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Seroprevalence of Hepatitis B virus infection and associated factors among health care workers in Southern Ghana

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ABSTRACT

Introduction: The World Health Organization estimates that 37% of Hepatitis B Virus (HBV) infections among Health Care Workers (HCWs) are due to percutaneous occupational exposure to blood and body fluids. In Ghana, occupational exposures are rising; however, the burden of HBV infection in HCWs remains unknown. Our study estimated the prevalence of HBV surface antigens and associated factors among HCWs.

Methods: We conducted a cross-sectional survey of 340 HCWs using a structured pretested questionnaire and screening for HBV surface antigens. Data were analyzed using SPSS version 20.0 with a level of significance set at <0.05.

Results: The overall crude prevalence of current HBV infection was 5.9 % (95% CI, 3.0–8.0). Adjusted prevalence by test performance was 5.8%. Prevalence was highest among males 10.2% (95% CI, 4.8-18.5), HCWs other than nurses and doctors 9.2% (95% CI, 4.5–16.2), and those working at lower-level facilities 9.7% (95% CI, 4.8–17.1). Training in the prevention of blood-borne infections was significantly associated with HBV infection (adjusted odds ratio 3.2; 95% CI, 1.1–9.1)

Conclusions: HBV infection is high in this population. In addition to lifesaving interventions such as vaccination and the use of immunoglobulin, training in blood-borne infections could prevent new HBV infections among Ghanaian HCWs.

Introduction

Hepatitis B Virus (HBV) infection is a liver infection causing life-threatening inflammation. Globally, HBV has been identified as the most common chronic infection afflicting humans [1]. A recent World Health Organization (WHO) estimate suggests that 296 million people were living with the chronic form of HBV in 2019, with 1.5 million new infections occurring annually. In 2019 alone, HBV accounted for close to 820 000 mortalities, primarily resulting from cirrhosis and hepatocellular carcinoma [2]. HBV infection has been identified as the tenth leading cause of death globally, hence its inclusion in major public health priorities [1]. Health Care Workers (HCWs) are exposed to human blood and other potentially infectious biological agents more frequently than the general population. Out of the 60 or more microbial agents responsible for blood-borne transmissible infectious diseases, HBV is one of the infections most frequently transmitted to HCWs; therefore, HBV is considered a significant occupational hazard to HCWs globally [3]. In the global health sector strategy on viral hepatitis, the WHO recognized the danger of HBV to HCWs and, under its infection prevention strategy, emphasized the protection of HCWs as a priority for countries in the quest to eliminate the infection [4]. In Ghana, the prevalence of HBV is high among the general population; recent systematic reviews estimated prevalence rates of 12.3% and 14.4% [5,6], placing it as a highly endemic country. Studies have shown that the rate of HBV infection could be 2–4 times higher among HCWs than in the general population [7]. Given the high prevalence estimated among the general Ghanaian population, there is a need to estimate the frequency and burden of HBV infection and its associated factors among HCWs, as the occupational group with the highest infection risk. Such estimates could provide the basis for comparison of future trends and allow for evaluation of the effectiveness of control and prevention interventions in this high-risk population.

Most studies in the area of HBV infection in HCWs in Ghana focused on knowledge, perceptions and vaccination coverage without estimating the disease burden in this population [8–12]. Only one study has estimated HBV prevalence in HCWs, but this was limited to medical

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laboratory scientists [13]. To address this knowledge gap, our study was designed to estimate the prevalence of HBV surface antigen (HBsAg) and associated factors among HCWs from 5 facilities in the Greater Accra Region of Ghana.

Materials and methods

Design

We conducted a cross-sectional hospital-based study in the Greater Accra Region in the second half of 2020. The cross-sectional design was most appropriate for estimating the prevalence of HBsAg among the study population.

Study setting

Greater Accra Region is the capital of Ghana and is the second most populous region in the country after the Ashanti Region, but has the smallest land area [14]. The region is located in the south-central part of the country, bordering the Central Region to the west, Volta Region to the east, Eastern Region to the north, and the Gulf of Guinea to the south. The region is 1 of 16 administrative regions in the country [15]. There are 29 health administrative districts and 1297 health institutions consisting of 1 regional hospital, 2 teaching hospitals, 2 psychiatric hospitals, 3 university hospitals, 10 district hospitals, 118 general hospitals, 21 polyclinics, 292 clinics, 35 health centers, 707 Community-Based Health Planning and Services (CHPS) compounds and 106 maternity homes. In our study health facilities were stratified into 5 levels of care, and participants were drawn from a randomly sampled facility from each stratum.

Study population

Participants of the study were drawn from 6 categories of HCWs: doctors, nurses, laboratory staff, anesthetists, physician assistants and orderlies (sanitation workers). Participants were individuals ≥18 years old, were permanent workers in the 5 selected health facilities, and had worked in their respective facilities for ≥6 months.

Sample size estimation

A systematic review and meta-analysis of HBV prevalence studies in Ghana has estimated national prevalence at 12.3% [5]. It has also been established that HBV infection could be 2–4 times higher in HCWs compared with the population they serve. Considering these two factors, a prevalence of 50% was anticipated and used to estimate the sample size. The formula for calculating proportions in cross-sectional studies proposed by Cochrane [17] was used to compute the sample size. Other statistical assumptions such as population correction factor, design effect and allocation for non-response were duly considered producing a total sample size of 363 HCWs for the study.

Sampling procedure

Healthcare facilities in the region were stratified into 5 levels of care: regional hospitals, district hospitals, polyclinics, health centers and CHPS compounds. One facility was randomly selected from each stratum except the regional hospital since there is only one regional hospital in the Greater Accra Region. The number of HCWs selected was proportional to facility size. In each selected facility, HCWs were stratified into 6 staff categories. The human resources officers of the selected facilities provided the staff list for each category; these category-specific lists served as a sampling frame for the random selection of HCWs from each job category in the respective study sites.

Table 1
Sociodemographic and Occupational variables of participants.

Variables	N(340)	Percent (100%)
Age in years		
≤30	127	37.4
>30	213	62.6
Sex		
Male	88	25.9
Female	252	74.1
Tertiary Education		
Above.	41	12.0
≤Below	299	88.0
Cadre of staff		
Doctors/Nurses	231	68.0
Others	109	32.0
Risk level		
No	44	12.9
Medium	269	79.1
High	27	8.0
Risk Perception		
High	295	86.8
Low	45	13.2
Duration of employment		
<10 years	260	76.5
≥10 years	80	23.5
Facility type		
Higher Level	237	69.7
Lower Level	103	30.3
Facility Factor		
Good	237	69.7
Poor	103	30.3
Work unit		
Critical[a]	155	45.6
Non-Critical	185	54.4
Training		
Trained	274	80.6
Not Trained	66	19.4
Lifetime NSIs[b]		
Exposure	216	63.5
No exposure	124	36.5
Mucocutaneous Exposure		
Exposed	264	77.6
Not exposed	76	22.4

[a] Critical unit-unit or department where there is high risk of blood and body fluid exposure.
[b] Needle Stick Injuries.

Data collection instrument

A self-administered structured pretested questionnaire was used to collect data from consenting HCWs. Questions covered sociodemographics (e.g., age, sex, duration of employment), occupational characteristics (e.g., job category, duration of employment, needle stick injury exposure) and personal risk factors for HBV infection (e.g., lifetime surgery, lifetime blood transfusion, lifetime dentist).

Sample collection and laboratory procedure

Following completion of the questionnaire, 5 ml of venous blood was aseptically collected from each participant under a strict aseptic phlebotomy procedure using 5 ml sterile syringes into an Ethylenediaminetetraacetic acid tube and centrifuged at 2200–2500 rpm for 15 minutes to separate the serum. Serum samples were then transported at 2–4 °C under cold chain conditions to a central laboratory where qualitative detection of HBsAg, an indicator of current HBV infection, was carried out using an Advanced Quality TM One Step multi-HBV Test Device Cassette (In Tec Products, Inc.). Two drops of each serum sample were dropped carefully into the wells of the test device. The results were read after 15 minutes following the appearance of red lines at the test and control bands or regions of the test kit. The determination of a neg-

Table 2
Prevalence of HBsAg positivity (Current HBV infection).

			HBV infection (HBsAg)		
Variables	N(340)	n(20)	Percent (95% CI)	Chi	P-value
Age in years				4.66	0.031
≤30	127	12	9.4(5 - 15.9)		
>30	213	8	3.8(1.6 - 7.3)		
Sex				4.04	0.044
Male	88	9	10.2(4.8 - 18.5)		
Female	252	11	4.4(2.2 - 7.7)		
Tertiary Education				***	0.488
Above.	41	1	2.4(0.1 - 12.9)		
≤Below	299	19	6.4(3.9 - 9.7)		
Cadre of staff				3.14	0.076
Doctors/Nurses	231	10	4.3(2.1 - 7.8)		
Others	109	10	9.2(4.5 - 16.2)		
Risk level				***[c]	0.187
No	44	5	11.3(3.8-24.6)		
Medium	269	13	4.8(2.6-8.1)		
High	27	2	7.4(0.9-24.3)		
Risk Perception				5.20	0.023
High	295	14	4.7(2.6 - 7.8)		
Low	45	6	13.3(5.1 - 26.8)		
Duration of employment				2.16	0.141
<10 years	260	18	6.9(4.2 - 10.7)		
≥10 years	80	2	2.5(0.3 - 8.7)		
Facility type				3.91	0.048
Higher Level	237	10	4.2(2 - 7.6)		
Lower Level	103	10	9.7(4.8 - 17.1)		
Facility Factor				3.91	0.048
Good	237	10	4.2(2 - 7.6)		
Poor	103	10	9.7(4.8 - 17.1)		
Work unit				0.17	0.683
Critical[a]	155	10	6.5(3.1 - 11.5)		
Non-Critical	185	10	5.4(2.6 - 9.7)		
Training				8.89	0.003
Trained	274	11	4(2 - 7.1)		
Not Trained	66	9	13.6(6.4 - 24.3)		
Lifetime NSIs[b]				1.21	0.272
Exposure	216	15	6.9(3.9 - 11.2)		
No exposure	124	5	4(1.3 - 9.2)		
Mucocutanous				1.95	0.162
Exposed	264	13	4.9(2.6 - 8.3)		
Not exposed	76	7	9.2(3.8 - 18.1)		

[a] Critical unit-unit or department where there is high risk of blood and body fluid exposure.
[b] Needle Stick Injuries.
[c] Estimates from Fishers Exact Test.

ative or positive test result was carried out following the manufacturer's instructions.

Research data analysis

Research data were coded, entered and analyzed using IBM SPSS software (version 21, Chicago, Illinois, USA). Some variables were categorized into 2 groups: age into ≤30 years and >30 years; education level into 'below tertiary' for participants without university level education and 'above tertiary' for those with a university level education or above; job category into 'doctors, nurses, midwives, anesthetists and physician assistants' and 'others' for orderlies or hospital sanitation workers and laboratory staff; and professional experience into ≤10 years and >10 years.

Risks of HBV exposure not related to the occupation of the HCW were referred to as behavioral risk factors. HCWs without any of these risk factors were classified as having no risk, those with 1–3 factors as intermediate risk and those with ≥4 risk factors as at high risk of infection with HBV [18].

Our estimation of the prevalence of HBV infection proceeded in 2 steps. First, we report the raw frequencies of positive tests as a proportion of the final sample size. Second, we report the estimated sample prevalence, adjusted for test performance characteristics of sensitivity and specificity [19]. The test performance indicators of sensitivity 99.0% and specificity 95.5% provided by the WHO following an evaluation exercise that led to the recommendation of the test kit as being valid for detecting HBsAg [20].

Categorical variables were presented as proportions in tables and a chart. Pearson's chi-square test or Fisher's exact tests were performed as necessary to assess associations between current HBV infection (HBsAg) and the sociodemographic and occupational variables. Odds ratios with 95% CIs were calculated through univariate and multivariate logistic regression analyses to investigate the influence of personal and occupational factors on the occurrence of HBV infection, adjusting for potential factors that could act as confounders (e.g., blood transfusion, intimate contact with a known HBV carrier, dental procedure, lifetime surgery, tattoo or scarification). A *P*-value of < 0.05 was considered significant.

Results

Background characteristics of participants

All 363 HCWs sampled gave consent to participate in the questionnaire and blood testing. However, the results presented below are based

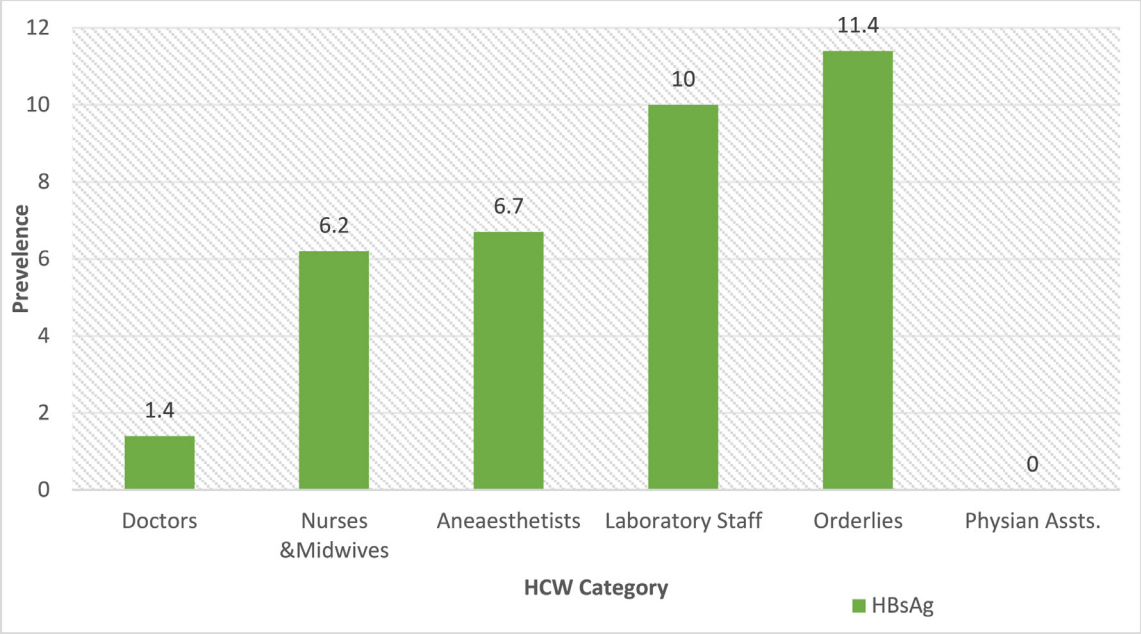

Fig. 1. HBsAg acquisition by job category or cadre.

on 340 fully completed questionnaires and corresponding blood samples representing a 93.7 % response rate.

Table 1 shows that most HCWs who participated in the study were women (252), representing 74.1% of participants. Their average age was 34.5 years with an SD of ± 7.7. Most participants, 88.0% (299/340), had attained tertiary-level education. Doctors and nurses/midwives were 68.0% of the participants. The majority of HCWs, (260) 76.5%, had less than 10 years of working experience. A total of 155 (45.6%) worked as providers in critical units (e.g., labor ward, theatre) where blood and body fluid exposures are much more likely, whilst 54.4% (185) provided care at less critical units or departments.

Receipt of training in the prevention of blood-borne infections was widespread, with almost 80.6% of participants having attended a training workshop. The health facility environment of the HCW was observed to be good or conducive for prevention of HBV for most participants (69.7%.) (Table 1).

Prevalence of current HBV infection (HBsAg) among HCWs

Twenty (20) of the 340 respondents tested positive for HBsAg, giving a crude prevalence of 5.9% (95% CI, 3.0–8.0) among the study population. Using test performance values of sensitivity of 99.0% and specificity of 95.5%, the prevalence of HBV infection (HBsAg), adjusted for test performance, was 5.8%. The results presented in Table 1 show that HBV infection prevalence was highest among participants <30 years of age (9.4%). HBV infection was more common in men (10.2%) than women (4.4%). HCWs below the postgraduate level of education were more affected, 19 (6.4%) than those with above post graduate level education. The prevalence of HBV infection was higher (13.6%) in HCWs who had never attended training or workshops on blood-borne infections and their prevention than their trained conterparts. HCWs working in lower levels of the health care system (CHPS, health centers and polyclinics) were much more affected (9.7%) than those working at higher level facilities. HBV infection was more predominant (6.9%) in individual HCWs who had worked for <10 years compared to those with over 10 years work experience. Prevalence was also higher in those working in critical units (6.5%) than those working in units with minimal exposure or in non-critical areas. HBV prevalence was lower (4.2%) in health facilities with good facility conditions that promote HBV prevention compared with 9.7% in HCWs with poor facility conditions (Table 2). Fig. 1 shows the HBsAg positivity by job category, demonstrating that orderlies (hospital sanitary workers) recorded the highest prevalence of HBV infection.

Factors associated with current HBV infection

After adjusting for the other factors associated with HBV infection using a logistic regression model, the results presented in Table 3 show that HCWs who were not trained in the prevention of blood-borne infections had more than 3 times higher odds of HBV infection (adjusted odds ratio 3.2; 95% CI, 1.1–9.5) compared with their trained counterparts.

Discussion

Our study, conducted among 6 different categories of HCWs drawn from 5 public health facilities in the Greater Accra Region, found an HBsAg prevalence of 5.9%. According to the WHO classification of levels of HBV infection and endemicity among populations, 5.9% is indicative of an intermediate level of endemicity since it falls within the range of 2%–7% [16].

A recent meta-analysis of prevalence studies conducted in Ghana among specific populations other than HCWs estimated a pooled HBV infection prevalence of 12.3% [5], positioning Ghana as a highly endemic region (HBsAg prevalence >8%) [16]. Although previous studies have shown that HBV prevalence could be 2–4 times higher in HCWs compared with the general population [7], our study found HBsAg prevalence at almost half the level estimated for the general Ghanaian population. This difference in prevalence could be explained by the emergence and use of strategies such as vaccination, standard precautions and infection prevention and control, pursued at both individual HCW and health facility level, which prevent new HBV infections [3]. This argument is supported by findings that show a decline in new HBV infections where vaccination among HCWs is being pursued [21].

Our study's estimate of prevalence among HCWs (5.9%) is comparable with a prevalence of 5.7% reported among HCWs in Northern Tanzania, which is also located in a high endemic zone [22] and it is also similar to an overall pooled prevalence of 6.1% as estimated by a systematic review of studies conducted among HCWs in the African region

Table 3
Factors associated with current HBV infection (HBsAg).

Variables	N(340)	HBsAg n(20)	Crude Estimates uOR (95% CI)	P-value	Adjusted Estimates aOR (95% CI)	P-value
Age in years				0.037		0.121
≤30	127	12	1.00		1.00	
>30	213	8	0.4(0.1 - 0.9)		0.4(0.1-1.3)	
Sex				0.051		0.053
Male	88	9	1.00		1.00	
Female	252	11	0.4(0.2 - 1)		0.3(0.1-1)	
Tertiary Education				0.337		0.859
Above.	41	1	1.00		1.00	
≤Below	299	19	2.7(0.4 - 20.8)		1.2(0.1-11)	
Cadre of staff				0.083		0.211
Doctors/Nurses	231	10	1.00		1.00	
Others	109	10	0.4(0.2 - 1.1)		0.5(0.1-1.5)	
Risk level						
No	44	5	1.00		1.00	
Medium	269	13	0.4(0.1-1.2)	0.094	0.5(0.1-2)	0.352
High	27	2	0.6(0.1-3.5)	0.59	1.2(0.2-8.5)	0.880
Risk Perception				0.278		0.098
High	295	14	1.00		1.00	
Low	45	6	0.6(0.2 - 1.6)		2.9(0.8-10)	
Duration of employment				0.159		0.557
<10 years	260	18	1.00		1.00	
≥10 years	80	2	2.9(0.7 - 12.8)		1.7(0.3-9.3)	
Facility type				0.054		0.827
Higher Level	237	10	1.00		1.00	
Lower Level	103	10	2.4(1 - 6.1)		1.6(0-106.2)	
Facility Factor				0.054		0.582
Good	237	10	1.00		1.00	
Poor	103	10	2.4(1 - 6.1)		3.3(0-220.5)	
Work unit[a]				0.683		0.916
Critical[a]	155	10	1.00		1.00	
Non-Critical	185	10	0.8(0.3 - 2)		0.9(0.3-2.9)	
Training				0.005		0.033
Trained	274	11	1.00		1.00	
Not Trained	66	9	3.8(1.5 - 9.5)		3.2(1.1-9.1)	
Lifetime NSIs[b]				0.255		0.086
Exposure	216	15	1.00		1.00	
No exposure	124	5	0.6(0.2 - 1.5)		0.3(0.1-1.2)	
Mucocutanous				0.588		0.605
Exposed	264	13	1.00		1.00	
Not exposed	76	7	1.5(0.3 - 6.7)		1.4(0.4-4.3)	

[a] Critical unit-unit or department where there is high risk of blood and body fluid exposure
[b] Needle Stick Injuries

[23]. Nevertheless, the 5.9% HBV prevalence among HCWs, although lower than for the general Ghanaian population, is still a concern since HCWs can suffer major complications associated with HBV infection, which includes cirrhosis of the liver, hepatocellular carcinoma and even death [1].

On the other hand, this intermediate-level prevalence could explain the inadequacy of implementing preventive strategies among HCWs in the Greater Accra Region. It is important that a lot more is invested into protecting HCWs from occupational exposures and that preventive intervention are made to reach all susceptible HCWs as soon as practicable. This is possible because evidence from the Americas, Asia, and Europe suggests that a marginal reduction in HBV prevalence is achievable, especially among HCWs who are the most vulnerable, when HBV vaccination is vigorously pursued [24–26]. An important finding of our study is the high frequency of HBV infection among lower-level staff, for example, orderlies, compared with doctors and nurses. This finding is not new. A study in Nigeria observed a similar trend of higher HBsAg positivity among sanitary workers in a Nigerian hospital [27]. Orderlies do not directly handle patients but are involved in day-to-day sanitation activities, including cleaning the hospital environment. Their roles and responsibilities include cleaning spillages of blood and body fluids and discarding hospital waste that may harbor infectious pathogens, including HBV [28]. It has also been reported that orderlies are the most exposed to infectious pathogens due to their lack of awareness, lack of training, low socioeconomic status and low level of education [29]. Our study suggests that hospital sanitation, cleaning and waste-handling activities may contribute to HBV acquisition and infection among HCWs, especially in low to middle-income settings where HBV prevalence is high in the general population. Inferring from the above observation, HCWs in lower-level job categories are more vulnerable and have a higher incidence of HBV infection than other HCW job categories (e.g., doctors and nurses).

Conclusion

The 5.9% prevalence of HBV infection among HCWs in Southern Ghana, although less than half that estimated for the general population, is still a concern against the goal of global elimination of HBV. The prevalence may be explained by inadequate implementation of preventive strategies among HCWs in the Greater Accra Region. Therefore, it is important that more is invested in protecting HCWs from occupational exposures and that preventive interventions reach all susceptible HCWs as soon as practicable. Key preventive measures should include continuous training of HCWs in preventing blood-borne infections within the health care facility. In addition, more attention needs to be paid to the lower-level job categories since they appear to be at higher risk for HBV infection. Therefore, urgent support in the form of education,

training and vaccination against HBV is required among this vulnerable subgroup.

Ethics statement

The Institutional Review Board of the Noguchi Memorial Institute of Medical Research (005/17-18) and the Ethical Review Committee of the Ghana Health Service (GHS-ERC 006/08/17) gave ethical approval for the study to be undertaken. The study's nature, purpose and procedures were explained to participants, and thereafter, they voluntarily completed consent forms. Confidentiality was ensured regarding test results. The blood samples examined in the study were provided voluntarily by the participants. The principal investigator was solely responsible for communicating the test results to the participants. Those who tested positive for HBV were counselled and given referral letters to seek treatment and care. All source documents were de-identified using serial numbers instead of participants' names.

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Availability of data and materials

The data for this study are available from the corresponding author upon reasonable request.

Declaration of Competing interest

The authors have no financial or non-financial interests to declare.

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