



Original article

Response rate to vaccination against Hepatitis B virus among health care workers at St. Dominic Hospital, Akwatia, Ghana

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ABSTRACT

Background: Hepatitis B is a major contributor to the burden of infectious diseases worldwide. Many preventive measures have been employed, however, active immunization with hepatitis B vaccine remains the single most important hepatitis B prevention measure. WHO recommends that all health care workers (HCWs) should be vaccinated against HBV. However, proportions of individuals do not respond to the recommended standard three dose of HBV vaccination and remain susceptible to the infection. **Objectives:** This study was to assess the response rate to vaccination against HBV among health care workers and to determine predictors of non-response to HBV vaccine in HCWs. **Methods and Materials:** A prospective study carried out at the Saint Dominic Hospital, Akwatia, involving 100 HCWs from 29th August, 2018 to 4th June, 2019. All the participants received the standard protocol of 3 intramuscular injections of HBV vaccine (Engerix B) at 0, 1, and 6 months. Qualitative and quantitative serum anti-HBs was determined 1-2 months after the last injection in order to detect the responders and non-responders. **Results:** Majority (54.0%) of the participants were males. The Median age of the study participants was 35 (29, 47) with age range of 20-65 years. Out of the 100 HCWs 90 (90%) were responders and 10 (10%) were non-responders to hepatitis B vaccine. Non-responders had increased odds of being female, though this was not statistically significant (COR=1.47 (0.42 - 5.17)). **Conclusion:** All HCWs should undergo confirmatory testing of immune response after completion of scheduled standard HBV immunization. This will ensure safety of all HCWs against HBV infection.

KEYWORDS: Health care workers, Immune response, Hepatitis B vaccine, Ghana.

INTRODUCTION

Hepatitis B is a major contributor to the burden of infectious diseases worldwide. Based on serological data, it was estimated that in 1995 more than 2 billion people globally had evidence of past or present HBV infection. [1] In 2015 the global prevalence of HBV infection in the general population was estimated at 3.5% with about 257 million persons living with chronic HBV infection. [2] Reported prevalence of HBV infection ranges from 12-15% from blood donors in Ghana and is the leading cause of liver cirrhosis and hepatocellular carcinoma in this country. [3]

Many preventive measures have been employed, including screening of blood donors, preparation of plasma-derived products in a way that inactivates hepatitis B virus, the implementation of infection control measures, and administration of hepatitis B immunoglobulin. [4] However, active immunization with hepatitis B vaccine remains the single most important hepatitis B prevention measure.

It is recognized that antibody levels of anti-HBs (Hepatitis B surface antibody) above 10 IU/l offer effective protection against the HBV. [5] The positive response rate after vaccination varies between 85 and 100%. [6] Several factors may reduce seroconversion: age, sex, weight, heredity, smoking, immunosuppression and the subcutaneous administration. [7-10] It is recommended that all health workers should be screened for HBV and vaccinated because they are at an increased risk of acquiring HBV.

Routine post-vaccination testing is not recommended by World Health Organisation (WHO). However the following groups should be considered for post-vaccination testing: (i) persons at risk of occupational exposure to HBV infection, e.g. health-care workers; (ii) infants born to HBsAg-positive mothers; (iii) chronic haemodialysis patients; (iv) HIV-positive and other immunocompromised persons; and (v) sex partners or needle-sharing partners of persons who are HBsAg-positive. Almost all individuals (infants, children, adolescents and adults) who do not respond to a primary 3-dose series with anti-HBs antibody concentrations of ≥ 10 mIU/mL do respond to an additional 3-dose vaccination series. [11] However routine post vaccination measurement of serum anti-HBs is not done among health care workers in this country. Therefore, this study was to assess the response rate to vaccination against HBV among health care workers and to determine the characteristics that influence the response to HBV vaccination.

MATERIALS AND METHODS

This was a prospective study carried out at the Saint Dominic Hospital, Akwatia from 29th August, 2018 to 4th June, 2019. One hundred staff working at various department of St. Dominic hospital who gave their consent, have never received HBV vaccination and tested negative to HBsAg were part of this study.

SDH is a major referral hospital in Denkyembour district and the other surrounding districts. SDH was founded in 1960 by Dominican Sisters from Speyer, Germany to provide healthcare for the people of Akwatia and its environs. SDH currently has a total bed capacity of 339 and offer a breadth of medical and surgical services including internal medicine, paediatrics, ophthalmology, obstetrics and gynaecologist and general surgery. A selected group of St. Dominic hospital staff who have never received hepatitis B vaccination were part of this study.

Data Collection

The following information were collected from each participant: age, gender, educational level, occupation, number of years working in the hospital environment, alcohol and smoking history. Any chronic diseases such as diabetes, hypertension, chronic kidney disease, chronic liver disease, retroviral infection, tuberculosis etc were elicited from the participants. Drug history of the patients was also found out to know if any participant was on immunosuppressive drugs.

The following investigations were conducted for all the participants; HBsAg (pre-participation), quantitative serum anti-HBs and fasting blood glucose (FBG).

All the participants received the standard protocol of 3 intramuscular injections of HBV vaccine (Engerix B) at 0, 1, and 6 months. Qualitative and quantitative serum anti-HBs was determined 1-2 months after the last injection. Levels of

anti-HBs < 10 mIU/mL were considered to be negative and not protective and samples showing an anti-HBs titre ≥ 10 mIU/mL were considered protective¹.

Statistical analysis

Analysis was done with Stata 15 statistical software package. Continuous variables such as age, work experience, BMI, FBG and blood pressure were expressed as mean \pm standard deviation (normal data) or median (interquartile range) for non-normal data. Response to HBV vaccinations as well as qualitative variables were expressed as proportions. The Fisher Exact (categorical) and Wilcoxon Rank Sum (quantitative variables) tests were used to assess associations and test statistical differences. A univariable logistic was performed to determine the factors associated with non-response to HBV vaccination among healthcare workers. Statistical significance for all tests was set at $p < 0.05$.

Ethical Considerations

The details and reason for the study were explained clearly in the language that was understood by the participants. They were assured that enrolment into the study is wholly voluntary and that their care will not be jeopardized by refusing to participate in the study. Informed written consent was obtained before subjects were enrolled in the study. Approval was sought from the University of Ghana School of Medicine and Dentistry Ethics and Protocol Review Committee before the study was commenced.

RESULTS

Socio demographic characteristics of Health Care Workers (HCWs)

Socio demographic characteristics of the participants enrolled in this study are described in Table 1 and 2. Majority (54.0%) of the participants were male. Out of 100 participants, 67.0% were below 40 years. The median age of the study participants was 35 (29, 47) with age range of 20-65 years. Nurses constituted majority (41%) of the healthcare workers sampled. None of the study participants reported ever smoking.

Immune response to HBV vaccine

Immune response to HBV as measured by anti-HBs titers vaccine and its relation to socio demographic and clinical factors are illustrated in Table 4. Overall, the majority of those vaccinated (51.0%) had a high level of immune response (i.e. antiHBs > 100 mIU/mL) 38.0% were hypo-responders (i.e. anti-HBs titer between 10 and 100 mIU/mL) and 10.0% did not develop a sufficient anti-HBs response (non-responders) (Table 3).

Risk factors for non-response to HBV vaccine

Bivariate analysis of risk factors for non-response to HBV vaccine is described in Table 4. Non-responders had increased odds of being female, though this was not statistically significant (COR=1.47 (0.42 - 5.17)). There were no significant associations among the following characteristics of the participants: age ($p = 0.650$), BMI ($p = 0.551$), duration of work ($p = 0.864$), systolic ($p = 0.157$) and diastolic ($p = 0.672$) blood pressure and fasting blood glucose ($p = 0.588$) of the subjects.

Table:1 Demographic characteristic of study participants

Socio-demographic variables	Frequency	Percentage %
Sex (n=100)		
Male	54	54
Female	46	46
Level of Education (n=100)		
Primary	4	4
Middle School/JHS	18	18
Senior High School (SHS)	6	6
Tertiary	66	66
Post-graduate	5	5
None	1	1
Marital Status (n=100)		
Single	35	35
Married	64	64
Divorced	1	1
Occupation (n=100)		
Physician	8	8
Nurse	41	41
Laboratorian	11	11
Administrator	7	7
Other	33	33

Table: 2 Age distribution of the participants

Age range (yrs.)	20 – 65 years		
Age (yrs.), median (IQR)	35 (29,47)		
Age (years)	Non-responders (n=10)	Responders (n=90)	Total
	N (%)	N(%)	
20-29	3 (30.0)	23 (25.7)	26
30-39	3 (30.0)	38 (42.2)	41
40-49	2 (20.0)	10 (11.1)	12
50-59	1 (10.0)	13 (14.4)	14
> 60	1 (10.0)	6 (6.6)	7

Table: 3 Distribution of responder type based on anti-HBs titres

Type of response (anti-HBS) mIU/mL	N (%)
Non-responders (< 10 mIU/mL)	10 (10)
Hypo-responders (≥10 – < 100 mIU/mL)	39 (39)
Hyper-responders (≥ 100 mIU/mL)	51 (51)

Table 4 Bivariate analysis of risk factors for non-response to HBV vaccine

Variables	Non-responders (n=11)	¹ Responders (n=89)	Crude OR (95% CI)	p-value
	N (%)			
Sex				
Male	5 (45.5)	49 (55.1)	ref	

Female	6 (54.5)	40 (44.9)	1.47 (0.42 - 5.17)	0.548
Age (years)*	33	35	0.98 (0.93 - 1.04)	0.650
Duration of work (years)*	9	8	1.01 (0.93 - 1.08)	0.864
Body Mass index (kg/m ²)	24.8 ± 3.8	25.6 ± 4.8	0.95 (0.83 - 1.10)	0.551
Fasting blood glucose (mmol/l)	5.5 ± 0.6	5.7 ± 1.5	0.83 (0.42 - 1.62)	0.588
Systolic BP (mmHg)	110.9 ± 11.1	116.1 ± 14.2	0.96 (0.91 - 1.02)	0.157
Diastolic BP (mmHg)	70.7 ± 5.5	72.1 ± 10.8	0.99 (0.93 - 1.04)	0.672
History of chronic illness				
No	10 (90.9)	83 (93.3)	ref	
Yes	1 (9.1)	6 (6.7)	1.38 (0.15 - 12.69)	0.774
Diabetes				
No	11 (100)	87 (97.8)	ref	
Yes	0 (0)	2 (2.2)	1	--
Alcohol				
No	11 (100)	80 (89.9)	ref	
Yes	0 (0)	9 (10.1)	1	--

* - Median ref – reference group ¹ Responders (hypo + hyper- responders)

DISCUSSION

WHO recommends that all health workers should be screened for HBV infection and vaccinated because they are at an increased risk of acquiring HBV. However, proportions of individuals do not respond to the recommended standard three dose of HBV vaccination and remain susceptible to the infection. Routine post-vaccination testing is not recommended by WHO. However those who are at increased risk of acquiring HBV infection including health care workers should be considered for post-vaccination testing. This study was to assess the response rate to vaccination against HBV among health care workers and to determine predictors of non-response to HBV vaccine in HCWs. In our study, about 10% of HCW did not develop a protective level (< 10 mIU/mL) of anti- HBs, a proportion which is comparable to the global level for a poor immune response to HBV immunization of 5–15%. [6]

These findings are similar to studies by Chathuranga et al. [12] and Muvunyi et al. [13] who reported non-response rate of 9.9% and 9.6% among healthcare workers in Sri Lanka and Rwanda respectively. However, this is lower than 14% and 17.2% non-responders reported by Zeeshan et al. [14] in Pakistan and by Zamani et al. [15] in Saudi Arabia respectively. Moreover, the 10% non-responders in this study was higher than 4% reported by Hussein et al. [16] in Egypt. The differences may be as a result of different brand of vaccines used and ethnicity factors.

The study showed that there was no significant association with age which disagreed with the findings by Tripathy et al. [17] and Chaudhari et al. [18] they found out that there was strong association between age and response to HBV vaccination. This may be because the majority of our study population were younger than 40 years of age. Similarly, BMI in our study was not significantly different between

vaccine responders and non-responders as observed in a study by Hussein et al. [16] in Egypt.

Smoking and alcohol have been proposed as probable reasons for a poor immune response to HBV immunization, however, in this study there were no difference between smokers and alcoholics in-terms of responders and non-responders. The reason may be that our study has low proportion of non-responders to the vaccine and also few participants were smokers and alcoholics. There were no significant differences between male and female non-responders in this study and this contradict findings that have been reported in previous studies. [12, 19] The reason for this contradiction is not clear. Diabetics and hypertension were not significantly different between vaccine responders and non-responders as observed in this study.

This study is not without limitation, though the study showed similarities in the post-HBV vaccination immune response among healthcare workers in Ghana and other countries, it was unable to explore all potential predictors of non-response to the vaccine, such as genetic factors.

In conclusion, this current study demonstrates that all HCWs should undergo confirmatory testing of immune response after completion of scheduled standard HBV immunization. This will give an opportunity to those who didn't respond to the first 3 doses of the vaccination to re-vaccinate. This will ensure safety of all HCWs against HBV infection.

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Competing interest: The authors declare that they have no competing interests.

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