Seroprevalence of HBsAg among adolescents and adults in the Muhayil Aseer region of KSA: 25 years after the introduction of national vaccination

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Abstract

Objective: The objective of this work was to investigate the seroprevalence and associated risk factors of HBsAg among adolescents and adults in the Muhayil Aseer region of KSA.

Methods: A cross-sectional study was conducted on a selected sample of adolescents and adults in the Muhayil Aseer region of KSA. A comprehensive questionnaire-based interview was performed for all participants, blood samples were taken, and sera were tested for HBsAg.

Results: The study included 133 adolescents and 938 adults. A seroprevalence of 1.5% and 6.1% were recorded among adolescents and adults, respectively. The study showed that persons without the hepatitis B vaccination carried a significantly higher risk for developing sero-positivity for HBsAg.

Conclusion: The present study further endorsed the effectiveness of vaccination in preventing hepatitis B virus (HBV) infection. Strict preventive measures against HBV infection need to be fostered in the study area.

Keywords: Adolescents; HBsAg seroprevalence; HBV; Muhayil Aseer; Vaccination

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Introduction

Earlier studies and reports dating back to 1980 on the seroprevalence of hepatitis B virus (HBV) infection in KSA
that were compiled and further analysed by Al-Faleh in 2003 have documented a high endemicity of HBV infection: 5–10% of the population were infected. The highest rate of infection was in the southern region of KSA. By 1989, a year prior to the addition of the HBV vaccine to the Extended Program of Immunization (EPI), the prevalence of HBV infection among children was 7%. Consequently, a mass vaccination program was launched in that year. Eventually, a steady significant decline of HBV infection among children was observed. In 2008, a sero-survey was conducted in regions of different HBV endemicity and Al-Faleh et al. documented a zero prevalence of HBsAg among students (16–18 years of age) in Almadinah Almunawwarah and Al-Qaseem both of which are located in the Aseer region, the region with the highest endemicity, thus documenting the efficacy of the HBV vaccine and its long-term protection. According to the Ministry of Health, new cases of HBV infection (4259) reported in 2013 amounted to 70% of all reported cases (6106) of viral hepatitis.

Previously in KSA, the HBV vaccine was given in three doses (0, 1 and 5 months). However, as of January 2013, the schedule has been revised and re-adjusted: commencing at birth and continuing at 2-month intervals for a total of four doses. Strict measures are undertaken by the authorities to ensure that all children complete their EPI. Since the introduction of the HBV vaccination in 1990, it is expected that all children and adults of 25 years of age or younger have been vaccinated against HBV.

The objective of this work was to investigate the sero-prevalence of HBsAg among adolescents and adults utilizing a sensitive enzyme immunoasay capable of detecting less than 0.1 WHO IU/ml HBsAg in Muhayil Aseer, located in southwest KSA. In addition, relevant risk factors were studied in the selected area.

Materials and Methods

Settings

The study was a cross-sectional study on a representative sample of adolescents and adults in the Muhayil Aseer region of KSA.

The study area

The Aseer region is located in the southwest of KSA and covers an area of more than 80,000 km². It borders Jizan and is located to its northeast. The region is divided into 11 Governorates. The Muhayil Governorate is the location of the current study (Figure 1) and has a total population of 214,758 (Saudi Central Department of Statistics and Information, 2013). Health care is provided through a network of 36 primary health care centres and a general hospital, the Muhayil General Hospital.

Sampling procedures

During late 2014, patients and their relatives who were aged 10 years or older and attended the outpatients’ clinics of Muhayil General Hospital for any reason (attending clinics, doing any laboratory investigation, blood donation and pre-marital screening) were included in the sample.

Questionnaire interview

A comprehensive questionnaire interview was offered to all participants. The questionnaire included socio-demographic data and history of relevant exposures. History of blood transfusion was also enquired about. Similarly, the following data were collected: history of any surgical operations, tooth extraction, wet cupping and hepatitis B vaccination.

Ethical approval

The study was reviewed and approved by the ethical committee of King Khalid University. Informed consent was obtained from each individual.

Blood sampling

Approximately 5- to 10-ml venous blood samples in plain tubes were taken from each participant and were allowed to clot at room temperature (range 18 °C–20 °C). Samples were then centrifuged at 10,000 rpm for 10 min, and the separated sera were aliquoted into two portions and stored at −20 °C until transported in ice boxes to the Virus Lab of the Abha College of Medicine, where they were grouped by collection area and stored in classified boxes in similar conditions as described above.

Serologic tests for HBsAg

HBsAg was tested by a fourth generation enzyme immunoasay (ELISA) obtained from DIA.PRO Diagnostic Bioprobes Sr1 via G. Carducci, Milano, Italy. Briefly, the solid phase was pre-coated with mouse monoclonal antibodies specific to the sub determinants a, d and y. Test sera were reacted with these antibodies, incubated and washed. The captured HBsAg was further reacted with conjugated mouse monoclonal antibodies against those sub determinants. Test plates were subsequently washed and reacted with a substrate. The resulting colour was read by a double beam multi-scan ELISA reader at 450 nm. The manufacturer’s protocols were strictly followed in testing and interpreting the results.

Statistical analysis

Data were coded, validated and analysed using the Statistical Package for the Social Sciences (SPSS), version 13.0 (SPSS Inc., Chicago, IL, USA). The frequency, percentage, arithmetic mean, and mode are used to present the data. The chi-square test and Fishers’ exact test were used as tests of significance at a 5% level of significance. Binary logistic multivariate analysis, adjusted odds ratio and antecedent 95% CIs were used to identify potential risk factors for HBsAg seropositivity.
Results

Description of the study sample

The present study included 1071 persons in the Muhayil Aseer region of KSA. Participant’s ages ranged from 10 to 72 years with an average age of $35.4 \pm 17.8$ years and a median of 30 years. The present study included 133 (12.4%) adolescents (aged 11–19 years) and 938 adults (20 years and older). Regarding sex distribution, 50.4% (67) of adolescents and 51.1% (479) of adults were males. The gender difference was not statistically significant ($\chi^2 = 0.222, P = 0.882$). Regarding the marital status among adults, 75.2% were married, 20.1% were widowed or divorced, and the rest were single. The majority of adolescents (96.3%) were single. The majority of adult females (95.1%) were housewives. The highest proportion of adult males (45.3%) were either farmers or shepherds. As for the level of education of adults, 24.5% were illiterate. Very few (2.3%) were university educated.

History of relevant exposures

History of blood transfusion among adolescents (1.5%, 2) was not significantly different ($\chi^2 = 0.153, P = 0.283$) from that of adults (3.1%, 3). Similarly, history of surgical operations and history of wet cupping were not significantly different among adolescents and adults. However, history of hepatitis B vaccination was significantly higher among adolescents (64.7%, 86) compared to adults (24.9%, 234).

Sero-prevalence of hepatitis B (HBsAg)

Two adolescents tested positive for the hepatitis B surface antigen, giving a sero-prevalence of 1.5%. Among the adults, 57 tested positive for the hepatitis B surface antigen, giving a sero-prevalence of 6.1% (Figure 2). The age difference was statistically significant ($\chi^2 = 4.681, P = 0.015$) (see Table 1).

Determinants of HBsAg sero-positivity

Multivariate binary logistic regression analysis was used to identify potential risk factors associated with HBsAg sero-positivity (Table 2). After adjusting for other potential risk factors, the following factors were identified as significant:

- Age: The risk of HBsAg sero-positivity increased with age ($\chi^2 = 4.681, P = 0.015$).
- Sex: Males had a higher risk of HBsAg sero-positivity compared to females ($\chi^2 = 3.841, P = 0.049$).
- Marital status: Married individuals had a lower risk of HBsAg sero-positivity compared to single individuals ($\chi^2 = 4.681, P = 0.015$).

Figure 1: Map showing the Aseer region and Muhayil area.

Figure 2: Seroprevalence of Hepatitis B (HBsAg) Viral Infections among the study sample of adolescents and adults in the Muhayil Aseer region of KSA.
Hepatitis B virus infection (HBV) is a major cause of chronic liver disease worldwide. Data from the World Health Organization (WHO) estimates the burden of HBV infection to be approximately 2 billion cases with more than 240 million known to be chronically infected. In addition, more than half a million patients worldwide die annually as a result of HBV-related liver diseases, such as decompensated liver cirrhosis, end-stage liver disease or hepatocellular carcinomas.

HBV infection is endemic in KSA. A plethora of studies have been published since 1984 addressing various aspects of the disease: its prevalence among the general population and the different age groups in the Kingdom, blood donors, health care workers, pregnant women, and highlights the effectiveness of vaccination in preventing HBV infection. Furthermore, the effectiveness of vaccination was also reflected in the relative high rate of HBV infection among adults (6.1%), most of who were not vaccinated and were exposed to the risk factors of acquiring the infection investigated in this study. This rate of infection among adults is higher than the range of 1.5%—2.6% reported by Memish et al., in 2010. The assay employed in this study is capable of detecting very low quantities of HBsAg (<0.1 WHO IU/ml HBsAg), thus the sensitivity of this assay may be higher than that of earlier assays employed in previous studies and might explain the higher rate found in this study.

Although wet cupping, a common practice in KSA, was not implicated in the transmission of HBV infection in this study, it was found by Alothman and Al Ghamdi to be the only plausible risk factor for transmission of HIV to a Saudi citizen. The equipment used for wet cupping is available as disposable off-the-shelf items in local pharmacies. Therefore, health education in such remote areas must take into consideration the local habits and practices that may play a role in HBV transmission.

Prevention of HBV infection can be achieved through a variety of actions. Advocacy and continuous efforts to raise awareness of HBV infections among the general population will help to reduce transmission in the general community and in remote areas such as Muhayil, the focus region of the present study. Strengthening efforts to keep coverage of the HBV vaccine in the EPI programs of the affected areas is also important. Implementation of strict blood safety strategies that include keeping high quality-assured screening of all donated blood and blood components used for transfusion will also help. Additionally, infection control precautions in health care settings will significantly help prevent the transmission of the infection. Similarly, safe injection practices can protect against HBV transmission.

In conclusion, the present study further highlights the effectiveness of vaccination in preventing HBV infection. However, in addition to vaccination, strict preventive measures need to be encouraged in the study area.

### Table 1: Distribution of the study sample of adolescents (aged 10–19 years) and adults (aged 20 years and older) in the Muhayil Aseer region, by relevant exposures and seropositivity.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Adolescents (N = 133)</th>
<th>Adults (N = 938)</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>History of blood transfusion</td>
<td>2</td>
<td>30</td>
<td>3.2</td>
</tr>
<tr>
<td>History of surgical operations</td>
<td>2</td>
<td>43</td>
<td>4.6</td>
</tr>
<tr>
<td>History of tooth extraction</td>
<td>4</td>
<td>88</td>
<td>9.4</td>
</tr>
<tr>
<td>History of wet cupping</td>
<td>0</td>
<td>0</td>
<td>2.3</td>
</tr>
<tr>
<td>History of hepatitis B vaccination</td>
<td>86</td>
<td>234</td>
<td>24.9</td>
</tr>
<tr>
<td>HBsAg seropositive</td>
<td>2</td>
<td>57</td>
<td>6.1</td>
</tr>
</tbody>
</table>

### Table 2: Multivariate analysis, adjusted Odds ratio (aOR) and antecedent 95% confidence intervals (CI) of potential risk factors determining sero-positive HBsAg in the Muhayil Aseer region of KSA.

<table>
<thead>
<tr>
<th>Variable</th>
<th>aOR</th>
<th>95% CI Lower</th>
<th>95% CI Upper</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender: Males vs. Females</td>
<td>1.024</td>
<td>0.591</td>
<td>1.776</td>
</tr>
<tr>
<td>History of blood transfusion: Yes vs. No</td>
<td>2.704</td>
<td>0.909</td>
<td>8.048</td>
</tr>
<tr>
<td>History of any surgical operation: Yes vs. No</td>
<td>1.652</td>
<td>0.605</td>
<td>4.514</td>
</tr>
<tr>
<td>History of tooth extraction: Yes vs. No</td>
<td>1.811</td>
<td>0.847</td>
<td>3.871</td>
</tr>
<tr>
<td>History of wet cupping: Yes vs. No</td>
<td>1.125</td>
<td>0.236</td>
<td>5.378</td>
</tr>
<tr>
<td>History of yellow eye in adulthood: Yes vs. No</td>
<td>1.076</td>
<td>0.279</td>
<td>4.149</td>
</tr>
<tr>
<td>History of hepatitis B vaccination: No vs. Yes</td>
<td>2.792</td>
<td>1.182</td>
<td>6.623</td>
</tr>
</tbody>
</table>

* Significant (P < 0.05).
Study limitations

- The study was based entirely on the recall of the interviewees, and thus, there is an inherent recall bias.
- No further investigations were performed regarding other markers of HBV infection.

Author’s contribution

SMA is the sole author of the article, who perceived and designed the study, while Roche Saudi Arabia provided the required funds. The author conducted the research, interpreted the results of the study and analyzed the data. He drafted the manuscript and critically revised its content and approved its final version and is responsible for the content.

Conflict of interest

The author has no conflict of interest to declare.

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