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Original Article

Prevalence and predictors of hepatitis B in Jeddah City, Saudi Arabia: a population-based seroprevalence study

Rajaa M Al-Raddadi[1], Noha A Dashash[1], Hani A Alghamdi[2], Hanan S Alzahrani[3], Abdullah J Alsahafi[2], Abdullah M Algarni[2], Zeyad M AlRaddadi[4], Majed M Alghamdi[1], Raghad F Hakim[5], Abdulmohsen H Al-Zalabani[6]

[1] *Joint Program of Family and Community Medicine, Ministry of Health, Jeddah, Saudi Arabia*
[2] *Preventive Medicine Department, Public Health Directorate, Ministry of Health, Jeddah, Saudi Arabia*
[3] *Alnaeim Primary Health Care Centre, Ministry of Health, Jeddah, Saudi Arabia*
[4] *Research Center, King Faisal Specialist Hospital and Research Center, Jeddah, Saudi Arabia*
[5] *College of Medicine, King Abdulaziz University, Jeddah, Saudi Arabia*
[6] *Dept of Family and Community Medicine, College of Medicine, Taibah University, Madinah, Saudi Arabia*

Abstract

Introduction: Despite solid preventive strategies to reduce the risk of hepatitis B virus (HBV) infection, recent reports about its prevalence and predictors are lacking in several Saudi cities at the community level. This study aimed to assess the seroprevalence of HBV and to identify the most important predictors among the Saudi population in Jeddah city, Saudi Arabia.

Methodology: A cross-sectional study was conducted among 5,584 Saudi people attending primary health-care centers in Jeddah city during 2012/2013. Sociodemographic and hepatitis-related data were collected. HBV was diagnosed by ELISA test. The seroprevalence of HBV was estimated, and appropriate statistical analyses were performed, including univariate and multivariable regression analyses.

Results: The seroprevalence of HBV was 2.2% (95% CI = 1.82–2.58) in the studied participants. The prevalence was higher among non-governmental workers (3.5%), male participants (3.4%) and those aged ≥ 25 years (2.4%). The most important predictors for increasing the risk of HBV in this study were HBV contacts, male sex, history of dental procedures and blood transfusion. The significant positive risks associated with these predictors were 3.3, 2.5, 2.0 and 1.65, respectively. HBV vaccination, on the other hand, was associated with a significant risk reduction of 88% (OR = 0.12; 95% CI = 0.03–0.51).

Conclusions: The seroprevalence of HBV was relatively low among the Saudi population in Jeddah city reflecting the actions taken by health authorities to control HBV infection. However, more efforts, particularly in relation to health education programmes, strict control of blood banks and dental clinics, are still needed.

Key words: Hepatitis B; risk factors; seroprevalence; Saudi Arabia; infectious diseases; epidemiology.

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Introduction

Hepatitis B virus (HBV) infection is a global health problem, especially in Asia, the Middle East and Africa. It is the main cause of acute and chronic hepatitis as well as liver cirrhosis and hepatocellular carcinoma [1]. The World Health Organization has estimated that 780,000 people die each year from hepatitis B infection – 650,000 from cirrhosis and liver cancer due to chronic hepatitis B infection and another 130,000 from acute hepatitis B [2]. Although the incidence of HBV infection has markedly declined following mass vaccination programmes, the average prevalence of chronic HBV infection worldwide is still estimated at 6.6%, with 2.8% reported in developed and 7.6% in developing countries [3,4].

Chronic hepatitis B is an important medical problem in Saudi Arabia, and acquisition of HBV infection occurs mainly by the horizontal route in early life. Seroprevalence studies in Saudi Arabia before 1990 showed that the prevalence of Hepatitis B Surface Antigen (HBsAg) seropositivity among Saudi children up to 12 years of age was on average 6.7%, and 7.4% among adults [3]. However, since the use of the national vaccination strategy for infants in 1990, the incidence has shown a marked drop among children, although it is still slightly high in adults, and it was estimated to be 3.3% [5,6].

Despite the observed significant decline in the prevalence of HBV infection in the last two decades in Saudi Arabia, this viral disease causes significant

morbidity and mortality. It imposes a great burden on the country's health-care system. In 2007, the Saudi Ministry of Health (MOH) ranked viral hepatitis as the second most common viral disease after chickenpox, with almost 9000 new cases diagnosed over the year (52% HBV, 32% HCV and 16% HAV) [7].

Progress in studying the seroprevalence of HBV in Saudi Arabia has accelerated dramatically over the last two decades and shown marked variation by region. The highest seroprevalence of HBV was found in Madinah (9.02%) [8], the eastern region (6.7%) and the south-western region (8.7%), whereas in Tabouk city in the north-western region the prevalence was 3.0%, and the central city of Riyadh recorded the lowest prevalence rate (1.5%) of all regions [9–12]. However, most of these surveys were restricted to certain sectors of the population, such as pregnant females, voluntary blood donors, health-care workers and students [9–16]. Furthermore, these surveys did not clearly examine all risk factors suspected to be associated with the risk of this disease. The present study aimed to determine the seroprevalence of HBV and to identify the most important predictors of HBV among a large Saudi population cohort attending primary health-care centers in Jeddah city, Saudi Arabia.

Methodology

The present cross-sectional study recruited a Saudi population attending primary health-care centers in Jeddah city, Saudi Arabia, to determine the seroprevalence of HBV and to identify the most important predictors associated with it. Data were collected during the period between June 2012 and March 2013. Jeddah city is the major urban city of western Saudi Arabia on the Red Sea coast. The Saudi population of Jeddah city was 1,753,595 according to the 2010 Census [17]. The basic health-care system in Saudi Arabia is divided into primary, secondary and tertiary. Primary health-care services are provided through 2037 primary health-care centers distributed all over the Kingdom [18].

Saudi population above 20 years of age was eligible to participate in this study. Thirty primary health-care centers were chosen randomly from a total of 48 centers serving Jeddah city and its suburban areas. The sample size was calculated according to the reported high prevalence of HBV infection (around 9%) reported in previous studies in Saudi Arabia [9–11], with an estimated precision of 1%, and confidence interval of 95%. The primary calculated sample size was 3,150 people. To account for design effect and non-response, the sample size was doubled to include 6000 participants. The study enrolled 200 participants from each selected primary health-care centre.

A comprehensive predesigned structured questionnaire was used to collect sociodemographic and HBV-related data from each study participant. The sociodemographic factors were: age in years (< 25 vs. ≥ 25 years), sex (male vs. female), marital status (single, married, divorced or widowed), education (illiterate, basic education, or university or higher) and occupation (does not work, student, governmental worker, non-governmental worker). The HBV-related factors included history of tattooing, bloodletting (hijama), blood and blood product transfusion, dental procedures, haemodialysis, IV drug abuse, sharing razors and toothbrushes, travelling abroad, hepatitis vaccination and hepatitis B contacts. The face validity of the questionnaire was checked through discussions with a hepatology consultant and two epidemiologists.

The data were collected by trained data collectors from the enrolled 6,000 participants. Of these participants, 5,584 agreed to participate and to give a blood sample (93% response rate). Four hundred and sixteen participants refused to give a blood sample and thus were excluded from the study. However, when compared to responders, the sociodemographic characteristics of non-respondents did not show significant difference. Participants were clearly informed about the aim and scope of the study, and no one was obliged to participate in it. Before filling in the questionnaires, the interviewer read out the consent form to obtain written consent from the participants. Ethical considerations were also taken into account to ensure the confidentiality and privacy of the collected data. The study protocol was approved by the Ethics Committee of King Abdullah Medical City.

The participants were tested for HBsAg. Approximately 5–10 ml of venous blood samples in plain tubes were taken from each participant and allowed to clot at room temperature (range 18 °C to 20 °C). Samples were then centrifuged at 10,000 rpm for 10 minutes, and the separated sera were aliquoted into two portions and stored at -20 °C until transported in iceboxes to Alborg Lab, where they were grouped by area of collection and stored in classified boxes in similar conditions to those described above. The HBV markers were detected by standard enzyme-immunosorbent assay (ELISA) using commercial kits (Abbott Laboratories, Lake Forest, Illinois, USA) for HbsAg according to the manufacturer's instructions. Participants with positive HBsAg were considered as cases while those with negative HBsAg were considered as the controls to build up the nested case-

control approach necessary to examine the risk factors associated with HBV.

The collected data were analysed by using the SAS software, version 8.2 (SAS Institute Inc.). In order to compare the distribution of the studied factors according to the seroprevalence of HBV among participants, we used χ^2 tests for the categorical variables and a *t* test for the continuous variables. P values ≤ 0.05 were used as an indicator of statistically significant differences. Univariate logistic regression models were used to estimate odds ratios (OR) and their 95% confidence intervals for the association of hepatitis B with the studied sociodemographic and hepatitis-related factors. All variables with a statistically significant association with HBV were included in the final predictive model based on the stepwise regression with a p-value of 0.01 as an entry criterion and a p-value of 0.05 as an exclusion criterion. Finally, the predictors obtained from the stepwise model were entered into a multivariate logistic regression model while controlling for possible covariates.

Results

The overall response rate in this study was 93.0% (5584/6000), with no significant differences between respondents and non-respondents regarding sociodemographic characteristics. The seroprevalence of HBV was 2.2% (95% CI = 1.82–2.58) in the studied participants. The prevalence was higher among non-governmental workers (3.5%), male participants (3.4%) and those aged ≥ 25 years (2.4%).

Table 1 shows the sociodemographic characteristics of the study sample by their seroprevalence of HBV. Although the mean age was higher among HBV participants, no statistically significant difference was detected. However, there were statistically significant differences between HBV and non-hepatitis participants regarding participants' sex and marital status. In this cohort, HBV cases were more prevalent among participants ≥ 25 years, males, married, divorced and widows, those with less than university educational level, and non-governmental workers.

Table 2 shows the risk of HBV with the sociodemographic factors in the univariate regression model. The risk of hepatitis is found to increase significantly among males with a twofold increase in the risk of HBV (OR = 2.03; 95% CI = 1.43–2.93). The risk was also significantly increased among married participants (OR = 1.90; 95% CI = 1.16–3.14) and non-governmental workers (OR = 1.80; 95% CI = 1.10–2.84). A non-significant risk reduction, however, was observed among students (15%), and participants that reported university and higher education (4%).

Table 1. Sociodemographic characteristics of the studied cohort (n = 5,584) by seroprevalence of hepatitis B, Jeddah city, Saudi Arabia, 2012-2013

Sociodemographic characteristics*	**Non-hepatitis B participants (n = 5461)**	**Hepatitis B participants (n = 123)**	**P value**
Age in years, mean (SD)	38.0 ± 15.3	38.8 ± 15.2	0.56
Age			
< 25 years	1248 (98.4)	21 (1.6)	
≥ 25 years	4213 (97.6)	102 (2.4)	0.15
Sex, n (%)			
Male	1622 (96.6)	57 (3.4)	
Female	3839 (98.3)	66 (1.7)	<.0001*
Marital status, n (%)			
Single	1414 (98.7)	19 (1.3)	
Married	3630 (97.5)	93 (2.5)	
Divorced and widowed	417 (97.2)	11 (2.5)	0.03*
Education, n (%)			
Illiterate	1251 (98.1)	24 (1.9)	
Less than university	3574 (97.6)	87 (2.4)	
University and higher	636 (98.1)	12 (1.9)	0.47
Occupation, n (%)			
Does not work	2989 (98.0)	61 (2.0)	
Student	517 (98.3)	9 (1.7)	
Governmental worker	1263 (97.8)	28 (2.2)	
Non-governmental worker	692 (96.5)	25 (3.5)	0.08

*Significant

Table 2. Sociodemographic factors and the risk of hepatitis B in the studied cohort (n = 5,584), Jeddah city, Saudi Arabia, 2012-2013

Risk factors	Non-hepatitis B participants (n=5461)	Hepatitis B cases (n=123)	OR	95% CI
Age				
< 25 years	1248	21	1.00	Ref.
≥ 25 years	4213	102	1.45	1.02–2.30
Sex				
Female	3839	66	1.00	Ref.
Male	1622	57	2.03	1.43–2.93
Marital status				
Single	1414	19	1.00	Ref.
Married	3630	93	1.90	1.16–3.14
Divorced	417	11	1.96	0.92–4.15
Education				
Illiterate	1251	24	1.00	Ref.
Less than university	3574	87	1.27	0.80–2.00
University and higher	636	12	0.96	0.47–-1.98
Occupation				
Does not work	2989	61	1.00	Ref.
Student	517	9	0.85	0.42–1.70
Governmental worker	1263	28	1.09	0.70–1.70
Non-governmental worker	692	25	1.80	1.10–2.84

Table 3. Association of hepatitis-related factors with the risk of hepatitis B in the studied cohort (n = 5,584), Jeddah city, Saudi Arabia, 2012-2013

Risk factors	Non-hepatitis B participants (n = 5461)	Hepatitis B cases (n=123)	OR	95% CI
Tattooing				
No	5393	123	-	-
Yes	68	0	-	-
Bloodletting (Hijama)				
No	5019	109	1.00	Ref.
Yes	442	14	1.46	0.83–2.57
Blood transfusion				
No	5034	106	1.00	Ref.
Yes	427	17	1.90	1.12–3.18
Blood product transfusion				
No	5245	116	1.00	Ref.
Yes	216	7	1.47	0.68–3.18
Haemodialysis				
No	5388	119	1.00	Ref.
Yes	73	4	2.50	0.90–6.90
History of dental procedures				
No	2628	37	1.00	Ref.
Yes	2833	86	2.15	1.46–3.18
IV drug abuse				
No	5398	122	1.00	Ref.
Yes	63	1	0.70	0.10–5.10
Sharing razors				
No	5252	115	1.00	Ref.
Yes	209	8	1.75	0.85–3.62
Sharing toothbrushes				
No	5369	120	1.00	Ref.
Yes	92	3	1.45	0.46–4.67
Travelling abroad				
No	4817	107	1.00	Ref.
Yes	644	16	1.10	0.65–1.90
Vaccination status				
No	4783	120	1.00	Ref.
2 doses	54	1	0.73	0.10–5.38
> 2 doses	624	2	0.13	0.05–0.51
Hepatitis B contacts				
No	96	5068	1.00	Ref.
Yes	27	393	3.60	2.30–5.60

Table 3 presents the association of hepatitis-related factors with the risk of HBV. Sharing a toothbrush and travelling abroad appeared to have no or minimal effect on the risk of hepatitis B in this studied cohort. A non-significant increased risk was observed in association with bloodletting (hijama), sharing razors and sharing toothbrushes. Significant positive risks were detected among participants with a history of blood transfusion (OR = 1.90; 95% CI = 1.12–3.18), and those that reported previous dental procedures (OR = 2.15; 95% CI = 1.46–3.18). Although not significant, the risk was also increased 2.5 folds among those that reported haemodialysis (OR = 2.50; 95% CI = 0.90–6.90). Patients who reported that they had had HBV contacts were found to have a 3.6-fold increase in the risk of HBV compared with those who reported no HBV contacts, with an odds ratio of 3.60 (95% CI = 2.30–5.60). On the other hand, a history of HBV vaccination was associated with risk reduction, with the highest significant reduction being observed among participants who reported more than two doses of vaccination (OR = 0.13; 95% CI = 0.05–0.51). Table 4 shows the predictors of HBV according to the results of the predictive regression model including all variables with statistically significant odds ratios in the previous tables. The adjusted predictors of HBV in this study were male sex, history of blood transfusion, dental procedures, HBV contacts and vaccination. The risk was significantly increased among males (OR = 2.50; 95% CI = 1.60–3.65), participants that reported a history of dental procedures (OR = 2.00; 95% CI = 1.33–2.96) and those who had undergone a blood transfusion (OR = 1.65; 95% CI = 1.03–2.78). The highest risk of HBV in the predictive model was observed among those patients that reported that they had had HBV contacts and the adjusted OR was 3.30 (95% CI = 2.10–5.30). However, according to the model, the HBV risk was significantly reduced among participants that reported HBV vaccination. Vaccination of more than two doses was associated with a significant risk reduction of HBV by 88% among the studied participants.

Discussion

The present study revealed the seroprevalence of HBV in the studied population to be 2.2% (95% CI = 1.82–2.58). This result differs from previously reported rates from different parts of Saudi Arabia. The seroprevalence reported in previous Saudi studies showed marked variations by region and study population. The seroprevalence of HBV was high in Madinah (9.02%) [8] and the eastern region of Saudi Arabia (6.7%) [9]. In the south-western region, Najran city, the seroprevalence was much higher (8.7%) among health-care workers, while it was as low as 1.7% among health students [10]. Tabouk city in the north-western region showed a seroprevalence of 3.0% [11], whereas the central city of Riyadh recorded the lowest prevalence rates (1.5%) of all regions [12]. In Jazan region, HBsAg was positive in 3.8% of 29,949 blood units that were collected from healthy voluntary and replacement native Saudi blood donors over a period of six years from January 2004 to December 2009 [16].

Table 4. Predictors of hepatitis B in the studied cohort, Jeddah city, Saudi Arabia, 2012-2013: Results of the predictive logistic regression model

Predictor*	Non-hepatitis participants (n = 5461)	Hepatitis cases (n = 123)	OR**	95% CI
Sex				
Female	3839	66	1.00	Ref.
Male	1622	57	2.50	1.60–3.75
History of dental procedures				
No	2628	37	1.00	Ref.
Yes	2833	86	2.00	1.33–2.96
Blood transfusion				
No	5034	106	1.00	Ref.
Yes	427	17	1.65	1.03–2.78
Vaccination status				
No	4783	120	1.00	Ref.
2 doses	54	1	0.80	0.10–5.93
>2 doses	624	2	0.12	0.03–0.51
Hepatitis B contacts				
No	96	5068	1.00	Ref.
Yes	27	393	3.30	2.10–5.30

* Based on predictor logistic regression model, including variables that are significant in Tables 2 and 3; ** OR adjusted by age and marital status.

The seroprevalence of HBV in this study, however, showed high rates among non-governmental workers, male participants and those aged ≥ 25 years. These findings appeared to be consistent with the results of several Saudi [13–16] and non-Saudi studies [19,20]. On the other hand, the prevalence of HBsAg in this study was low among students and this matched with that reported in the Najran study (1.7%) [10]. The Kingdom of Saudi Arabia introduced the national strategy of HBV vaccination of all children from 1990 [21]. Accordingly, nearly all students enrolled in this and other studies were born after that year, and it is expected that virtually all of them had received the HBV vaccination in the national programme.

In this study, the results of univariate regression models revealed significant increased risk of HBV among males, married, non-governmental workers and those aged ≥ 25 years. This finding is in agreement with previous results reported by Mehdi *et al.* [22], and this finding may be explained by the increased exposure encountered by males, non-governmental workers and those of an older age [21]. The significant high risk of HBV among married participants in this study could also be due to their older age. In the univariate model, the study results showed no significant association between HBV and risky procedures (tattooing, bloodletting (hijama), sharing razors and toothbrushes) and behaviours (IV drug use and travelling abroad), which is not consistent with other studies, particularly in Western countries. The above-mentioned risk behaviours, however, are not common in Islamic communities. Furthermore, traditional medical practices including scarification and tattooing have become infrequent as a result of a better utilization of free and accessible healthcare facilities.

The results of univariate and predictive regression analyses have revealed significant positive risks of HBV among participants with a history of blood transfusion, and those that reported previous dental procedures. The risk of transmitting hepatitis through transfusions of blood and blood products has been known since 1950 [23,24]. Usually, HBV infection occurs when an individual receives blood with HBsAg and anti-HBc (Hepatitis B core antibody) in the serum or plasma of donors [25,26]. In Saudi Arabia, the prevalence of HBsAg in blood donors was found to range from 2.7% to 9.8% [9,11,12]. Also, the prevalence of anti-HBc and HBsAg negative blood samples was 3.2% [27] and 13.5% [9] in Saudi blood donors. These reported high rates of HBsAg and anti-HBc in blood donors might increase the risk of HBV among recipients, particularly when the blood banking control measures are not prompt [28].

In this study, participants that reported that they had lived with HBV patients (HBV contacts) showed a 3.6-fold increase in the risk of HBV compared with those that reported no HBV contacts. Family history of HBV infection was found to be significantly associated with HBV markers in previous studies [3,6]. Close contact between family members through the sharing of toothbrushes, towels and shaving items is common among families of a low socio-economic level, and this might increase the risk of horizontal transmission of HBV [6].

History of hepatitis B vaccination was associated with risk reduction, with the highest significant reduction (88%) being observed among participants that reported more than two doses of vaccination. Hepatitis B vaccine is given mandatorily to all Saudi participants born after 1990 in the first year of their life [21]. Recent studies conducted in regions of HBV endemicity in Saudi Arabia have documented a zero prevalence of HBsAg among school students [29] and medical students [30], which thereby documents the efficacy of HBV vaccine and its long-term protection.

The present study appeared to have a number of strengths, which include being a community-based study with a relatively high response rate. This study is the first to determine the prevalence of HBsAg and to examine its associated risk factors in a community-based sample in Jeddah city. Finally, most of the estimated risks in this study have shown a high precision.

The limitations of this study should not be overlooked, however. The anti-HBc was not examined among HBsAg negative participants because of funding constraints. This could lead to underestimation of the actual seroprevalence of HBV. Because of its cross-sectional nature, the causal influences of the risk factors cannot be determined in this study. However, the consistent results obtained in this and other similar studies endorse the role of these factors in the risk of HBV.

In conclusion, the seroprevalence of HBV was relatively low among the Saudi population in Jeddah city. The observed low rate in this study reflects the actions taken by Saudi health authorities during the last two decades. The risk of HBV was associated with male sex, a history of dental procedures, blood transfusion and hepatitis B contacts. Hepatitis vaccination appeared to have a strong protective effect against HBV. Accordingly, more efforts, particularly those concerning strict control of blood banks and dental

clinics, health education programmes about the natural history of the disease and ensuring high hepatitis B vaccination coverage, are still needed.

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Corresponding author
Dr Abdulmohsen H Al-Zalabani, MD. ABCM.
Head of Department of Family and Community Medicine
College of Medicine, Taibah University
PO box 42317, Madinah, 41541
Saudi Arabia
Phone: +966148618888 ext. 3018
Email: aalzalabani@gmail.com

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