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Prevalence and risk factors of hepatitis B virus infection among medical laboratory science students in a Ghanaian tertiary institution

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Abstract

Purpose – This study aimed to determine the prevalence and risk factors of hepatitis B virus (HBV) infection among medical laboratory science students (MLSSs) in the University of Health and Allied Sciences (UHAS), Ghana.

Design/methodology/approach – A cross-sectional study design was employed to recruit a total of 178 students into the study. A self-administered questionnaire was used to gather relevant information on risk factors, and a hepatitis B diagnostic test kit was used to test for HBV infection. Descriptive, chi-square test, bivariate and multiple logistic regression statistical analysis were computed. Significance was observed at $p < 0.05$.

Findings – The prevalence of HBV infection among MLSSs was 6.7%. Torn gloves and splash of blood and body fluids contributed to 43.0% and 28.0% of all the risk factors of HBV infection, respectively. Also, 43.3% of students had received at least one dose of the hepatitis B vaccination. Sharp object-related injury and torn gloves increased the odds of HBV infection, while vaccination decreased the odds of HBV infection.

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Originality/value – This study reveals the prevalence of HBV among MLSSs, who are recognized as being among the high-risk student populations aside from student nurses.

Keywords Hepatitis B, Health-care workers, Health-care students, Health facilities, Ghana

Paper type Research paper

Introduction

An approximation of 33% of people in the world has serological confirmation of current contamination with hepatitis B virus (HBV) [1]. Hepatitis B infection is a known risk factor for the development of chronic hepatitis, liver cirrhosis and hepatocellular carcinoma as late-term complications [2]. Furthermore, it remains one of the high-standing reasons for liver disease [3].

According to the World Health Organization (WHO), approximately 257 m people are living with chronic HBV infection which resulted in 877,000 deaths in 2015, mostly from adverse effects such as liver cancer and cirrhosis of the liver [4]. The WHO estimates sub-Saharan Africa and East Asia as the areas with the highest prevalence of HBV infection, with 5–10% of the adult population chronically infected [5].

In Africa, hepatitis B prevalence is projected to be at an average of 10% or more [6, 7]. A Ghana Health Service (GHS) report showed a total of 51,052 suspected acute viral hepatitis cases; out of which 7,581 were confirmed positive with 108 deaths in the year 2014 [8]. Also, 30.8% of all laboratory-confirmed cases of viral hepatitis attributable to chronic hepatitis B infection were recorded by the Volta Region of Ghana [9].

HBV infection is one of the most efficiently transmitted blood-borne diseases that are significant in the health-care setting [10, 11]. Health-care workers (HCWs) are at risk of exposure if patients are infected and vice versa [12]. HCWs have about four times increased risk of infecting themselves with HBV due to their frequent exposure to infectious blood or body fluids in their line of work through the routes of exposure such as a needlestick [13, 14].

Hepatitis B disease is a serious job-related risk for HCWs [5], especially students pursuing healthcare-related programs due to their inexperience in the field of work at the various health facilities. Studies conducted among HCWs in some countries suggested that nurses and laboratory technicians are more prone to HBV infections [15, 16]. Therefore, this makes nursing students and medical laboratory science students (MLSSs) part of the high-risk group [16].

Numerous studies conducted among HCWs have predicted varying prevalence of hepatitis B infection. A study conducted among HCWs in a tertiary hospital in Uganda revealed that out of 370 HCWs that participated, the seroprevalence of HBV disease was 8.1% [17]. A similar study conducted among HCWs in Saudi Arabia revealed that 8.7% were infected with hepatitis B [18]. A recent study among HCWs in Indonesia also published a prevalence of 4.1% hepatitis B infection [19].

A previous study conducted among health students found a hepatitis B prevalence of 1.7% [18]. In another research study conducted among biomedical students of African descent attending Usmanu Danfodiyo University Sokoto in North-Western Nigeria, out of the 186 students tested, 25 were positive for hepatitis B surface antigen (HBsAg). This represented a high prevalence of 13.4% [20]. Also, a comparable study conducted among medicine and health science students found an overall hepatitis B prevalence of 4.2%. A similar study conducted among nursing students in the Techiman North and South Districts reported a 10.1% prevalence of HBV infection [21]. A high hepatitis B prevalence of 14.3% was found among senior high school students in the Volta Region of Ghana [22]. Almost all the studies conducted in Ghana on HBV infection which took place in the period between 1995 and 2015 focused on patients rather than health-care practitioners [7]. Moreover, all of the few studies conducted among HCWs concentrated on the prediction of the spread of the disease to HCWs from patients, with none on the prevalence and risk factors of the disease among HCWs or MLSSs [7].

Therefore, this study determined the prevalence and risk factors of HBV infection among MLSSs of the University of Health and Allied Sciences (UHAS), Ho, Volta Region, Ghana.

Methods

Study design

A cross-sectional survey was conducted among second-, third- and fourth-year MLSSs in the UHAS. These students were interviewed on their sociodemographic characteristics, risk factors and preventive measures of HBV infection. The prevalence of HBV infection among study participants was also assessed by testing for HBV infection using approved HBsAg standard diagnostic test kits.

Study area

The research work was carried out in the UHAS, located in Ho, in the Volta Region of Ghana. The university is one of the newest and youngest public universities in Ghana. The university operates under six schools, namely the School of Medicine, the School of Nursing and Midwifery, School of Public Health, School of Basic and Biomedical Sciences, School of Pharmacy and School of Allied Health Sciences. The School of Allied Health Sciences is situated on the premises of the Volta Regional Hospital, now Ho Teaching Hospital, the leading referral hospital in the region. The School of Allied Health Sciences comprises six departments which include the Department of Medical Laboratory Science (DMLS). The department trains and awards the Bachelor of Medical Laboratory Science degree.

Sample population

Inclusion criteria

Continuing students who were reading for the medical laboratory science program, currently in their second, third or fourth year of study, and had completed at least an annual compulsory vocational training program across health-care facilities in Ghana were eligible for the study.

Exclusion criteria

Continuing students who were not studying medical laboratory science programme not in their 2nd, 3rd or 4th year at the time of research and had completed no compulsory vocational training programme done throughout the heath care centres in Ghana were ineligible and were not recruited for the study.

Sampling procedure

Using Cochran's formulae, $\frac{Z^2 * p\ (1-p)}{d^2}$ and prevalence of hepatitis B infection in a previous study in Nigeria among biomedical students [20], a sample size of 187 was calculated using a prevalence (p) of 13.4%, 5% margin error (d), 95% confidence interval (Z) given as 1.96 and 5% attrition. This total sample size was distributed depending on the class size of each year group. The number of participants eligible for recruitment in the second, third and fourth-year groups was 95, 68 and 24, respectively. Simple random sampling was used to recruit individual participants. However, 178 participants (91 for second year, 64 for third year and 23 for fourth-year students) gave their consent and partook in the study, resulting in a response rate of 95%.

Data collection

A closed-ended questionnaire was used to gather relevant data, particularly on risk factors and preventive measures. The questionnaire was primarily structured into three sections:

Section A: sociodemographic characteristics,

Section B: risk factors and

Section C: preventive factors.

Section A addressed sociodemographic characteristics such as gender, age, work history, year group and duration of vocational training.

Section B comprised of questions to identify risk factors that study participants got exposed to during their vocational training programs, these included needle prick, a splash of blood and body fluids, torn gloves and sexual activities.

Finally, section C consisted of questions aimed to find out various measures undertaken by participants to avert the infection of HBV such as the use of gloves, disinfection practices, vaccination, training on infectious diseases. HBsAg rapid diagnostic test (RDT) kits approved by the Ghana Food and Drugs Authority (FDA) were used to test for hepatitis B infection and to ascertain the prevalence of the infection.

The result of the test was entered into the fourth section of the questionnaire. The testing was done by wiping the area to be lanced (thumb) with an alcohol swab, followed by a prick on the thumb with a sterile lancet after the end of the thumb had been squeezed. The first drop of blood was wiped off with sterile alcohol-impregnated gauze or cotton. The micropipette was used to take about 100ul fresh blood. One drop of the whole blood obtained was added into a sample pad of the hepatitis B pouched strip. After the blood had adsorbed onto the pad, a drop of a whole blood diluent was added. A single line shown on the interface of the pouched strip indicated negative, suggesting the absence of infection, whilst a double line showed a positive result and signified the presence of the disease.

Data analysis

Data from completed questionnaires and the result of hepatitis B status were then entered into Microsoft Excel and imported into Stata statistical software, version 15. Descriptive statistics were used to analyze the demographic factors, risk factors, preventive factors and prevalence of HBV infection. A chi-square test and Fisher's exact test were used to test for the association between risk factors and HBV infection based on a statistical significance at a 95% confidence interval. Crude odds ratios (OR), adjusted odds ratios (AOR), 95% confidence intervals (CI) and p-values were calculated using bivariate and multiple logistic regression. The variables with an observed association of p-value < 0.05 were noted and considered significant.

Ethical approval

Approval of the study protocol with identity number GHS-ERC:112/12/17 was obtained from the Ethical Review Committee of the Ghana Health Service (GHS-ERC) before the commencement of the study. Permission was sought from the DMLS of the UHAS before the data collection.

Study participants were briefed about the purpose, risk and benefits of the study before appending their signature on the consent form to take part in the survey. Counseling was provided for all participants, however, those who tested positive were subsequently referred to the Volta Regional Hospital (now Ho Teaching Hospital) for further testing and treatment. On the other hand, participants who tested negative were educated and admonished to practice infection prevention measures. The Hepatitis B test kit used for testing the presence of the Hepatitis virus infection was produced by Guangzhou Wondfo Biotech Co., Ltd. in China and was approved by Food and Drug Authority to be used for diagnoses purposes in Ghana.

Results

Sociodemographic characteristics

As shown in Table 1, a total of 178 MLSSs were recruited into the study. In total, 139 (78.09%) of these participants were males, the majority, 118 (66.29%) were within 20–24 years and the least were between 15 and 19 years old. Besides, more than half the students were second-year students, 91 (51.12%), followed by third-year, 64 (35.96%), and fourth-year, 23 (12.92%), groups. A considerable number of students, 155 (87.08%), had no working experience before university education. During the time of the study, most students, 105 (58.99%), had embarked on vocational training for "<2 months."

Prevalence of HBV infection

Out of the 178 students that tested for the HBsAg, 12 (6.7%) tested positive (reactive), Table 1.

Prevalence of risk factors

Torn gloves contributed to the highest, 32.0%, of all the risk factors experienced by participants. This was followed by a splash of blood and body fluids (21.4%), needle prick (14.0%) and sharp injury (7.9%), Table 1.

Preventive measures

Almost all, 98.9% and 99.4% of participants disinfected their working benches and used gloves, respectively, during their internship program. A little over half, 52.2% of participants had received training on infectious diseases before commencing their vocational training. Also, only 43.3% of them had received the hepatitis B vaccination, Table 1.

Association between risk factors and the prevalence of hepatitis B infection

The association between sharp injury and HBV infection was significant (Pearson $\chi^2 = 11.5$, p-value ≤ 0.001). Besides, the relationship between torn gloves and HBV infection was also significant (Pearson $\chi^2 = 10.9$, p-value ≤ 0.001). The association between duration of vocational training and HBV infection was also significant (Pearson $\chi^2 = 8.7$, p-value $= 0.03$). Furthermore, the association between vaccination and prevalence of HBV infection was also significant (Pearson chi-square $= 6.4$, p-value $= 0.01$), Table 1.

Bivariate analysis and multiple logistic regression of the association of HBV infection among participants with risk factors of HBV

Sharp object-related injury increases the odds of HBV infection among the students by more than ten times (AOR $= 10.35$, 95% CI $= 1.28$–83.99, p-value $= 0.034$) compared to those who never experience sharp-related injuries. Also, torn gloves increase the odds of HBV infection among the students by almost six times (AOR $= 5.90$, 95% CI $= 1.33$–26.29, p-value $= 0.019$) compared to those that did not have any experience of using torn gloves. On the contrary, vaccination decreases the odds of HBV infection among the students by almost 91% (AOR $= 0.09$, 95% CI $= 0.01$–20.79, p-value $= 0.033$) compared to students who have never taken any vaccine of hepatitis B at the time of the study, Table 2.

Discussion

HBV infection continues to be a problem for HCWs, especially students in the health-care profession. HBsAg prevalence of 6.7% was found among MLSSs. This result was lower than the prevalence of 10.1% reported in a similar study among nursing students in Ghana [21]. A comparable study conducted in Nigeria also found a prevalence of 13.4%, which was also higher than the one reported by our study [20]. The dissimilarity in results can be aligned to many factors, from risk factors to preventive measures taken by students. Our study, for

Variable	Frequency $n = 178$ (100.0%)	HBV− $n = 166$ (93.3%)	HBV+ $n = 12$ (6.7%)	Chi-square	p-value
Gender				0.2	0.64
Male	139 (78.1)	129 (92.81%)	10 (7.19%)		
Female	39 (21.9)	37 (94.87%)	2 (5.13%)		
Age (years)				0.6	0.91
15–19	14 (7.9)	13 (92.86%)	1 (7.14%)		
20–24	118 (66.3)	111 (94.07%)	7 (5.93%)		
25–29	31 (17.4)	28 (90.32%)	3 (9.68%)		
>29	15 (8.4)	14 (93.33%)	1 (6.67%)		
Work history				0.2	0.62
Never worked	155 (87.1)	144 (92.90%)	11 (7.10%)		
Ever worked	23 (12.9)	22 (95.65%)	1 (4.35%)		
Year group				4.8	0.09
Second	91 (51.1)	86 (94.51%)	5 (5.49%)		
Third	64 (36.0)	61 (95.31%)	3 (4.69%)		
Fourth	23 (12.9)	19 (82.61%)	4 (17.39%)		
Vocational training (months)				*8.7*	*0.03*
<2	105 (59.0)	97 (92.38%)	8 (7.62%)		
3–4	52 (29.2)	50 (96.15%)	2 (3.85%)		
5–6	15 (8.4)	15 (100.00%)	0 (0.00%)		
>6	6 (3.4)	4 (66.67%)	2 (33.33%)		
Needle prick				0.4	0.60
Yes	25 (14.04)	24 (96.00%)	1 (4.00%)		
No	153 (85.96)	142 (92.81%)	11 (7.19%)		
Sharp injury				*11.5*	*<0.001*
Yes	14 (7.87)	10 (71.43%)	4 (28.57%)		
No	164 (92.13)	156 (95.12%)	8 (4.88%)		
Splash				1.1	0.30
Yes	38 (21.35)	34 (89.47%)	4 (10.53%)		
No	140 (78.65)	132 (94.29%)	8 (5.71%)		
Torn gloves				*10.9*	*<0.001*
Yes	57 (32.02)	48 (84.21%)	9 (15.79%)		
No	121 (67.98)	118 (97.52%)	3 (2.48%)		
Sex				0.5	0.47
Yes	26 (14.61)	27 (96.43%)	1 (3.57%)		
No	152 (85.39)	139 (92.67%)	11 (7.33%)		
Use of gloves				0.1	0.79
Yes	177 (99.44)	165 (93.22%)	12 (6.78%)		
No	1 (0.56)	1 (100.00%)	0 (0.00%)		
Disinfection				0.1	0.70
Yes	176 (98.88)	164 (93.18%)	12 (6.82%)		
No	2 (1.12)	2 (100.00%)	0 (0.00%)		
Training on ID				0.0	0.89*
Yes	93 (52.25)	86 (93.48%)	6 (6.52%)		
No	85 (51.98)	79 (92.94%)	6 (7.06%)		
Vaccinated				*6.4*	*0.01*
Yes	77(43.26)	76 (98.70%)	1 (1.30%)		
No	101(56.74)	90 (89.11%)	11 (10.89%)		

Note(s): ID: infectious diseases

Table 1. Sociodemographic characteristics of participants and chi-square analysis of risk factors of hepatitis B infection

Table 2.
Bivariate and multivariate logistic regression analysis of risk factors of hepatitis B infection

Variable	Frequency $n = 178$ (100.0%)	HBV− $n = 166$ (93.3%)	HBV+ $n = 12$ (6.7%)	*p*-value	COR OR (95% CI)	*p*-value	AOR OR (95% CI)
Gender				0.651		0.767	
Male	139 (78.1)	129 (92.81%)	10 (7.19%)		1.43 (0.30–6.84)		1.43 (0.21–9.60)
Female	39 (21.9)	37 (94.87%)	2 (5.13%)		Ref		Ref
Needle prick				0.561		0.104	
Yes	25 (14.04)	24 (96.00%)	1 (4.00%)		0.54 (0.06–4.36)		0.09 (0.00–1.57)
No	153 (85.96)	142 (92.81%)	11 (7.19%)		Ref		Ref
Sharp injury				0.003		*0.034*	
Yes	14 (7.87)	10 (71.43%)	4 (28.57%)		7.80 (2.00–30.34)		10.35 (1.28–83.99)
No	164 (92.13)	156 (95.12%)	8 (4.88%)		Ref		Ref
Splash				0.301			
Yes	38 (21.35)	34 (89.47%)	4 (10.53%)		1.94 (0.55–6.83)	0.736	1.27 (0.27 – 5.99)
No	140 (78.65)	132 (94.29%)	8 (5.71%)		Ref		Ref
Torn gloves				0.004		*0.019*	
Yes	57 (32.02)	48 (84.21%)	9 (15.79%)		7.38 (1.91–28.42)		5.90 (1.33–26.29)
No	121 (67.98)	118 (97.52%)	3 (2.48%)		Ref		Ref
Sex				0.476		0.297	
Yes	26 (14.61)	27 (96.43%)	1 (3.57%)		0.47 (0.06–3.78)		0.22 (0.02–2.87)
No	152 (85.39)	139 (92.67%)	11 (7.33%)		Ref		Ref
Vaccinated				0.035		*0.030*	
Yes	77 (43.26)	76 (98.70%)	1 (1.30%)		0.11 (0.01–0.85)		0.09 (0.01–0.79)
No	101 (56.74)	90 (89.11%)	11 (10.89%)		Ref		Ref

instance, predicted exposure to sharp injury, torn gloves and status of vaccination as predicting factors of hepatitis B infection.

This study found that the duration of vocational training was significantly (Pearson chi-square = 8.7, p-value = 0.03) associated with the prevalence of hepatitis B infection; nonetheless, it was not significant on the logistic regression model. Duration of vocational training is also seen to be linked with experience since the duration of vocational training determines the number of times the student had been to vocational internship programs in our study. In respect of all these, experience is needed by students to perform sophisticated medical procedures including invasion that can lead to exposure to the hepatitis B infection [23].

The occurrence of torn gloves was shown to be highest, (32.0%), among all the other risk factors. This finding was coherent with another study that found more than half, (54.8%), of health-care students (HCSs) experiencing torn gloves led to them becoming contaminated with blood [21]. However, our prediction was higher than a study among nursing and midwifery students that found only 29.1% of participants experiencing torn gloves [24]. The consistent high occurrence of torn gloves has been associated with shaking of patients during sample collection [25]. Also, wearing and removal of gloves have been mentioned as well. Many studies have recommended double gloving to reduce the risk of HBV infection [23, 26].

The high occurrence of torn gloves among participants increased the odds of HBV infection among the students by almost six times (AOR = 5.90, p-value = 0.019) compared to those whose gloves were not torn. This confirms the need to educate on ways of wearing and removing gloves as well as placing priority on the purchase of high-quality gloves for medical procedures. Nevertheless, results were different from a comparable study that did not predict torn gloves as a risk factor that influences the prevalence of hepatitis B infection [21].

According to our study, sharp-related injury increased the odds of HBV infection among the students by more than ten times (AOR = 10.35, p-value = 0.034) compared to those who experienced no sharp injury. This prediction was parallel to a study that revealed that sharp-related injury increased the odds of hepatitis B infection by a little over three times [21]. To avoid or prevent sharp-related injuries, the following preventive measures can be implemented – provision of safe procedures for usage and disposal of medical sharps, elimination of unnecessary use of sharp objects, ban of recapping of sharp objects and provision of medical devices that can be used instead of sharp objects [19].

Although the WHO recommends 100% coverage of hepatitis B vaccination, our study only found 43.0% of participants who were fully vaccinated against the hepatitis B infection. Our results were consistent with studies among students of a medical college that achieved a vaccination rate of 42.2% and 34% in Pakistan and Nigeria, respectively [27, 28]. Yet, similar studies conducted among nursing and health (medical, dental and nursing) students revealed a higher hepatitis B coverage of 65.6% and 83.7%, correspondingly [21, 29]. Students have always brought up the issues of high vaccination costs and being at low risk of infection as reasons for not vaccinating. There is also a lack of policy for vaccination of students in most health institutions which seems to impede the uptake of vaccination [18, 23].

Although a study [21] found no significant association between vaccination and HBV infection, our study showed that vaccination decreased the odds of HBV infection by exactly 91% (AOR = 0.09, p-value = 0.033). This finding depicts the protective effect of vaccination against HBV infection in this study. The WHO has called for the need to achieve high vaccination coverage due to the high exposure rates of HBV infection, particularly among health workers [5]. A recent study among health students had advocated for the need for regular hepatitis B vaccination before clinical years. Regardless of the preventive measures taken by students in this study and other studies as well, a high hepatitis B vaccination rate is ideal for protecting students against HBV infection [19, 30, 31].

Despite over 90% of students' frequent use of gloves, disinfecting the working area and receiving training on infectious diseases, the association between these risk factors and the prevalence of HBV infection was not statistically significant in our study. These predictions in our study were coherent with other studies conducted in Ghana and Uganda [16, 21]. However, these measures are basic infection prevention control measures that need to be encouraged among students as well as HCWs to avoid contracting the hepatitis B disease [16, 19]. These measures can be backed by policies to ensure continuous practice among HCWs, especially MLSSs, who happened to be part of the high-risk groups of exposures and infections [15, 16].

Conclusion

Sharp object-related injuries and torn gloves were the most significant risk factors for hepatitis B infection, while vaccination was the only significant preventive measure in this study. Our study predicted the prevalence of 6.7% HBV infection among students. Educating students on the use and precautions associated with sharp-related objects during their internship can reduce this exposure. Additionally, students should be oriented on the wearing and removal of gloves, which seems to increase the experience of torn gloves. There should be an urgent call for policies of procurement of quality gloves and scale up vaccination coverage among health students to drastically reduce the prevalence of HBV.

Limitations

Some students participated in the research only by answering questionnaires and not partaking in checking their hepatitis B infection status. This might have weakened or strengthened the link between HBV infection and risk factors. There was a possibility of recall bias among the students for exposure to the risk factors of HBV infection that occurred in the laboratory or hospital facility during their vocational training programs. This might have contributed to distortion in the prevalence of risk factors. The generalizability of the results of this study is limited since participants were drawn from only one institution. A large sample size of participants from different institutions may probably present a different picture but similar findings.

Conflict of Interest: None

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