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High prevalence of active and occult hepatitis B virus infections in healthcare workers from two provinces of South Africa

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ABSTRACT

Background: Hepatitis B (HB) is a vaccine-preventable liver disease caused by infection with the blood-borne hepatitis B virus (HBV). South African healthcare workers (HCWs) may be at high risk of occupational exposure to HBV infection, since previous studies have found suboptimal levels of protection against HBV in HCWs.

Methods: A descriptive prevalence study based on self-administered questionnaires with data on demographics and HB vaccination status, and stored serum samples collected from 2009 to 2012, from 333 HCWs working or studying in Gauteng and Mpumalanga province hospitals or nursing colleges, was conducted. Samples were tested for HB surface antigen (HBsAg), antibodies to HBsAg (anti-HBs), antibodies to HB core antigen (anti-HBc), and HBV deoxyribonucleic acid (DNA).

Results: The majority of HCWs from whom the serum samples were drawn were black (91.4% [298/326]), female (82.6% [275/333]) and had received at least one dose of HB vaccine (70.9% [236/333]). The average age was 38.8 years (range: 19–62). Of the HCWs, 23.2% (73/314) were susceptible (negative for all markers); 9.6% (30/314) were infected (HBsAg and/or DNA positive); 29.0% (91/314) were exposed (positive for either HBsAg, anti-HBc, or DNA); 18.8% (59/314) were immune due to natural infection (anti-HBs and anti-HBc positive only); while 47.8% (150/314) were immune due to vaccination (anti-HBs positive only). Furthermore, HBV DNA was detected in 8.6% (27/314) and occult HBV infection (OBI) (HBV DNA positive but HBsAg negative) was found in 6.7% (21/314) of samples.

Discussion and conclusion: This study, which is the first to report OBI in South African HCWs, found high rates of active HBV infection and sub-optimal protection against HBV in HCWs. There is a need to strengthen vaccination programmes through a policy that ensures protection for all HCWs and their patients.

1. Introduction

Hepatitis B (HB) is a vaccine-preventable liver disease caused by hepatitis B virus (HBV) infection. It is a major global public health concern, with approximately 240 million people being chronic carriers (i.e. HB surface antigen [HBsAg] positive for >6 months), of which up to 700,000 die each year from cirrhosis or hepatocellular carcinoma [1]. HBV is highly endemic (⩾8% of the population is HBsAg positive) in sub-Saharan Africa [2].

Before the introduction of universal infant vaccination against HB in South Africa in 1995, HBsAg carriage in the black population was estimated at ~10%, while >70% had been exposed (i.e. positive for any HBV marker) to HBV [3]. HBV is a blood-borne virus, thus healthcare workers (HCWs) who work with patients' blood and body fluids are at high risk of occupational exposure. South African HCWs are at particularly high risk, since human immunodeficiency virus (HIV)/HBV co-infection is common in South African patients, with HIV co-infection being a well-established risk factor for increased HBV replication and transmission [4].

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Immunisation of HCWs against HBV is crucial for infection control, thus the South African National Department of Health (SANDoH) recommends all HCWs be vaccinated against HBV before being exposed to patients. However, limited studies investigating antibodies against HBsAg (anti-HBs) among South African HCWs have found sub-optimal levels of protection against HBV, with only 30.6–52.4% having protective levels of anti-HBs (i.e. anti-HBs ⩾ 10mIU/ml) [5,6]. This study aimed to determine the prevalence of HBV markers of susceptibility, protection, exposure and infection in HCWs working in two provinces of South Africa, stratified by vaccination status.

2. Methods

This descriptive prevalence study used (a) demographic and HB vaccination status data and (b) blood specimens collected from various sub-studies of a larger cross-sectional study on HB prevention and control in South African HCWs, which surveyed various HCW populations of Gauteng and Mpumalanga provinces, and offered free HBV testing. Only HCWs at high risk of being exposed to patients' blood or body fluids were surveyed in these sub-studies, while HCWs who had limited patient contact were excluded. The first population (SP-A) comprised of 113 HCWs (nurses, nursing college students, and medical doctors) from various Gauteng Province hospitals and nursing colleges, who participated in three sub-studies on HB vaccination in HCWs ($N = 725$) conducted in 2009–2010 as described elsewhere [7], and accepted an offer of free HBV testing. The second population (SP-B) comprised of 125 HCWs (student/qualified nurses, doctors and auxiliary staff handling patient specimens/cleaning contaminated equipment) from a Gauteng referral hospital in Tshwane that was not included in the 2009–2010 survey, who participated in a study on occupational exposures and HB vaccination ($N = 390$) in 2011 [8], and accepted an offer of free HBV testing. The third population (SP-C) comprised of 95 HCWs (student/qualified nurses, medical doctors, lay counsellors performing HIV testing and auxiliary staff) from a Mpumalanga Province district hospital, who participated in a study on HBV infections in HCWs ($N = 95$) in 2012, for which all HCWs at risk of exposure to HBV (6 doctors, 168 nurses, 98 student nurses, 5 lay counsellors performing HIV testing, 4 laboratory technicians and 57 cleaners) had been invited to participate (unpublished data). No sampling was conducted for this current prevalence study, with all 1210 HCWs who participated in the three studies being offered free HBV testing. Of all HCWs, 333 accepted HBV free testing. Thus 333 blood samples and their related questionnaire data were included in this study.

Blood samples were transported to the laboratory at ~4 °C and centrifuged at 1300 × gravity for 15 min. Serum fractions not tested immediately were stored at −20 °C. Samples were tested for HBsAg, anti-HBs, and antibodies to HB core antigen (anti-HBc) using Elecsys® 2010 electrochemiluminescence immunoassays (Roche Diagnostics, Penzburg, Germany) following the manufacturer's instructions. Serology testing for SP-A, SP-B and SP-C was conducted in 2009–2010, 2011 and 2012 respectively. Viral deoxyribonucleic acid (DNA) was extracted using the High Pure Viral Nucleic Acid kit (Roche Diagnostics, Penzburg, Germany) with one modification of incubating the extracts at 80 °C for 5 min during elution, as previously described [9]. The positive control included in each extraction step was used at a concentration of 9 copies/ml, as polymerase chain reaction (PCR) sensitivity testing [9] had identified that this was the minimum HBV DNA detection limit. HBV DNA was amplified using real time PCR (qPCR) (LightCycler Software Version 4.1, Roche Diagnostics, Penzburg, Germany), as previously described [10] with some modifications. These

Table 1
Summary of serology and HBV DNA results stratified by vaccination status ($n = 314$[a]).

HBV markers	Vaccinated with at least 1 dose, *n* (%)	Not vaccinated/can't remember, *n* (%)	Total, *n* (%)
Susceptible[b]	39 (17.6)	34 (37.0)	73 (23.2)
HBsAg−, anti-HBs−, anti-HBc−, and DNA−	36 (16.2)	32 (34.8)	68 (21.7)
HBsAg−, low anti-HBs+, anti-HBc−, and DNA−	3 (1.4)	2 (2.3)	5 (1.6)
Exposed[c]	60 (27.0)	31 (33.7)	91 (29.0)
Total anti-HBc+	46 (20.7)	27 (29.3)	73 (23.2)
Only HBsAg+ and DNA+	2 (0.9)	0 (0.0)	2 (0.6)
Only HBsAg+	0 (0.0)	1 (1.1)	1 (0.3)
Only DNA+	4 (1.8)	0 (0.0)	4 (12.7)
Only HBsAg+ and anti-HBs+	1 (0.5)	0 (0.0)	1 (0.3)
Only anti-HBs+ and DNA+	7 (3.2)	3 (3.3)	10 (3.2)
Infected[d]	19 (8.6)	11 (12.0)	30 (9.6)
Only HBsAg+	0 (0.0)	1 (1.1)	1 (0.3)
Only DNA+	4 (1.8)	0 (0.0)	4 (12.7)
Only HBsAg+ and anti- HBc+	0 (0.0)	1 (1.1)	1 (0.3)
Only HBsAg+ and DNA+	2 (0.9)	0 (0.0)	2 (0.6)
Only HBsAg+, anti-HBc+, and DNA+	3 (1.4)	1 (1.1)	4 (12.7)
Only anti-HBs+, anti-HBc+, and DNA+	2 (0.9)	5 (5.4)	7 (2.2)
Only anti-HBs+ and DNA+	7 (3.2)	3 (3.3)	10 (3.2)
Only HBsAg+ and anti-HBs+	1 (0.5)	0 (0.0)	1 (0.3)
Occult HBV infection[e]	13 (5.9)	8 (8.7)	21 (6.7)
All anti-HBs ⩾ 10mIU/ml	172 (77.5)	54 (58.7)	226 (72.0)
Total anti-HBs+, anti-HBc−	130 (58.6)	30 (32.6)	160 (51.0)
Total anti-HBs+, anti-HBc+	42 (18.9)	24 (26.1)	66 (21.0)
Protected (anti-HBs ⩾ 10mIU/ml and DNA−)	163 (73.4)	46 (50.0)	209 (66.6)
Only anti-HBs+	123 (55.4)	27 (29.3)	150 (47.8)
Only anti-HBs+ and anti-HBc+	40 (18.0)	19 (20.7)	59 (18.8)
Total	222 (70.7)	92 (29.3)	314 (100)

[a] Of the total population of 333, only 314 specimens had sufficient sera to test for all markers.
[b] Negative for HBsAg, anti-HBs, anti-HBc and HBV DNA.
[c] HBsAg positive and/or anti-HBc positive and/or HBV DNA positive (Note: the results for the exposed who remain infected are repeated under infected).
[d] HBsAg positive and/or HBV DNA positive.
[e] HBV DNA positive and HBsAg negative.

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