–1.6)	0.280
High risk of acquisition	27	2	0.5(0.1–2.7)	0.427	0.6(0.1–3.8)	0.584
Perception of susceptibility of HBV				0.367		0.202
Good risk perception	295	6	1.0		1.0	
Poor risk perception	45	22	0.7(0.3–1.6)		2.1(0.7–6.3)	
Length of Professional experience				0.462		0.773
Less than 10 years	260	23	1.0		1.0	
10 years and above	80	5	1.5(0.5–4)		1.2(0.4–3.7)	
Level of healthcare delivery				0.005		0.704
Secondary and tertiary level	237	15	1.0		1.0	
Primary Level	103	13	2.1(1.1–4.7)		2.0(0.1–65)	
Health facility Support Indicator				0.057		0.741
Very supportive	237	15	1.0		1.0	
Less supportive	103	13	2.1(1–4.7)		1.8(0.1–58.7)	
Work Department				0.204		0.120
Critical or high-risk unit	155	16	1.0		1.0	
Non-Critical or medium to low-risk unit	185	12	0.6(0.3–1.3)		0.5(0.2–1.2)	
Training in blood borne IPC€				0.027		0.044
Trained in infection prevention	274	18	1.0		1.0	
Not Trained in infection prevention	66	10	2.5(1.1–5.8)		2.6(1.1–6.4)	
Self-reported exposure				0.241		0.191
Exposure	216	20	1.0		1.0	
No exposure	124	8	0.6(0.3–1.4)		0.5(0.2–1.4)	

* Risk perception refers to having the perception that HBV is a serious disease, one is at risk of the disease and the benefits of preventing outweigh the cost

** Work department refers to the department of work with critical units having a higher risk of blood and body fluid exposure, €Infection prevention and control

of Ghana. The same reason explains the findings from a global-level systematic review which reported a higher prevalence of occupational exposures among HCWs in less developed countries compared to those in the Americas [25]. The high exposure prevalence observed in this study has implications for HCW safety as these exposures could translate into actual HBV infections in the face of sub-optimal pre and post-exposure prophylaxis uptake among the Ghanaian HCWs [27]. Health facility level, as well as health system policy directives and guidelines, are urgently needed to drive facility-level interventions targeted at reducing these occupational exposures.

Anti-HBc denoting lifetime exposure to HBV was isolated in 8. 2%. of the study population. The difference in the two indicators being reported (8.2% for Anti-HBc and 63% for self-reported occupational exposure) in this study is not surprising. The authors of this study have the understanding that not all exposures sustained by HCWs, be it mucocutaneous, percutaneous or non-intact skin would lead to the transmission of HBV. This is because studies have demonstrated that the transmission and for that matter the acquisition of HBV by non-infected, non-immune HCW is dependent on the HBeAg status and viral load of the source patient, the type of body fluid

involved, the degree or extent of the exposure and also the type of medical procedure involved [3]. This notwithstanding, it is not all individuals who have the biological advantage to fight the HBV upon having an occupational exposure. This is because studies have demonstrated that 37% of HBV infections among HCWs are a result of occupational exposures [28]. This provides the basis for the recommendation for HCWs to obtain maximum protection against HBV by taking advantage of the high efficacy rate of the HBV vaccine [29, 30] and protecting themselves from the infection and its life-threatening complications.

The Anti-HBc prevalence estimated in our study is lower than 60.1% and 48.1% reported in a related study among Ugandan HCWs [31, 32]. On the contrary, the findings of our study are two times higher than estimates from a related research which reported an Anti-HBc prevalence of 4.1% among HCWs in an European country [33]. HBV exposure and corresponding infection are known to be prevalent among HCWs in low-income countries, particularly in Africa compared to Western and well-developed countries where the disease is less endemic [4]. The differences in the results of the two studies mirror the geographical dispersal of HBV infection and the level of endemicity. This is because anti-HBc prevalence has a direct and positive correlation with HBsAg prevalence in most populations [34].

Again, the lifetime exposure to HBV that as reported in this study is slightly higher than the prevalence of actual HBV infections (HBsAg positivity) of 5.9% reported recently among the same population of Ghanaian HCWs (the two studies were done simultaneously) among the same participants [19]. There is the possibility that some of the HCWs who were exposed to HBV were able to fight the virus, and perhaps developed active immunity against the virus. This could probably explain the difference in the prevalence of lifetime exposure and the prevalence of current HBV infection (HBsAg positivity) reported in the related study. Comparing these two studies, it is clear that just about 2% of exposed HCWs had resolved infections indicating that reliance on naturally acquired immunity against HBV may not be the best strategy for HBV prevention in this population. This explanation gives credence to the fact that vaccination against HBV is the mainstay for HBV prevention especially among HCWs who constantly suffer exposures to blood and body fluids since vaccination offers a better and higher level of seroprotection against HBV.

This study found that the female gender was protective for Anti-HBc acquisition as female HCWs in this study demonstrated lesser odds of having serological evidence of exposure to HBV. This observation is not new because studies done in America, Brazil and Nigeria have equally reported a lower risk of exposure and HBV antigenemia among female HCWs compared to their male counterparts [35–37]. This is probably due to a higher level of adherence to HBV preventive measures among female HCWs compared to their male counterparts [38–40]. This observation implies that the burden of HBV exposure and subsequent infection may be higher in male HCWs than their female counterparts and hence the need to target this gender category much more in HBV preventive programs with so much attention paid to their adherence to standard precautions and uptake of pre- and post-exposure prophylaxis.

The study also found that receipt of training in infection prevention significantly reduced the odds of having serological evidence of HBV exposure. Similarly, an African study recently reported that the risk of occupational exposure to HBV was significantly higher in HCWs who lack training in infection prevention and control compared to those who received optimum training [6]. Healthcare worker training and educational programs ensure optimum human resources knowledge, skills development and performance through planned and coordinated training and educational programmes. Specifically, In-service training for HCWs in the area of HBV prevention is crucial specifically for sustaining HBV preventive behaviour and maintaining HCW competencies in general. Researchers from Egypt and the United States suggest that in-service training in blood-borne infection prevention in health facilities has the potential to increase the overall safety of HCW through increasing knowledge and promotion of positive attitudes towards the prevention of HBV and other blood-borne infections [41, 42].

We infer from this study that continuous training for HCWs can significantly reduce HCWs' risk of exposure to HBV and therefore recommend repeated onsite in-service training for all categories of HCWs especially in resource-poor settings. We therefore call for continuous evaluation of the impact of these training sessions on the HCW populations. We strongly advocate for the training programmes to be appropriately designed using holistic approaches that will trigger behavioural change and ultimately improve HBV preventive behaviour.

Study limitations

This study employed a cross-sectional design, implying that the observed association may not necessarily imply a causal relationship. Moreover, recall bias and social desirability bias could affect the accuracy of the data that was collected from the participants on reported biological material exposures. Again, data was collected from HCWs working in only public or government-owned facilities in the Greater Accra Region. This represents sampling bias since HCWs working in other regions and

private health facilities may have different levels of HBV exposure.

Conclusions

The findings of this study suggest that self-reported exposure to HBV-contaminated biological materials was high with a corresponding high lifetime exposure to hepatitis B virus. The female gender was protective of Anti-HBc acquisition. Periodic training for healthcare workers on bloodborne infection prevention has the potential to prevent the occurrence of blood and body fluid exposures in the healthcare setting and this can translate into a significant reduction in the risk of occupational exposure to the hepatitis B virus.

Abbreviations

Anti–HBc	Hepatitis B Core Antibody
CDC	Centre for Disease Control
CHPS	Community-based Health Planning and Services
GHS	Ghana Health Service
HBV	Hepatitis B virus
HBsAg	Hepatitis B Surface Antigen
HCWs	Healthcare workers
WHO	World Health Organisation

Acknowledgements

We thank all the respondents who participated voluntarily in the study and a special thanks to the research assistants who made this project possible.

Author contributions

Senoo-Dogbey V.E. Conceptualization, Methodology, Software, Data curation, Writing, Original draft, Preparation, Visualization, Investigation, Validation. Klutse: E.E. Methodology, Investigation, Validation, Writing, Original draft, Preparation Reviewing and Editing,

Funding

This research received no funds or grants from public, private, or nonprofit agencies.

Data availability

Data is available from the corresponding authour upon reasonable request.

Declarations

Ethics approval and consent to participate

Ethical clearance was obtained from the local ethical review committee in Ghana. Facility heads and hospital administrators granted permission for data collection to be undertaken.

Informed consent to participate

The participants were informed about the study's objectives and valid written consent was obtained before the data collection could begin. The respondents had the right to refuse, withdraw, or terminate at any point without giving any reason. The information provided by the respondents was treated with the highest degree of confidentiality.

Consent for publication

Not Applicable.

Competing interests

The authors declare no competing interests.

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Received: 22 March 2024 / Accepted: 1 August 2024
Published online: 13 September 2024

References

1. Trepo C, Chan H, Lok A. Hepatitis B virus infection. Lancet. 2014;384:2053–63. https://doi.org/10.1016/S0140-6736(14)60220-8
2. Lozano R, Naghavi M, Foreman K, Lim S, Shibuya K. Global burden of disease study 2010. Lancet. 2012;380:2095–128. https://doi.org/10.1016/S0140-6736(12)61728-0.Global
3. Coppola N, De Pascalis S, Onorato L, Calò F, Sagnelli C, Sagnelli E. Hepatitis B virus and hepatitis C virus infection in healthcare workers. World J Hepatol. 2016;8:273–81. https://doi.org/10.4254/wjh.v8.i5.273
4. Mahamat G, Kenmoe S, Akazong EW, Ebogo-Belobo JT, Mbaga DS, Bowo-Ngandji A, et al. Global prevalence of hepatitis B virus serological markers among healthcare workers: a systematic review and meta-analysis. World J Hepatol. 2021;13:1190–202. https://doi.org/10.4254/wjh.v13.i9.1190
5. Bhat M, Ghali P, Deschenes M, Wong P. Hepatitis B and the infected health care worker: public safety at what cost? Can J Gastroenterol. 2012;26:257–60.
6. Auta A, Adewuyi EO, Tor-Anyiin A, Aziz D, Ogbole E, Ogbonna BO, et al. Health-Care workers' occupational exposures to body fluids in 21 countries in Africa: systematic review and meta-analysis. Bull World Health Organ. 2017. https://doi.org/10.2471/BLT.17.195735
7. Obirikorang C, Opoku SK, Obirikorang Y, Yorke EAJ, Donkoh ET, Chidera C, et al. Awareness and occupational exposures to needlestick injuries among healthcare workers: a quantitative assessment in a Ghanaian metropolis. Glob J Qual Saf Healthc. 2018;4–5. https://doi.org/10.4103/JQSH.JQSH
8. Lori JR, McCullagh MC, Krueger A, Oteng R. Sharps injuries among emergency department nurses in one tertiary care hospital in Ghana. Int Emerg Nurs. 2015;28:14–9. https://doi.org/10.1016/j.ienj.2015.11.007
9. Appiagyei H, Nakua EK, Donkor P, Mock C. Occupational injuries among health care workers at a public hospital in Ghana. Pan Afr Med J. 2021;39. https://doi.org/10.11604/pamj.2021.39.103.23542
10. Alaru M, Kyiu C, Yariga F, Osman A. Prevalence of needle stick injury among healthcare workers in Savelugu Municipal Hospital. Asian J Med Heal. 2023;21:127–36.
11. Odonkor ST, Sallar AM. Occupational health and safety knowledge, attitudes and practices among healthcare workers in Accra Ghana. Sci Afr. 2024;24:e02130. https://doi.org/10.1016/j.sciaf.2024.e02130
12. Akagbo SE, Nortey P, Ackumey MM. Knowledge of standard precautions and barriers to compliance among healthcare workers in the Lower Manya Krobo District, Ghana. BMC Res Notes. 2017;10:1–10. https://doi.org/10.1186/s13104-017-2748-9
13. Konlan KD, Aarah-Bapuah M, Kombat JM, Wuffele GM. The level of nurses ' knowledge on occupational post-exposure to hepatitis B infection in the Tamale metropolis, Ghana. BMC Heal Serv Res. 2016;1:1–15. https://doi.org/10.1186/s12913-017-2182-7
14. Sunkwa-Mills G, Senah K, Breinholdt M, Aberese-Ako M, Tersbøl BP. A qualitative study of infection prevention and control practices in the maternal units of two Ghanaian hospitals. Antimicrob Resist Infect Control. 2023;12:1–15. https://doi.org/10.1186/s13756-023-01330-z
15. Ansa GA, Ofori KNA, Houphouet EE, Amoabeng AA, Sifa JS, Amenuveve CK, et al. Hepatitis B vaccine uptake among healthcare workers in a referral hospital, Accra. Pan Afr Med J. 2019;33:1–10. https://doi.org/10.11604/pamj.2019.33.96.18042
16. Kondor VD. Health worker compliance with infection prevention and control policy in Ghana: a case study of La General Hospital. Texila Int J Public Heal. 2021;9:150–61. https://doi.org/10.21522/tijph.2013.09.02.art014
17. Senoo-Dogbey VE, Armah D, Wuaku DA. Hepatitis B infection prevention: audit of selected healthcare facilities in the Greater Accra Region, Ghana. Infect Prev Pract. 2023;5:100284. https://doi.org/10.1016/j.infpip.2023.100284
18. Senoo-Dogbey V, Wuaku D, Mumuni A. Adherence to the three-component Hepatitis B virus vaccination protocol among healthcare workers in hepatitis B virus endemic settings in Ghana. Vaccine X. 2024;16:100421. https://doi.org/10.1016/j.jvacx.2023.100421

19. Senoo-Dogbey VE, Wuaku DA, Armah D. Seroprevalence of Hepatitis B virus infection and associated factors among health care workers in Southern Ghana. IJID Reg. 2023;6:84–9. https://doi.org/10.1016/j.ijregi.2023.01.009
20. Ott JJ, Stevens GA, Groeger J, Wiersma ST. Global epidemiology of hepatitis B virus infection: new estimates of age-specific HBsAg seroprevalence and endemicity. Vaccine. 2012;30:2212–9. https://doi.org/10.1016/j.vaccine.2011.12.116
21. Ofori-Asenso R, Agyeman AA. Hepatitis B in Ghana: a systematic review & meta-analysis of prevalence studies (1995–2015). BMC Infect Dis. 2016;16:130. https://doi.org/10.1186/s12879-016-1467-5
22. Senoo-Dogbey V, Wuaku DA, Armah D. Seroprevalence of Hepatitis B virus infection and associated factors among health care workers in Southern Ghana. IJID Reg. 2023;6:84–9. https://doi.org/10.1016/j.ijregi.2023.01.009
23. Gara N, Abdalla A, Rivera E, Zhao X, Werner JM, Liang TJ, et al. Durability of antibody response against hepatitis B virus in healthcare workers vaccinated as adults. Clin Infect Dis. 2015;60:505–13. https://doi.org/10.1093/cid/ciu867
24. Stoltzfus J. Logistic regression: a brief primer. Acad Emerg Med. 2011;18:1099–104. https://doi.org/10.1111/j.1553-2712.2011.01185.x
25. Bouya S, Balouchi A, Rafiemanesh H, Amirshah M. Global prevalence of device related causes of needle stick injuries among healthcare workers: a systematic review and meta analysis. Ann Glob Heal. 2020;86:1–8. https://doi.org/10.1515/reveh-2021-0148
26. Ziglam H, El-Hattab M, Shingheer N, Zorgani A, Elahmer O. Hepatitis B vaccination status among healthcare workers in a tertiary care hospital in Tripoli, Libya. J Infect Public Health. 2013;6:246–51. https://doi.org/10.1016/j.jiph.2013.02.001
27. Senoo-Dogbey VE, Ohene LA, Wuaku DA. Occupational exposure to Hepatitis B virus, disease burden and pathways for postexposure prophylaxis management: recommendations for healthcare workers in highly endemic settings. Infect Prev Pract. 2024;6:100354. https://doi.org/10.1016/j.infpip.2024.100354
28. Rapiti E, Prüss-üstün A, Hutlin Y, Campbell-lendrum D, Corvalán C, Woodward A. Sharps injuries: assessing the burden of disease from sharps injuries to health-care workers at national and local levels. World Heal Organ Environ Burd Dis Ser No 11. 2005;1–50.
29. National Center for Immunization Research & Surveillance. Hepatitis B vaccines for Australians: In: NCIRS Fact Sheet. 2015 [cited 1 Mar 2017] pp. 1–11. https://ncirs.org.au/ncirs-fact-sheets-faqs/hepatitis-b-vaccines-for-australians
30. Senoo Dogbey VE, Armah D, Wuaku AD. Hepatitis B virus vaccination post serological testing and antibody levels of vaccinated health care workers in Accra, Ghana. Vaccine X. 2023;14:100294. https://doi.org/10.1016/j.jvacx.2023.100294
31. Braka F, Nanyunja. M, Makumbi I, Mbabazi W, Kasasa S, Rosamund L. Hepatitis B infection among health workers in Uganda: evidence of the need for health worker protection. Vaccine. 2006;24:6930–7. https://doi.org/10.1016/j.vaccine.2006.08.029
32. Ziraba AK, Bwogi J, Namale A, Wainaina CW, Mayanja-Kizza H. Sero-prevalence and risk factors for hepatitis B virus infection among health care workers in a tertiary hospital in Uganda. BMC Infect Dis. 2010;10:191. https://doi.org/10.1186/1471-2334-10-191
33. Domínguez A, Urbiztondo L, Bayas JM, Borrás E, Broner S, Campins M, et al. Serological survey of hepatitis B immunity in healthcare workers in Catalonia (Spain). Hum Vaccines Immunother. 2017. https://doi.org/10.1080/21645515.2017.1264791
34. Zhu Q, Shao X, Chen S, Li D, Chen X, Liu W, et al. Epidemiological serosurvey of hepatitis B virus among children aged 1–14 years in Guangdong Province, China. Int J Infect Dis. 2018;71:25–9. https://doi.org/10.1016/j.ijid.2018.01.027
35. Elikwu CJ, Shonekan O, Shobowale E, Nwadike V, Tayo B, Okangba C, et al. Seroprevalence of hepatitis B surface antigenaemia among healthcare worker in a private Nigerian tertiary health institution. Int J Infect Control. 2016;12:1–6. https://doi.org/10.3396/IJIC.v12i2.013.16
36. Luong NV, Diallo M, Gannon L, Luta M, Maduka-ezeh A. Infection trend, distribution, and factors associated with Hepatitis B Virus infection in Delaware, 2005–15. 2017;2: 1–7.
37. Machado de P, Felippe GD, Martins T, Trevisol DJ, Vieira e Silva RA, Narciso-Schiavon JL, et al. Prevalence and factors associated with hepatitis B virus infection among senior citizens in a Southern Brazilian city. Hepat Mon. 2013;13:1–10. https://doi.org/10.5812/hepatmon.7874
38. Akosionu O, Virnig B, Call KT, Yuan JM, Chanthanouvong S, Nguyen RHN. The impact of gender differences in attitudes and beliefs concerning HBV vaccination and screening in the Lao Community. J Immigr Minor Heal. 2016;18:277–81. https://doi.org/10.1007/s10903-015-0160-x
39. Gabresilassie A, Kumei A, Yemane D. Standard Precautions Practice among Health Care Workers in Public Health Facilities of Mekelle Special Zone, Northern Ethiopia. J Community Med Health Educ. 2014;04:1000286. https://doi.org/10.4172/2161-0711.1000286
40. Ochu CL, Beynon CM. Hepatitis B vaccination coverage, knowledge and sociodemographic determinants of uptake in high risk public safety workers in Kaduna State, Nigeria: a cross sectional survey. BMJ Open. 2017;7:1–10. https://doi.org/10.1136/bmjopen-2017-015845
41. El-leithy B. Education program about blood born-pathogens transmission on primary health care workers in Ismailia city (an intervention study). Egypt J Occup Med. 2013;37: 121–139. Available: https://www.capacityplus.org/in-service-training-improvement-framework-launched.html
42. Bailey R, Bluestone J, Ngobua S, Petracca F, Schaefer L, Wuliji T et al. In-Service Training Improvement Framework Launched at the Third Global Forum on Human Resources for Health. 2018 [cited 11 Dec 2018] pp. 11–13. Available: https://www.capacityplus.org/in-service-training-improvement-framework-launched.html

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