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Trend in incidence of hepatitis B virus infection during a decade of universal childhood hepatitis B vaccination in Saudi Arabia

Tariq A. Madani*

Ministry of Health, Riyadh, and Department of Medicine, King Abdulaziz University, Jeddah, Saudi Arabia

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Summary Since 1990, the national strategy to eliminate hepatitis B virus (HBV) infection in Saudi Arabia has included universal administration of HBV vaccine to all infants. From 1990 to 1995 this vaccine was also routinely administered to children at school entry. The prevalence of hepatitis B surface antigen (HBsAg) among children before this programme was reported to be 6.7%. The objective of this study was to describe the trend in incidence of HBV infection over a decade of surveillance following the introduction of this programme. From January 1990 to December 1999 a total of 30 784 cases of HBV infection (positive for HBsAg) were reported. The total number of HBV infections among children <15 years of age was 4180 cases, with a prevalence of 0.05%. The total number of HBV infections among adults was 26 604 cases, with a prevalence of 0.22%. The prevalence varied by region, ranging from 0.03% to 0.72% with a mean prevalence of 0.15%. There was a clear decline in incidence among children whereas the incidence in adults slightly rose, perhaps owing to population growth estimated to be 3.3% annually. This study showed that the universal childhood HBV vaccination programme had an enormous positive impact on HBsAg seroprevalence among children in Saudi Arabia.

1. Introduction

Hepatitis B virus (HBV) infection is a major public health problem worldwide. The WHO estimated that two billion people (one-third of the world's population) have serological evidence of either current (positive for HBV surface antigen (HBsAg)) or past (positive for antibody to surface antigen (anti-HBs) or antibody to core antigen (anti-HBc) and negative for HBsAg) infection with HBV. Of these, an estimated 350 million subjects have chronic HBV infection (positive for HBsAg with or without the envelope antigen (HBeAg)). At least one million chronically infected persons die annually of HBV-related complications, namely cirrhosis and hepatocellular carcinoma (Lavanchy, 2004).

Serosurvey studies in Saudi Arabia before 1990 showed that the prevalence of HBsAg positivity among Saudi Arabian children up to 12 years of age was on average 6.7% (Al-Faleh et al., 1992). Among adults, the prevalence of

* Present address: Department of Medicine, King Abdulaziz University Hospital, P.O. Box 80215, Jeddah 21589, Saudi Arabia. Tel.: +966 2 640 8243; fax: +966 2 640 8315.
E-mail address: taamadani@yahoo.com.

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HBsAg positivity was reported to be 7.4% (Al-Faleh, 1988). Since 1990, the national strategy to eliminate HBV infection in Saudi Arabia has included universal administration of HBV vaccine to all infants. Issuance of birth certificates in Saudi Arabia has been made conditional upon completion of the first year vaccinations to ensure complete vaccination coverage. The first dose of the HBV vaccine is administered at birth, the second at 1—2 months of age and the third at 6 months of age. From 1990 to 1995 this vaccine was also routinely administered in a three-dose series to children at school entry. Thus, subjects born in Saudi Arabia after 1985 are generally immunised against HBV. The objective of this study was to describe the trend in incidence of HBV infection over a decade of surveillance following the introduction of these interventions.

2. Materials and methods

2.1. Study area

Saudi Arabia occupies most of the Arabian Peninsula, with an area of approximately 2 240 000 km^2. It comprises 13 administrative provinces, namely Makkah province (which includes the holy city of Makkah, Jeddah and Tayef), Madinah province (which includes the holy city of Madinah), Riyadh province (which includes the capital city Riyadh), the Eastern province (which includes Dammam, Ahsa and Hafr Albaten), Asir province (which includes Abha and Bisha), Jouf province (which includes Jouf and Qurayyat), Hudud Shamaliyah (North borders) province (which includes Arar) and Baha, Jizan, Najran, Hail, Qassim and Tabook provinces. The latest census conducted in Saudi Arabia in 2004 indicates that the total population is 22 673 538, of whom 16 529 302 (72.9%) subjects are Saudi Arabian. Approximately 40.8% of the population is <15 years of age, 56.1% is 15—64 years and 3.1% is >64 years of age. The population annual growth rate is 3.3%. The infant mortality rate is 19.1 per 1000 live births and the maternal mortality rate is 1.8 per 10 000 live births. The total life expectancy at birth is 71.4 years.

2.2. Data collection

HBV infection and other causes of acute or chronic viral hepatitis have been notifiable in Saudi Arabia since 1990. Ministry of Health officials rely on healthcare providers, laboratories and other public health personnel to report the occurrence of these infections to the Department of Preventive Medicine in the Central Ministry of Health office in Riyadh, where all surveillance data are compiled. HBV infection was identified by laboratory testing for HBsAg for various indications, including clinical suspicion and routine screening of blood and organ donors, pregnant women, newborns of infected mothers, contacts of HBV-infected patients, prisoners, intravenous drug users, patients with other sexually transmitted infections and expatriates pre employment. Any subject with positive HBsAg confirmed by neutralisation test was considered to be HBV-infected. The results of other HBV markers, such as HBeAg, anti HBc (IgM and IgG) and liver enzymes, and clinical evaluation of HBsAg-positive subjects were not included in the surveillance system. Thus, HBV-infected patients reported to the Ministry of Health included asymptomatic carriers, patients with active chronic infection and acutely infected patients.

Table 1 Prevalence per 100 000 population of hepatitis B virus infection by region (1990—1999)

	No. of cases	Mean population during the surveillance period	Cases per 100 000 population
Baha	2837	393 327	721
Hafr Albaten	991	280 727	353
East	6101	1 824 952	334
Asir	3404	1 297 311	262
Jeddah	5535	2 866 113	193
Makkah	2104	1 483 258	142
Madinah	1672	1 283 251	130
Najran	439	356 250	123
North borders	279	270 808	103
Qassim	914	890 625	103
Bisha	253	288 321	88
Riyadh	3872	4 538 346	85
Qunfoda	46	55 725	83
Tayef	640	883 186	72
Qeryat	81	113 393	71
Ahsaa	555	940 217	59
Hail	282	487 778	58
Tabook	295	575 000	51
Jizan	416	1 030 159	40
Jouf	68	205 882	33
Total	30 784	20 064 629	153

3. Results

From January 1990 to December 1999, 30 784 cases of HBV infection (HBsAg-positive) were reported to the Ministry of Health, of whom 17 762 (57.7%) cases were males. The frequency of cases and the prevalence per 100 000 population by region are shown in Table 1. The prevalence of HBV infection by region ranged from 0.03% to 0.72% (33—721 cases per 100 000 population) with a mean prevalence of 0.15% (153 cases per 100 000 population). Figure 1 shows the frequency of HBV cases by age group. The mean paediatric (<15 years) and adult (≥15 years) population during the study period was 8 186 368.6 and 11 878 260.4 individuals, respectively. The total number of HBV infections among children was 4180 cases, with a prevalence of 0.05% (51 cases per 100 000 paediatric population). The total number of HBV infections among adults was 26 604, cases with a prevalence of 0.22% (224 cases per 100 000 adult population). Figure 2 shows the

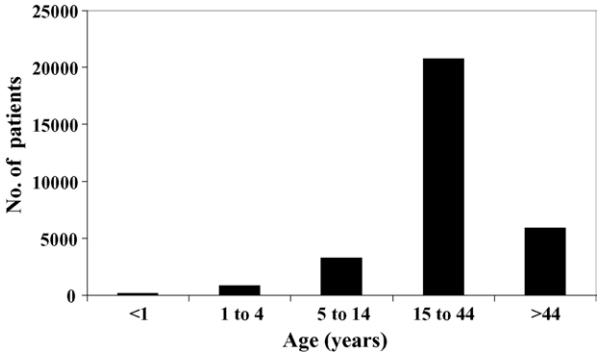

Figure 1 Hepatitis B virus infection cases by age group in Saudi Arabia (1990—1999).

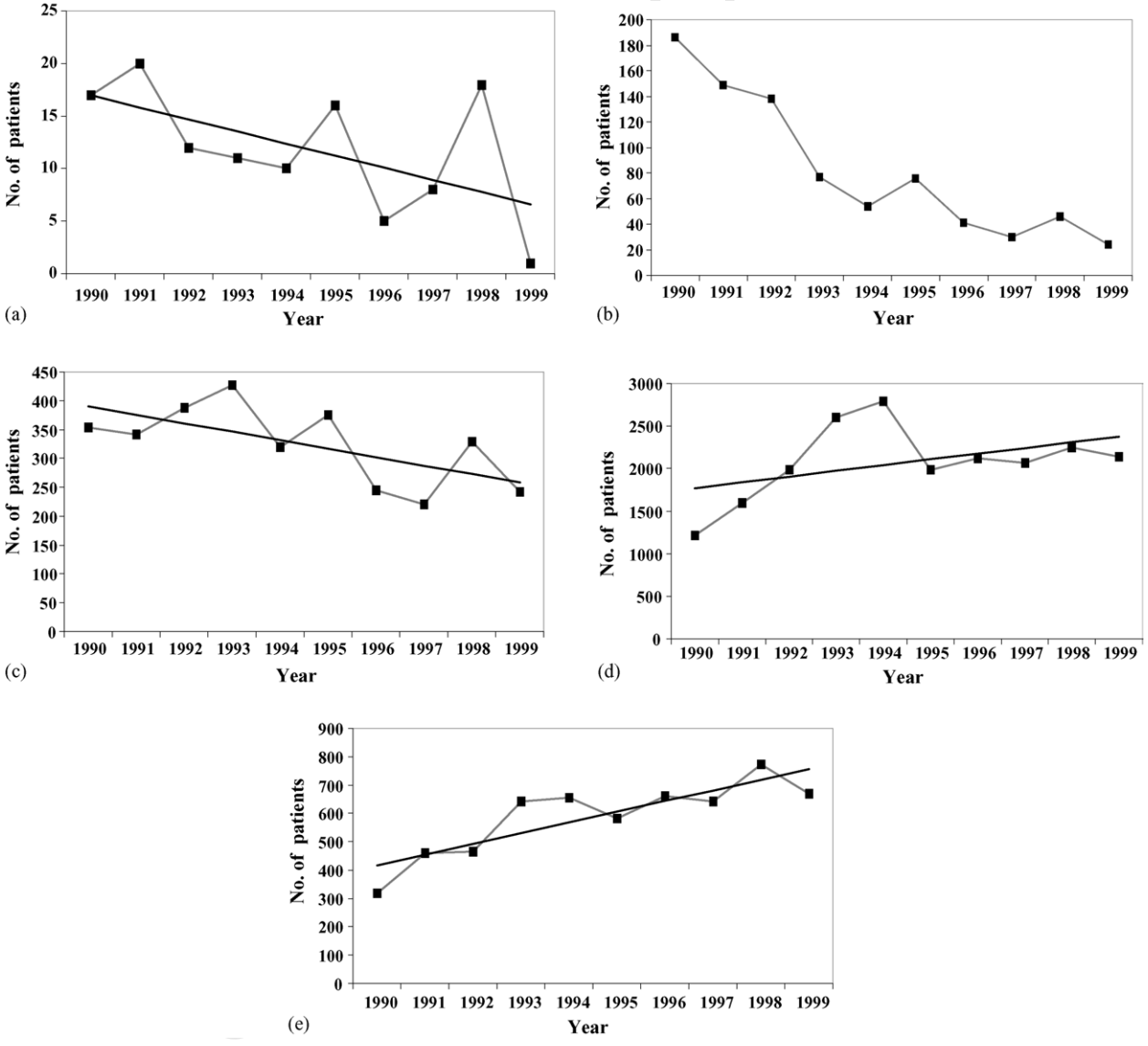

Figure 2 Annually reported hepatitis B virus infection cases in Saudi Arabia (1990—1999) in patients (a) <1 year (b) 1—4 years (c) 5—14 years (d) 15—44 years and (e) >44 years of age.

frequency of cases and the trend by year of surveillance for the different age groups <1 year, 1—4 years, 5—14 years, 15—44 years and >44 years, respectively.

4. Discussion

Globally, HBV carriage rate varies between 1% and 20%. This variation is related to differences in the mode of transmission and age at infection. In low-prevalence areas (rate 0.1—2%) such as the USA, Canada, western Europe, Australia and New Zealand, sexual and percutaneous transmission during adulthood are the main modes of transmission (Pyrsopoulos and Reddy, 2005). In intermediate-prevalence areas (rate 3—5%) such as eastern and northern Europe, Japan, the Mediterranean basin, the Middle East, Latin and South America, and central Asia, sexual and percutaneous transmission and transmission during delivery are the main modes of transmission (Pyrsopoulos and Reddy, 2005). In high-prevalence areas (rate 10—20%) such as China, Indonesia, sub-Saharan Africa, the Pacific islands and Southeast Asia, the predominant mode of transmission is perinatal (Pyrsopoulos and Reddy, 2005). Vaccination programmes implemented in highly endemic areas markedly decreased the prevalence of HBV infection. For instance, HBsAg seroprevalence in Taiwan declined from 10% in 1984 (before vaccination programmes) to less than 1% in 1994, and the incidence of hepatocellular carcinoma likewise declined from 0.52% to 0.13% (Huang and Lin, 2000; Van Damme, 2001).

This study showed that the prevalence of HBV infection in Saudi Arabia was on average 0.15% (153 cases per 100 000 population) with wide variations between various regions. The prevalence was highest in Baha (0.72%), Hafr Albaten (0.35%), the Eastern region (0.33%) and Asir (0.26%), and was lowest in Tabook (0.05%), Jizan (0.04%) and Jouf (0.03%). The relatively high prevalence in Baha, which is located on the Sarawat mountains in the south-west of Saudi Arabia, may be due to the fact that the community in this region is somewhat closed. Marriage among partners from the same tribe or community is a common traditional practice in this region, suggesting that sexual transmission may be an important cause of the increased prevalence. However, this remains a speculation that needs to be confirmed in further studies. The prevalence of HBV infection among children (0.05%) was far lower than the prevalence among adults (0.22%). The cumulative number of reported HBV infections was notably low in infants (118 cases), indicating that perinatal transmission was not a major mode of transmission.

HBV vaccine has been included in the national childhood immunisation programme in Saudi Arabia since 1990. The vaccine was also routinely administered to children at school entry from 1990 to 1995. Before commencement of this programme, a national HBV seroprevalence study among 4575 Saudi children in December 1989 and January 1990 showed that 6.7% of children were positive for HBsAg and 19.7% of them were positive for any HBV marker (HBsAg, anti-HBs or anti-HBc) (Al-Faleh et al., 1992). An impressive positive impact of this programme on HBsAg seroprevalence in Saudi Arabia was demonstrated by Al-Faleh et al. (1999) in a national HBV seroprevalence study among 4791 vaccinated Saudi children in 1997. The study showed a significant

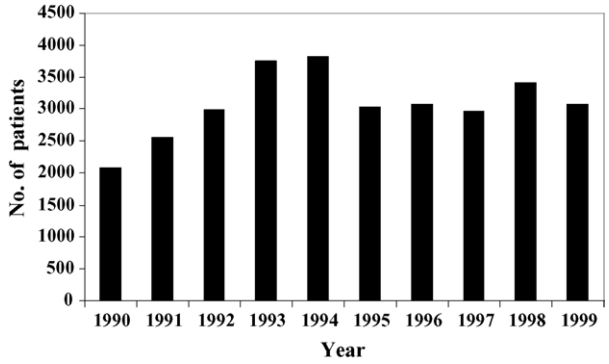

Figure 3 Annually reported hepatitis B virus infection cases in Saudi Arabia (1990—1999).

decline in HBsAg prevalence from 6.7% observed before the programme to 0.31% (15 of 4791 patients) 8 years after commencing the programme. The overall response rate to the HBV vaccine (anti-HBs titre of more than 10 IU/l) among 4087 vaccinated Saudi Arabian children up to 12 years of age was approximately 77% (Al-Faleh et al., 1999). It was noted that the seroconversion rate in those vaccinated at birth was 77% compared with 71% in those vaccinated at school entry (Al-Faleh et al., 1999). In a recent study among 13 443 blood donors in the Eastern region of Saudi Arabia, HBsAg prevalence was 2.58% in 1998 and 1.67% in 2001 (Bashawri et al., 2004). In another recent study in 2002 among 2664 pregnant Saudi Arabian women 12 years after commencing the HBV vaccine programme, 65 women (2.44%) were positive for HBsAg and 4 women (0.15%) were positive for HBeAg. The prevalence of HBsAg among pregnant women <20 years of age was significantly lower than that among older pregnant women (1/186 (0.5%) vs. 64/2478 (2.6%), respectively) (Al-Mazrou et al., 2004).

The current study showed the trend in incidence of HBV infection in different age groups over a decade of surveillance following commencement of the universal HBV vaccination programme. The incidence ranged from 2086 to 3827 cases per year over the surveillance period. Although there was no noticeable decline in the overall incidence (Figure 3), there was a clear decline in incidence among all three paediatric age groups, namely infants <1 year of age, children 1—4 years of age and children 5—14 years of age (Figure 2a—c). Such a clear decline in the incidence of HBV infection in children up to 14 years of age confirms the enormous positive impact of this programme in the prevention of transmission of this infection among children. The trend in incidence in the other age groups (15—44 years and >44 years) slightly rose (Figure 2d and e), perhaps owing to population growth estimated to be 3.3% annually over the surveillance period.

A positive impact of the HBV universal vaccination programme on the incidence of hepatocellular carcinoma in Saudi Arabia can be demonstrated by data from the National Cancer Registry showing a declining trend in the annually reported cases of hepatocellular carcinoma from 1994 through 2001 for Saudi Arabian patients <45 years as well as for patients ≥45 years of age. The total incidence per 100 000 Saudi population declined from 2.6 in 1994 to 1.9 in 2001 (unpublished data from the National Cancer Registry, Ministry of Health, Saudi Arabia).

The strategy to prevent HBV infection in Saudi Arabia is multifaceted. In addition to the universal childhood HBV vaccination programme, the strategy includes health education, routine screening of blood and organ donors for HBsAg and anti-HBs, proper sterilisation of surgical and dental equipment, and routine screening of high-risk subjects such as household and sexual contacts of HBV patients, haemodialysis patients, patients requiring recurrent blood transfusion, intravenous drug users and patients with other sexually transmitted infections. Additionally, HBV vaccine is routinely administered to all healthcare workers and high-risk subjects. Good hygienic practice in barbers shops and traditional therapy settings such as wet cupping (Hijama) is also emphasised in Saudi Arabia. Hepatitis B Ig is routinely administered to infants born to HBsAg-positive mothers and to susceptible healthcare workers following exposure to HBV virus in healthcare settings. All non-Saudi Arabians willing to be employed in Saudi Arabia are routinely screened for HBV infection pre employment and only HBsAg-negative subjects are permitted to work in Saudi Arabia.

In conclusion, the incidence of HBV infection in Saudi Arabia has markedly decreased among children as a result of the universal childhood HBV vaccination programme that was commenced in 1990. It is foreseeable that the incidence of this infection and its complications (cirrhosis and hepatocellular carcinoma) will also substantially decline among adults in the near future as the cohort of vaccinees grow older.

Conflicts of interest statement

The author has no conflicts of interest concerning the work reported in this paper.

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