Prevalence of HBV and Assessment of Hepatitis B Vaccine Response among Dental Health Care Workers in Dental Teaching Hospital, Umm Al-Qura University, Saudi Arabia

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Hepatitis-B Virus (HBV) infection is a serious health problem that can be prevented by vaccination. Dental Health Care Workers (DHCWs) are at-risk of occupational exposure to HBV infection. This study was aimed to assess the prevalence of HBV and evaluate the immune response to hepatitis B vaccine among DHCWs in Dental Teaching Hospital, Umm Al-Qura University, Saudi Arabia. A cross-sectional study was conducted on 139 DHCWs, 71 males and 68 females. Blood samples were collected and the levels of hepatitis B surface antigen (HBsAg) and hepatitis B surface antibody (anti-HBs) were measured by Chemiluminescent Microparticle Immunoassay. The prevalence of HBV among DHCWs was zero (0.0%). The hepatitis B vaccine was given to 95% of DHCWs. Among the vaccinated participants, 90.1% (n=119) have protective immunity to hepatitis B. An inverse correlation between anti-HBs levels and increasing the duration of vaccination (*P*<0.0001) was found. We compared the anti-HBs levels in 28 students who received childhood vaccine and revaccinated at age of 21. The anti-HBs concentration was greater than 10mIU/mL (protected) in 17.9% of those who had childhood vaccine compared to 100% one-year after revaccination. The mean of anti-HBs levels for childhood vaccine was 5.6 mIU/mL and these levels increased significantly to 620 mIU/mL after recent revaccination (*P*< 0.0001). In conclusion, Hepatitis B vaccine is effective in prevention of HBV infection among DHCWs. Non-protected individuals should be identified and revaccinated.

Viral hepatitis is a global serious health problem triggered about 1.5 Million deaths in 2013, which represents an increase the number of death rate by 63% between 1990 and 2013. Almost 50% of these deaths are caused by Hepatitis B virus (HBV) due to liver cirrhosis and hepatocellular carcinoma.[1] About 257 million individuals have chronic HBV infection worldwide, mostly in East Asia and sub-Saharan Africa. [2]

HBV infection is endemic in Saudi Arabia, but the prevalence of HBV declines significantly over the last 30 years. The percentage of HBsAg positive was 19.9% in males and 9.3% in females in 1985, [3] and 8.8% in children in 1990.[4] The prevalence of HBsAg among Saudi Arabian children decreased from 6.7% to 0.3 %. [5] A recent cross-sectional study of HBV prevalence from 2013 to 2014 in Aseer region, Saudi Arabia, showed an overall seroprevalence was 5.9%, and 0.8% in children (<15 years) and 1.3% among individuals aged 15-24 years.[6] The prevalence of HBsAg in south-western Saudi Arabia between 1995 and 1998 was 5.4% among blood donors and 5.1% in the community. [7] The prevalence of HBsAg declined to 3% from 2005 to 2006, [8] and 3.24% between 2011 and 2015. [9]

The vaccine is highly effective in preventing HBV infection. Among individuals who received the HBV vaccine, 80% - 100% achieve the protected antibody levels.[10] The risk for HBV infection varies from one country to another. In high-risk countries for HBV there should be an annual and periodic measurement of anti-HBs level and administration of booster vaccine according to anti-HBs level evaluation. [11]

Many countries have introduced vaccinations in the early 1980s. In Saudi Arabia, a program was started in 1989 to vaccinate children at 2, 4, and 6 months of age. [12] In 1990, a catch-up program was commenced for vaccination of school children and high-risk groups including healthcare workers. [13] Because of these policies, the HBV prevalence has been declined. This was echoed by the data of premarital screening of 74662 persons in 2008 that showed only 1.3% tested positive. [14] In addition, a marked reduction in the prevalence of HBV among 24173 blood donors from 2000 - 2002 of whom, 1.5% tested positive for HBV. [15]

Health Care Workers (HCWs) are at high risk of exposure to bloodborne pathogen HBV due to occupational exposure to infected blood and lack of protective equipment. Dental HCWs (DHCWs) can be infected with HBV during dental procedures, or from sharp injuries. Studies have reported that the risk of exposure for general dentists is about three to four times more than that of the general population. [16], [17] The awareness of hepatitis-B vaccination among DHCWs has increased significantly in recent years. However, a few DHCWs have no intention to be vaccinated which make them susceptible to HBV infection and can also be a threat to their patients. [18]

Hence, in this study, we aim to detect the Hepatitis B surface antigen (HBsAg) and measure the levels of anti-HBs antibody among DHCWs.

Material and Methods

A cross-sectional double-blind study was conducted on dental health care workers (DHCWs) at Dental Teaching Hospital, Umm Al-Qura University. 139 DHCWs volunteers (71 male and 68 female) out of the total 340, participated in this study including 109 students, 11 dentists, 11 nurses, 6 cleaners and 2 dental technicians. The study was conducted after obtaining signed informed consent and ethical approval of Institutional Review Board (IRB) committee of faculty dentistry, Umm Al-Qura University.

Sample Collection

Blood samples were collected in a 4ml tube without anticoagulant and kept in an upright position overnight in the refrigerator (2 – 6°C). The serum was used to measure he levels of hepatitis B markers including HBsAg and anti-HBs using Chemiluminescent Microparticle Immunoassay (CMIA).

Chemiluminescent Microparticle Immunoassay (CMIA)

Hepatitis-B surface antigen (HBsAg) is used as a marker for screening of HBV infection.[19] CMIA was performed using architect system automated immuno analyser of the Abbott diagnostic services (Ireland). CMIA is Chemiluminescent Microparticle Immuno Assay based on Enzyme Linked Immuno Sorrbant Assay (ELISA).

In HBsAg assay, serum samples were added to anti-HBs coated microparticles. After washing, acridinium-labelled anti-HBs conjugate was added. In anti-HBs assay, serum samples were added to rHBsAg coated microparticles. After washing, acridinium-labelled rHBsAg conjugate was added. After washing, Pre-Trigger and Trigger Solutions were added to the reaction mixture. The resulting chemiluminescent reaction was measured as relative light units (RLUs). A direct relationship exists between the amount of HBsAg or anti-HBs in the sample and the RLUs detected by the ARCHITECT i* System optics. The specimen was considered reactive for HBsAg if the concentration was $\geq$ 1.00 S/CO, whereas the specimen is considered reactive for anti-HBs if the concentration was $\geq$ 10.00 mIU/mL.

Statistical Analysis

The collected data were analysed by SPSS program using Kruskal-Wallis and Paired-Samples T Test statistical tests.

Results

DHCWs who contributed in this study included 109 students (78.4%), 11 dentists (7.9%), 11 nurses (7.9%), 6 cleaners (4.3%) and 2 dental technicians (1.4%). Most of the participants were Saudis (no=120) and only 19 persons were non-Saudis. The percentage of male participants was 51.1% while the female participants represented 48.9%, with mean age 24.51±5.59 years. The prevalence of HBV infection among DHCWs participants was zero (0.0%). This result reflects the awareness of DHCWs and strict implementation of infection control procedures in the hospital.

Hepatitis B vaccination is widely available in Saudi Arabia. In 1990, the Ministry of Health started HBV vaccination program for infants.[12] The vaccinated individual is considered to be immunized (protected) to HBV when anti-HBs level is 10 mIU/mL or more.[20] In this study, 95% participants were vaccinated, 117 (88.6%) received hepatitis B vaccine during adulthood whereas 15 (11.4%) were vaccinated only during childhood. Among the vaccinated DHCWs, 119 individuals (90.1%) were protected and 13 persons (9.9%) were non-protected (Fig. 1). The mean value of anti-HBs level in vaccinated DHCWs was 519.24 ± 428.67 mIU/mL.

In the present study, the anti-HBs levels were measured in response to hepatitis B vaccine that was received at variable periods before sample collection (Fig. 2). An inverse correlation between the anti-HBs level and duration of vaccine (P<0.0001) was found. The median of anti-HBs levels in relation to the last dose of vaccine are shown in Fig. 2.

In a group of students (no=28) the anti-HBs levels were measured after 20 years of receiving childhood vaccine and one year after revaccination at age of 21y with three-dose HB vaccination regimen at 0, 5 and 6 months (Fig. 3). Only 17.9% of students were protected after childhood vaccine compared to 100% protection after revaccination. The mean of anti-HBs levels for childhood vaccine was 5.6 mIU/mL and these levels increased tremendously to 620 mIU/mL after recent revaccination and this increment was highly significant (P<0.0001). This result shows clearly the importance of booster vaccination.

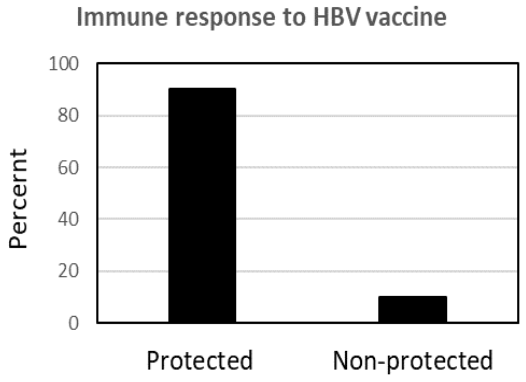
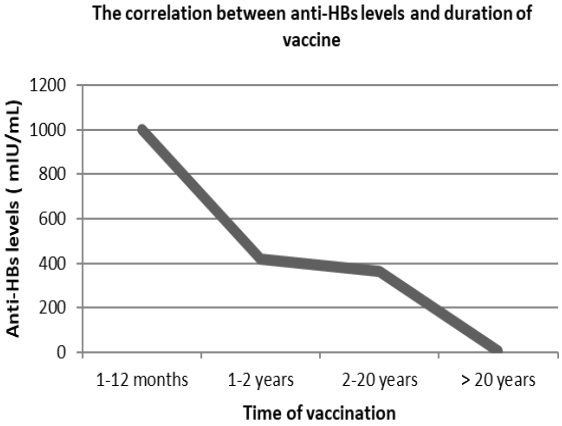


Figure 1. Antibody response after vaccination with HBV vaccine. Among the vaccinated DHCWs, the anti-HBs level was more than 10 mIU/mL in 90.1% (protected) and less than 10 mIU/mL in in 9.9% (non-protected).



Time of HBV vaccine	Number	Anti-HBs level
< 1 year	37	1000.00
1-2 years	50	416.19
2-20 years	30	362.14
>20 years	15	32.15

Figure 2. The correlation between anti-HBs levels and duration of vaccine. The levels of anti-HBs were inversely correlated to the duration of vaccine ($p < 0.0001$). The median of HBsAb level was 1000 mIU/mL for those who were vaccinated within last 12 months, 416.19 mIU/mL in last 1-2 years, 362.14 mIU/mL between the previous 2-20 years and 32.15 mIU/mL more than 20 years.

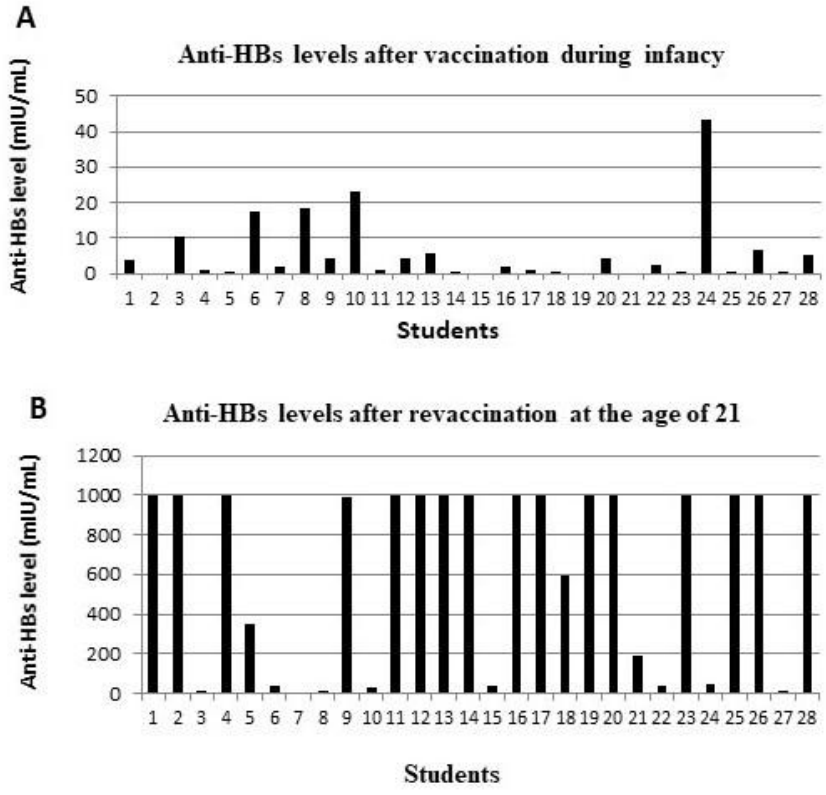


Figure 3. Comparison of the anti-HBs levels after childhood vaccine and revaccination. A group of students (no = 28) were vaccinated at infancy and revaccinated at age of 21. The anti-HBs levels were measured after vaccination at age of 21 for childhood vaccine (A) while levels were assessed one year after revaccination (B). The mean of anti-HBs level for childhood vaccine was 5.57 and this level increased tremendously to 620.02 after recent re-vaccination ($P < 0.0001$).

Discussion

In this study, we monitored HBV infection by detecting HBsAg and assessed the immune response to hepatitis B vaccine via measuring of anti-HBs levels. The prevalence of HBV infection among DHCWs was zero (0.0%). This result reflects the awareness of the risk associated with HBV infection and strict implementation of infection control procedures. Other studies have shown dramatic decline in prevalence of HBV over the last 30 years in Saudi Arabia. The prevalence of HBV among Saudi Arabian children decreased from 6.7% to 0.3 %. [5]

In addition, HBV positive individual among Saudi blood donors between 1995 and 1998 was 5.4% [7] and this percentage declined to 3% in 2005-2006.[8] Moreover, only 1.3% were tested positive for HBV among Saudi premarital testing in 2008.[14] This decline may be attributed to several factors, including the implementation of childhood HBV vaccination, premarital and blood donor screening for HBV, HCV and HIV and increased awareness of safe clinical practices through strict performance of infection control procedures. Improved socioeconomic conditions, educational status and personal hygiene may have an impact on the prevalence of HBV because the high incidence of HBV is observed in poor socioeconomic conditions in some societies. [21]

The hepatitis B vaccine provide 80% - 100% protection against HBV infection in those who receive the 3-dose vaccine series [CDC 2015]. [10] In this study, 90.1% of DHCWs have protective immunity to HBV. This result is compatible with the finding of Zeeshan *et al*., [22] Chathuranga *et al*.,[23] Basireddy *et al*.[24] and Thomas *et al*.[25] who showed 86.2%, 91.1%, 96.5% and 98.9% protective immunity respectively.

In the present study, we analysed the level of anti-HBs in relation to the last dose of vaccine and we found that anti-HBs levels continue to diminish by increasing duration. In support of our findings, other studies provided data showing a significant reduction in the seroprotection response by increasing the period since primary vaccination. Pasko and Beam [26] have found that 35.9 % of HCW who received the hepatitis B vaccine lost anti-HBs over 36-months. In long-term follow-up studies of persons vaccinated of children vaccinated beginning at birth with 3 doses of hepatitis B vaccine, large proportion of participants exhibited waning immunity 5–15 years after initial vaccination. [27], [28], [29], [30]

Despite evidence of inverse relationship between anti-HBs responses and increasing the duration since primary vaccination, other studies have shown that hepatitis B vaccine is efficient at preventing chronic HBV infections. The follow-up studies have shown that chronic HBV infections affected fewer vaccinated children and suggested that no booster vaccination is needed before 10 years of age following hepatitis B childhood vaccine. [27], [31], [32]. This could be attributed to the efficiency of immune memory in most of vaccinated children.

In conclusion, administration of hepatitis B vaccine and implementation of infection control policies are effective in prevention of HBV infection among DHCWs. Non-protected individuals after the childhood vaccinations should be identified and one or more booster doses must be given.

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