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Hepatitis B virus among Saudi National Guard Personnel: Seroprevalence and risk of exposure

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Summary

Background: Data on HBV prevalence among active military personnel in Saudi Arabia (SA) are lacking. In addition, the work-related risk of exposure is unclear. The objective of this study was to estimate the seroprevalence of HBV and the risk of HBV exposure among SA National Guard (SANG) soldiers.

Methods: A cross-sectional study was performed and included 400 male SANG soldiers working in Jeddah during January 2009. All soldiers completed a questionnaire to assess their risk of exposure and gave a blood sample to test for hepatitis serology markers.

Results: A total of 16 (4.0%) soldiers were positive for HbsAg, 53 (13.2%) were positive for anti-HBc, and 230 (57.5%) were positive for anti-HBs. None of the soldiers had acute HBV infection, but 15 (3.8%) were chronic HBV carriers. A total of 152 (38.0%) soldiers were susceptible to HBV infection, and 230 (57.5%) were immune to HBV infection, primarily (84.3%) due to HBV vaccination. Compared with those who were negative for anti-HBc (never exposed), soldiers who were positive for anti-HBc were more likely to be older, have a lower education level, have a higher income, have a longer service duration, have a household member with HBV disease, have undergone surgery, or have undergone endoscopy. In the multivariate logistic regression model, older age, presence of a household member with HBV disease and previous endoscopy were independent predictors of HBV exposure.

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Conclusion: We report a 4% prevalence of HBsAg in the Saudi military population. This HBV prevalence was higher than those in the general Saudi population and military populations from Western countries. Both work-related and community-related risk factors for exposure are suggested.

Introduction

According to the most recent World Health Organization (WHO) estimates, approximately one-third of the world's population has serologic evidence of HBV infection, and 350 million live with chronic infection. Moreover, approximately 600 thousand of those infected with HBV die every year [1]. HBV is a major public health problem in Saudi Arabia (SA), which used to be among the countries with the highest hepatitis B surface antigen (HBsAg) seroprevalence [2]. According to the Saudi Ministry of Health (MOH) data, viral hepatitis ranked as the second most common reportable viral disease after chickenpox, with an incidence rate of 19.8 per 100 thousand population [3]. The HBV incidence was found to be more than double that of hepatitis C. Jeddah, a multicultural coastal city, reported more new HBV infections than any other city in SA, with a greater than 50% excess risk, at 31.0 per 100 thousand population [3].

In Saudi Arabia in the 1990s, the HBV prevalence was estimated to be between 5% and 10% in different studies [4—6]. The universal administration of the HBV vaccine to all Saudi infants/children beginning in 1990 [7] most likely caused the large (79%) decrease in HBV incidence among those <15 years old, but only a moderate decrease (19%) among those $\geq$15 years old was observed [8]. This decrease in HBV incidence was reflected in more than a 50% decline in the prevalence of HBV among Saudi blood donors [9,10]. In the last decade, prevalence studies on Saudi blood donors estimated the HBV prevalence to be between 1.5% and 3.0% [11—13].

In SA, the incidence of HBV seropositivity was reported to be high in the military population [14]. HBV was ranked as the most common reportable communicable disease among SA National Guard (SANG) personnel in Jeddah [15]. Unfortunately, there are limited data on HBV prevalence among military personnel in SA, and the available data are derived from mixed populations [16]. Moreover, it is unclear whether military personnel have work-related risk factors for exposure that might put them at a higher risk of contracting HBV. The objective of this study was to estimate the seroprevalence of HBV and the related risk factors for exposure among SANG soldiers.

Methods

Population

The current study was conducted among SANG soldiers in Jeddah, SA. The Jeddah governorate is located in the western region of SA and is considered the primary Saudi seaport and the main port of entry for Makkah pilgrims. The 2009 Jeddah population was estimated to be 3.3 million, including 1.5 million non-Saudis [3]. Approximately 10,000 male SANG soldiers serve at Jeddah. They primarily receive health services provided by the National Guard Health Affairs (NGHA) through one tertiary hospital and five primary healthcare centers.

Study design

A cross-sectional study was performed and included male SANG soldiers working in Jeddah during January 2009. Four hundred participants were randomly selected from the SANG soldier roster. Written consent was provided after verbal explanation of the study objectives. The participation rate was 96%, and all consenting participants completed a questionnaire and gave a blood sample. The current study obtained all required ethical approval from the ethical committees of King Abdulaziz Medical City (KAMC) in Jeddah and Riyadh.

Sample size

There has been wide variation in the reported prevalence of HBV among adult Saudis, with a decreasing trend over the last three decades. A prevalence of HBsAg approaching 1.0% was previously reported [9]. We estimated that 367 samples would allow us to detect an HBsAg prevalence of 1.0% with an absolute confidence limit of $\pm$1.0% at a confidence level of 95%. The sample was increased to 400 to allow for detecting a 15% difference in the prevalence of a certain risky characteristic or behavior among those who were positive and negative for hepatitis B surface antibody (anti-HBs), assuming that the anti-HBc prevalence is 15% [13,17].

Questionnaire

A self-administered questionnaire was developed and administered to all participants. It included identification data, personal and socio-demographic characteristics, and HBV-related questions. These questions included knowledge of HBV, history of HBV vaccination, personal and family history of HBV symptoms and complications, and potential exposure to HBV.

Laboratory testing

In total, 10 mL of venous blood was collected in a plain (without anticoagulant) test tube from each participant and transported to the serology section of the KAMC-Jeddah laboratory under appropriate conditions within 3 h for processing. Separated sera were tested for hepatitis serology markers using both an enzyme-linked immunosorbant assay (ELISA) and a chemiluminescent microparticle immunoassay (MIA). Hepatitis serology markers were assessed as follows: (1) HBsAg-positive samples were confirmed using the Axsym HBsAg confirmatory test [18,19]. Confirmed HBsAg-positive samples were tested for hepatitis B e antigen (HBeAg) and antibody (anti-HBe), (2) anti-HBs, (3) IgG antibody to hepatitis B core antigen (anti-HBc IgG), and (4) IgM antibody to hepatitis B core antigen (anti-HBc IgM). The results of the tests for hepatitis serology markers were interpreted according to the standard Centers for Disease Control and Prevention (CDC) guidelines [20].

Statistical analysis

The data were presented as frequencies and percentages for categorical data and the mean and standard deviation (SD) for continuous data. The prevalence of HBV serology markers was presented as a percentage. Socio-demographic characteristics and HBV exposure risk factors were compared between those who were positive and negative for anti-HBc. The significance of the differences between groups was tested using Student's *t*-test for continuous data and the Chi-square test or Fisher's exact test (as appropriate) for categorical data. Univariate (with one variable at a time) and multivariate (with all variables together) logistic regression models were constructed to determine the crude and independent predictors, respectively, of anti-HBc positivity. Independent predictors were identified using conditional backward stepwise elimination of variables with *p*-values >0.10, and those variables with a *p*-value <0.05 were retained. All *p*-values were two tailed. *p*-Values <0.05 were considered significant. SPSS software (release 16.0, SPSS Inc., Chicago, USA) was used for all statistical analyses.

Results

The prevalences of serology markers and the hepatitis B viral loads of the 400 male SANG soldiers examined in the current study are shown in Table 1. A total of 16 (4.0%) soldiers were positive for HbsAg, 53 (13.2%) soldiers were positive for anti-HBc, 230 (57.5%) soldiers were positive for anti-HBs, 2 (0.5%) soldiers were positive for HBeAg, 13 (3.2%) soldiers were positive for anti-HBe, and none were positive for IgM anti-HBc. Of the 16 soldiers who were positive for HbsAg, 14 (87.5%) were either reactive ($N = 12$) or highly reactive ($N = 2$), as indicated by the hepatitis B viral load determined by PCR.

Using the standard CDC interpretation (Table 1), none of the soldiers had acute HBV infection (positive for HbsAg, anti-HBc, and IgM anti-HBc but negative for anti-HBs), but 15 (3.8%) soldiers were chronic HBV carriers. The majority of chronic HBV carriers (86.7%) were highly infective, as indicated by their positivity for both HbeAg and HBV DNA. In contrast, 152 (38.0%) soldiers were susceptible to HBV infection, as indicated by their negativity for HbsAg, anti-HBc, and anti-HBs. Of the 230 (57.5%) soldiers who were immune to HBV infection (positive for anti-HBs and negative for HbsAg), 194 (84.3%) were immune due to hepatitis B vaccination (negative for anti-HBc), and 36 (15.7%) were immune due to natural infection (positive for anti-HBc). Of the 53 (13.2%) soldiers who were exposed to HBV infection (positive for anti-HBc), 36 (67.9%) soldiers were immune due to natural infection, 15 (28.3%) soldiers were chronic HBV carriers, and 2 (3.8%) had unclear results. These unclear results could be due to one of four possibilities: (1) resolved infection (most common), (2) false-positive anti-HBc results, meaning the subject is susceptible, (3) ''low-level'' chronic infection, or (4) resolving acute infection.

The characteristics of the studied soldiers are shown in Table 2. The mean age was 30.7 ± 6.1 years (median 29; range 21—48 years). Almost two-thirds (64%) of the soldiers were 25—34 years old. Few soldiers could not read and write (1.0%) or had university degrees (2.2%), whereas the majority of the soldiers (96.8%) had primary or secondary school education, typically secondary school education (43.5%). The majority of the soldiers (78.5%)

Table 1 Prevalence of serology markers and viral load of hepatitis B virus (HBV) among SANG soldiers (Jeddah, 2009).

Characteristics	Frequency (%)
Serology markers:	
Positive hepatitis B surface antigen (HBsAg)	16 (4.0%)
Positive hepatitis B core antibody (anti-HBc)	53 (13.2%)
Positive hepatitis B surface antibody (anti-HBs)	230 (57.5%)
Positive hepatitis B e antigen (HBeAg)	2 (0.5%)
Positive hepatitis B e antibody (anti-HBe)	13 (3.2%)
Positive IgM antibody to hepatitis B core antigen (IgM anti-HBc)	0 (0.0%)
Hepatitis B viral load by Polymerase Chain Reaction (PCR)[a]	
Negative	2 (12.5%)
Reactive	12 (75.0%)
Highly reactive	2 (12.5%)
Interpretations:	
Susceptible	152 (38.0%)
Negative HbsAg, negative anti-HBc and negative anti-HBs	
Immune due to natural infection	36 (9.0%)
Negative HbsAg, positive anti-HBc and positive anti-HBs	
Immune due to hepatitis B vaccination	194 (48.5%)
Negative HbsAg, negative anti-HBc and positive anti-HBs	
Acute HBV infection	0 (0.0%)
Positive HbsAg, positive anti-HBc, negative anti-HBs and positive IgM anti-HBc	
Chronic HBV carrier	15 (3.8%)
Positive HbsAg, positive anti-HBc, negative anti-HBs and negative IgM anti-HBc	
Inactive chronic HBV carrier with low infectivity	2 (0.5%)
Positive HbsAg, positive anti-HBc, negative anti-HBs, negative HBeAg and positive anti-HBe	
Active chronic HBV carrier with highly infectivity	13 (3.2%)
Positive HbsAg, positive anti-HBc, negative anti-HBs, positive HBeAg, negative anti-HBe and positive HBV DNA	
Unclear[b]	2 (0.5%)
Negative HbsAg, positive anti-HBc and negative anti-HBs	

[a] For those who were positive for HbsAg.
[b] Unclear could be one of four possibilities; (1) resolved infection (most common), (2) false-positive anti-HBc, thus susceptible, (3) ''low level'' chronic infection, or (4) resolving acute infection.

were married, and only 21.0% were single; 2 (0.5%) were divorced. The majority of the soldiers (81.0%) reported a monthly income between 3000 and 8000 SR, and 61.5% described their income as sufficient. Almost two-thirds (63.8%) of the soldiers were engaged in technical jobs, and approximately one-third (36.2%) were engaged in administrative jobs. The majority (93.8%) of soldiers were in the lower military ranks (lower than sergeant), with 34.5% soldiers, 31.5% first soldiers, 17.0% corporals, and 10.8% under-sergeants. The average duration of SANG service was 10.0 ± 6.8 years (median 9), and 43.2% had >9 years of service. Almost two-thirds (65.8%) of the soldiers were either current (66.3%) or former (33.7%) smokers of cigarettes, mo'asel or hubble—bubble. Only 17.5% of the soldiers had a household employee, and these employees were primarily (77.8%) of Asian origin. On average, soldiers had 5.4 ± 3.0 household members living in a house of 4.7 ± 1.9 rooms. Only 19.5% of soldiers reported previous HBV vaccination, and only 30.8% of them completed at least three doses (Table 3). A total of 28 (7.0%) soldiers reported having yellowish discoloration of the eyes, 7 (1.8%) soldiers reported having HBV disease, and 43 (10.8%) soldiers reported having a household member with HBV disease.

Tables 2 and 3 compare the socio-demographic characteristics and potential exposure risk factors of the studied soldiers by their exposure status, as indicated by the presence or absence of anti-HBc. Compared with those who were never exposed, soldiers exposed to HBV were more likely to be older (33.0 ± 6.5 vs 30.4 ± 5.9 years, $p = 0.003$), have a lower education level (34.0% vs 47.6% for secondary education or higher, $p = 0.030$), have a higher income (28.3% vs 17.6% for those with monthly income >8000 SR, $p = 0.064$), have a longer

Table 2 Socio-demographic characteristics of SANG soldiers by hepatitis B virus (HBV) exposure status (Jeddah, 2009).

	Positive anti-HBc	Negative anti-HBc	Overall	*p*-Value[a]
Age (mean ± SD, years)	33.0 ± 6.5	30.4 ± 5.9	30.7 ± 6.1	0.003
Age groups				
<25 years	2 (3.8%)	55 (15.9%)	57 (14.2%)	0.021
25—34 years	34 (64.2%)	222 (64.0%)	256 (64.0%)	
≥35 years	17 (32.1%)	70 (20.2%)	87 (21.8%)	
Educational level				
Elementary or lower	18 (34.0%)	65 (18.7%)	83 (20.8%)	0.03
Intermediate	17 (32.1%)	117 (33.7%)	134 (33.5%)	
Secondary or higher	18 (34.0%)	165 (47.6%)	183 (45.8%)	
Marital status				
Single or divorced	8 (15.1%)	78 (22.5%)	86 (21.5%)	0.223
Married	45 (84.9%)	269 (77.5%)	314 (78.5%)	
Monthly income, amount				
≤8000 SR	38 (71.7%)	286 (82.4%)	324 (81.0%)	0.064
>8000 SR	15 (28.3%)	61 (17.6%)	76 (19.0%)	
Monthly income, sufficiency				
Sufficient	37 (69.8%)	209 (60.2%)	246 (61.5%)	0.182
Insufficient	16 (30.2%)	138 (39.8%)	154 (38.5%)	
Type of the job				
Technical	38 (71.7%)	217 (62.5%)	255 (63.8%)	0.196
Administrative	15 (28.3%)	130 (37.5%)	145 (36.2%)	
Rank				
Soldier	16 (30.2%)	122 (35.2%)	138 (34.5%)	0.776
First soldier	18 (34.0%)	108 (31.1%)	126 (31.5%)	
Corporal or higher	19 (35.8%)	117 (33.7%)	136 (34.0%)	
Service years	12.2 ± 7.3	9.7 ± 6.6	10.0 ± 6.8	0.013
Duration of service groups				
≤9 years	23 (43.4%)	204 (58.8%)	227 (56.8%)	0.035
>9 years	30 (56.6%)	143 (41.2%)	173 (43.2%)	
Current/previous smoking	37 (69.8%)	227 (65.4%)	264 (66.0%)	0.529
Number of household members	5.7 ± 2.7	5.3 ± 3.0	5.4 ± 3.0	0.464
Number of household rooms	4.8 ± 1.9	4.7 ± 1.8	4.7 ± 1.9	0.595
Presence of household workers	13 (24.5%)	57 (16.4%)	70 (17.5%)	0.148

Data were presented as frequency and percentage or mean and standard deviation.
[a] Using Chi-square or *t*-test.

service duration (12.2 ± 7.3 vs 9.7 ± 6.6 years, $p = 0.013$), and report a household member with HBV disease (20.8% vs 9.2%, $p = 0.012$). Additionally, soldiers exposed to HBV were more likely to report having undergone surgery (45.3% vs 31.4%, $p = 0.046$) or endoscopy (18.9% vs 6.9%, $p = 0.008$) compared with those who were never exposed to HBV.

Unlike the univariate logistic regression models that showed a similar association of HBV exposure with the socio-demographic characteristics and exposure risk factors presented above (Table 4), only the following were independent predictors of HBV exposure in the multivariate logistic regression model: older age (OR = 5.35, 95% CI 1.15—25.01 for those aged ≥35 years compared with those aged <25 years), presence of a household member with HBV disease (OR = 2.35, 95% CI 1.06—5.19), and previous endoscopy (OR = 2.55, 95% CI 1.06—6.11). Additionally, technical work showed a trend of being an independent predictor of HBV exposure compared with administrative work (OR = 1.81, 95% CI 0.94—3.47, $p = 0.077$).

Discussion

The current study examined the prevalence of different HBV serological markers and the risk factors for exposure among a group of active SANG military personnel in Jeddah. Our findings estimated the prevalence of HBsAg at 4%, which is slightly higher than the prevalence recently reported for the general Saudi population. In the last decade,

Table 3 History of hepatitis B virus (HBV) and its potential exposure risks by its exposure status (Jeddah, 2009).

	Positive anti-HBc	Negative anti-HBc	Overall	*p*-Value
HBV vaccine				
Getting HBV vaccine	10 (18.9%)	68 (19.6%)	78 (19.5%)	0.901
Three doses of HBV vaccine	3 (30.0%)	21 (30.9%)	24 (30.8%)	0.635
Personal history				
Yellowish discolouration of eyes or skin	8 (15.1%)	20 (5.8%)	28 (7.0%)	0.021[a]
HBV illness	6 (11.3%)	1 (0.3%)	7 (1.8%)	<0.001[a]
Liver cirrhosis	2 (3.8%)	1 (0.3%)	3 (0.8%)	0.046[a]
Liver tumor	1 (2.0%)	2 (0.6%)	3 (0.8%)	0.338[a]
Household history				
HBV illness	11 (20.8%)	32 (9.2%)	43 (10.8%)	0.012
Liver cirrhosis	2 (3.8%)	12 (3.5%)	14 (3.5%)	1.000[a]
Liver tumor	1 (1.9%)	5 (1.4%)	6 (1.5%)	0.576[a]
Potential exposure risks				
Dental work visits	41 (77.4%)	246 (70.9%)	287 (71.8%)	0.33
Frequent visits (≥3 times/year)	16 (42.1%)	84 (36.1%)	100 (36.9%)	0.473
Circumcision by traditional healers	26 (49.1%)	158 (45.5%)	184 (46.0%)	0.632
Surgery	24 (45.3%)	109 (31.4%)	133 (33.2%)	0.046
Sharing shaving tools	15 (28.3%)	94 (27.1%)	109 (27.2%)	0.853
Cupping	9 (17.0%)	66 (19.0%)	75 (18.8%)	0.723
Extra-marital sexual relations	7 (13.2%)	38 (11.0%)	45 (11.2%)	0.628
Endoscopy	10 (18.9%)	24 (6.9%)	34 (8.5%)	0.008[a]
Multiple-use of disposable syringes	5 (9.4%)	28 (8.1%)	33 (8.2%)	0.788[a]
Sharing toothbrush	2 (3.8%)	22 (6.3%)	24 (6.0%)	0.755[a]
Blood transfusion	4 (7.5%)	14 (4.0%)	18 (4.5%)	0.277[a]
Acupuncture	1 (1.9%)	6 (1.7%)	7 (1.8%)	1.000[a]
Tattooing	0 (0.0%)	4 (1.2%)	4 (1.0%)	1.000[a]
Renal dialysis	0 (0.0%)	2 (0.6%)	2 (0.5%)	1.000[a]

Data were presented as frequency and percentage.
[a] Using Fisher's exact test otherwise Chi-square.

prevalence studies focused on Saudi blood donors estimated the HBV prevalence to be between 1.5% and 3.0% [11—13]. The higher prevalence found in our study may indicate a relatively higher risk of acquiring HBV infection among SANG military personnel. Military personnel are at higher risk because of work responsibilities and training activities, which involve a high risk of injury and the possibility of requiring an emergent blood transfusion, and because they live in groups, which might increase the possibility of sharing personal materials. The percentage of subjects exposed to HBV infection in this study (13.2%) was also higher than that previously reported in SA in the last decade (3.2—9.2%) [12,17]. It has been reported previously that the HBV incidence in the SANG population (which includes military personnel and their families) is many times higher than that the national HBV incidence reported by the Saudi Ministry of Health [8]. Additionally, the higher prevalence of HBV among military personnel relative to the general population was previously suggested in SA [13,16] and elsewhere [21,22]. However, this difference in prevalence was not found in a study of Lithuanian army soldiers, for whom the HBV prevalence was similar to that of the general Lithuanian population [23]. The relatively higher HBV risk among military personnel could be related to their lifestyle, which may involve a greater risk of acquiring sexually transmitted diseases, and their work responsibilities, which involve deployment to endemic areas, a high risk of injury, and the possibility of requiring an emergent blood transfusion [24—26].

The prevalence of HBsAg in our population (4.0%) was higher than those previously observed in many studies of Western military populations. For example, HBsAg positivity was estimated at 0.3% in US army recruits [27], 0.5% in Spanish army recruits [28], 1.1% in Greek warship personnel [24], and 2.0% in Lithuanian army soldiers [23]. This difference might be explained by the difference in HBV endemicity between SA and these countries. For example, SA used to be among the countries with the highest hepatitis B surface antigen (HBsAg) seroprevalence (≥8%) [2], and even after the decrease in the rate over the last decade [9,10],

Table 4 Predictors of HBV exposure (positive anti-HBc) among SANG soldiers using univariate and multivariate logistic regression models (Jeddah, 2009).

	Univariate analysis		Multivariate analysis[a]	
	OR (95% CI)	*p*-Value	OR (95% CI)	*p*-Value
Age (reference: <25 years)				
Age 25—34 years	4.21 (0.98—18.07)	0.053	4.33 (1.00—18.79)	0.05
Age ≥35 years	6.68 (1.48—30.15)	0.014	5.35 (1.15—25.01)	0.033
Education (reference: elementary or lower)				
Intermediate education	0.53 (0.25—1.09)	0.083		
Secondary education or higher	0.39 (0.19—0.80)	0.011		
Married	1.63 (0.74—3.61)	0.227		
Monthly income >8000 SR	1.85 (0.96—3.58)	0.067		
Technical work	1.52 (0.80—2.87)	0.199	1.81 (0.94—3.47)	0.077
Duration of service >9 years	1.86 (1.04—3.34)	0.037		
HBV vaccine	0.95 (0.46—2.00)	0.901		
Household history of HBV	2.58 (1.21—5.50)	0.014	2.35 (1.06—5.19)	0.035
Blood transfusion	1.94 (0.61—6.14)	0.258		
Surgery	1.81 (1.01—3.25)	0.048		
Endoscopy	3.13 (1.40—6.99)	0.005	2.55 (1.06—6.11)	0.036
Dental work visits	1.40 (0.71—2.78)	0.332		
Extra-marital sexual relations	1.24 (0.52—2.94)	0.629		
Circumcision by traditional healers	1.15 (0.65—2.05)	0.632		
Cupping	0.87 (0.41—1.87)	0.723		
Sharing shaving tools	1.06 (0.56—2.02)	0.854		

[a] Using conditional backward stepwise elimination of variables with *p*-value >0.10 and retaining variables with *p*-value <0.05.
OR, odds ratio; 95% CI, 95% confidence interval.

SA is still an intermediate-risk country (2—7%). In contrast, the majority of Western countries have a lower risk (<2%).

Because the universal administration of the HBV vaccine to all Saudi infants/children began in 1990 [7], we can confirm that even the youngest soldier in our study (21 years in 2009) did not receive the HBV vaccine through the universal vaccination program. Moreover, assuming the strict implementation of the local military regulation of not allowing recruits to start working when they are positive for an infectious disease, including HBV, at the time of pre-employment screening, all positive subjects discovered in our study most likely contracted the infection during their military service. This may explain the observed association between longer service duration and anti-HBc positivity. Interestingly, there was no association between receiving the HBV vaccine, the frequency of which was low, and HBsAg or anti-HBc positivity. Moreover, vaccination was reported at comparable rates between susceptible and non-susceptible soldiers. This finding is difficult to interpret, especially when almost 85% of those who were immune to HBV were immune due to hepatitis B vaccination. However, we cannot exclude recall bias and a lack of awareness of the type of vaccine given among our soldiers, who had a median service duration of 9 years and typically only primary or secondary school education.

Because both longer service duration and technical military work were associated with anti-HBc positivity, the mode of transmission of HBV is probably related to work and most likely not perinatal, as observed in many endemic areas around the world [29]. The association between the presence of a household member with HBV disease and anti-HBc positivity in both the univariate and multivariate analyses may suggest that non-occupational community HBV transmission occurs as well. The occurrence of non-occupational transmission is further supported by the association of surgery (in the univariate analysis) and endoscopy (in both the univariate and multivariate analyses) with anti-HBc positivity. Although military personnel are one of main populations at increased risk for acquiring sexually transmitted diseases [26], sexual activity was not an important risk factor for exposure in our population. This finding might be explained by the conservative lifestyle in SA, which does not condone extra-marital sexual relations. Additionally, we cannot exclude intentional bias introduced by the participant to avoid stigma because of their sexual behaviors or sexual orientation.

The current study had many advantages, including targeting only active military personnel, a large sample size ($N = 400$), a low level of non-participation (4%), the analysis of a complete panel of HBV serology markers, and the evaluation of risk factors for exposure. Nevertheless, we acknowledge several limitations: our self-reported data are susceptible to bias either intentionally or unintentionally, and the cross-sectional design does not allow the determination of causality. Additionally, the study design and the small number of those with HBV infection (15 out of 400) made it difficult to examine the risk factors of infection.

In conclusion, we report a 4% prevalence of HBsAg among Saudi military personnel. This HBV prevalence was higher than that in the general Saudi population and military populations from Western countries. Both work-related and community-related risk factors for exposure are suggested. The low vaccine coverage among our susceptible population may indicate the need for periodic testing for HBV susceptibility and strict vaccination of susceptible individuals.

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