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Abdulhakim Alabdulmunim Date

Evaluation of Reported Cases of the Hepatitis B Infection,

Kingdom of Saudi Arabia, 2014 – 2018

By Abdulhakim Alabdulmunim

Master of Public Health

Hubert Department of Global Health

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Scott JN McNabb, PhD, MS

Thesis Committee Chair

Evaluation of Reported Cases of the Hepatitis B Infection, Kingdom of Saudi Arabia, 2014 – 2018

By

Abdulhakim Alabdulmunim, BSc, Majmaah University (2015)

Thesis Committee Chair: Scott JN McNabb, PhD, MS

A thesis submitted to the Faculty of the

Rollins School of Public Health of Emory University

in partial fulfillment of the requirements for the degree of

Master of Public Health

in Hubert Department of Global Health 2020

ABSTRACT

Background: Hepatitis B virus (HBV) remains a significant global health concern, especially in nations such as the Kingdom Saudi Arabia (KSA), which experiences a large number of infectious ailments coupled with the lack of effective protection measures. The purpose of the study was to evaluate the reported cases of HBV in KSA between 2014 – 2018. This study should help policymakers and program planners in the implementation of appropriate interventions to monitor HBV through improving public health surveillance (PHS).

Methods: Data from the Ministry of Health (MoH) National Hepatitis Program (NHP) and the General Authority for Statistics in KSA were analyzed by year, gender, nationality, region, and age group. Mann-Whitney testing determined if there was a significant difference between two independent groups. If the p-value was < 0.05, there was a significant difference at the 95% confidence level (CI).

Results: There were 26,136 reported cases of HBV during the 5-year period 2014 – 2018. In 2014, the incidence rate (IR) of HBV was 14.2 (95% CI=13.8, 14.6) per 100,000 population compared with a significantly increased 22.2 (95% CI=21.7, 22.7) in 2018. Gender (p-value= 0.421) was not significant but Saudi versus non-Saudi was (p-value= 0.008). The greatest number of reported cases was found among those 15 – 44 years of age, followed by those > 45 years of age. Variations of IRs of HBV across regions were found; Makkah with the highest.

Conclusions: Despite the immunization program, HBV remains a significant health threat in KSA. The KSA MoH should strengthen public health surveillance (PHS) to monitor and evaluate the risk of the disease across the nation. Public health stakeholders and decision-makers should shift their attention to preventive mechanisms that will reverse the trend of rising HBV cases, hence achieve public health goals.

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Chapter 1

Introduction

Hepatitis B virus (HBV) is a widespread global infection (28). Estimated that two billion people worldwide have been infected with HBV, 360 million have chronic infections and 600, 000 die each year (26). A DNA virus classified in the virus family Hepadnaviridae (26), it is 42– 47 mm in diameter; concentrations in blood may reach 10^8 virions per ml (27). HBV is restricted to humans with no animal reservoirs and transmitted through blood or other body fluids of infected individuals. Infants, healthcare workers, people having contact with those infected by HBV, drug addicts, and blood donors are at high risk for HBV.

Diagnosis through serologic markers in blood tests identifies different stages of HBV infection and those highly vulnerable to complications. A contagious, liver-based infection caused by HBV, manifestations of hepatitis B differ from person to person. The acute phase occurs within six months of infection and is accompanied by negligible symptoms (12). Liver damage due to HB affects the body immune responses.

There are several methods to avoid HBV infection. One is HBV vaccine. Vaccines that protect people from HBV infection have existed > 40 years (27). Immunization promotes the development of antibodies against this virus resulting in long-term protection. Unfortunately, vaccination may fail because of improper storage of vaccine doses, obesity, chronic liver diseases, or renal failure of an immunized person (27). It is essential to implement prenatal screening programs to identify pregnant women with HBV so as to prevent virus transmission from mother to child. Additionally, some countries have implemented programs focused on

providing free, clean syringes to intravenous drug users. Despite these prevention efforts, HBV is widespread and dangerous.

Background

In the Kingdom of Saudi Arabia (KSA) and other countries in the Middle East, limited data describes the extent and prevalence, and these estimates come from the Ministry of Health (MOH) (17). While the KSA MOH is monitoring the number of case reports, there is insufficient information regarding additional risk factors (e.g., social status and race). There are factors that inhibit the understanding and identification of HBV rates, including the lack of appropriate infrastructure and qualified staff (17). Despite these challenges, there is a large vaccination campaign in KSA, focused on HBV-eradication efforts through the implementation of an immunization program in 1989 (1). While there was a reported drop of 6.7 % in ten years since instituted, the KSA still faces problems with the reduction of the HBV (7). KSA is now experiencing an exponential increase in the number of chronic HBV infections. As of 2007, KSA reported 9,000 new known cases of hepatitis, with about 52% of these being HBV (8).

The increase in infections can be attributed to several factors (e.g., blood donation and drug users, lack of public health surveillance [PHS] (6,9). Shared needles among drug users is a leading mechanism for HBV spread (17). The existing prejudice and stigmatization directed towards drug users render it difficult for the addicts to openly participate in preventative efforts by using safer methods when using drugs (17). Cultural factors equally contribute to the rising cases of HBV, such as unsafe ear- piercing practices (17). Lack of proper screening procedures and equipment during blood donations is another means through which HBV is spread in the nation. Specifically, the infection is linked to blood transfusion among pregnant

women and people with hematological disorders (20). In KSA the level of occult HBV Infection (OBI) is 0.3% among blood donors (12). OBI is a health complication associated with untraceable levels of HBsAg and low serum quantities in the liver. Minimizing the transmission of HBV through blood donation necessitates the effective screening of blood donors using sensitive molecular techniques.

Statement of Problem

The HBV incidence rate in KSA is increasing at an alarming level. Studies indicate that the worrying factor is that HBV has no known treatment, whereas transmission methods continue to increase (1). Prevalence is neither age-specific nor gender- specific since both men and women, and the young and the old contract HBV. To reduce infection rates, the preventive and distribution channels must be understood; specifically, intervention and strategies to reduce new cases. The system must incorporate better follow-up patient policies and generate more efficient PHS for diagnostic purposes.

Rationale

The available literature show case gaps in KSA HBV trends and prevalence across nationality and gender lines that hinder the goal of eliminating HBV (1). This study addressed these gaps and will aid the understanding of HBV infection trends. The analyses of risk factors that caused HBV infections, symptoms exhibited by the affected patients, and the incubation period findings from this study will provide a greater understanding of HBV infection in KSA; this includes age, gender, nationality, and region. This will inform prevention efforts and best strategies to stem the HBV crisis. This study will help policymakers and program planners in the implementation of appropriate approaches to monitor HBV through the evaluation and

utilization of HBV PHS programs. Ultimately, the study will play an essential role in reducing and eliminating HBV infection in the country.

Objectives

- Estimate the HBV trends in KSA between 2014 and 2018
- Analyze the incidence rate of HBV in the KSA by regions, gender, nationality groups
- Conduct comparisons on HBV cases across different age groups

Chapter 2

Literature Review

Global Hepatitis B

A global hepatitis report published by the World Health Organization (WHO) in 2017 showed the extent to be severe and stated in 2015 there were 2.7 million individuals infected and 1.34 million deaths caused by HBV. The number of deaths matched those caused by tuberculosis (TB) and were more than caused by HIV (28). Moreover, while mortality caused by TB and HIV was declining, deaths caused by HBV have increased. Further, if left untreated, it results in the development of deadly health-related conditions (e.g., cirrhosis and hepatocellular carcinoma). About 720,000 die each year because of cirrhosis caused by HBV or HCV, and 470.000 die because of carcinoma. Between 15% – 25% of people with chronic HBV die because of cirrhosis or liver cancer (24).

HBV infection is dangerous; however, mass media do not pay as much attention to HBV as to HIV or other diseases. Many are unaware of potential threats by HBV, which puts them at risk infection. In 2016, the WHO adopted the Global Health Security Strategy (GHSS) on viral hepatitis (28). This focused on eliminating HBV threats and eliminating it as a public health threat by 2030. This report showed the prevalence of HBV infection was greatest in Africa (8.5% infected) and high in the Eastern Mediterranean Region (4.3% infected), while lowest in America and Europe (WHO, 2017).

As for the Middle East, data on HBV is often not available making it difficult to estimate the extent of the problem (17). Some data show HBV is consistently a problem in the Arab world; its prevalence ranges from 2% – 8% in different countries. According to WHO, The

highest rates of HBV are observed in Yemen (5.1%), Sudan (> 8%), Syria (2 – 7%), Tunisia (2 – 7%), Libya (2 – 7%), UAE (2 – 7%), Qatar (2 – 7%), Bahrain (2 – 7%), Mauritania (2 – 7%). In some countries, there are data on HBV prevalence. As for KSA, the estimated HBV prevalence is 4.25% (17).

Several risk factors cause high HBV rates in Arab countries. There is a lack of qualified staff and infrastructure linked to blood transfusion. Donation of blood occurs in an emergency; persons are rarely screened for HBV (17). Further, some countries in this region may use ineffective HBV tests, such as the Rapid test kits, which have low sensitivity and often provide false results. As for drug users, their prevalence of HBV is 18.5% in KSA and 16% in Syria (17). The problem is that many drug users hide their addiction because of stigmatization and prejudice in society toward this at-risk population. As for culture-specific risks of HBV, people can become infected through unsafe ear piercing, which is a common practice in Arab countries (17).

The spread of hepatitis in KSA is problematic. While KSA is a developed country, HBV rates there are high. In 2007, the KSA Ministry of Health (MoH) reported hepatitis to be the second most common viral disease behind chickenpox (1). In 2007, 9,000 new hepatitis cases were reported each year; 52% were HBV. The prevalence of HBV infection has changed significantly in the past 30 –40 years. In 1988, the overall prevalence of HBV was 8.3% (3). However, it dropped, and in 2013 was 4.25% (17).

In 1989 KSA launched a mass vaccination program for citizens and instigated another initiative focused on vaccinating children in 1990 (1). This was meant to ensure the country's population prioritized the measures taken to curb the disease. Additionally, the government

introduced a mandatory vaccination of healthcare workers and hemodialysis patients and intravenous drug users (1). Consequently, the spread of the disease at healthcare centers was curtailed, enhancing the country's wellbeing. The percentage of hemodialysis patients infected by HBV was about 5.88% by 2004 (8). Additionally, people contracted HBV during dental services (22), and the dentists 'risk of exposure to HBV was six times greater compared to the general population (25). KSA MoH policy has played a significant role in reducing HBV. Additionally, universal blood bank screening was implemented, and public awareness regarding HBV became significantly greater. About 80% of people living in KSA have heard about HBV (16). Further, education among medical professionals is adequate about HBV.

The living conditions of KSA people has improved, resulting in a decrease of HBV. Still, HBV in KSA remain high compared to other developed countries; it is essential to implement more effective strategies and measures to protect people from this viral infection. In the past several years, the incidence rate of HBV infection has slightly increased from 11.060/100.000 in 2015 to 22.242/ 100.000 in 2018 (23). According to Alshabanat, *et* al. (2013) the distribution of HBV in KSA varies by region (10). HBV cases reported in Jeddah in 2013 were 5,625 , representing 23.7% of the country's totalincidence (10). The reason for the high percentage in KSA's port city compared to other regions is the enhanced exposure to HBV risk factors, considering that Jeddah's commercial and gateway attributes toward pilgrims make it attractive to people from various parts of the world. Riyadh recorded the second-highest HBV cases by 2013, with 4,400 reported cases representing 18.6% of total infections (10). Moreover, KSA Eastern province had 3,343 cases, representing 14% of total ,while Medinah had 1,943, which was only 8.2 %of total infections .

However, we must understand that population in these regions varies significantly. A study by Al-Raddadi, *et* al. (2016) showed the highest seroprevalence of HBV was in Medinah (9.02%), eastern region (6.7%), and south-western region (8.7%); the lowest prevalence rate was in Riyadh (1.5%) (6). In most of theleading cities, HBV is spread predominantly through sexual contact, contaminated syringes among drug users, and from mother to child. Therefore, understanding HBV prevalence by region helps the government to institute practical remedial actions.

Studies focused on gender in KSA do not show significant differences. For instance, the study by Al-Humayed (2017), which included 1,532 participants from the Tihamet Aseer area aged from 8 – 81 years, found HBV prevalence rates were approximately the same between men and women (4). However, studies indicated that men in KSA infected with HBV had a greater chance of developing cirrhosis and chronic liver disease. This can be explained by the fact that estrogen, has a positive protective effect on the liver. KSA MoH showed that in 2018 there were 3,351 cases of new HBV infections among men and 2,253 among females (23). The gender composition of KSA is approximately the same, so men have higher risks of becoming infected with HBV. However, in one study by Al Ajlan (2011), the HBsAg rates were reversed for men and women; the prevalence rate of HBsAg for males was 0.17% and 0.78% for females (2). HBsAg indicates that a person is infected with HBV; however, this person may remain asymptomatic. Rates were different in this study likely because the sample used consisted of students, and in general, prevalence rates of HBV among this population are lower compared to the general population (2). While studies show controversial results, official MoH statistics show that men are more likely to become infected with HBV compared to women (23).

However, there are also various factors influencing the chances of becoming infected, such as education and socioeconomic status. Hence, in some regions and in some cases, women may be at higher risk of becoming infected with HBV.

As for HBV by nationality, the KSA MoH reported that the incidence rate among Saudis in 2018 was 26.98/100.000 population, while the incidence rate among non-Saudis was 14.46/100.000 (23). This could be attributed that pre-employment medical checkups of expatriates to the KSA. Unfortunately, there is a lack of information on the non-Saudi HBV incidence rates, by nationality. The incidence and prevalence rates among non-Saudis may vary depending on nationality and native country. Non-Saudis with better education and from developed countries are less likely to be infected with HBV or to become infected with HBV in KSA. In contrast, people from developing countries may have higher risks of being infected.

Age is another variable associated either with increased risk of contracting HBV infection. The older a person gets, the higher their chance of becoming infected with HBV. Studies found that in the past several decades, HBV rates have significantly decreased among all age groups (5). For instance, the average HBV prevalence among children belonging to the following age groups: >1 yo; 1– 4yo ;and 5 – 14yo were 1.1, 0.3, and 2.1/100 000 , respectively. Interestingly ,the prevalence of HBV infection of people aged <15 years compared to those aged <15 years was 20 times greater. For those aged <15, the average annual prevalence rate was 1.2/100,000, and for the population aged 15>, it was 24.2/100,000 (5).

Before the vaccination campaign, the overall prevalence of HBsAg equaled to 6.7% in all age groups; however, the overall prevalence of HBV declined between 2004 and 2013 by 47.34% in Eastern KSA region following vaccination (5). While the decline in incidence has been

significant after the vaccination implemented in 1990, there was a slight increase in adult incidence rates in 2005, attributed to population growth of KSA (21). Statistics indicated that vaccination is useful, and has long-lasting positive effects on reducing rates of HBV. Immunization does not require many resources and can be implemented relatively quickly.

It is also important to mention the additional factors that affected people in KSA. There are at-risk groups, which have higher chances of becoming infected with HBV. For instance, blood donors often get infected by transfusion-transmissible HBV. The study conducted by Alzahrani, *et* al. (2019) found HBV prevalence increased from 2011 to 2012; however, it decreased in 2013 (12). The authors screened blood donors for HBsAg, anti-HBc, and HBV DNA using the HBsAg Qualitative II kit (12). Using HBsAg tests for screening is a somewhat effective strategy for reducing transfusion-transmissible HBV. However, the results provided by HBsAg tests may not always be valid, and may not find the presence of a virus in a donor's blood. However, in the vast majority of cases, a simple HBsAg test can be useful.

Unfortunately, many infections in KSA occur during the prenatal period, when pregnant women are infected with HBV. The statistics show different rates of HBV infection among this population, and the meta-analysis conducted by Malekifar, *et* al. (2019) stated that HBsAg prevalence ranges from 1.6% to 7.5% (13). The pooled prevalence in KSA is 2.63%, as it was found in the samestudy (21).

The study by Alrowaily, *et* al. (2008) found that the HBV prevalence rate among pregnant women was 1.6% (9). In 1984, the prevalence rate among this population was 2.8% (14). Hence, there is a slight decrease in HBV prevalence rate among pregnant women in the last 40 years. Heroin drug users are another at-risk group, which has high HBV prevalence

rates. The prevalence of HBsAg among this population is 7.7% (11). Furthermore, 12.3% of heroin drug users are infected by HBV andHCV (11). The vast majority of individuals suffering from HBV are aged 30 years and more, which may be associated by the 1989 vaccination program.

Chapter 3

Manuscript

Hepatitis B virus (HBV) is a widespread global infection (28). Estimated that two billion people worldwide have been infected with HBV, 360million people have chronic infections, and 600, 000die each year (26). A DNA virus classified in the virus family Hepadnaviridae (26) ,the virus is 42-47 mm in diameter and its concentrations in blood may reach 10^8 virions per ml (27). HBV is restricted to humans with no animal reservoirs and transmitted through blood or other body fluids of infected individuals. Infants, healthcare workers, people having contact with those infected by HBV, drug addicts, and blood donors are at high risk of HBV.

Diagnosis through serologic markers in blood tests identifies different stages of HBV infection and those highly vulnerable to complications. A contagious, liver-based infection caused by HBV, manifestations of hepatitis B differ from person to person. The acute phase occurs within six months of infection and is accompanied by negligible symptoms (12). Liver damage due to HB affects the body immune responses.

There are several methods to avoid HBV infection. One is HBV vaccine. Vaccines that protect people from HBV infection have existed > 40 years (27). Immunization promotes the development of antibodies against this virus resulting in long-term protection. Unfortunately, vaccination may fail because of improper storage of vaccine doses, obesity, chronic liver diseases, or renal failure of an immunized person (27). It is essential to implement prenatal screening programs to identify pregnant women with HBV so as to prevent virus transmission from mother to child. Additionally, some countries have implemented programs focused on

providing free, clean syringes to intravenous drug users. Despite these prevention efforts, HBV is widespread and dangerous.

In the Kingdom of Saudi Arabia (KSA) and other countries in the Middle East, limited data describes the extent and prevalence and these estimates come from the Ministry of Health (MOH) (17). While KSA MOH is monitoring the number of case reports, there is insufficient information regarding additional risk factors (e.g., social status and race). There are factors that inhibit the understanding and identification of HBV rates, including the lack of appropriate infrastructure and qualified staff (17). Despite these challenges, there is a large vaccination campaign in KSA, focused on HBV- eradication efforts through the implementation of an immunization program in1989 (1). While there was a reported drop of about 6.7% in ten years since instituted, KSA still faces problems with the reduction of the HBV (7). KSA is now experiencing an exponential increase in the number of chronic HBV infections. As of 2007 ,KSA reported 9, 000 new known cases of hepatitis, with about 52% of these being HBV (8).

The increase in infections can be attributed to several factors (e.g., blood donation and drug users, lack of public health surveillance [PHS] methods) (6,9). Shared needles among drug users is a leading means of spreading HBV (17). The existing prejudice and stigmatization directed towards drug users render it difficult for the addicts to openly participate in preventative efforts by using safer methods when using drugs (17). Cultural factors equally contribute to the rising cases of HBV, such as unsafe ear-piercing practices (17). Lack of proper screening procedures and equipment during blood donations is another means through which HBV is spread in the nation. Specifically, the infection is linked to blood transfusion among pregnant women and people with hematological disorders (20). In KSA the level of occult HBV

Infection (OBI) is0.3 %among blood donors (12). OBI is a health complication associated with untraceable levels of HBsAg and low serum quantities in the liver. Minimizing the transmission of HBV through blood donation necessitates the effective screening of blood donors using sensitive molecular techniques.

The HBV infection rate in KSA is increasing at an alarming rate. Studies indicate that the worrying factor is that HBV has no known treatment, whereas transmission methods continue to increase (1). Prevalence is neither age-specific nor gender-specific since both men and women, and the young and the old contract HBV. To reduce infection rates, the preventive and distribution channels must be understood; specifically, intervention and strategies to reduce new cases. The system must incorporate better follow-up patient policies and generate more efficient PHS for diagnosis purposes.

The available literature showcases gaps in KSA HBV trends and prevalence across nationality and gender lines that hinder the goal of eliminating HBV (1). This study addresses those gaps and will aid the understanding of HBV infection trends. The analyses of risk factors that cause HBV infections, symptoms exhibited by the affected patients, and the incubation period findings from this study will provide a greater understanding of HBV infection in KSA; this includes age, gender, nationality, and region. This will inform prevention efforts and best strategies for stemming the HBV crisis. This study will help policymakers and program planners in the implementation of appropriate approaches to monitor HBV through the evaluation and utilization of HBV surveillance programs. Ultimately, the study will play an essential role in reducing and eliminating HBV infection in the country.

Data Sources

In the KSA region, PHS teams have the responsibility of updating the MOH's National Hepatitis Program (NHP) about the status of hepatitis B in the population. They are expected to send monthly reports of HBV infections that have been confirmed in the laboratory. Some of the data items included in the PHS reports include demographic aspects such as nationality, age, and gender, in addition to epidemiologic and clinical data. In this study, we retrieved population data from the General Authority for Statistics. This population data was recorded in the period 2014 – 2018.

Study Variables

Several variables included in this study are the administrative region and nationality. Others include the age group and the gender of the participants. The nationality consists of the KSA nationals and foreigners (non-Saudis). The age groups were divided into five: less than one year, 1 – 5 years, 5 – 15 years, 16 – 44 years, and > 45 years of age. This study included data from different administrative regions across KSA (Northern Border, Riyadh, Aseer, Eastern, and Quassim. Others are Najran, Makkah, Al-Jouf, Hail, Tabbouk, Al-Baha, and Madinah in addition to Jazan).

Statistical Analyses

Descriptive analyses were performed to determine the burden of HBV in the population and the rate of disease occurrence.

We calculated the incidence rates (IRs) per 100,000 persons > five years (2014 – 2018) based on the different variables (i.e., gender, age, nationality, and administrative region). Similarly, the number of cases was calculated over the period 2014 –2018. Mann-Whitney test

is a nonparametric test used to determine if there is a significant difference between two independent groups. This comparison was based upon the confidence interval for the sample mean calculated. If the p-value is less than 0.05, there is a significant difference between the two values at that 95 % confidence level.

Ethics

This research involved secondary data analyses without personal identifiers. Thus, it did not meet the definition of human subject's research and was classified as exempt by the Emory University Institutional Review Board.

Results

The total number of reported HBV infections was 26,136 cases for the period 2014 – 2018. Over a 5-year period of monitoring for HBV infection from 2014 – 2018, there was a significant increase in the incidence rate from 11.1 per 100,000 population in 2015 to 22.2 in 2018. The lowest incidence rate was 11.1 (95% CI= 10.7, 11.4) for 2015. We found the smallest incidence rate was between 2014 – 2016, but incidence rate rose to > 20 for 2017 and 2018 (Table 1).

Table 1. Reported Cases of Hepatitis B Virus Infection and Incidence Rates, Kingdom of Saudi Arabia, 2014 – 2018

Year	Cases	Incidence rate*	95% CI°
2014	4,323	14.2	13.8 – 14.6
2015	3,486	11.1	10.7 – 11.4
2016	4,327	13.6	13.2 – 14.0
2017	6,568	20.1	19.6 – 20.6
2018	7,432	22.2	21.7 – 22.7
Total	26,136		

*Incidence rate/100,000 population
°CI : confidence interval

When studying the number of cases, by gender, Mann-Whitney test was non-significant showing that we could reject the hypothesis that the behavior of male and female were the same (p-value = 0.421). We found the number of cases among males and females was comparable in 2016. However, from 2014 until 2017, the incidence rate was significantly greater among males than females. In 2017, the difference in the number of cases was marked; 17.5 (95% CI= 16.9, 18.3) among females compared to 22.1 (95% CI=21.4, 22.7) among males. There was substantially increase in the incidence rate for females, from 8.9 in 2015 (95% CI = 8.4,9.4) to 24.2 in 2018 (95% CI = 22.4, 25.1). There was an increase in the incidence rates for males between 2015 and 2017, from 12.6 in 2015 (95% CI = 12.1, 13.2) to 22.1 in 2017 (95% CI = 21.4, 22.7) (Table 2).

Table 2. Reported Cases of Hepatitis B Virus Infection and Incidence Rates, by Year and Gender, Kingdom of Saudi Arabia, 2014 – 2018

Year	Female		Male	
	Cases (IR°)	95% CI°	Cases (IR°)	95% CI°
2014	1575 (12.1)	11.5 – 12.6	2748 (15.9)	15.3 – 16.5
2015	1244 (8.9)	8.4 – 9.4	2242 (12.6)	12.1 – 13.2
2016	1656 (14.5)	13.9 – 15.1	2671 (14.6)	14.1 – 15.2
2017	2436 (17.5)	16.9 – 18.3	4132 (22.1)	21.4 – 22.7
2018	3435 (24.2)	22.4 – 25.1	3997 (20.7)	20.1 – 21.4
Total	7976		11774	

IR° : incidence rate/100,000 population
CI° : confidence interval

Using Mann-Whitney to compare nationality groups, we found that Saudi and non-Saudi citizens were different (p-value = 0.008). When we studied the incidence rate of hepatitis B by nationality, we found in 2014 the incidence rate was 17.4 (95% CI= 16.9,18.1) per 100,000 Saudi citizens compared to 7.7 (95% CI=7.1,8.2) per 100,000 non Saudis. So, the smallest difference in the incidence rates occurred in 2015. Saudi citizens had a 2 – 3 times greater HBV incidence than non-Saudis in 2014. The greatest difference in incidence rates between Saudis citizens and non-Saudis occurred in 2014 and 2016. There was substantially increase for Saudi citizens from 13.1 in 2015 (95% CI = 12.6,13.6) to 26.9 in 2018 (95% CI = 26.2,27.9). For non-Saudis, we found 7.3 in 2015 (95% CI=6.8,7.8) to 14.4 in 2018 (95% CI = 13.7,15.1). However, during 2014 – 2018, the incidence rate was significantly greater among Saudi citizens than Non-Saudis. (Table 3).

Table 3. Incidence Rate of Hepatitis B Virus Infection and Incidence Rates, by Year and Nationality, Kingdom of Saudi Arabia, 2014 – 2018

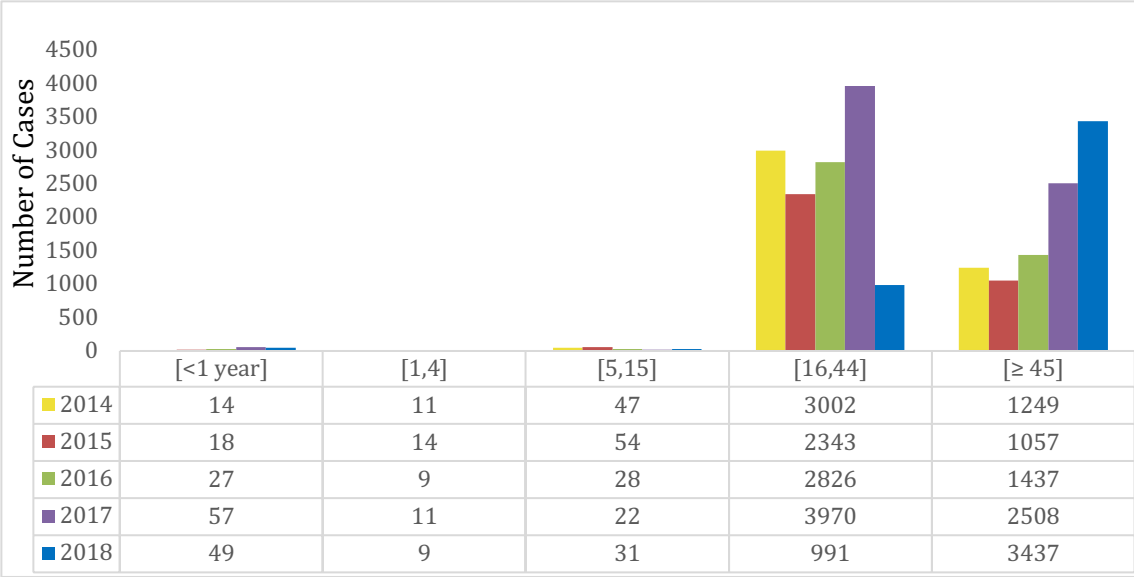
Year	Saudi		Non-Saudi	
	Cases (IR°)	95% CI°	Cases (IR°)	95% CI°
2014	3547 (17.4)	16.9 – 18.1	776 (7.7)	7.1 – 8.2
2015	2732 (13.1)	12.6 – 13.6	754 (7.3)	6.8 – 7.8
2016	3403 (16.9)	16.3 – 17.52	924 (7.8)	7.3 – 8.4
2017	4754 (23.2)	22.6 – 23.9	1814 (14.9)	14.2 – 15.6
2018	5604 (26.9)	26.2 – 27.7	1828 (14.4)	13.7 – 15.1

IR° : incidence rate/100,000 population
CI° : confidence interval

By age group, those in the 16 – 44 year-old age range had the majority of hepatitis B cases over 2014 – 2017 period (13,132 cases). This group represents between 60% and 86% of cases in all age groups. In the over-45 age group, there were 9,688 cases; among those aged 5-15 years, there were 182 cases; among those aged 1-5 years, there were 54 cases; and among those under

one-year old, there were 165 cases. We note that 2,915 cases with unknown age in 2018, so we can not assume that the number was decreasing for this year, but we excluded it from our age variable (Figure 1).

Figure 1. Reported Cases of Hepatitis B Virus Infection, By Year and Age Category, Kingdom of Saudi Arabia, 2014 – 2018

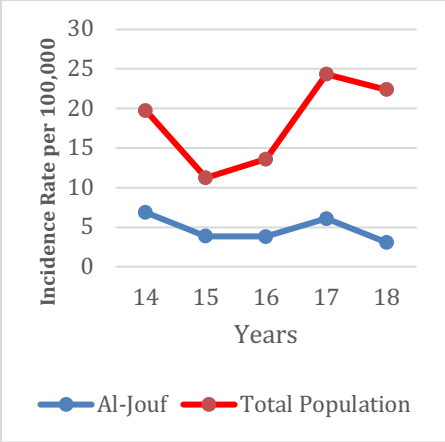


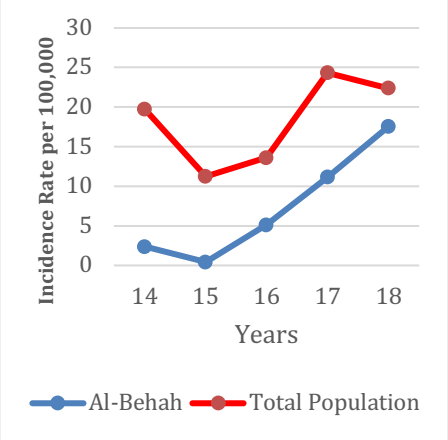
	[<1 year]	[1,4]	[5,15]	[16,44]	[≥ 45]
2014	14	11	47	3002	1249
2015	18	14	54	2343	1057
2016	27	9	28	2826	1437
2017	57	11	22	3970	2508
2018	49	9	31	991	3437

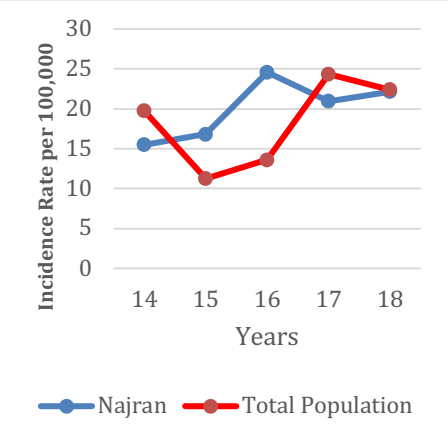
Breaking down the hepatitis B cases by administrative region, massive variations was noted. over the 5-years PHS period, the number of hepatitis cases was highest in Makkah. The second highest overall was in Najran region, followed by in Northen and the Jazan region for 2017 and 2018. The lowest number of cases over the study period was seen in Hail an region, followed by Quassim and Al-Jouf regions. Also, we found that for Riyadh, Makkah, Medinah, El Baha and Jazan regions, the number of cases and the incidence rate were increasing over the 2014-2018. The number of cases was decreasing over the 2014-2018 in Asser Tabbouk and Al-Jouf region and the Incidence rate was decreasing over the 2014-2018 in Quassim, Hail and Al-Jouf region. (Figure 2)

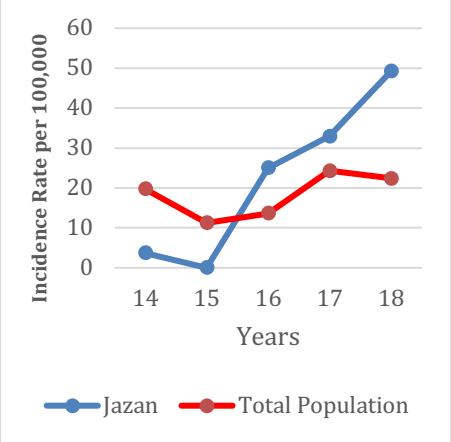
Figure 2-1. Incidence Rates of Hepatitis B Virus Infection, by year and Region, Kingdom of Saudi Arabia, 2014 – 2018

Figure 2-2. Incidence Rates of Hepatitis B Virus Infection, by year and Region, Kingdom of Saudi Arabia, 2014 – 2018









Discussion

The primary purpose of this study was to evaluate changes in the incidence rates of HBV over a period of five years, 2014 – 2018. The study sought to understand how the incidence rates of HBV differed across administrative regions, nationalities, age groups, and gender. The highest incidence rate was observed in 2018 at 22.2 cases per 100,000 population compared to the lowest rate in 2015 at 11.1 cases per 100,000. These findings contrasted with the results of Aljumah *et* al., 2019 who recorded a significant decline in HBV incidence from 19.3 in 2009 to 14.7 in 2013. The disparities due to nationality and gender were greatest in 2018, as indicated by the incidence rate of 26.9 and 15.1 for Saudis and non-Saudis, respectively. In the period 2014 – 2017, the incidence rate of HBV was greater in males than females. Over the period 2014 – 2018, the age group with the highest incidence of HBV was 16 – 44 years old. When regions were considered, Makkah recorded the greatest number of HBV cases during the study period.

The rising cases of HBV in KSA are surprising considering the emphasis by the government on immunization. Probably, the high incidence is due to a low diagnostic rate, which makes some people infectious unknowingly (7). Poor adherence to medication may raise the risk of infections and can explain the high burden of HBV (7). A significant disparity is observed between Saudi nationals and non-Saudis and can be explained by a higher HBV examination of the latter in their countries of origin. The data also show a higher burden of HBV among males than females. Since most of the data are derived from blood donor registers that consists of more males than females, the incidence of HBV seems to be biased towards males (1). Further, the high burden of HBV in the people aged 16 years and a low incidence in

children could be due to the absence of a HBV vaccination program for adults. A higher age also means a long duration of being exposed to the disease.

The strength of this study lies in the use of data that covered multiple administrative regions in KSA, hence higher external validity. Besides, we relied on recent data that represented the actual state of HBV infections. However, there are several limitations that prevented the author from providing a comprehensive overview of the state of HBV incidences in KSA. First, the data does not include some critical aspects such as marital and employment status that could also explain differences in infections. The study also lacked details of the mortality and survival rates of the HBV cases. Another concern was the inclusion of data from three groups only: high-risk; couples; and blood donors. The use of data from the entire population would provide a better assessment of the HBV problem. The KSA MoH should strengthen PHS to capture all cases of HBV and hence provide an accurate incidence rate.

HBV is a significant healthcare problem that continues to face the population in KSA. Despite the government-led initiatives such as vaccination and screening, a substantial proportion of the people are grappling with the disease that is associated with adverse consequences, including morbidity and mortality. It raises the healthcare expenditure in addition to lowering the quality of life as people struggle with a chronic illness. The high burden of HBV in KSA depicts a country that is still struggling to safeguard the wellbeing of the people. All public health stakeholders must be concerned about the overall plan to manage the disease. They must evaluate their decisions to find out whether they are meeting the intended public health objectives. In this regard, a more holistic public health approach is needed if the government is committed to alleviating the burden of HBV in the population. The KSA MoH

should strengthen PHS to monitor and evaluate the risk of the disease across the nation. Prevention strategies should be aligned to the behavior and needs of the population, including the high-risk groups. Importantly, the policies and strategies employed by MOH should be based on intensive research of the health gaps in the community.

The public health stakeholders must redefine their priorities to reverse the worrying trend of HBV infections. Moreover, additional studies are required to test various hypotheses that have emerged from the current research. For example, there is a need for a thorough investigation to understand the reasons for HBV disparities between the Saudi nationals and non-Saudi. Besides, more research should provide evidence to explain the high incidence of HBV in males relative to females. The research findings will guide the government in identifying the risk factors for HBV infection, followed by sensible strategies to protect the population and reduce the incidence rate.

Chapter 4

Conclusion and Recommendations

This study showed hepatitis B infection to be a major healthcare problem in KSA. Every individual across the age spectrum must be concerned about their HBV status. The disease exposes the population to morbidity and mortality while raising government expenditure in managing the situation. Public health stakeholders and decision-makers must shift their attention to preventive mechanisms that will reverse the trend of rising HBV cases, hence achieve public health goals.

Strengthen of Public Health Surveillance (PHS)

The government must strengthen PHS to identify all cases of the disease and institute immediate treatment to prevent further infections. This will ensure early detection of the infection in addition to having an accurate outlook of the HBV in the community. Screening should be increased among the individuals > 16 years of age. Contact tracing of all infected individuals is recommended to link them with healthcare services (7). The public health department should develop a patient registry to keep track of all cases of HBV and help the country actual burden and incidence of the disease. Since the study has depicted different risks across various population groups, the public health authorities must align prevention and control strategies with the degree of vulnerability.

Vaccination Programs

KSA has an expanded HBV vaccination program since 1990 in response to an increased burden of the disease. All newborns receive HBV vaccine. A catchup program was conducted

for older children by ensuring mandatory vaccination for the children enrolled in school in the period 1990 – 1996 (7). However, the effectiveness of the program is in doubt, as the current study has demonstrated a disproportionately higher burden of the disease among individuals aged 16 years and above. In this regard, the government should initiate another comprehensive vaccination program that will cover all the at-risk individuals (19). Importantly, all the individuals should be followed up to ensure they comply with vaccination guidelines of initial and booster doses (18). This intervention will prevent further infections and protect the public from the complications of HBV, such as fatal liver damage.

Maternal Screening

The KSA MoH should upscale maternal screening of HBV since they are at risk of exposing unborn children. Mothers who test positive for HBV should receive antiviral therapy to reduce the viral load and hence lower the probability of neonatal infections (15). Children born of HBV positive mothers should receive HBV immunoglobulin in addition to the hepatitis B vaccine within 12 hours after birth (15). This intervention will reduce instances of maternal-fetal transmission of HBV.

Community Awareness

As part of the HBV prevention strategies, the KSA MoH should develop public health education programs to raise community awareness levels of hepatitis B. The educational interventions should target the general population in addition to the high-risk groups (7). They should include information on the risk of infections such as unprotected sexual contact, injection drug use, and maternal transmission to the newborns. Therefore, enhanced public knowledge will enable the public to embrace vaccination and screening interventions.

They will make personal decisions that will have a community-level effect in keeping the infections low. A population-centered educational initiative will ensure buy-in by the community members and public goodwill.

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