



Hepatitis B Prevalence, Knowledge and Occupational Factors among Health Care Workers in Fako Division, South West Region Cameroon

**Serge Ngekeng^{1*}, Alain Chichom-Mefire¹, Peter Fon Nde¹,
Dickson Shey Nsagha¹, Alphonse Tonia Nkuigwe², Kevine Tiogouo²,
Franka Mbu Oben², Patou Franck Ekotang² and Simeon Pierre Choukem¹**

¹*Faculty of Health Sciences, University of Buea, P.O.Box 63, Buea, Cameroon.*

²*School of Health Sciences, Biaka University Institute of Buea, P.O Box 273 Buea, Cameroon.*

Authors' contributions

This work was carried out in collaboration between all authors. Author SN designed the study, performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript. Authors ACM and PFN participated in designing the study. Authors KT, ATN and FMO managed the analyses of the study. Author PFE managed the literature searches. Author DSN revised the first draft. All authors read and approved the final manuscript.

Article Information

DOI: 10.9734/MRJI/2018/40445

Editor(s):

(1) Gyanendra Singh, Gene Therapy & Louisiana Vaccine Center, School of Medicine, LSU Health Sciences Center, Louisiana, USA.

Reviewers:

(1) Birendra Prasad Gupta, Tribhuvan University, Nepal.

(2) Chook Jack Bee, School of Healthcare and Medical Sciences, Sunway University, Malaysia.

Complete Peer review History: <http://www.sciencedomain.org/review-history/24068>

Original Research Article

Received 24th January 2018

Accepted 27th March 2018

Published 9th April 2018

ABSTRACT

Aims: Hepatitis B is a major public health problem in Cameroon and health care workers (HCWs) due to the nature of their work continue to be at high risk. Only very few studies have investigated the hepatitis B surface antigen (HBsAg) prevalence and its associated factors among health care workers in Cameroon. The purpose of this study was thus to investigate HBsAg prevalence as well as to assess knowledge and history of occupational exposure among HCWS in the Fako division of Cameroon.

Study Design: A hospital based cross sectional study design was used for this study.

Place and Duration of Study: The study was carried out in 12 different health institutions within the Fako Division, South West Cameroon in the month of February 2018.

*Corresponding author: E-mail: sergengekeng1@gmail.com;

Methodology: Our study included 281 HCWs (10 Doctors, 115 nurses, 26 lab workers, 3 pharmacists, 8 social workers, 37 cleaners, and 82 interns) who were on duty during the study period. The male to female ratio was 0.35 with a modal age class of 18-29 years. Data was collected using a pretested self-administered structured questionnaire. HBsAg testing was done using Acon hepatitis B surface antigen rapid test strip (Acon Laboratories Inc. San Diego, CA). Categorical variables were compared using Chi square test or its equivalents and a *P*-value less than .05 was considered significant.

Results: From our study only 58.72% of participants had sufficient knowledge about hepatitis B infection and even less (33.1%) had sufficient knowledge concerning the transmission and prevention of the disease. Only 45.91% of participants had adequate knowledge about the hepatitis B vaccine similarly. Up to 86.22% of participants had been victims of at least one type of occupational exposure to blood and other infectious fluids. We recorded an HBsAg prevalence of 4.98% among HCWs and the male gender was significantly associated with the infection (*P* = .04). Age and other socio-demographic factors were not found to be significantly associated to HBsAg prevalence.

Conclusion: HCWs have a low knowledge level about the hepatitis B infection, its transmission, prevention and vaccine. This is coupled with a high occurrence of occupational exposures among these HCWs. Therefore more effort should be made to educate HCWs about hepatitis B, especially those who are less qualified. The prevalence of 4.98% for HBsAg in HCWs in Fako Division is lower than in other regions of the country.

Keywords: Hepatitis B; health care workers; HBsAg; prevalence; occupational exposures.

1. INTRODUCTION

HBV infection poses a major public health problem and according to WHO, there are more than two billion infected persons globally with 350 million of them suffering from chronic disease which principally comprises liver cirrhosis and hepatocellular carcinoma [1]. In developing countries most especially, hepatitis B features among the most pertinent infectious diseases [2]. Sub-Saharan Africa has particularly high hepatitis B virus (HBV) infection prevalence and according to different studies, values range between 7-26% in different countries [3]. The hepatitis B virus is transmitted through blood and other blood derived fluids and it has a 50 to 100 fold greater infectivity than HIV [4]. Infection with HBV is the leading cause of liver disease worldwide and is responsible for 80% of deaths due to liver cancer [5].

HBV infection constitutes the most pertinent infection threat for health care workers (HCWs) with their risk due to occupational exposures being four times greater than that of the general population [6]. WHO estimates that about two million HCWs are exposed each year and Sub-Saharan Africa and other low income countries account for about 90% of the infections resulting from these exposures [7,8]. Generally HBV transmission risk from infected carriers to others who get exposed varies from 6 to 30% [9]. In the health care setting, the risk of transmission is two

way, from patient to HCW or from HCW to the patient and a surge in cases of the latter has been reported [9]. There have been 50 spates of transmission of HBV from HCW to patients since 1972 with 48 HCWs including 39 surgeons transmitting the disease to about 500 patients [10]. Greater exposures are recorded among nurses than among any other health care profession [9].

In developing countries usually, hepatitis B knowledge among HCWs is inadequate and their preventive practices likewise [11,12].

In Cameroon only a very limited number of studies have been conducted on the prevalence of the HBsAg and associated factors among HCWs despite a rising prevalence [13]. Our study sought to investigate the HBsAg prevalence, and to assess the knowledge about hepatitis B, predisposing factors and history of occupational exposures among HCWs in the four health areas, Buea, Limbe, Tiko and Muyuka comprising the Fako division of the South West Region of Cameroon.

2. MATERIALS AND METHODS

2.1 Study Area and Sampling

This was a multi-practice study carried out in 12 health facilities within the four health areas that make up the Fako division of the south west

region of Cameroon. The health facilities included 6 public hospitals, 2 parastatal hospitals and 4 private owned hospitals. The study included 281 health care workers and trainees who were working at the selected hospitals during the study period. The participants included 10 doctors, 115 nurses, 26 lab workers, 37 cleaners, 8 social workers and 3 pharmacists. Participants were recruited using a non-randomized and successive sampling of eligible HCWs met at their station of work. Recruitment was done during all working shifts.

2.2 Study Design

This study was a cross sectional laboratory based study carried out in the month of February 2018. Ethical clearance was sought from the Institutional Ethics Committee for Research on Human Health of the University of Douala. Administrative clearance for the study was acquired from the South West regional delegation for public health and from the directors of all health facilities included in the study. The study was commenced only after obtaining due authorization from necessary authorities. Only HCWs who gave their informed consent were recruited into the study. For confidentiality purposes, no name was required from research participants and only unique identification codes were used to identify participants. Furthermore, the researcher assured participants that there would be no unauthorized disclosure of test results, that no other analysis would be performed on their blood samples except those stated on the research information sheet, and that no part of participant's personal information or laboratory findings would be used for purposes other than strictly for educational and scientific advancement. Participants benefited by getting their test results and the necessary advice on how to proceed depending on their results.

2.3 Data Collection and Laboratory Investigation

A self-administered structured questionnaire that was pretested was used to obtain demographic data and information on knowledge and occupational exposure history among participants. After filling the questionnaire, 2ml of venous blood was collected aseptically by venipuncture and transferred into an Ethylene Diamine Tetra-acetic Acid (EDTA) tube. The samples were later centrifuged and the plasma used for HBsAg testing. HBsAg testing was done

using the Acon Hepatitis B surface antigen rapid test strip (Acon Laboratories Inc. San Diego, CA). This test makes use of both monoclonal and polyclonal antibodies to detect elevated levels of HBsAg in blood. The manufacturer's instructions were used to interpret test results while maintaining standard laboratory precautions.

2.4 Statistical Analysis

All data obtained were entered into a Microsoft excel spreadsheet and analyzed using the Epi Info software (version 7) (Centers for Disease Control and Prevention, USA). Categorical variables were compared by chi-square. Results for categorical variables are presented as proportions while those for quantitative variables are presented as means with standard deviations (SD). For the analysis of the factors influencing HBsAg positivity, odds ratios (OR) with their 95% confidence intervals (CI) were used. Binary logistic regression analysis was used for analyzing these risk factors. For this purpose we grouped variables into two categories. The age was grouped into two classes: <30 and ≥30 years. Profession was categorized into medical for "doctors and nurses" and paramedical for "Lab workers, cleaners, pharmacists and social workers". The working experience was divided in two groups: ≤ 6 years and > 6 years. Finally household income was dichotomized into two groups: <100,000XAF and ≥100,000XAF. *P* values of <0.05 were considered to be statistically significant.

3. RESULTS

3.1 Socio-Demographic Characteristics of Study Participants

Of the 281 participants, more than half (55.57%) were below 30 years and the male female ratio was 0.35. Also of the 281 participants 82 were still in their training years while 103 had worked for only 5 years or less. A majority of participants (72.6%) also had a household income less than 100,000XAF (~\$200) a month (Table 1).

3.2 Knowledge of HCWs about Hepatitis B Infection

Knowledge proficiency of hepatitis B infection was tested through 12 questions asked to participants. The maximum score was 12 and the minimum was 0. Of the 281 participants, 18(6.43%) were not aware of the existence of hepatitis B. The mean knowledge score among

participants was 9.49 with a standard deviation of 2.02. More than half of the respondents (58.72%) had a score above the mean knowledge score about hepatitis B infection. Most participants 244(86.83%) and 238(84.70%) responded accurately that hepatitis B affects the liver and that it could lead to liver cancer respectively (Table 2).

3.3 Knowledge of HCWs about Hepatitis B Transmission and Prevention

Eleven questions were asked to assess participants' knowledge on hepatitis B transmission and prevention with only 93(33.1%) participants scoring above the mean score of 8.52 (SD=2.0). However majority of respondents 252(89.68%) and 212(75.44%) could correctly

identify blood transfusion and sharps injury as means of hepatitis b transmission respectively (Table 3).

3.4 Knowledge of HCWs about Hepatitis B Vaccine

To evaluate knowledge concerning the hepatitis B vaccine, HCWs were asked 12 questions and the mean score was 8.15 with a SD of 1.94. Only 45.91% of respondents scored above the mean knowledge score about HBV vaccine. In this study, 219(78.21%) respondents answered correctly that 3 doses of hepatitis B vaccine were required to complete the vaccination but only 97(34.64%) knew that the vaccine was not contra-indicated for immune compromised persons (Table 4).

Table 1. Socio-demographic characteristics of participants

Characteristic	Categories	Number	Percentage
Age	18-29	157	55.87
	30-50	106	37.72
	51-65	18	6.71
Gender	Female	208	74.02
	Male	73	25.98
Professional experience	Intern	82	29.18
	1-5	103	36.65
	6-10	50	17.79
	>10	46	16.37
Profession	Doctor	18	6.41
	Nurse	170	60.50
	Laboratory worker	45	16.01
	Cleaners	37	13.17
	Others	11	3.91
Household income	<100,000XAF	208	72.60
	100,000-200,000XAF	54	20.64
	>200,000XAF	19	6.76

Table 2. Knowledge about hepatitis B infection among HCWs in Fako division

Question	Correct answers (%)
Hepatitis B is a disease that affects the liver	244(86.83)
Hepatitis B can lead to liver cancer	238(84.70)
Hepatitis B infection can be acquired through needle stick injury	212(75.44)
HBV can be found in semen or vaginal fluid of infected persons	233(82.92)
Hepatitis B is a very infectious disease	243(86.48)
Hepatitis B is more infectious than HIV	219(77.94)
Hepatitis B infection is preventable by vaccination	262(93.24)
People infected with HBV may stay for long without showing any signs.	222(79.0)
All persons exposed to HBV develop acute hepatitis immediately	178(63.35)
Hepatitis B is endemic in most parts of the world	134(47.69)
Sub Saharan Africa is a high endemic zone for hepatitis B	221(78.65)

Table 3. Knowledge about hepatitis B transmission and prevention among HCWs in Fako division

Question	Correct answer (%)
Hepatitis B can be transmitted by blood transfusion from an infected person	252(89.68)
Hepatitis B can be transmitted through cuts and pricks from infected sharps	212(75.44)
Hepatitis B can be transmitted through sexual intercourse with an infected person	235(83.63)
Hepatitis B can be transmitted from an infected mother to her child during pregnancy	204(72.60)
Hepatitis B can be transmitted by drinking polluted water	198(70.46)
Hepatitis B can be transmitted through contaminated faeces	173(61.57)
Hepatitis B can be prevented by vaccination	262(93.24)
Hepatitis B can be prevented by proper sharps disposal	248(88.26)
Hepatitis B can be prevented by avoiding contaminated water	167(59.43)
Hepatitis B can be prevented by avoiding multiple sex partners	246(87.54)
Hepatitis B can be prevented by avoiding improperly cooked food	198(70.46)

Table 4. Knowledge about hepatitis B vaccine among HCWs

Question	Correct answer (%)
There is effective vaccine to prevent hepatitis B infection	263(93.57)
Hepatitis B vaccine can be given as post-exposure prophylaxis	174(61.92)
A complete hepatitis B vaccine schedule comprises at least 3 doses taken within 6 months	219(78.21)
Hepatitis B vaccine is contraindicated for immune compromised persons	97(34.64)
Hepatitis B vaccine is effective to treat patients with acute hepatitis B infection	160(56.94)
Hepatitis B vaccine is highly effective in preventing hepatitis B infection if given within 48 hours after exposure	194(69.04)
Hepatitis B vaccine is recommended for health care workers as part of work place safety	257(91.46)
After taking full dose vaccination of hepatitis B, there is no need for a blood test to confirm immunity against hepatitis B	171(60.85)
Full dose hepatitis B vaccine provides 100% protection for 90% of adults	230(81.85)
Full dose hepatitis B vaccine protects against HBV for at least 15 years	210(74.73)
Hepatitis B vaccine causes problems if given to people who are already immune	132(47.14)
Hepatitis B vaccine is recommended for all health care workers	181(64.41)

3.5 History of Occupational Exposures among HCWs

Participants were asked about 4 different kinds of common occupational exposures and 242(86.22%) of the 281 participants had a history of at least one type of occupational exposure. The most prevalent exposure type was splash of blood and other body fluids on the skin of HCWs (Table 5).

3.6 Prevalence of HBsAg among HCWs

The prevalence of HBsAg among participants was 4.98% (95%CI = 2.75% to 8.22%). HBsAg prevalence was significantly associated to gender ($P = .04$) (Table 6).

4. DISCUSSION

From our findings 6.43% of workers in hospitals had never heard of hepatitis B and only around 59 percent of them scored above the mean knowledge score about hepatitis B infection. Being at the frontline of health care, HCWs are expected to at least be in the know of a common malady like hepatitis B and to be knowledgeable enough in order to protect both themselves and the patients they look after. Our findings are similar to those reported in Northwestern Ethiopia [2] and Yaoundé, Cameroon [13] where only 52% and 47% of HCWs had good knowledge about hepatitis B infection respectively. Our results are however lower than two earlier findings in Yaoundé Cameroon

Table 5. History of occupational exposures among HCWs in Fako division

Question	Yes answer (%)
Has blood or other body fluids from a patient splashed on your skin before?	215(76.51)
Has blood or other body fluids from a patient splashed in your eye or mouth before?	93(33.10)
Has blood or other body fluids from a patient ever splashed on a cut or unprotected wound?	78(27.76)
Have you been accidentally pierced by a used sharp before?	165(58.72)

Table 6. Effect of socio demographic factors on HBsAg prevalence among HCWs

Factor	Divisions	Total	Prevalence (%)	Odds ratio (95%CI)	P value
Age	<30	157	8 (5.10)	1	.92
	≥30	124	6 (4.84)	0.95 (0.32-2.80)	
Gender	Female	208	7 (3.37)	1	.04
	Male	73	7 (9.59)	3.05 (1.03-9.00)	
Profession	Medical	188	10 (5.32)	1	.71
	Paramedical	93	4 (4.30)	0.80 (0.24-2.62)	
Working experience	<6years	185	10 (5.41)	1	.65
	≥6years	96	4 (4.17)	0.76 (0.23-2.49)	
Household income	<100,000XAF	204	9 (4.41)	1	.47
	≥100,000XAF	77	5 (6.49)	1.50 (0.49-4.64)	

CI Confidence interval

among medical students [14] and surgical residents [15] which both reported high level knowledge. Given that both study populations constitute some of the most educated health care workers, the difference in knowledge level is justifiable and indicates that more education must be done especially with the lesser educated categories of HCWs. However most participants (86.48%) knew that hepatitis B is highly infectious and 77.94% even knew that it was more infectious than HIV. This is good as such an understanding will lead the HCWs to take necessary measures to prevent the infection. Although most participants answered correctly that sub Saharan Africa is a high endemic zone for Hepatitis B, only 47.69% knew that the disease is endemic in almost all parts of the world. Only a handful of participants (6.76%) did not know that there was a vaccine against hepatitis B indicating a good general awareness of the existence of the vaccine.

Up to 29.54% and 38.43% of participants wrongly identified that hepatitis B can be transmitted through drinking polluted water and through the faeco-oral route respectively. This finding is higher than that in Northwest Ethiopia where 9.9% said faeco-oral transmission was possible and 20.9% said transmission could occur through drinking polluted water [2]. This difference is understandable since our study included both interns and cleaners, categories

which usually have insufficient knowledge and which were not included in the Ethiopian study. For similar reasons we had up to about 41% and 30% of participants who wrongly said that avoiding polluted water and improperly cooked food were prevention methods for hepatitis B respectively. HCWs must be well educated on the transmission and prevention of hepatitis B in order for them to better protect themselves within the work place.

Only 45.91% of our study participants scored above the mean score of knowledge about the hepatitis B vaccine showing a low knowledge level among the HCWs. Up to 38.18% of respondents did not know that the hepatitis B vaccine can be given as post exposure prophylaxis. This is a gap in knowledge which must be urgently filled seeing that on a daily basis HCWs suffer injuries which exposes them and not understanding possible remedies like post exposure prophylaxis increases their risk of developing acute infection. Almost 40% of respondents also did not know of the necessity of an immune response test after completing the hepatitis B vaccination. Many adults in Cameroon scarcely take any vaccines except for travel purposes; this explains why HCWs are very less knowledgeable about the hepatitis B vaccine, because like other vaccines they are mainly considered important for children only. Similar low levels of knowledge about the

hepatitis B vaccine were reported in Northwest Ethiopia [2]. However in our study almost 92% of participants knew that the hepatitis B vaccine was recommended for all HCWs.

Health care workers are generally at risk of exposure to a variety of blood transmitted microbes by needle pricks, mucocutaneous contamination and other work related injuries and among these infections hepatitis B virus (HBV), hepatitis C virus (HCV), and HIV are notable [16,17]. Our study recorded a high prevalence of at least one type of injury, a finding that ties with that from Yaoundé Cameroon carried out among medical students [14]. Factors such as inadequate training, work overload, limited staff, and short working experience are all factors that have been reported to account for high level of occupational exposures [18,19]. There is need for more education on safety measures in the hospital environment to reduce the incidence of these work place exposures.

The prevalence of HBsAg in our study was 4.98%. HBsAg positivity usually indicates either an active hepatitis B infection or a chronic carrier state, both of which could eventually lead to life threatening liver diseases like cirrhosis and hepatocellular carcinoma [13]. Positive HCWs are not only a risk to their families but most especially to the patients they cater for. Elsewhere in Africa similar HBsAg prevalence to ours have been reported among HCWs, such as 8.1 % in Uganda [20] 7 % in Tanzania [21] 2.9 % in Rwanda [22] and 1.8 % in Libya [23]. Values higher than our results have however been reported in Cameroon, 11% among HCWs [13] 10.1% among blood donors [24] 10.2% among pregnant women [25] and 23.7% among HIV infected individuals [26]. Higher values among the other populations suggests other means of transmission may have a greater role than health care occupational exposures meanwhile the higher value among HCWs in Yaoundé is probably due to differences in safety practices between the two regions.

In our study HBsAg prevalence was significantly higher in men than in women (OR = 3.05) findings similar to a Yaoundé study that recorded a threefold higher prevalence in men than in women [27]. Other studies have also reported similar higher prevalence in men [28,29,30].

The odds of HBsAg positivity was slightly lower in those below 30 years (OR = 0.95) than those 30 and above even though we did not find age to

be significantly associated to HBsAg prevalence ($P = .92$). Even though profession too was not significantly associated to HBsAg prevalence, paramedical staff had lower risk (OR = 0.80) of infection than medical staff. Those who had worked for 6 years and more had a lower chance of having disease (OR = 0.76) than those who had worked for less ($P = .65$).

4. CONCLUSION

Health care workers in Fako Division are continually at high risk of contracting hepatitis B due their insufficient knowledge level and high frequency of occupational exposures to potentially infectious body fluids. With a rising prevalence of hepatitis B infection in the country, adequate measures must be taken to educate HCWs on hepatitis B transmission, prevention and vaccination most especially. There should also be refresher courses on good practices and post exposure management measures in the health care setting.

CONSENT

Written informed consent was obtained from each participant before their enrollment into the study.

ETHICAL APPROVAL

All authors hereby declare that all experiments have been examined and approved by the Institutional Ethics Committee for Research on Human Health of the University of Douala and have therefore been performed in accordance with the ethical standards laid down in the 1964 declaration of Helsinki. The Institutional Ethics Committee for Research on Human Health of the University of Douala Project number is 1254 IEC/02/2018/T.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Shweitzer A, Horn J, Mikolajczyk RT, Krause G, Ott JJ. Estimations of worldwide prevalence of chronic hepatitis B virus infection: A systematic review of data published between 1965 and 2013. *Lancet*. 2015;386:1546-1555.

2. Abeje G, Azage M. Hepatitis B vaccine knowledge and vaccination status among health care workers of Bahir Dar City Administration, Northwest Ethiopia: A cross sectional study. *BMC Infect Dis.* 2015;15(1):30-35.
3. Schweitzer A, Horn J, Mikolajczyk RT, Krause G, Ott JJ. Estimations of worldwide prevalence of chronic hepatitis B virus infection: A systematic review of data published between 1965 and 2013. *The Lancet.* 2015;386(10003):1546–55.
4. Centers for Disease Control and Prevention. Hepatitis B; 2012. Available:<http://www.cdc.gov/vaccines/pubs/pinkbook/downloads/hepb.pdf>
5. Fufore MB, mbbs Cook PA, Kirfi AM. Health workers' knowledge, attitude and practice towards hepatitis b infection in northern Nigeria. *International Journal of Caring Sciences.* 2016;9(3):939.
6. Ciorlia LAS, Zanetta DMT. Hepatitis B in healthcare workers: Prevalence, Vaccination and relation to occupational factors. *BJID.* 2005;9(5):384-389.
7. WHO. The World Health Report- Reducing Risks, Promoting Healthy Life [Internet]. WHO; 2002. [Cited 2017 Jul 25] Available:<http://www.who.int/whr/2002/en/>
8. ABSTRACT - 7sharps. pdf [Internet]. [Cited 2017 Jul 25] Available:http://www.who.int/quantifying_e_himpacts/global/7sharps.pdf
9. Namwaka M, Mpundu M, Musonda P. Hepatitis B vaccination coverage and the determinants of vaccination among health care workers in selected health facilities in Lusaka district, Zambia: An exploratory study. *Annals of Occupational and Environmental Medicine.* 2017;29:32.
10. Aziz S, Memon A, Tily H. Prevalence of HIV, hepatitis B and C amongst health workers of civil hospital. *J Pak Medical Association.* 2006;2(15):302.
11. Samuel SO, Aderibigbe SA, Salami TA, Babatunde OA. Health workers' knowledge, attitude and behaviour towards hepatitis B infection in Southern Nigeria. *International Journal of Medicine and Medical Sciences.* 2009;1(10):418-424.
12. Adekanle O, Ndububa D, Olowookere S, Ijarotimi O, Ijadunola K. Knowledge of hepatitis B virus infection, immunization with hepatitis B vaccine, risk perception, and challenges to control hepatitis among hospital workers in a Nigerian tertiary hospital. *Hepatitis, Research and Treatment.* 2015;1-6.
13. Tatsilong HOP, Noubiap JJN, Nansseu JRN, Aminde LN, Bigna JJR, Ndze VN, Moyou RS. Hepatitis B infection awareness, vaccine perceptions and uptake, and serological profile of a group of health care workers in Yaoundé, Cameroon. *BMC Public Health.* 2016;16:706.
14. Noubiap JJN, Nansseu JRN, Kengne KK, Tchokfe Ndoula S, Agyingi LA. Occupational exposure to blood, hepatitis B vaccine knowledge and uptake among medical students in Cameroon. *BMC Med Educ.* 2013;13:148.
15. Noubiap JJN, Nansseu JRN, Kengne KK, Wonkam A, Wiysonge CS. Low hepatitis B vaccine uptake among surgical residents in Cameroon. *Int Arch Med.* 2014;7:11.
16. Talas MS. Occupational exposure to blood and body fluids among Turkish Nursing Students during clinical practice training: Frequency of needlestick/sharp injuries and hepatitis B immunization. *J Clin Nurs.* 2010;7(2):129-35.
17. Zhang M, Wang H, Miao J, Du X, Li T, Wu Z. Occupational exposure to blood and body fluids among health care workers in a General Hospital, China. *American Journal of Industrial Medicine.* 2009;52:89–98.
18. Rogers B, Goodno L. Evaluation of interventions to prevent needlestick injuries in health care occupations. *Am J Prev Med.* 2000;18(4):90–98.
19. Kohn WG, Collins AS, Cleveland JL, Harte JA, Eklund KJ, Malvitz DM. Guidelines for infection control in dental health-care settings–2003. *MMWR Recomm Rep.* 2003;52(RR-17):1–61.
20. Ziraba AK, Bwogi J, Namale A, Wainaina CW, Mayanja-Kizza H. Seroprevalence and risk factors for hepatitis B virus infection among health care workers in a tertiary hospital in Uganda. *BMC Infect Dis.* 2010;10:191.
21. Mueller A, Stoetter L, Kalluvya S, Stich A, Majinge C, Weissbrich B, Kasang C. Prevalence of hepatitis B virus infection among health care workers in a tertiary hospital in Tanzania. *BMC Infect Dis.* 2015;15:386.
22. Kateera F, Walker TD, Mutesa L, Mutabazi V, Musabeyesu E, Mukabatsinda C, Bihizimana P, Kyamanywa P, Karenzi B, Orikiiriza JT. Hepatitis B and C seroprevalence among health care

- workers in a tertiary hospital in Rwanda. *Trans R Soc Trop Med Hyg.* 2015; 109(3):203–8.
23. Elzouki AN, Elgamay SM, Zorgani A, Elahmer O. Hepatitis B and C status among health care workers in the five main hospitals in eastern Libya. *J Infect Public Health.* 2014;7(6):534–41.
24. Noubiap JJN, Joko WYA, Nansseu JRN, Tene UG, Siaka C. Sero-epidemiology of human immunodeficiency virus, hepatitis B and C viruses, and syphilis infections among first-time blood donors in Edéa, Cameroon. *Int J Infect Dis IJID Off Publ Int Soc Infect Dis.* 2013;17(10):e832-837.
25. Noubiap JJN, Nansseu JRN, Ndoula ST, Bigna JJR, Jingi AM, Fokom-Domgue J. Prevalence, infectivity and correlates of hepatitis B virus infection among pregnant women in a rural district of the Far North Region of Cameroon. *BMC Public Health.* 2015;15:454.
26. Noubiap JJN, Aka PV, Nanfack AJ, Agyingi LA, Ngai JN, Nyambi PN. Hepatitis B and C co-infections in some HIV-positive populations in Cameroon, West Central Africa: Analysis of Samples collected over more than a decade. *PloS One.* 2015; 10(9):e0137375.
27. Noah Noah D, Njouom R, Bonny A, Pirsou Meli J, Biwole Sida M. HBs antigene prevalence in blood donors and the risk of transfusion of hepatitis B at the central hospital of Yaounde, Cameroon. *Open J Gastroenterol.* 2011;1:23–2.
28. Koanga Mogtomo ML, Louandji Fomekong S, Fotso Kuate H, Ngonon Ngane A. Detection of infectious agents in blood banks in Douala (1995-2004). *Cahiers d'Etudes et de Recherches Francophones/ Santé.* 2009;19:3-8.
29. Zekeng L, Kaptue L. HIV 1 serology and HBsAg and HBeAg carrier status in blood donors at the Yaounde University Hospital, Cameroon. *Annales de la Société Belge de Médecine Tropicale.* 1990;70:49-53.
30. Mueller A, Stoetter L, Kalluvya S, Stich A, Majinge C, Weissbrich B, Kasang C. Prevalence of hepatitis B virus infection among health care workers in a tertiary hospital in Tanzania. *BMC Infectious Diseases.* 2015;15:386.

© 2018 Ngekeng et al.; This is an Open Access article distributed under the terms of the Creative Commons Attribution License (<http://creativecommons.org/licenses/by/4.0>), which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

Peer-review history:

The peer review history for this paper can be accessed here:
<http://www.sciencedomain.org/review-history/24068>