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Distribution of Serological Markers of Hepatitis B Virus Infection among Health Care Workers in Ghana

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ABSTRACT

Introduction: The prevalence of Hepatitis B Virus (HBV) among the Ghanaian population is high and also occupational exposures to blood and body fluids that could potentially result in HBV infection is high among Health Care Workers (HCWs). However, the distribution of serological markers of HBV infection among HCW remains largely unknown. The study aimed to describe the distribution of HBV serological markers among the Ghanaian HCWs.

Methods: A hospital-based cross-sectional survey involving 363 HCWs drawn from five health institutions selected through a stratified random sampling procedure was undertaken. A structured pretested questionnaire was the research instrument that was utilized to collect data from health care workers who also gave 5mls of venous blood to be evaluated qualitatively for the presence of five serological markers of HBV. Enzyme-Linked Immunosorbent Assay (ELISA) procedure was subsequently undertaken to detect IgM HBcAb. Data were analyzed using SPSS version 20.0.

Results: The predominant HBV maker among the population was Anti-HBs; 57.4% (195/340) and the least was HBeAg; 1.5% (5/340). One third (123/340) of the HCWs were naïve to HBV. Lifetime exposure to HBV (Anti-HBc) prevalence was 8.2% (28/340) (95% CI= 5.0%-11).

Conclusions: Even though Anti-HBs is the predominant antibody marker identified among the population of HCWs evaluated, one-third of the participants remain susceptible to HBV infection. Protective measures need to be instituted to prevent new infections among HCWs who are currently naïve to the virus. Sanitary workers or orderlies need to be given special consideration in HBV prevention campaigns.

Key words: Health Care Worker, Hepatitis B infection, Serological markers

Introduction

Hepatitis B virus (HBV) infection is a liver infection and subsequent inflammation that is life-threatening. Globally, the infection has been identified as the most common chronic infection afflicting humans.[1] Current estimates revealed a global prevalence of 3.9% representing approximately 240 million infections.[2,3] In Ghana, however, recent estimates from systematic reviews and meta-analysis suggest a slight increase in HBV infection among the general population.[4,5] This is an indication of increasing risk to Health Care Workers (HCW) who provide care to the population since studies elsewhere have demonstrated that HBV infection among HCWs could be two to four times higher compared to the general population that they serve.[6] This means that the HCW population is very vulnerable and needs to be given much consideration in HBV research and preventive interventions. Unfortunately, the few studies done in Ghana on HBV focuses largely on blood donors and pregnant women. Information on HCWs who are one of the most vulnerable populations as far as HBV infection is concerned has not been widely explored. Few of the

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studies in the area of HBV especially among HCWs has been focused on the determination of HBsAg only although it is well established that the detection of HBV serological markers in at risk populations can provide basis for diagnosing individuals with the infection, identifying susceptible individuals, predicting the natural course of the infection as well as assessing the clinical stage of the infection.[7] To be able to close these research gaps, this study was designed and implemented to identify and describe the distribution of HBV serological markers among HCWs in the Southern part of Ghana.

Methods

The study was a Cross-Sectional Hospital-based study that took place in the Greater Accra Region of Ghana in the year 2019. The cross-sectional design was most appropriate for the estimation of the prevalence and distribution of HBV serological markers among the population of HCWs.

The study was conducted in the Greater Accra Region. The Region is known to be the second highly populated region in Ghana with a considerably higher number of health facilities and HCWs compared to the other 15 regions in the country. The HCWs by their constant interaction with patients are constantly exposed to blood and body fluids thus making them susceptible to occupational acquisition of HBV infection. Study participants in this present study were drawn from five health institutions within the Greater Accra Region. All the five levels of health care according to the Ghana Health Service were represented in the selection of health facilities. These include District Hospital, Polyclinic, Health Centre, and Community Based Health Planning Services (CHPs).

Participants of the study were drawn from six categories of HCWs comprising of Doctors, Nurses, Laboratory staff, Anesthetists, Physician assistants and Orderlies. They were those who had worked in the five selected facilities for 6 months and above and had consented to be part of the study.

The HBV prevalence of 50% was anticipated and used to estimate the sample size.[8] The 50% prevalence was used because at the time of the study, no study was specifically done which estimated the prevalence of HBV among Ghanaian HCWs. The formula for estimating proportions in cross-sectional studies was used to compute the sample size.[8] Other statistical assumptions such as population correction factor, design effect (1.5) and allocation for non-response (2%) were all factored into the sample size calculations. Therefore, the overall sample size estimated for the sample was 363 health care workers.

The research participants were selected from five health facilities that were designated as study sites. Health care workers were allocated to the five facilities using proportional allocation procedures such that the facility with the largest health force contributed more participants to the study. In each selected facility, however, HCWs were stratified into six cadres of staff (Doctors, Nurses/Midwives, Laboratory staff, Physician assistants, Anesthetists, and Orderlies). The allocation of HCWs to the various categories in each of the five study sites was equally done proportionately to size. The category-specific staff list was used as a sampling frame to randomly select participants for the study.

A structured pretested questionnaire which was self-administered in almost all instances was used to collect data from the participants who gave voluntary consent to participate in the study. The data collection instrument had questions that elicited information on socio-demographic characteristics, personal and occupational risk factors for HBV infection as well as HBV vaccination status. Each consenting participant gave 5 ml of venous blood through a phlebotomy procedure which was undertaken under strict aseptic techniques using 5mls sterile syringes and single-use sterile gauge 21 needles. The blood sample was centrifuged at 2200-2500 RPM for 15 minutes and transported under cold chain conditions to a central laboratory. HBV serological markers of interest were detected qualitatively using Hepatitis B Virus Profile Kit called Advanced Quality TM One Step multi-HBV Test Device Cassette (In Tec Products, Inc.) The markers identified were; Hepatitis B surface antigen (HBsAg), Hepatitis B core antibody (Anti-HBc), Hepatitis B E Antigen (HBeAg) and Hepatitis B E antibody (Anti-HBe). Abiding by the manufacturer's instructions, two drops of serum samples from each consenting participant was dropped carefully into the wells designated for each serological marker on the test device. Adequate time was allowed for the samples to move down the test and control regions of the test device. The results were then read in 15 minutes following the appearance of red lines at the test and control bands or regions of the test kit. Determination of test results was done per the manufacturer's instructions regarding positive and negative tests. Samples with known HBV markers

were tested at the beginning of the procedure as part of quality checks and to confirm the validity of the tests. The detection of IgM class of Anti-HBc was done using ELISA procedures with Anticorase Mb-96(TMB) by General Biologicals. To ensure the validity of the ELISA procedures, the mean Optic Density (OD) values of both positive and negative controls were compared to the validity ranges outlined by the manufacturers of Anticorase MB-96 TMB.

SPSS version 20.0 (Chicago Illinois USA) was used to code, enter, and analyze data. Data were summarized using descriptive statistics using frequencies and proportions. The results were presented in charts and tables.

Ethical clearance was sought and obtained from the Ethical Review Committee (ERC) of the Ghana Health Service (GHS-ERC 006/08/17). The heads of the five health institutions were contacted and the study procedures and sampling procedures were clearly explained, and the respective institutional heads gave approval for the study to be undertaken. 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. The principal investigator was the individual responsible for communicating the test results to the participants as a way of ensuring confidentiality. Those participants who were found to be infected were referred for treatment and care.

Results

The minimum sample allocated for the study was 363 out of which 340 completed questionnaires and corresponding blood samples were eligible for analysis and this represents a 93.7 % response rate.

Most of the HCWs who participated in the study were females, (252) representing 74.1%. The participants aged 34.5 years on average with a standard deviation of ± 7.7. The majority of the participants, 299/340 (88.0%) had attained up to a postgraduate level of education. Doctors and Nurses/midwives formed 68% of the entire study population. The majority representing 260 (76.5%) of the Health Care Workers 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 185 (54.4%) 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 the respondents admitting ever attending such training workshops. The health facility environment of the HCW was observed to be good or conducive for majority of the participants (69.7 %.). A total of 207 (60.9%) of the HCWs had received at least one dose of HBV vaccination. The background characteristics of the participants is summarized in Table 1 below.

The laboratory results of the HCWs revealed that 5.9% (20/340) were reactive to HBsAg denoting the presence of current HBV infection. Envelope antigen which is a marker of active viral replication was identified in 1.5 % (5/340) of the total population. Most of the infections were in the inactive form as 15/20 (75 %) of that infected demonstrated positivity to anti-HBe which is a marker of slow viral replication. A total of 195 (57.4%) HCWs showed the presence of a protective antibody (anti-HBs) against HBV infection. Total HBV core antibody (anti-HBc) IgG class which denotes lifetime exposure to HBV was isolated in 27 (7.9%) of the participating HCWs. Only 1 (0.3%) HCW was reactive to anti-HBc IgM class, an indication of a new or recent infection. The overall anti-HBc prevalence was 8.2% (Table 2).

The overall prevalence of antigen serological markers namely HBsAg, HBeAg were 5.9%, and 1.5% respectively. Twenty-five percent of those that were reactive to HBsAg were also reactive to HBeAg. The two antigens were more prevalent among orderlies than the other categories of HCWs (Fig. 1).

Protective antibody to HBV (HBsAb) was the most predominant marker detected in the population with an overall prevalence of 57.4% (195/340). The prevalence was highest among laboratory staff (70.0%) followed by physician assistants (63.2%). The least Anti-HBs prevalence was observed among Orderlies. Anti-HBc (IgM & IgG) which denotes lifetime exposure to HBV recorded an overall prevalence of 8.2% with the highest prevalence among orderlies (Table 3).

Table 4 shows that the majority 189 (55.6%) of the HCWs had isolated Anti-HBs an indication of immunity against HBV because of vaccination. Another 6 (1.8%) had a combination of anti-HBs and anti-HBc denoting immunity because of past exposure to HBV. No serological marker was identified in 123 (36.1%) of the HCWs indicating their susceptibility to infection with HBV in the presence of an exposure. Two individuals 2 (0.5%) had intermediate results (Table 4)

Table 1: Socio-demographic, occupational and personal risk 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
Education		
Postgraduate level	41	12.0
≤Below Post Graduate level	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
Duration of employment		
<10 years	260	76.5
≥10 years	80	23.5
Facility type		
Higher Level Facility	237	69.7
Lower-Level Facility	103	30.3
Facility Factor**		
Good	237	69.7
Poor	103	30.3
Work unit		
Critical	155	45.6
Non-Critical	185	54.4
Training		
Trained	274	80.6
Not Trained	66	19.4
Life time Needle stick injury		
Exposure	216	63.5
No exposure	124	36.5
Mucocutaneus Exposure		
Exposed	264	77.6
Not exposed	76	22.4
Vaccination against HBV		
Yes	207	60.9
No	133	39.1

*** Risk level – (Risk of HBV exposure that is not related to the occupation of the HCW was referred to as behavioral risk factors. These factors included blood transfusion, and intimate contact with a known HBV carrier, dental procedure, lifetime surgery and tattoo or scarification. 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 or more risk factors as being at high risk of exposure and infection with HBV)

**Health facility factor is an independent variable generated by assessing HCW's work environment for factors that could promote adherence to HBV prevention recommendations. The variable was originally obtained as a continuous variable but was eventually re-categorized and used as binary variables.

Table 2: Distribution of serological markers of hepatitis B virus among participating HCWs (N=340).

Variable/ Marker	Frequency (N=340)		Overall Prevalence
	Positive	Negative	
HBsAg	20	320	5.9
Anti-HBs	195*	145	57.4
HBeAg	5	335	1.5
Anti-HBe	15	325	4.4
Anti-HBc IgG	27**	313	7.9
Anti-HBc IgM	1	339	0.3

*Anti-HBs acquired naturally through past infection or vaccine-induced ** current, healed and isolated infections

Table 3: Distribution of serological HBV antibody markers by cadre or job categories (N=340)

Cadre	Not Tested	Anti-HBe	Anti- HBs	Anti- HBc
Doctor	69	1(1.4%)	40(58.0%)	3(4.3%)
Nurse & Midwife	162	9(6.1%)	90(55.6%)	13(8.0%)
Anesthetist	15	0 (0.0)	11(73.3%)	1(6.7)
Laboratory staff	40	3(10.0)	29(72.5%)	5(12.5%)
Orderly	35	2(11.4)	12(34.3%)	5(14.3%)
Physician Assistant (PA)	19	0(0.0%)	13(68.4%)	1(5.2%)
Overall	340	15(4.4%)	195(57.4%)	28(8.2%)

Table 4: Classification of HCWs based on the presence or absence of Markers (N=340)

Serological Markers			Marker combination Category	Freq. (%)
HBsAg	Anti-HBs	Anti-HBc		
Negative	Negative	Negative	Susceptible to HBV infection	123 (36.1%)
Negative	Positive	Positive	Immune after past infection	6 (1.8%)
Negative	Positive	Negative	Immune after Vaccination	189 (55.6%)
Positive	Negative	Positive	Current Infection	20 (5.9%)
Negative	Negative	Positive	**Intermediate result** 1.Isolated Anti-HBc or 2.Resolving Acute infection or 3.Chronic infection with a low Level of HBsAg	2 (0.6%)
Total	-	-	-	**340 (100%)**

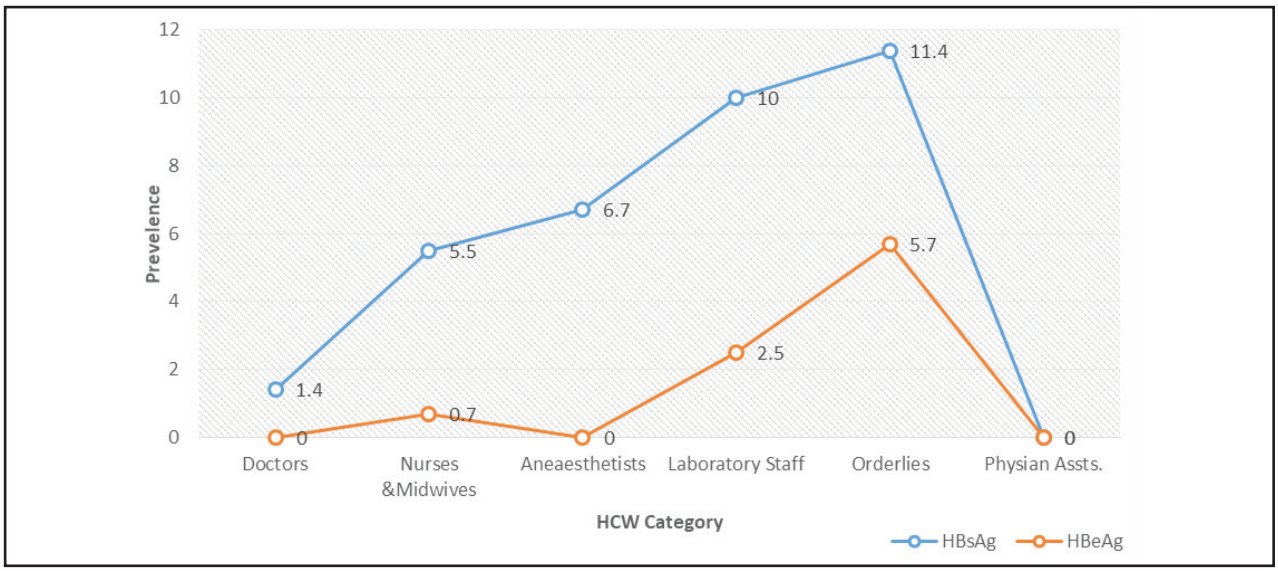

Figure 1: Distribution of Serological HBV Antigen Markers by Cadre

Discussion

This study describes the distribution of serological markers of HBV among HCWs in the southern zone of Ghana found HBsAg prevalence of 5.9% among the population. This observation is similar to reports from Tanzania reporting a prevalence of 5.7%. Rather to the contrary, two other studies done in Libya and Egypt which are both Northern African countries reported a far lower prevalence of HBsAg among HCWs even though they both had a similar design and involved various categories of HCWs just like this present study.[9; 10] One plausible reason for the difference in results could be the geographical location of the North African countries. Studies have shown that HBV infection has a great geographical variation and West African countries lie within the high endemic regions according to WHO classification of HBV endemicity.[11] This study being one of the very few studies among HCWs in Ghana has provided an epidemiological baseline for future comparisons of HBV infection trends.

This study identified HBeAg prevalence of 1.5% among the entire HCW population. However, a prevalence of 25% was estimated among HCWs who demonstrated serological evidence of current HBV infection. HBeAg was also more predominant among Orderlies or sanitary workers. Elsewhere, a study also found HBeAg prevalence of 19.2% among HCWs which is almost comparable to what this study has reported. [12] However, the 25% prevalence of HBeAg among infected HCWs is contrarily higher in comparison to 13.3% reported in the middle belt of Ghana among Ghanaian blood donors. [13] It is unclear from this study what could have contributed to the high prevalence of HBeAg among the infected HCWs. However, it is known from previous studies that the HBV genotype predominant in a particular geographical location has a role in determining the frequency of HBeAg, chronicity to HBV, the occurrence of major complications as well as response to anti-retroviral treatment among that population.[14] It is worth noting that the E HBV genotype is known to be the most predominant genotype circulating in Ghana.[15]

This observation brings to light the possibility of infected HCWs transmitting HBV infection to others including the patients they care for. Even though the occupational health and safety policy of the Ghana Health Service outlined the treatment regimen for infected HCWs, it is now clear that another guideline is needed in managing Ghanaian HCWs who are infected with HBV and what level of viral load is allowable to perform exposure-prone procedures.

The progression of HBV to chronicity with its associated pathogenesis is directly correlated with viral replication. HBeAg is known from research evidence to be the serological marker denoting active viral proliferation in liver cells, infectivity, and the possibility of transmission. This marker has also been associated with chronic liver disease, cancer and cirrhosis of the liver which are all major complications of the infection [16,17] and therefore the need for timely and effective treatment to affected HCWs cannot be overemphasized in this study.

One outstanding finding of this study is the observation that 36.1% of the study participants were naïve to HBV in that, no serological marker was detected in their sera. These individuals being naïve means they had never in their lifetime encountered HBV neither do they have any indication of artificial immunity against the virus. They are said to be susceptible to infection in the presence of exposures to contaminated blood and body fluids. This finding agrees with a prevalence of 30%-42% of no HBV marker observed amidst HCW populations in Asia, North Africa and Southern Africa.[18-21] This finding is however non-compliant with recommendations by WHO, CDC, Ghana Health Service and other national and international organizations concerning HCW protection from HBV.[22, 23] According to these organizations, in the presence of abundant logistics to prevent contact with blood and body fluids as well as the optimum practice of standard precautions, HCWs must obtain one serological marker in the form of anti-HBs through vaccination early in their carrier to gain protection from HBV and its associated morbidity and mortality. This finding gives credence to the fact that not all HCWs in the Greater Accra Region are adherent to the recommendation of vaccination against HBV infection. The situation is worrying given the high HBV prevalence among the Ghanaian population as demonstrated by two recent systematic reviews and meta-analysis.[4,5]

This study found 1.8 % (6/340) of HCWs having a combination of anti-HBs and anti-HBc, denoting natural immunity following past infection. Natural immunity as a result of past exposure is a possibility among HCW populations. In an European country, the prevalence of 11.3% and 22.5% of a combination of Anti-HBs (+) and Anti-HBc (+) have been documented in two separate population sub-groups.[24] Specifically among HCWs in Tanzania, a study found that 36.5% of HCWs

were immune as a result of past infections.[25] The 1.8% natural immunity in this present study is lower than what the studies from Europe and Tanzania reported and therefore suggestive that sero clearance of HBsAg among the population studied was quite low in that, only 1.8% of the HCWs in this present study were able to successfully overcome the acute form of HBV infection, and subsequently developed protective anti-HBs to the virus. This finding nevertheless, provides a basis to concur with the claim that HCW protection from HBV is best achieved by vaccination even in highly endemic countries rather than relying on natural immunity that may not happen in all exposed individuals.[26]

The study found 55.6% of the HCWs demonstrating immunity to HBV in the absence of Anti-HBc an indication of immunity resulting from vaccination. This finding could have contributed to the lower HBV prevalence among the HCWs compared to the general Ghanaian population.[4,5] This is because there is evidence to support the fact that a decline in new HBV infections is possible among HCWs in situations where HCW vaccination against HBV and the practice of standard precautions are in pursuit.[27]

Conclusion

Even though Anti-Hbs is the predominant marker detected among the Ghanaian HCWs, one-third of the population is susceptible to HBV infection. Cost-effective intervention in the form of HBV vaccination is urgently required to protect the HCWs given the high HBV prevalence among the population that they serve. Special attention also needs to be given to orderlies or sanitation workers who bear the highest burden of HBV infection among the HCW who participated in this study.

Data Availability Statement

Data will be made available by the corresponding author upon request

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