Raslan *et al. Egyptian Liver Journal* (2022) 12:46
https://doi.org/10.1186/s43066-022-00207-x

Egyptian Liver Journal

ORIGINAL RESEARCH ARTICLE

Open Access

The prevalence and determinants of hepatitis B among Egyptian adults: a further analysis of a country-representative survey

Eman Raslan[1], Mohamed AbdAllah[2] and Saeed Soliman[1*]

Abstract

Background: Hepatitis B virus (HBV) infection is a major worldwide healthcare problem with subsequent serious complications including cirrhosis and hepatocellular carcinoma (HCC). Hence, taking cognizance of HBV impact is critical for future planning of its control and prevention.

Objectives: To assess the prevalence of HBV in Egypt, analyse the demographic characteristics of HBV-infected patients and examine the common routes of its transmission.

Methods: This is a cross-sectional study of data from the Egyptian Health Issues Survey (EHIS), which employed a nationally representative sample of 16,004 individuals. The survey participants were categorized into two groups: group A, HBV positive, and group B, HBV negative. Comparative analysis was performed to identify demographic features and define possible risk factors.

Results: The total number of participants included in the study was 16,004. The mean age (± SD) was 33.5 (± *12.4*) years. The prevalence of HBV was 1.52%. Demographic analysis showed that HBV was more prevalent among males, married people, people with jobs and smokers ($P = 0.0011$, *0.002*, < 0.001 and *0.0036*) respectively. Employing an adjusted multivariate logistic regression model, we observed an increased likelihood of HBV infection in married adults who received cupping without blood and who did not know if they had schistosomiasis injection therapy.

Conclusion: The application of special screening programs to highly susceptible patients and treatment optimization is recommended for the elimination of HBV. EHIS indicates the likely success of the previous Egyptian control plan for viral hepatitis through reducing several risk factors.

Keywords: Hepatitis B virus, Egyptian Health Issues Survey, High risk groups, Prevention, Risk factors

Introduction

Infection with hepatitis B virus (henceforth HBV) is a serious global health problem with significant morbidity and mortality [1]. The overall global burden of HBV remains enormous [2]. HBV is a partly double-stranded DNA [3], which is transmitted through contact with infected blood and body fluids [4]. The virus remains infectious for long periods on surfaces [5].

Moreover, HBV infection is highly variable in both presentation and severity: about 70% of acute infections in healthy adults are asymptomatic, while the remaining 30% of patients have symptoms such as fever, malaise, anorexia, nausea, vomiting, diarrhoea, abdominal pain and jaundice [6]. Elevated alanine transaminase levels, presence of hepatitis B surface antigen and hepatitis B core antigen are characteristic of acute infection [3]. On the other hand, chronic hepatitis B features the persistence of hepatitis B surface antigen for more than

*Correspondence: saeed.salah@medicine.cu.edu.eg

[1] Family Medicine Department, Faculty of Medicine, Cairo University, Giza, Egypt
Full list of author information is available at the end of the article

6 months [7]. HBV replication induces hepatic inflammation and progression of liver fibrosis [3].

The 5-year cumulative incidence of cirrhosis ranges from 8 to 20% in untreated patients with chronic HBV, and that of hepatic decompensation is 20% among cirrhotic patients [7].

HBV is an oncogenic virus [8], that is, its DNA can integrate into the host hepatocyte genome, promoting the development of hepatocellular carcinoma (HCC) [9].

HBV accounts for more than half of primary liver tumours cases worldwide [10]. HCC develops in about 20% of non-cirrhotic patients, while the annual risk of HCC in cirrhotic patients is 2 to 5% [7, 9]. Therefore, it is essential for primary care providers to play an active role in the screening, diagnosis and management of HBV [11]. Such preventive measures constitute a major component of the management of HBV infection [12].

Despite the fact that vaccination remains the most effective prevention method of HBV [13], more attention should also be paid to general education and specialized courses for protection of high-risk groups [14]. High-risk groups for HBV infection include intravenous drug users, infants born to infected mothers, males who have sexual intercourse with other males, haemodialysis patients, healthcare workers and household contacts with HBV-chronic patients [15].

To that end, the World Health Organization (WHO) goals include 90% complete coverage of HBV vaccination, a reduction in the prevalence of HBsAg in children < 5 years of age to 0.1% and an improvement in the rates of treatment to 80% by 2030 [16]. Besides, better understanding of the epidemiology and burden of HBV, its main routes of transmission, the high-risk groups and natural history of the disease is pivotal for its management [17]. This study aims to assess the prevalence of HBV in Egypt, analyse the demographic characteristics of HBV infected patients and trace the most common routes of transmission, all in relation to the current Egyptian preventive measures.

Methods

Study design and data source

This study was based on the data from the most recent Egyptian Health Issues Survey (EHIS) which was conducted by El-Zanaty and associates in 2015 [18]. The EHIS was administered by the Egyptian Ministry of Health and Population (MOHP) and funded by the United States Agency for International Development (USAID), which focuses on the most challenging health issues, namely, blood-borne viruses, non-communicable disease (NCDs) risk factors (hypertension, smoking and obesity) and maternal and reproductive health.

Sampling and data collection

The study design of EHIS was the same as that of the Egyptian Demographic and Health Survey-2014 (EDHS) to investigate different health indicators [19]. In both EDHS and EHIS, a nation-representative sample was calculated in multistage stratified sampling. Stratification and primary sampling units (PSUs) were based on the most recent census carried out by the Egyptian Central Agency for Public Mobilization and Statistics (CAPMAS); each Shiakha (an urban neighbourhood unit) or village represents a primary sampling unit (PSU). The EDHS had a representative sample of 842 PSUs, while EHIS enrolled a subsample of 614 PSUs from the selected list of PSUs for EDHS. Figure 1 provides a detailed description of the sampling technique [18].

Participants

The data of a total sample size of 16,671 participants aged 15–59 years old who agreed to participate in the EHIS were included; the participants who did not agree to perform the hepatitis B tests or had missing results ($n = 677$) were excluded. The inclusion criteria for EHIS were that individuals aged 15–59 who were usual residents or present in the EHIS sample households on the night before the EHIS interviewer's visit were eligible for a detailed interview on a range of health issues.

Outcome variable: hepatitis B result

Procedures for testing

Testing for HBV

Screening using hepatitis B surface antigen test (HBsAg) followed enzyme-linked immunosorbent assay (ELISA) technique, which is a reliable test of apparent HBV infection; individuals with a positive HBsAg result had an active HBV infection. A sample of seven millilitres of venous blood were obtained from each participant. Samples were stored in ethylenediaminetetraacetic acid (EDTA) vacutainer tubes with a unique pre-printed barcode identification number (ID). These samples were collected temporarily in field laboratories where they were centrifuged, and the obtained plasma samples were stored in liquid nitrogen tanks using the same ID coding system. The testing procedure was completed in the Egyptian Central Public Health Laboratory (CPHL). Retesting of 10% of samples in CPHL and 5% in Theodor Bilharz Research Institute was conducted for quality assurance.

Criteria for classification

HBsAg test, which detects the presence of hepatitis B surface antigen in the blood, was used to identify individuals with an active hepatitis B infection. Based on the

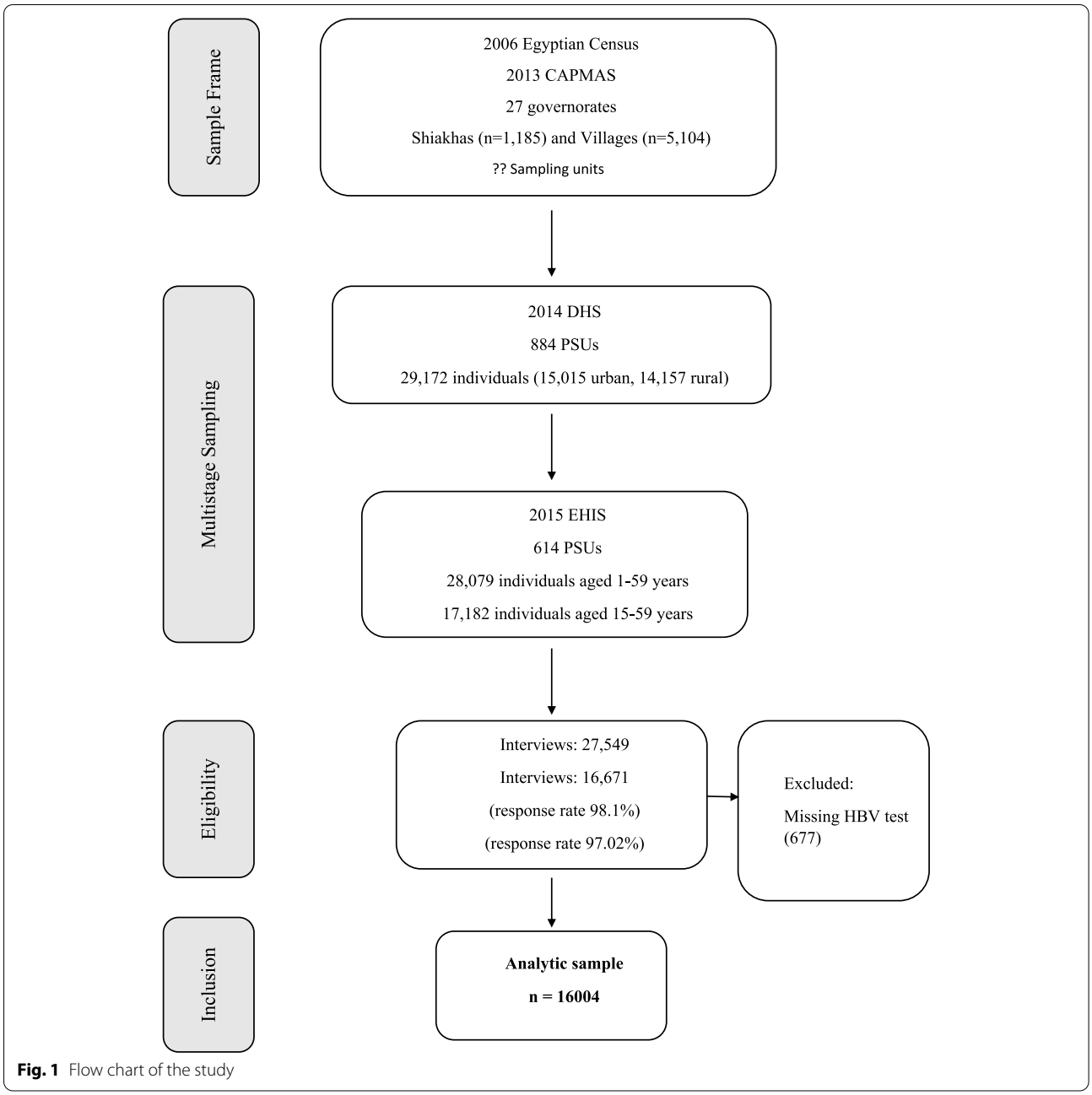

Fig. 1 Flow chart of the study

laboratory results, study participants were categorised into HBV positive group "if tested positive to HBsAg test" and HBV negative group.

Predictor variables/determinants

Based on the literature review and available data, the following predictors/risk factors for having hepatitis B positive results have been selected for analysis:

- Demographic variables (age, gender, marital status, residence, education level, work, religion, and smoking)
- Medical/ surgical procedures: history of hospitalization, stitches, catheterization, dialysis, endoscopy, surgeries, blood transfusion, intravenous lines or injections and schistosomiasis injections
- Dental interventions of any kind

- Complementary and alternative medicine (CAM) techniques: acupuncture and cupping with or without blood
- Circumcision: we combined data on both male and female circumcision into a single variable and included another variable about who did the circumcision
- Barbers and beauty salons services: hair salons and barber visits frequency and whether the participant uses his/her own utilities or the shop utilities
- Tattooing and ear-piercing

Ethical considerations

Ethics approval for EHIS was obtained from the Research Ethics Committee of the Ministry of Health and Population (MOHP). Informed consent was signed by all participants prior to serological testing for HBV. A permission was also granted from DHS to conduct this analysis. Patients with positive HBsAg were referred to special centres for further assessment and treatment, if needed.

Statistical analysis

Data were retrieved from demographic health survey (DHS) website and analysed using Stata® (version 16), considering significant level of $P \leq 0.05$. Descriptive statistics were presented in the form of frequency tabulations for categorical variables and summarized by mean/median and SD/IQR for continuous variables. Complex survey design was incorporated in all analyses considering sample weights, strata and primary sampling units. Bivariate association between categorical variables was conducted using the chi-square test with reporting of the Scott-Rao χ^2; only variables with significant association on the bivariate tests were entered in the unadjusted and the adjusted logistic regression models.

Results

The total number of eligible populations included in this analysis was 16,004. The following are the main characteristics: age range and mean ($\pm SD$) age was 15–59 and 33.5 (± 12.4) years respectively. 55.2% ($n=8838$) were females and 44.8% ($n=7166$) were males. Most participants (68.7% ($n=10{,}776$)) were married, while 27.2% ($n=4345$) were never married. Over a half of participants (51.8% ($n=8295$)) lived in rural areas, while 48.8% ($n=7709$) lived in urban areas. More than half of the study population had secondary school level education (56.9% ($n=9175$)), while 15.0% ($n=2396$), 12.7% ($n=2027$) and 15.0% ($n=2406$) had no education, primary school education and college level education, respectively. Most of the study population (79%, $n=12{,}642$) were non-smokers, while 20% ($n=3362$) were everyday smokers.

Table 1 Description of the studied population ($n=16{,}004$)

	Hepatitis B testing final result				
	Positive		Negative		*P***
	N	Wt[a] %	*N*	Wt %	
Age					
15–29	73	1.04	6841	98.96	0.0546
30–44	1001	1.87	5266	98.13	
45–59	71	1.91	3654	98.09	
Gender					
Male	142	1.98	7025	98.02	0.0011
Female	102	1.15	8736	98.85	
Type of place of residence					
Urban	116	1.95	5842	98.05	0.07
Rural	127	1.27	9919	98.73	
Marital status					
Never married	33	0.79	4096	99.21	0.002
Married	198	1.8	10,802	98.2	
Divorced or widowed	13	1.52	863	98.48	
Highest educational level attained					
No education	47	1.82	2518	98.18	0.13
Primary	50	2.45	2005	97.55	
Secondary	117	1.3	8879	98.7	
Higher	30	1.24	2359	98.76	
Has job					
Yes	150	2.1	6983	97.9	<0.001
No	94	1.06	8778	98.94	
Religion					
Muslim	232	1.52	15,081	98.48	0.974
Christian	12	1.63	677	98.37	
Other	0	0	1	100	
Currently smoke cigarettes or other tobacco products					
Smoker	81	2.39	3282	97.61	0.0036
Non-smoker	163	1.29	12,479	98.71	

**Rao Scott chi-square test was used

[a] Weighted numbers and percent were reported

Overall, 1.52% ($n=277$) tested positive in the final HBV test, representing the prevalence of HBV. The bivariate association of HBV results and participant characteristics are illustrated in Table 1: gender, marital status, job status and smoking have significant association with positive HBV test. Interestingly, HBV prevalence was higher with older age groups, but this was marginally statistically insignificant ($P=0.0546$). The mean (*95% CI*) age of HBV positive participants was 37.4 (35.6–39.1) and was statistically significant *higher* than the mean (*95% CI*) age of hepatitis B negative participants which was 33.5 (33.3–33.7) by adjusted post

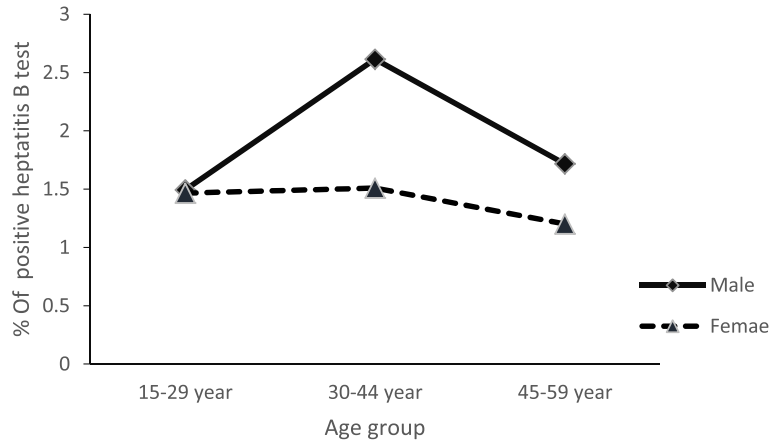

Fig. 2 Prevalence of hepatitis B by age group and gender

estimation Wald test of difference of survey means. Figure 2 provides further illustration of the distribution of prevalence of hepatitis B across age groups and gender, while Table 2 shows the association of HBV prevalence and medical and surgical procedures, circumcision, acupuncture, cupping, tattooing and barbershop and beauty salons; of these exposures, cupping "with and without blood" injection for treatment for schistosomiasis and endoscopy were associated with HBV infection.

Table 3 shows predictors of HBV infection status in unadjusted and adjusted regression models. In the former, age groups, gender, marital status, job status, smoking cigarettes, receiving cupping, and receiving injection treatment for schistosomiasis were significant predictors for HBV infection; in the latter, married participants compared to participants who never married were more likely to have HBV infection (OR 1.97; 95% CI 1.04–3.5) and who did not receive cupping without blood had 83% less odds of HBV infection compared to those who did (OR 0.17; 95% CI 0.05–0.59). Participants who did not know if they had schistosomiasis injection therapy were *more* likely to have HBV infection, compared to participants who had a history of receiving injection therapy for schistosomiasis (OR 4.73; 95% CI 1.39–16.12).

Discussion

HBV is a highly infectious blood-borne pathogen [17]. According to WHO, there are about 257 million people living with chronic HBV in the world, and there were an estimated 887,000 deaths in 2015 mostly due to cirrhosis and hepatocellular carcinoma [20]. The chronicity of HBV, in addition to its hepatic and extrahepatic complications, makes it a global target for elimination. In 2016, the United Nations announced the 2030 sustained development goals (SDGs), and WHO adopted a global viral hepatitis strategy adopted by member states targeting the elimination of viral HBV by 2030 [21].

Despite the tremendous Egyptian efforts in the management of hepatitis C virus (HCV), elimination of HBV has yet to gain much traction. In this study, the prevalence HBV is 1.52%, while in 2015, it was 6.3% [22, 23]. The higher magnitude of the HCV problem in Egypt has masked the HBV dilemma. In 2018, Egypt launched a mass campaign for the screening of and treatment for HCV. All Egyptian adults were eligible to be enrolled in this campaign [24]. The model of mass testing and treatment is one of the most effective pillars of disease elimination. It has been tried with other infectious diseases such as Malaria [25]. According to a German report by Krauth, mass screening, however, is not cost effective in diseases with low prevalence [26], and so mass screening of HBV− unlike HCV− was not a priority in Egypt.

HBV is a preventable disease. Introduction of the highly effective recombinant HBV vaccine has led to a significant decrease in HBV incidence [27]. HCV and HBV have common routes of transmission; therefore, it is believed that mass campaigns for schistosomiasis treatment in the 1980s led to increased HBV transmission as well as HCV [28]. However, this was not evident in our study as only individuals who did not know about their history of anti-schistosomal treatment were significantly representative in the positive group (*P* value 0.016; OR 4.73; 95% CI 1.39–16.12). Developing a unified plan for prevention of blood borne pathogens could aid in the elimination of both HCV and HBV.

The Egyptian plan to control viral hepatitis began in the early 1990s with screening of blood donors [29]; then, in 1992, Egypt added HBV vaccine to the Egyptian compulsory list of vaccination [27]. Subsequently, Egypt

Table 2 Bivariate association between procedures and practices and hepatitis B final result ($n = 16{,}004$)

	Hepatitis B testing final result				
	Positive		Negative		*P***
	N	Wt[a] %	*N*	Wt %	
Ever hospitalized					
Yes	116	1.5	7642	98.5	0.977
No	127	1.54	8118	98.46	
Do not know	0	0	2	100	
Ever had surgery					
Yes	123	1.65	7329	98.35	0.409
No	120	1.41	8433	98.59	
Ever had blood transfusion					
Yes	21	2.55	799	97.45	0.17
No	223	1.47	14,921	98.53	
Do not know	0	0	40	100	
Ever had intravenous line					
Yes	141	1.59	8730.5	98.41	0.791
No	103	1.44	7027.38	98.56	
Do not know	0	0	3.48	100	
Ever had sutures/stitches					
Yes	151	1.71	8710	98.29	0.198
No	92	1.29	7049	98.71	
Do not know	0	0	3	100	
Ever had endoscopy					
Yes	19	2.99	612	97.01	0.0539
No	225	1.46	15,140	98.54	
Don't know	0	0	4	100	
Ever had dialysis					
Yes	0	0	27	100	0.661
No	244	1.52	15,733	98.48	
Ever had urinary catheter					
Yes	20	1.38	1472	98.62	0.897
No	223	1.54	14,284	98.46	
Do not know	0	0	3	100	
Ever had dental treatment of any kind					
Yes	183	1.66	10,807	98.34	0.183
No	61	1.21	4953	98.79	
Do not know	0	0	2	100	
Ever had aquapuncture					
Yes	0	0	63	100	0.627
No	244	1.53	15,696	98.47	
Do not know	1	100	0	0	
Ever received cupping without blood					
Yes	9	13.95	50	86.05	<0.001
No	235	1.48	15,709	98.52	
Do not know	0	0	3	100	
Ever received cupping with blood					
Yes	14	3.75	367	96.25	0.016
No	229	1.47	15,390	98.53	
Do not know	0	0	3	100	
Ever had received an injection to treat schistosomiasis (bilharziasis)					
Yes	17	1.35	1209	98.65	0.016
No	218	1.49	14,427	98.51	
Do not know	7	6.44	126	93.56	
Ever had received an injection for any purpose					
Yes	243	1.52	15,710	98.48	0.989
No	1	1.47	49	98.53	
Ever had a tattoo					
Yes	15.88	2.23	698	97.77	0.444
No	228	1.49	15,053	98.51	
Do not know	0	0	6	100	
Ever have ears pierced					
Yes	102	1.17	8595	98.83	0.717
No	0	0	132	100	
Do not know	0	0	3	100	
Going to barber (men)/beauty centre or hair salon (women)					
Regular (weekly or monthly)	146	1.85	7745	98.15	0.115
Irregular or feasts only	35	1.16	2984	98.84	
Never	63	1.23	5033	98.77	
If the respondent himself circumcised (male or female)					
Yes	238	1.59	14,764	98.41	0.066
No	6	0.57	994	99.43	

**Rao Scott chi-square test was used

[a] Weighted numbers and percent were reported

launched a preventive infection control plan to promote safe practices in hospitals and health care facilities in 2003. It was a nationwide plan to increase awareness, implement infection control measures in healthcare facilities and train healthcare workers [29].

For the sake of developing an effective plan for HBV elimination in Egypt, we need first to understand the characteristics and risk factors of HBV in Egypt. Our demographic analysis of EHIS revealed a higher prevalence of HBV among older population. Despite the marginally statistically insignificant difference between both groups (*P* value 0.0546), the mean age of HBV positive participants was greater than HBV negative participants (37.4 versus 33.5 years, respectively). This is likely due to the existing preventive measures and the campaign of compulsory HBV vaccine that started 30 years ago [29]. Egyptian males are also more liable to have HBV than females. Males have lower hygienic measures than females [30–32], larger proportion of people who inject drugs (PWID) [33] and, finally, Egyptian females have lower risk for HBV exposure due to higher proportion of

Table 3 Unadjusted and adjusted logistic regression of the association of hepatitis B result and risk factors

	Unadjusted OR (95% CI)	*P*	Adjusted OR (95% CI)	*P*
Age				
15–29	Reference		Reference	
30–44	1.82 (1.01, 3.23)	0.046	1.09 (0.57, 2.07)	0.79
45–59	1.85 (1.21, 2.82)	0.005	1.11 (0.66, 1.80)	0.657
Gender				
Male	Reference		Reference	
Female	0.57 (0.41, 0.80)	0.001	0.80 (0.52.1.22)	0.3
Marital status				
Never married	Reference		Reference	
Married	2.30 (1.39, 3.80)	0.001	1.97 (1.04, 3.75)	0.04
Divorced or widowed	1.93 (0.92, 4.10)	0.083	2.00 (0.85, 4.75)	0.113
Has job				
Yes	Reference		Reference	
No	0.5 (0.35, 0.71)	<0.001	0.73 (0.47, 1.13)	0.162
Currently smoke cigarettes or other tobacco products				
Smoker	Reference		Reference	
Non-smoker	0.53 (0.35, 0.82)	0.004	0.77 (0.47, 1.27)	0.315
Ever received cupping without blood				
Yes	Reference		Reference	
No	0.09 (0.02, 0.38)	0.001	0.17 (0.05, 0.59)	0.005
Do not know	1	Empty	1	Empty
Ever received cupping with blood				
Yes	Reference		Reference	
No	0.38 (0.17, 0.84)	0.017	0.59 0.25, 1.4)	0.235
Do not know	1	Empty	1	Empty
Ever had received an injection to treat schistosomiasis (bilharziasis)				
Yes	Reference		Reference	
No	1.10 (0.59, 2.08)	0.751	1.48 (0.76, 2.85)	0.248
Do not know	5.03 (1.10, 23.00)	0.037	4.73 (1.39, 16.12)	0.013
If the respondent himself circumcised (male or female)				
Yes	Reference		Reference	
No	0.358 (0.11, 1.12)	0.078	0.62 (0.20, 1.92)	0.404

Abbreviations: *Wt.%* weighted percent, *OR* odds ratio, *CI* confidence interval

unemployed females in Egypt which is furtherly reflected in the high significant difference between both groups regarding work status (*P* value <0.001) [34].

These findings relate to other national [23, 35, 36] and regional studies [37, 38]. The Egyptian report of sentinel acute viral hepatitis surveillance revealed a high prevalence of HBV among urban populations, yet this was not significant in our study (*P* value 0.07) [39]. Education level also did not show any significant difference between both groups despite the reports that associate higher education levels and good health [40, 41].

According to a meta-analysis conducted in 2014, smoking is an additive effect to HBV and HCV for the development of hepatocellular carcinoma [42]. A notice that needs a great attention as 20% of the selected sample from EHIS gave a history of smoking and there is a significant prevalence of HBV among Egyptian smokers. HBV can be transmitted through body fluids (e.g., seminal and vaginal fluids)" [43, 44] and that may explain the higher incidence of HBV among the married individuals (*P* value 0.002; OR 1.97; 95% CI 1.04–3.5). Some reports linked between some religious rituals and spread of blood-borne pathogens such as mourning blades in Shiite population [45]. Fortunately, these behaviours are not present in the Egyptian religious behaviours either in Sunni Muslims or Christians; thus, there is no statistical difference in HBV prevalence in Egypt regarding religion (*P* value 0.974).

The Egyptian prevention plan has achieved success in deterring the major causes of HBV transmission. Both study groups were comparable regarding performing all medical and dental procedures such as surgeries, hospitalization, insertion of intravenous lines and history of injections (*P* values 0.409, 0.977, 0.791 and 0.989 respectively). There is a statistically significant difference between both groups regarding history of performing gastrointestinal endoscopy (*P* value 0.0539). Screening for oesophageal varices is recommended for cirrhotic patients. Transmission of HBV through improper disinfection of endoscopes is possible due to the low infective viral load but it is not common in medical practice due to the major advances in disinfection techniques [46, 47].

Unsafe blood products remain a huge threat to spread HBV. This is supported by a WHO regional office of Eastern Mediterranean region (EMRO) report that stated that there are many countries in the region who still depend on the non-sensitive rapid diagnostic kits and that there are only 13 of the 22 countries in the region participating in an external quality assessment program [48]. The Egyptian efforts in the screening of blood donors' programs have led to an advanced control of HBV transmission through blood products as evident in the non-significant differences between both groups regarding the history of blood transfusion (*P* value = 0.17).

Because the application of CAM is rising in Egypt, there are several arguments regarding its safety, efficacy, and the evidence-based rationale. Malpractice and inexperienced professionals are main issues that need to be solved [49, 50]. These CAM techniques could be hazardous if applied in poor infection control measures and that could explain the significant difference between both groups regarding history of cupping with or without blood (*P* values 0.016 and < 0.001 respectively). Moreover, using an adjusted regression model, individuals who did not receive cupping without blood are less likely to have HBV infection than individuals who gave history of receiving cupping without blood (OR 0.17; 95% CI 0.05–0.59).

Female genital mutilation (FGM) is a global healthcare problem that affects women's sexual and reproductive health; therefore, a global call to ban FGM has been launched. In Egypt, FGM has been criminalized since 2008, leading to a drop in FGM rate in Egypt from 94 to 88% in 2015. Over half FGM were performed by a physician or nurse rather than a traditional practitioner [51, 52]. Unlike FGM, male circumcision may have a beneficial effect on man's health. It is prevalent in 94.7% of Egyptian males [53], and this high prevalence of circumcision in both genders may have led to insignificant difference between both groups (*P* value 0.066).

Barber and beauty salons services are also possible risk factors for blood-borne infections and poor knowledge of the barbers could aggravate the problem [54, 55]. Increased health awareness is mandatory for better disease control. Campaigns that encourage the use of disposable tools are highly recommended. Our findings coincide with those from a recent systematic review [56] that there is no association between hair and nail salons and the risk of HBV and HCV. Furthermore, despite the insignificant differences between both groups regarding tattooing, ear-piercing and going to barber/beauty salons, continuous follow-up and awareness campaigns need to be organized for better outcome.

These findings project an authentic image for HBV and its major risk factors in Egypt. This image can be a cornerstone in HBV elimination plan in Egypt. Still, new plans need new actions: new treatment guidelines, screening campaigns to highly susceptible groups such as HIV patients, PWID, hospital admissions of pregnant females to reduce-mother-to-child transmission and the use of single-use syringes as well as introduction of harm reduction policies to be implemented in the health system.

However, this study is limited primarily by its cross-sectional design, which precludes detection of a causal relationship between covariates and HBV infection. In addition, we were able to analyse only previously known risk factors.

In conclusion, Egypt has taken considerable steps to combat HCV. Still, there is a long way toward the elimination of HBV. EHIS revealed that the previous Egyptian control plan for viral hepatitis achieved success in controlling many risk factors. This study recommends the implementation of special screening programs to highly susceptible patients and treatment optimization as crucial steps for HBV elimination.

Code availability

Available from authors on request.

Authors' contributions

Eman Raslan: conceptualization—equal, validation—equal, writing-original draft—equal. Mohamed Abdallah: conceptualization-equal, validation—equal, writing-original draft—equal. Saeed Soliman: data curation—lead, methodology—lead, validation—equal, writing—original draft—equal. The author(s) read and approved the final manuscript.

Funding

No fund received for this research project.

Availability of data and materials

Data is publicly available on the DHS website.

Declarations

Ethics approval and consent to participate
The study is approved by an MoH research committee.

Consent for publication
Not applicable.

Competing interests
The authors read and approved the final manuscript.

Author details
[1]Family Medicine Department, Faculty of Medicine, Cairo University, Giza, Egypt. [2]Medical Research Division, National Research Center, Giza, Egypt.

Received: 30 November 2021 Accepted: 23 July 2022
Published online: 06 August 2022

References

1. Schweitzer A, Horn J, Mikolajczyk RT, Krause G, Ott JJ (2015) Estimations of worldwide prevalence of chronic hepatitis B virus infection: a systematic review of data published between 1965 and 2013. Lancet Lond Engl 386(10003):1546–1555
2. Khosravani A, Sarkari B, Negahban H, Sharifi A, Toori MA, Eilami O (2012) Hepatitis B Infection among high-risk population: a seroepidemiological survey in Southwest of Iran. BMC Infect Dis 12:378
3. Wilkins T, Sams R, Carpenter M (2019) Hepatitis B: screening, prevention, diagnosis, and treatment. Am Fam Physician 99(5):314–323
4. Committee on a National Strategy for the Elimination of Hepatitis B and C, Board on Population Health and Public Health Practice, Health and Medicine Division, National Academies of Sciences, Engineering, and Medicine (2016) In: Buckley GJ, Strom BL (eds) Eliminating the public health problem of hepatitis B and C in the United States: phase one report. National Academies Press (US), Washington (DC) Available from: http://www.ncbi.nlm.nih.gov/books/NBK368070/. Cited 2020 Oct 7
5. Updated U.S. Public Health Service guidelines for the management of occupational exposures to HBV, HCV, and HIV and recommendations for postexposure prophylaxis. Available from: https://www.cdc.gov/mmwr/preview/mmwrhtml/rr5011a1.htm. Cited 2020 Oct 7
6. Sako A, Yasunaga H, Horiguchi H, Hashimoto H, Masaki N, Matsuda S (2011) Acute hepatitis B in Japan: incidence, clinical practices, and health policy. Hepatol Res Off J Jpn Soc Hepatol 41(1):39–45
7. European Association for the Study of the Liver. Electronic address: easloffice@easloffice.eu, European Association for the Study of the Liver (2017) EASL 2017 Clinical Practice Guidelines on the management of hepatitis B virus infection. J Hepatol 67(2):370–398
8. Rivière L, Ducroux A, Buendia MA (2014) The oncogenic role of hepatitis B virus. Recent Results Cancer Res Fortschritte Krebsforsch Progres Dans Rech Sur Cancer 193:59–74
9. Trépo C, Chan HLY, Lok A (2014) Hepatitis B virus infection. Lancet Lond Engl 384(9959):2053–2063
10. Petruzziello A (2018) Epidemiology of hepatitis B virus (HBV) and hepatitis C virus (HCV) related hepatocellular carcinoma. Open Virol J 12:26–32
11. (2015) Guidelines for the prevention, care and treatment of persons with chronic hepatitis B infection. World Health Organization, Geneva. (WHO Guidelines Approved by the Guidelines Review Committee). Available from: http://www.ncbi.nlm.nih.gov/books/NBK305553/. Cited 2020 Oct 7
12. Djaogol T, Coste M, Marcellin F, Jaquet A, Chabrol F, Giles-Vernick T et al (2019) Prevention and care of hepatitis B in the rural region of Fatick in Senegal: a healthcare workers' perspective using a mixed methods approach. BMC Health Serv Res 19(1):627
13. Yuen M-F, Chen D-S, Dusheiko GM, Janssen HLA, Lau DTY, Locarnini SA et al (2018) Hepatitis B virus infection. Nat Rev Dis Primer 4:18035
14. Joukar F, Mansour-Ghanaei F, Naghipour MR, Hassanipour S (2018) Knowledge, distribution and risk factors of hepatitis B and C infection in high-risk groups in Guilan province, Iran. Hepat Mon 18(8):e65870
15. Terrault N, Lok A, McMahon B, Chang K, Hwang J, Jonas M et al (2018) Update on prevention, diagnosis, and treatment and of chronic hepatitis B: AASLD 2018 hepatitis B guidance. Hepatol Baltim Md 67(4):1560–1599
16. Cox AL, El-Sayed MH, Kao J-H, Lazarus JV, Lemoine M, Lok AS et al (2020) Progress towards elimination goals for viral hepatitis. Nat Rev Gastroenterol Hepatol 17(9):533–542
17. MacLachlan JH, Cowie BC (2015) Hepatitis B virus epidemiology. Cold Spring Harb Perspect Med 5(5) Available from: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4448582/. Cited 2020 Oct 1
18. Ministry of Health and Population/Egypt, El-Zanaty and Associates/Egypt, ICF International (2015) Egypt health issues survey 2015. Ministry of Health and Population/Egypt and ICF International, Cairo Available from: http://dhsprogram.com/pubs/pdf/FR313/FR313.pdf
19. Ministry of Health and Population/Egypt, El-Zanaty and Associates/Egypt, ICF International (2015) Egypt demographic and health survey 2014. Ministry of Health and Population and ICF International, Cairo Available from: http://dhsprogram.com/pubs/pdf/FR302/FR302.pdf
20. Hyun Kim B, Ray Kim W (2018) Epidemiology of hepatitis B virus infection in the United States. Clin Liver Dis 12(1):1–4
21. Waheed Y, Siddiq M, Jamil Z, Najmi MH (2018) Hepatitis elimination by 2030: progress and challenges. World J Gastroenterol 24(44):4959–4961
22. Gomaa A, Allam N, Elsharkway A, El Kassas M, Waked I (2017) Hepatitis C infection in Egypt: prevalence, impact, and management strategies. Hepatic Med Evid Res 9:17–25
23. Ismail SA, Cuadros DF, Benova L (2017) Hepatitis B in Egypt: a cross-sectional analysis of prevalence and risk factors for active infection from a nationwide survey. Liver Int Off J Int Assoc Study Liver 37(12):1814–1822
24. Waked I, Esmat G, Elsharkawy A, El-Serafy M, Abdel-Razek W, Ghalab R et al (2020) Screening and treatment program to eliminate hepatitis C in Egypt. N Engl J Med 382(12):1166–1174
25. Conner RO, Dieye Y, Hainsworth M, Tall A, Cissé B, Faye F et al (2020) Mass testing and treatment for malaria followed by weekly fever screening, testing and treatment in Northern Senegal: feasibility, cost and impact. Malar J 19 Available from: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7362450/. Cited 2020 Oct 1
26. Krauth C (2010) Health economic analysis of screening. GMS Curr Top Otorhinolaryngol Head Neck Surg 7 Available from: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3199833/. Cited 2020 Oct 1
27. El Sherbini A, Mohsen SA, Seleem Z, Ghany AA, Moneib A, Abaza AH (2006) Hepatitis B virus among schoolchildren in an endemic area in Egypt over a decade: impact of hepatitis B vaccine. Am J Infect Control 34(9):600–602
28. Strickland GT (2006) Liver disease in Egypt: hepatitis C superseded schistosomiasis as a result of iatrogenic and biological factors. Hepatology 43(5):915–922
29. Omran D, Alboraie M, Zayed RA, Wifi M-N, Naguib M, Eltabbakh M et al (2018) Towards hepatitis C virus elimination: Egyptian experience, achievements, and limitations. World J Gastroenterol 24(38):4330–4340
30. Al-Rifaai JM, Al Haddad AM, Qasem JA (2018) Personal hygiene among college students in Kuwait: a health promotion perspective. J Educ Health Promot 7 Available from: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6052777/. Cited 2020 Oct 2
31. Alcouffe F (1989) Oral hygiene behavior: differences between men and women. Clin Prev Dent 11(3):6–10
32. Rehman R, Zafar A, Mohib A, Baig M A gender-based comparison in health behaviors and state of happiness among university students. Cureus 10(3) Available from: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5959310/. Cited 2020 Oct 2
33. Oraby D (2013) Harm reduction approach in Egypt: the insight of injecting drug users. Harm Reduct J 10:17
34. Samari G (2017) First birth and the trajectory of women's empowerment in Egypt. BMC Pregnancy Childbirth 17(Suppl 2) Available from: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5688501/. Cited 2020 Oct 2
35. Jiménez-Pérez M, González-Grande R, España Contreras P, Pinazo Martínez I, de la Cruz Lombardo J, Olmedo Martín R (2016) Treatment of chronic hepatitis C with direct-acting antivirals: the role of resistance. World J Gastroenterol 22(29):6573–6581
36. Wasfi OAS, Sadek NA (2011) Prevalence of hepatitis B surface antigen and hepatitis C virus antibodies among blood donors in Alexandria, Egypt. East Mediterr Health J Rev Sante Mediterr Orient Al-Majallah Al-Sihhiyah Li-Sharq Al-Mutawassit 17(3):238–242

37. Alavian SM, Fallahian F, Lankarani KB (2007) The changing epidemiology of viral hepatitis B in Iran. J Gastrointest Liver Dis 16(4):403–406
38. Zidan A, Scheuerlein H, Schüle S, Settmacher U, Rauchfuss F (2012) Epidemiological pattern of hepatitis B and hepatitis C as etiological agents for hepatocellular carcinoma in Iran and worldwide. Hepat Mon 12(10 HCC) Available from: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3517809/. Cited 2020 Oct 3
39. Talaat M, Afifi S, Reaves EJ, Abu Elsood H, El-Gohary A, Refaey S et al (2019) Evidence of sustained reductions in the relative risk of acute hepatitis B and C virus infections, and the increasing burden of hepatitis a virus infection in Egypt: comparison of sentinel acute viral hepatitis surveillance results, 2001–17. BMC Infect Dis 19(1):159
40. Hahn RA, Truman BI (2015) Education improves public health and promotes health equity. Int J Health Serv Plan Adm Eval 45(4):657–678
41. Zajacova A, Lawrence EM (2018) The relationship between education and health: reducing disparities through a contextual approach. Annu Rev Public Health 39:273–289
42. Chuang S-C, Lee Y-CA, Hashibe M, Dai M, Zheng T, Boffetta P (2010) Interaction between cigarette smoking and HBV or HCV infection on the risk of liver cancer: a meta-analysis. Cancer Epidemiol Biomark Prev Publ Am Assoc Cancer Res Cosponsored Am Soc Prev Oncol 19(5):1261–1268
43. Karayiannis P, Novick DM, Lok AS, Fowler MJ, Monjardino J, Thomas HC (1985) Hepatitis B virus DNA in saliva, urine, and seminal fluid of carriers of hepatitis B e antigen. Br Med J Clin Res Ed 290(6485):1853–1855
44. Kwon SY, Lee CH (2011) Epidemiology and prevention of hepatitis B virus infection. Korean J Hepatol 17(2):87–95
45. Ahmed S, Chaturvedi H, Mehdi SR (2013) Seroprevalence of Hepatitis B virus infection among blood donors in Shia Muslims in a population of Lucknow. Bangladesh J Med Sci 12(2):146–149
46. Birnie GG, Quigley EM, Clements GB, Follet EA, Watkinson G (1983) Endoscopic transmission of hepatitis B virus. Gut 24(2):171–174
47. Chiaramonte M, Farini R, Truscia D, Zampieri L, Di Mario F, Pornaro E et al (1983) Risk of hepatitis B virus infection following upper gastrointestinal endoscopy: a prospective study in an endemic area. Hepatogastroenterology 30(5):189–191
48. Abdella Y, Riedner G, Hajjeh R, Sibinga CTS (2018) Blood transfusion and hepatitis: what does it take to prevent new infections? East Mediterr Health J 24(6):595–597
49. Cohen MH, Eisenberg DM (2002) Potential physician malpractice liability associated with complementary and integrative medical therapies. Ann Intern Med 136(8):596–603
50. Studdert DM, Eisenberg DM, Miller FH, Curto DA, Kaptchuk TJ, Brennan TA (1998) Medical malpractice implications of alternative medicine. JAMA 280(18):1610–1615
51. El-Gibaly O, Ibrahim B, Mensch BS, Clark WH (2002) The decline of female circumcision in Egypt: evidence and interpretation. Soc Sci Med 1982 54(2):205–220
52. Alkhalaileh D, Hayford SR, Norris AH, Gallo MF (2018) Prevalence and attitudes on female genital mutilation/cutting in Egypt since criminalisation in 2008. Cult Health Sex 20(2):173–182
53. Morris BJ, Wamai RG, Henebeng EB, Tobian AA, Klausner JD, Banerjee J et al (2016) Estimation of country-specific and global prevalence of male circumcision. Popul Health Metr 14 Available from: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4772313/. Cited 2020 Oct 3
54. Adoba P, Boadu SK, Agbodzakey H, Somuah D, Ephraim RKD, Odame EA (2015) High prevalence of hepatitis B and poor knowledge on hepatitis B and C viral infections among barbers: a cross-sectional study of the Obuasi municipality, Ghana. BMC Public Health 15 Available from: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4601136/. Cited 2020 Oct 3
55. Al-Rabeei NA, Al-Thaifani AA, Dallak AM (2012) Knowledge, attitudes, and practices of barbers regarding hepatitis B and C viral infection in Sana'a city, Yemen. J Community Health 37(5):935–939
56. Yang J, Hall K, Nuriddin A, Woolard D (2014) Risk for hepatitis B and C virus transmission in nail salons and barbershops and state regulatory requirements to prevent such transmission in the United States. J Public Health Manag Pract 20(6):E20–E30

Publisher's Note