



Seroprevalence and Factors Associated with Hepatitis B Virus Infection among Public Medical First Responders in a Public Health Region in Thailand

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ABSTRACT

Objectives: To investigate HBV seromarker prevalence and associated factors among public medical first responders (MFRs) in the fifth public health region of Thailand. **Methods:** This cross-sectional study was carried out among 344 public MFRs with age ≥ 18 years. Those who had no previous HBV vaccination voluntarily participated in blood testing for HBV seromarkers ($n = 269$). Data were analyzed using descriptive statistics, χ^2 -test or Fishers' exact test and Odds ratio (OR) with significant level at $\alpha = 0.05$. **Results:** The majority of MFRs were male (83.1%), aged 21-40 years (61.0%), and 68.6% used to receive new employee's pretraining. Approximately 6.7% had a history of jaundice, 62.2% had a history of tattooing or body piercing, 7.8% had a history of injecting drug use and 28% had a history of extramarital sex without using condom. During the last 3 months, 65.4% had blood exposure, 9.3% had a history of contacting jaundiced patients and 39.5% had a history of needle stick or sharp injury. The mean score of universal precaution practices was 4.1 ± 2.1 (total score = 7) classified as low level. For blood testing, 75.5% were positive for one or more HBV seromarkers, 6.3% were HBsAg \pm anti-HBc (without IgM anti-HBc), 61.3% were anti-HBs positive and 7.8% were anti-HBc positive only. Associated factor analysis revealed that significant factors for HBsAg positiveness were a history of jaundice (OR = 7.5, 95% CI = 1.8-32.2) and a history of contacting patients' blood or jaundiced patients while working (OR = 4.8, 95% CI = 1.1-21.7). Overall HBV seromarker positiveness comprised a history of tattooing (OR = 2.5, 95% CI = 1.4-4.4) and a history of contacting patients' blood or jaundiced patients while working (OR = 2.2, 95% CI = 1.2-3.8). **Conclusion:** This study revealed a total of 6.3% HBsAg positiveness. Significant risk factors for HBsAg included a history of jaundice and contacting with patients' blood or jaundiced patients. Overall HBV seromarker positiveness comprised a history of tattooing and contacting with patients' blood or jaundiced patients while working.

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INTRODUCTION

Hepatitis B virus (HBV) is a globally important blood-borne diseases in many countries including Thailand. Approximately

5% of the world's population or over 350 million people are hepatitis B carriers^{1,2}. Both parenteral and sexual routes are the predominant modes of HBV transmission^{3,4}.

The virus can be transmitted from symptomatic patients and asymptomatic carriers to others. These may develop acute and chronic types of HBV. Complications from the disease are quite serious; 6% to 10% of chronic hepatitis B patients acquire cirrhosis and hepatocellular carcinoma, the third leading cause of cancer-related death in the world⁵. HBV is found in blood or its products (10^9 virions/ml), and other secretions such as saliva, vagina secretions and semen (10^5 - 10^6 virions/ml). Contacting these fluids is one pathway for hepatitis transmission⁶⁻⁸. Other transmission pathways include vertical transmission from mother to child immediately before and after birth during the perinatal period, at a high prevalence rate and horizontal transmission found among healthcare workers contacting both directly (percutaneous transmission, mucocutaneous transmission or nonintact skin) or indirectly with blood or other secretions^{8,9}. Approximately 90% of people with HBV can be entirely cured; liver function returns to normal in 10 weeks and hepatitis B immunity occurs. The Center for Disease Control and Prevention (CDC) has estimated the proportion of people with acute HBV associated with known risk factors comprise 41% from heterosexual contact, 15% from injection drug use, 9% from homosexual activity, 2% from household contact, 1% from health care employment, 1% by others, and 31% from unknown factors⁸.

Hepatitis B remains a major public health concern in Thailand with approximately 3-5 million carriers⁹⁻¹¹. Recent studies have shown that Thailand serves as an intermediate endemic area of HBV transmission; the reported prevalence of HBsAg was 2-5%^{9,10}. This serious concern involves 15 to 25% of patients becoming chronic, including about 250 times that of normal people with liver cancer. Moreover, one half of carriers died from chronic hepatitis, cirrhosis or liver cancer^{12,13}. Major risk groups of HBV transmission in Thailand include injecting drug users, female commercial sex workers and patients with sexually transmitted diseases^{9,11,14,15}. Studies have found that some groups of healthcare workers such as physicians, nurses, nurse aids, laboratory technicians and medical first responders (MFRs) were at high risk for HBV due to occupational exposures^{7,16-18}. The pathogens can be transmitted by percutaneous, mucous membrane and nonintact skin exposure while performing their job responsibilities^{7,16,18,19}. In Thailand, most MFRs are volunteers. Because

the number of accidents has been increasing, Thai public MFRs' burden to help people has also increased. A report from the Road Safety Group Thailand (RSG) indicated that the trend of accidents with deaths and injuries increased over 5 years. Because their job duties expose them to blood or secretions during urgent treatment or first aid, the risk among Thai public MFRs may increase similar to ambulance personnel¹⁹. Limited data is available regarding occupational risk exposure for HBV transmission among this target group. A study of HBV seroprevalence and risk factors should be conducted to initiate a risk reduction plan that improves the quality of working life in this group.

MATERIALS AND METHODS

Study design and study participants

A cross-sectional study was carried out between August 2011 and February 2012 to investigate HBV seromarker prevalence, personal health histories, occupational exposure and other related factors among public MFRs in Public Health Region Five of Thailand. This region covers two provinces in central of Thailand and two provinces in the upper part of southern Thailand consisting of several tourist attractions where most accidents occur as compared with other regions (Figure 1). About 1,800 public MFRs worked in this public health region in 2010. Multi-stage random sampling was used for sample selection in one province from the central area and one province from the upper part of the southern area. The systematic random sampling was used to study MFRs from the name lists of each province (every third name). A total of 344 public MFRs, aged 18 years and over, who voluntarily participated in a questionnaire study were selected. However, only 269 voluntarily participated in blood testing due to the exclusion criteria of a previous HBV vaccination. Therefore, 344 public MFRs were included in the questionnaire study and 269 were included in the HBV seromarker study and risk factor analysis. The sample size for studying HBV seromarker prevalence was calculated from $n = Z_{\alpha/2}^2 PQN / Z_{\alpha/2}^2 PQ + Nd^2$, when $Z_{\alpha/2} = 1.96$, $P =$ proportion of HBV seropositive among emergency medical service personnel in the pilot study = 0.65, $Q = 1-P = 0.35$, $N = 1800$, $d = 0.05$. The calculated sample size was 251.

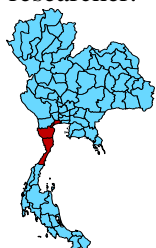
Study data were conducted using a structured questionnaire after the protocols were approved by the Ethics Committee of the

Faculty of Public Health, Mahidol University (MUPH2011-011). All 344 participants provided informed consent of whom 269 MFRs provided serum samples. Serum specimens were separated and kept at 0 to 4°C for transportation to the Microbiology Department, Faculty of Public Health, Mahidol University. All sera were stored at -20°C until laboratory tests for HBV seromarkers were performed.

Methods of HBV seromarker testing and questionnaire study

All serum samples were tested using the immunochromatographic sandwich principle to detect HBsAg and Anti-HBs (Blue Cross HBsAg, Biotech Canada joint-Venture (Beijing) Co., Ltd. Bioland NanoSign Anti-HBs, Bioland Korea Co., Ltd.) and competitive method to detect anti-HBc one step diagnostic rapid test, strip (NOVA TEST® Atlas Link Biotech Co., Ltd., USA). All laboratory tests had both sensitivity and specificity over 99.5%. In the case of HBsAg, a specimen with positive HBsAg immunochromatography was confirmed by ELISA for HBsAg and anti-HBc IgM was detected.

The structured questionnaire contained closed-ended questions including socio-demographic characteristics, personal health histories towards HBV transmission, occupational risk exposure towards HBV transmission in a previous 3-month period and universal precaution practices. Scoring of universal precaution practices was (a) regular practice = 1, and (b) sometimes or no practice = 0. The score level of the universal precaution was classified in three levels: the first group was at high level (score >80% of total score); the second was at moderate level (score 60 to 80%) and the third was at low level (score <60%). The content validity of this structured questionnaire was approved by three experts in infectious disease prevention before use. To simulate the real situation of the universal precaution practices among MFRs while working, 22 working runs were observed by the researcher.



Public Health Region 5 covers four provinces including Samut Sakhon, Samut Songkhram, Phetchaburi and Prachuan Khiri Khan.

Figure 1 Public Health Region 5, Thailand

Data analysis

Data were analyzed using a computer program (SPSS version 17.0 for Windows) and presented using descriptive statistics including percentage, mean and standard deviation. Risk factors of HBsAg positiveness and HBV seroprevalence were analyzed using χ^2 -test or Fishers' exact test. Odds ratio (OR) with 95% CI of OR were used. The critical level of statistical significance was set at $\alpha = 0.05$.

RESULTS

Sociodemographic characteristics of participants

Sociodemographic characteristics of 334 MFRs showed the majority were male (83.1%). The largest age group was 21-40 years (61.0%). Regarding marital status, 54.9% were single and 45.1% were married. Concerning educational level, 87.5% achieved secondary level and 12.5% obtained bachelor's degrees. Approximately 59.7% had annual medical check-ups. Regarding work experience, 68.6% received new employee pretraining on the topics of knowledge and practices towards emergency rescue and 47.2% had worked less than 10 years. Concerning workload, 57.8% worked less than 10 days monthly (Table 1).

Table 1 Sociodemographic characteristics of participants (n=344)

Sociodemographic variables	Number	Percentage
Sex		
Male	286	83.1
Female	58	16.9
Age group (years)		
≤ 20	65	18.9
21 - 40	228	66.3
41 - 60	51	14.8
Marital status		
Single	180	52.3
Married	155	45.1
Divorced	9	2.6
Educational level		
Secondary school	301	87.5
University	43	12.5
Annual medical check-up		
Yes	203	59.0
No	141	41.0
New employee's pretraining		
Yes	236	68.6
No	108	31.4
Work experience (years)		
< 1	110	32
1 - 10	177	51.5
> 10	57	16.5

Table 1 Sociodemographic characteristics of participants (n=344) (Cont)

Sociodemographic variables	Number	Percentage
Work frequency (days/month)		
< 10	199	57.7
11 - 20	75	21.8
> 20	70	20.3
Total	344	100

Personal health history and occupational risk exposure among participants

Twenty-three subjects (6.7%) had a history of jaundice, 5.5% had a history of receiving blood or hemodialysis, 62.2% had a history of tattooing or body piercing, 7.8% had a history of injecting drug use, 28% had a history of extramarital sex without using condom and 4.4% contracted a sexually transmitted disease in the previous year. Details are shown in Table 2. For occupational risk exposures in the previous 3-month period, 65.4% had blood exposure while working, 9.3% had a history of contacting jaundiced patients and 39.5% had a history of needle stick and sharp injury. Details are shown in Table 2.

Table 2 Personal health history and occupational risk exposure towards HBV among participants (n = 344)

Occupational risk exposure	Number	Percentage
History of jaundice		
Yes	23	6.7
No	321	93.3
History of receiving blood or hemodialysis		
Yes	19	5.5
No	325	94.5
History of tattooing or other body piercing		
Yes	214	62.2
No	130	37.8
History of injection drug use		
Yes	27	7.8
No	317	92.2
History of STDs in the previous year		
Yes	15	4.36
No	320	93.02
Not answered	9	2.62
History of extramarital sex relations without using condom		
Yes	98	28.5
No	191	55.5
Not answered	55	16.0
Blood and secretion exposure while working		
Yes	225	65.4
No	119	34.6

Table 2 Personal health history and occupational risk exposure towards HBV among participants (n = 344) (Cont)

Occupational risk exposure	Number	Percentage
History of contact jaundiced patients while working		
Yes	32	9.3
No	272	79.1
Not answered	40	11.6
Needle stick or sharp injury while working		
Yes	136	39.5
No	208	60.5

Universal precaution practices among participants

Results revealed that 85.5% and 75.3% of the participants wore disposable gloves regularly when contacting blood and bodily fluids and wounds or when dressing wounds, respectively. Approximately 64% regularly washed their hands before and after contacting blood and bodily fluids. Only 22.1% wore surgical masks and goggles to protect the mucous membranes of their eyes, nose and mouth when contacting injured persons with massive blood loss. The mean score for universal precaution practices was 4.1 ± 2.1 (total score = 7); this was classified as a low level (Table 3). Additional data from field observation among 22 working runs demonstrated that 86.4% of observed personnel regularly wore disposable gloves when contacting blood and bodily fluids and 73.3% wore disposable gloves regularly when contacting wounds or dressing wounds. About 54.5% regularly washed their hands before and after contacting blood and bodily fluids. However, when contacting a large amount of blood, only 22.7% (5/22) used surgical masks and goggles to protect the mucous membranes of their eyes, nose and mouth (Table 3).

Prevalence of HBsAg and HBV seromarkers and risk factors

Although 344 public MFRs gave their informed consent for the questionnaire study, only 269 participants (78.2%) provided serum for HBV seromarker study. The results revealed that 75.5% were positive for one or more HBV seromarkers. Approximately 6.3% were HBsAg±anti-HBc positive, 61.3% were anti-HBs positive, and 7.8% were anti-HBc positive only. All positive HBsAg±anti-HBc were negative for IgM anti-HBc. Males had a higher positiveness than females for HBsAg and overall HBV seromarkers. MFRs at age >30 years had a relatively higher positiveness

for HBsAg and overall HBV seromarkers than those with age ≤ 30 years. In addition, MFRs having lower education levels (secondary school) had a relatively higher positiveness for HBsAg and overall HBV seromarkers than those having higher educational levels (Bachelor's degree). MFRs with a work frequency >20 days monthly had a relatively higher positiveness for HBsAg and overall HBV seromarkers than those with a work frequency ≤ 20 days monthly. Details are shown in Table 4.

When we analyzed all possible associated factors for HBsAg and HBV seromarker positiveness, four factors were observed to be associated with HBsAg positiveness. Two included having a history of jaundice (OR = 7.5, 95% CI = 1.8-32.2) and a history of contacting patients' blood or jaundiced patients while working (OR = 4.8, 95% CI = 1.1-21.7). Moreover, overall HBV seromarker positiveness comprised a history of tattooing (OR = 2.5, 95% CI = 1.4-4.4) and a history of contacting patients' blood or jaundiced patients while working (OR = 2.2, 95% CI = 1.2-3.8), Table 5.

Table 3 Universal precaution practices among participants: data from questionnaire study (n = 344) compared with data from observation

Universal precaution practices	Questionnaire study Usual practices		Observation Personnel who practiced	
	No	%	No/Total	%
1. Handwashing before and after removing gloves or having direct contact with patients	206	59.9	7/22	31.8
2. Handwashing before and after contacting blood, blood products and bodily fluids	220	64.0	12/22	54.5
3. Wearing disposable gloves when contacting blood and bodily fluids	244	70.9	20/22	90.9
4. Wearing disposable gloves before contacting wounds or when dressing wounds	259	75.3	11/15	73.3
5. Wearing surgical masks, goggles to protect the mucous membranes of the eyes, nose and mouth while working	76	22.1	5/22	22.7
6. Disposing of blood contaminated gauze, wool and cloth are thrown in the infectious waste container	201	58.4	7/15	46.7
7. Cleaning blood contaminated equipment with 70% alcohol before using	212	61.6	15/22	68.2

Remarks: Mean \pm SD of UP = 4.1 \pm 2.1

Low level (< 4.2 score)	49.7%
Middle level (4.2-5.5 score)	19.5%
High level (> 5.5 score)	32.8%

Table 4 Seroprevalence of HBV seromarkers among participants categorized by sociodemographic variables (n = 269)

Socio-demographic characteristics	No. testd	HBsAg \pm Anti-HBc		Anti-HBs \pm Anti-HBc		Anti-HBc Only		Overall positive	
		No.	%	No.	%	No.	%	No.	%
Sex									
Male	225	17	7.6	137	60.9	19	8.4	173	76.9
Female	44	0	0.0	28	63.6	2	4.6	30	68.2
Age groups (years)									
≤ 30 years	152	9	5.9	84	55.3	14	9.2	107	70.4
> 30 years	117	8	6.8	82	69.2	7	6.0	96	82.1
Marital status									
Single	145	9	6.2	84	57.9	15	10.3	108	76.2
Married	124	8	6.5	81	65.3	6	4.8	21	70.0
Educational level									
Secondary level	239	16	6.7	145	60.7	21	8.8	182	76.2
Bachelor's degree	30	1	3.3	20	66.7	0	0.0	21	70.0
Work experience									
≤ 10 years	220	14	6.4	130	59.1	19	8.6	163	74.1
> 10 years	49	3	6.1	35	71.4	2	4.1	40	81.6

* All were negative for IgM anti-HBc

Table 4 Seroprevalence of HBV seromarkers among participants categorized by sociodemographic variables (n = 269) (Cont)

Socio-demographic characteristics	No. tested	HBsAg ± Anti-HBc		Anti-HBs ± Anti-HBc		Anti-HBc Only		Overall positive	
		No.	%	No.	%	No.	%	No.	%
Work frequency									
≤ 20 d/m	207	13	6.3	122	58.9	20	9.7	155	74.9
> 20 d/m	62	4	6.5	43	69.4	1	1.6	48	77.4
Total	269	17*	6.3	165	61.3	21	7.8	203	75.5

* All were negative for IgM anti-HBc

Table 5 Factors associated with HBsAg positivity and overall HBV seromarker positivity among participants after multiple logistic regression (n = 269)⁺

Studied variables	Risk factors for HBsAg positivity		Risk factors for HBV seromarker positivity	
	Odds ratio (95% CI)	p-value	Odds ratio (95% CI)	p-value
Sex: male	NC*	NC*	1.6 (0.8-3.2)	0.222
Age group: >30 years	1.2 (0.4-2.9)	0.281	1.8 (0.9-3.1)	0.054
Marital status: Married	1.1 (0.4-2.8)	0.934	1.1 (0.6-2.0)	0.686
Educational level: ≤Secondary school	2.1 (0.3-16.3)	0.485	1.4 (0.6-3.2)	0.462
Work experience: >10 years	1.4 (0.4-4.4)	0.588	1.6 (0.7-3.5)	0.234
History of jaundice: Yes	7.5 (1.8-32.2)	0.007**	3.3 (0.7-14.4)	0.076
History of receiving blood or hemodialysis	1.1 (0.1-8.6)	0.955	0.9 (0.5-1.7)	0.707
History of tattooing	1.1 (0.4-3.2)	0.818	2.5 (1.4-4.4)	0.002**
History of injecting drug	1.5 (0.3-7.1)	0.588	1.4 (0.5-4.3)	0.568
History of STDs in the previous year	1.8 (0.4-8.7)	0.441	1.3 (0.4-3.9)	0.715
History of extramarital sex relation without using condom	2.4 (0.9-9.7)	0.093	1.0 (0.6-1.7)	0.874
History of contacting patients' blood or jaundiced patients while working	4.8 (1.1-21.7)	0.035**	2.2 (1.2-3.8)	0.008**
History of needle stick or sharp injury while working	1.0 (0.4-2.6)	0.917	1.1 (0.6-1.9)	0.781
Low score level of universal precaution (from questionnaire)	1.2 (0.5-3.3)	0.694	0.7 (0.3-1.2)	0.153

* NC = Not calculated because all HBsAg positive cases (17 MFRs) were male

**Statistical significance at $\alpha = 0.05$

DISCUSSION

This majority of the 334 public MFRs working in several areas of Public Health Region 5 were male (83.1%) and single (52.3%). Approximately 87.5% finished secondary education and only 12.5% finished at university level. The findings corresponded with previous studies in this group^{17,19,20}. Surprisingly, about 31.4% of the MFRs did not pass the training before working. Generally, MFRs or other groups of personnel working in emergency medical services have to pass at least one 16-hour training including airway care and suctioning, patient health assessment, cardio-pulmonary resuscitation (CPR), stabilization of injuries, care for medical and trauma emergencies and other skills and procedures as permitted by local regulation¹⁹. This weakness should be reconsidered and strengthened. Additionally, the practices of universal precaution and standard precaution should be included in the training due to the low scores of the practices found in the present study. This important topic helps MFRs to be

aware of work safety and to reduce the risk of blood-borne, air-borne or droplet transmission.

Concerning personal health risk histories, 62.2% of MFRs had tattoos or pierced holes in the ears or nose or other parts of the body. About 7.8% had a history of injecting drug use and 28.5% had a history of extramarital sex relation without condom use. These risk histories were higher than in previous studies regarding some groups of Thai males, for example only 14.9 to 21.3% had tattoos, 2.2 to 2.3% had a history of injecting drug use and 8.1 to 16.4% had a history of extramarital sex relation without condom use^{14,15,21}. Additionally, these are known important risk factors for HBV, hepatitis C virus (HCV) and human immunodeficiency virus (HIV) transmission^{6,8,9,15,21}.

Data concerning occupational risk contact and universal precaution practices while working showed that 65.4% of MFRs had a history of contacting patient's blood and bodily fluids and 39.5% had a history of needle stick or sharp injury while working in

the previous three months. Several studies conducted among health care worker (HCWs) showed that 40% to 76.6% of accidents from work were percutaneous exposure incidents (needle stick or sharp injury)^{8,16,19}. In addition, 5.5% of personnel working in emergency medical service (EMS) had a history of needle stick and 3.1% had a history of mucous membrane exposure. These probably resulted from many factors including working environment, equipment readiness, working experience and universal precaution practices¹⁹. Preventive practices towards HBV transmission or universal precautions aim to prevent transmission of HBV, HIV and other blood-borne pathogens. The principal is to assume patients have blood-borne pathogens and ensure that health staff can minimize the risk of exposure to bodily fluids^{9,10,17,20}. The data from questionnaires, revealed 22.1 to 75.3% of MFRs usually practiced the selected items of universal precaution such as 59.9% usually practiced hand-washing before and after contacting patient's blood and secretions and only 22.1% usually practiced wearing a surgical mask and goggles to protect mucous membranes of the mouth, nose and eyes while working. In contrast, data from observation showed a corresponding proportion to most items concerning universal precaution practices. Compliance with these universal precaution practices has been shown to reduce the risk of exposure to blood and bodily fluids^{8,16,19,22}. Implementing a training package may help because universal precautions provide protection from a range of blood-borne pathogens, but their effectiveness relies upon the knowledge of HCWs and the level of compliance in their use^{19,22}.

Globally, over 350 million chronic carriers of hepatitis B virus (HBV) and over one million people die each year as a result of acute fulminant liver disease or HBV induced cirrhosis and liver cancer^{4,23}. Several groups at high risk of infection include homosexual men, intravenous drug abusers, chronically transfused patients, heterosexual contact by case or carriers and some groups of healthcare workers. One group of healthcare workers at risk for HBV transmission is the MFR group, such as emergency medical technicians, firefighters and paramedics^{17,19,22}. They encounter unique occupational hazards while delivering emergency care in the pre-hospital setting and are at risk for percutaneous injuries and blood splashes that are positive for HIV and other blood-borne pathogens. Previous studies have attempted to quantify the

frequency with which first responders sustain blood or body fluid exposure as a part of their job^{17,19,22}. Additionally, they reported that 0.9 to 25% of emergency medical personnel were positive for HBsAg^{19,20}. This present study found 6.3% of cases tested positive for HBsAg, 61.3% of cases were anti-HBs positive, only 7.8% were anti-HBc positive and 75.5% of cases tested positive for overall HBV seromarkers. This present study found a higher HBsAg positive rate than other studies conducted among related groups including hospital personnel and emergency medical service personnel^{16,20}. In addition, male MFRs had a relatively higher HBsAg and overall HBV seromarker positiveness than females. MFRs aged over 30 years had a relatively higher HBsAg and overall HBV seromarker positiveness than MFRs aged 30 years and younger. Moreover, MFRs with a work frequency over 20 days monthly had a relatively higher HBsAg and overall HBV seromarker positiveness than MFRs with a work frequency of 20 days or less monthly. Notably, having a history of jaundice and a history of contacting blood or jaundiced patients while working were significant risk factors for HBsAg positiveness, OR=7.5 ($p = 0.007$) and OR = 4.8 ($p = 0.035$), respectively. Additionally, a history of tattooing and a history of contacting patients' blood or jaundiced patients while working were significant risk factors for overall HBV seromarker positiveness, OR = 2.5 ($p = 0.002$) and OR = 2.2 ($p = 0.008$), respectively. This evidence corresponded with that of a study of risk factors for HBsAg positiveness among Thai pregnant women²⁴ and older Thai males¹⁵. Generally, HBV was recognized as a frequent occupational hazard among persons working in hospitals and health care facilities performing their job duties^{7,8,16,19}. The present study supported this evidence of occupational risk exposure to HBsAg and overall HBV seromarker positiveness ($p < 0.05$) among MFRs. This should be reconsidered and strengthened to provide HBV vaccination and preventive knowledge, attitudes and practices for this target group to reduce the risk of blood-borne transmission, especially regarding HBV.

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