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ORIGINAL ARTICLE

Hepatitis B and C seroprevalence among health care workers in a tertiary hospital in Rwanda

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Background: Hepatitis B (HBV) and hepatitis C (HCV) are significant global public health challenges with health care workers (HCWs) at especially high risk of exposure in resource-poor settings. We aimed to measure HBV and HCV prevalence, identify exposure risks and evaluate hepatitis-related knowledge amongst Rwandan tertiary hospital HCWs.

Methods: A cross sectional study involving tertiary hospital employees was conducted from October to December 2013. A pre-coded questionnaire was used to collect data on HCWs' socio-demographics, risk factors and knowledge of blood-borne infection prevention. Blood samples were drawn and screened for hepatitis B surface antigen (HBsAg) and anti-HCV antibodies.

Results: Among 378 consenting HCWs, the prevalence of HBsAg positivity was 2.9% (11/378; 95% CI 1.9 to 4.6%) and anti-HCV positivity 1.3% (5/378; 95% CI 0.7 to 2.7%). Occupational exposure to blood was reported in 57.1% (216/378). Of the 17 participants (4.5%; 17/378) who reported having received the HBV vaccine, only 3 participants (0.8%) had received the three-dose vaccination course. Only 42 HCWs (42/378; 11.1%) were aware that a HBV vaccine was available. Most HCW (95.2%; 360/378) reported having been tested for HIV in the last 6 months.

Conclusions: Despite their high workplace exposure risk, HBV and HCV sero-prevalence rates among HCWs were low. The low HBV vaccination coverage and poor knowledge of preventative measures among HCWs suggest low levels of viral hepatitis awareness despite this high exposure.

Keywords: Health care workers, Hepatitis B, Hepatitis C, Rwanda

Introduction

Chronic viral hepatitis due to hepatitis B (HBV) and hepatitis C (HCV) are of major global significance due to both their prevalence and the associated morbidity and mortality. More than 350 million people worldwide have chronic HBV, out of some 2 billion exposed, leading to more than 600 000 deaths per year; 170 million have chronic HCV, with almost 500 000 deaths per year.[1–3]

Almost one fifth of the world's prevalent cases of HCV occur in Africa[2] and the HBV prevalence across sub-Saharan Africa (SSA) is estimated at 2–8%.[4] There is a paucity of data on HBV and HCV sero-prevalence in Rwanda, with only a few non-representative studies conducted among high-risk groups including antenatally screened pregnant women[5] and HIV-positive patients, with reported prevalence rates of 2.4–5.2% for hepatitis B surface antigen (HBsAg) positivity and 4.9–5.7% for anti-HCV antibodies,[5,6] and among blood donors, with 1.6–3.5% and 2.6–2.9% seropositive for HBsAg and anti-HCV, respectively.[7]

To date, no previous studies of viral hepatitis have been done among health care workers (HCWs) in Rwanda. Studies in other SSA countries have reported highly variable prevalence for HBsAg positivity of 6–45%.[8–11] Adult vaccination rates against HBV remain low across much of the region. Universal vaccination of HCWs against HBV in Rwanda is planned by the Rwandan Ministry of Health, but not yet implemented.[12] HCWs are a key target group for HBV vaccination due to their high risk of workplace

exposure to blood-borne infections and their significant risk of transmission to their patients and other staff. For the few HCWs who may be HIV co-infected, knowledge of their viral hepatitis infection status may also guide optimal use of anti-viral medications that treat both infections and optimise case management.

This study primarily sought to estimate the sero-prevalence of viral hepatitis B and C infections and secondarily to characterise blood-borne infection knowledge, assess reported HBV vaccination rates and evaluate risk behaviours amongst HCWs at a large tertiary centre in Southern Province, Rwanda. These data were collected with the goal of informing policy decisions around prioritisation of viral hepatitis control amongst HCWs in Rwanda.

Materials and methods

Study population, recruitment and inclusion criteria

A descriptive cross-sectional study was conducted between October 2013 and December 2013 among workers at the University Teaching Hospital of Butare (CHUB) in Huye District, Southern Province, Rwanda. CHUB is the sole tertiary referral centre for southern Rwanda, with a catchment population of about 5 million people, and serves as a teaching site for Rwanda's sole medical school. The hospital employed 747 personnel at the time of the study.

A complete staff list of the hospital was obtained, and all currently employed staff were invited (with support from the hospital leadership and infection control office) to attend the study recruiting site within the hospital grounds during a 4-week period. All those aged over 18 years, attending during the study period, and providing valid informed consent, were eligible for study enrolment. Medical and nursing students on clinical placements were not considered as hospital staff and hence were ineligible for recruitment. Recruitment was on the basis of arrival at the study venue, without any random selection.

Sample size

The sample size was estimated to measure the sero-prevalence of hepatitis C infection among HCWs in Rwanda. Given the lack of prior local studies in the study population, the prevalence of HBV infection was estimated at 15%, based on the mean of prevalence figures obtained from other studies elsewhere in Africa in comparable populations.[8–10] Using the Kish and Leslie sample size formula for cross-sectional studies,[13] a sample size of 195 was calculated to achieve a 5% margin of error in estimating the HBV prevalence rate at a 95% confidence level in the HCW population. However, an effect size of 2 (total sample size of 390) was then estimated to ensure the adequacy of the sample size to screen for both HBV and HCV infections, assuming HBV is more prevalent but that minimal co-infection exists in the study population. Only study participants with both questionnaire and serological complete data were considered enrolled. Overall, 378 HCWs completed both the study questionnaire and provided a blood sample for testing and were included in the study.

Key outcomes and exposures

For this study, the primary outcomes of interest were the prevalence of viral hepatitis B and C infections. Exposures of interest were blood-borne infection risk behaviours, both in the workplace and at home, amongst HCWs. Potential effect modifiers assessed for included reported HBV vaccination rates, and knowledge and practices related to increased risk of blood-borne infections.

Study instrument

Study-trained interviewers fluent in English, French and Kinyarwanda administered a structured questionnaire in study participants' preferred language, uploaded on personal digital assistants (PDAs). Data on personal demographics, risk factors and knowledge of HBV/HCV infection prevention were collected.

Laboratory diagnosis

For each study participant, 5 ml of venous blood was collected from the cubital fossa. Each sample was centrifuged within 6 hours of collection into four serum aliquots for storage at -80°C and further testing later. All blood samples were taken by trained phlebotomists and processed by trained and experienced laboratory technicians. In this study, two rapid diagnostics test (RDTs) were used for serological diagnosis. Current HBV infection was detected using the Alere Determine HBsAg test (Alere Inc, Waltham, MA, USA) and was performed and interpreted in accordance with the recommendations of the manufacturer. This is a rapid one-step visual immune-chromatographic test for qualitative detection of HBsAg, with a sensitivity of 96% and specificity of 98% in previous trials.[14]

Diagnosis of HCV infection was performed using the 'Cypress Diagnostics' anti-HCV RDT method on human serum, a rapid chromatographic immunoassay test for qualitative detection of antibodies to HCV infection, with a sensitivity of 95.3% and specificity of 98.7% in previous trials.[15] The dipstick, patient samples and controls were allowed to equilibrate to room temperature. Thereafter, the dipstick was immersed in the samples for 15 seconds with the strip laid on a flat, clean, non-absorbent surface until the appearance of the coloured bands. Results were read after 20 minutes.

All HBsAg and anti-HCV sero-positive samples (at screening by RDT) were confirmed by an electro-chemiluminescence immunoassay with an immunoassay analyser (Cobas e411, Roche Diagnostics, Mannheim, Germany) using manufacturer-provided test kits.

Data analysis

All non-laboratory data were collected using a questionnaire uploaded on PDAs. Query programs were written into the database to limit the entry of incorrect data and to ensure data quality. The data were then transferred into STATA version 12.1 (STATA Corp., College Station, TX, USA) for data analysis. Outcome variables were HBsAg and anti-HCV seropositivity. Comparisons of characteristics between sero-positive and sero-negative study participants were made using the χ^2 test for categorical variables and t test for continuous variables. Associations between predictor variables and outcomes of interest were estimated using both univariate and multivariate logistic regression. In the final interpretation of results, a p-value <0.05 was considered statistically significant after adjusting for all relevant covariates. Individual missing data points on secondary variables obtained by questionnaire were excluded from analysis.

Ethical considerations

Participants were informed of the potential risks and benefits of the study and signed an informed consent form before enrolment in the study. Participants' data were anonymised to optimise confidentiality and privacy, with laboratory data collected and stored only by study number, in secure electronic and physical filing systems. The key record identifying the participant was kept confidential and not made available, except to the principal investigator responsible for results dissemination to individual participants. A report of overall HBV/HCV infection rates, not containing individual level data, was provided to the hospital management to inform infection control policy. Following testing, all staff were provided with test results on an individual basis, either electronically for negative results or strictly in person for positive results, with medical follow-up offered to staff with positive test results. All participants were offered post-test counselling and all staff negative for HBsAg were eligible for HBV vaccination, provided at study completion through the Rwanda Biomedical Centre.

Results

In total, 378 (50.6%) of the reported total of 747 registered hospital workers were enrolled, 206 (54.5%) were female, 40 (10.6%) doctors and 123 (32.5%) nurses. The mean age of the study population was 34.08 (SD 8.74) years and the age range was 18–63 years. Baseline study characteristics are detailed in Table 1.

Table 1. Baseline characteristics of the 378 hospital employees in a study at a tertiary centre in Southern Province, Rwanda

Variable	n (%)
Gender	
Male	172 (45.5)
Female	206 (54.5)
Age group	
18–29	125 (33.1)
30–39	174 (46.0)
40–49	58 (15.3
50+	21 (5.6)
Religion	
Catholic	200 (52.9)
Protestant	139 (36.7)
Seventh day adventist	19 (5)
Moslem	9 (2.5)
None	4 (1.1)
Other	7 (1.8)
Marital status	
Single	131 (34.6)
Married	232 (61.4)
Divorced/separated	4 (1.1)
Widow/widower	9 (2.4)
Living together	2 (0.5)
Current department of work	
Medicine	47 (12.4)
Obstetrics & gynaecology	30 (7.9)
Paediatrics	47 (12.4)
Surgery	52 (13.9)
Administration	28 (7.4)
Laboratory	11 (2.9)
Sterilisation	6 (1.7)
Other departments	156 (41.4)
Education	
None	3 (0.8)
Primary level	65 (17.2)
Secondary/vocational/tertiary	88 (23.3)
Other specialist training	222 (58.7)
Staff group	
Clinical HCWs	204 (54.2)
Non-clinical HCWs	132 (34.9)
Cleaners	41 (10.9)

HCWs: health care workers.

HBV/HCV prevalence

HBsAg and anti-HCV sero-positivity were seen in 11 (2.9%; 95% CI 1.9 to 4.6%) and 5 (1.3%; 95% CI 0.7 to 2.7%) of the study population, respectively. All HBsAg and anti-HCV samples positive at screening were also found positive by the confirmatory ELISA test. No single demographic or risk factor was statistically significantly associated with hepatitis B sero-positivty by univariate analysis (Table 2). Anti-HCV sero-positivity was too infrequent to allow for testing of statistical association.

HBV vaccination status and knowledge of preventative measures

Of the 17 participants (4.5%; 17/378;) who reported having received the hepatitis B vaccine, only 3 participants (0.8%; 3/378) had received the complete recommended three-dose vaccination course, while 13 HCWs (3.4%; 13/378) reported having started but not yet completed the course. The majority of HCWs (88.1%; 333/378) at CHUB knew that HBV and HCV were preventable. Knowledge of preventative measures varied, with the use of physical protective wear being widely recognised (75.7%; 286/378), but only a much smaller proportion knowing of the existence of hepatitis B vaccination (11.1%; 42/378), and very few displaying awareness of all major preventative measures (4.8%; 18/378).

Risk factors for hepatitis exposure

Importantly, 216 (57.1%; 216/378) of all participants reported an accidental, unprotected exposure to either blood or body fluids during the course of their work. Life time histories of blood transfusion were reported in 14 (3.7%; 14/378), surgery in 210 (55.6%; 210/378), dental procedures in 199 (52.7%; 199/378), body piercing in 75 (20.1%; 75/378) and 362 of the total 378 (96%) visited salons to have their hair and nails cut. Among men, 118 (68.6%; 118/378) reported being circumcised. All these exposures have potential for blood-borne infection transmission in settings where infection control practices are not routinely of a high standard. A detail of selected risk factor distributions by demographic variables are shown in Table 2.

Table 2. Risk factor distribution in the overall study population and univariate odds ratio estimates for hepatitis B positivity by risk factor

Risk factor	Total number (%)	Number HBsAg positive (%)	OR (95% CI)
Gender			
Female	206 (54.5)	4 (1.9)	0.47 (0.13–1.62)
Male	172 (45.5)	7 (4.1)	(ref)
Age group			
18–29	124 (33.1)	4 (3.2)	1.18 (0.34–4.10)
30–39	174 (46.0)	5 (2.9)	0.92 (0.28–3.07)
40–49	58 (15.3)	2 (3.4)	1.23 (0.26–5.84)
50+	21 (5.6)	0	NA
Married			
Yes	231 (61.9)	4 (1.7)	0.34 (0.1–1.2)
No	144 (38.1)	7 (4.9)	(ref)
Staff group			
Clinical HCWs	204 (54.2)	6 (2.9)	1.05 (0.31–3.5)
Non-clinical HCWs	132 (34.9)	4 (3.0)	1.06 (0.31–3.7)
Cleaners	41 (10.9)	1 (2.4)	0.82 (0.1–6.56)
History of dental procedure(s)			
Yes	199 (52.7)	3 (1.5)	0.33 (0.09–1.25)
No	179 (47.3)	8 (4.5)	(ref)
History of surgical procedure(s)			
Yes	210 (55.6)	6 (2.9)	0.95 (0.29–3.18)
No	167 (44.4)	5 (3.0)	(ref)
History of blood transfusion			
Yes	14 (3.7)	1 (7.1)	2.71 (0.32–22.82)
No	363 (96.3)	10 (2.8)	(ref)
History of traditional scarification			
Yes	48 (12.7)	2 (4.2)	1.55 (0.32–7.38)
No	329 (87.3)	9 (2.7)	(ref)
History of any body piercing			
Yes	75 (20.1)	1 (1.3)	0.39 (0.05–3.13)
No	302 (79.9)	10 (3.3)	(ref)
Ever been sexually active			
Yes	338 (89.4)	9 (4.2)	0.51 (0.11–2.43)
No	39 (10.6)	2 (1.2)	(ref)
Age of sexual debut			
12–18	48 (14.5)	1 (2.1)	0.72 (0.09–5.9)
19–24	154 (47.0)	5 (3.2)	1.43 (0.38–5.44)
25–29	91 (27.8)	3 (3.3)	1.32 (0.32–5.39)
30+	36 (10.7)	0	NA
Ever suffered from an STD			
Yes	32 (8.5)	1 (3.1)	1.05 (0.13–8.46)
No	335 (91.5)	10 (3.0)	(ref)
Ever had workplace BBV exposure			
Yes	216 (57.1)	9 (4.2)	3.50 (0.74–16.4)
No	162 (42.9)	2 (1.2)	(ref)
Circumcised (males)			
Yes	118 (68.6)	5 (4.2)	1.15 (0.21–6.13)
No	54 (31.4)	2 (3.7)	(ref)
Have at least one child (females)			
Yes	144 (38.1)	2 (1.4)	0.42 (0.06–3.07)
No	62	2 (3.2)	(ref)

Continued

Table 2. *Continued*

Risk factor	Total number (%)	Number HBsAg positive (%)	OR (95% CI)
Prior history of jaundice			
Yes	23 (6.1)	1 (4.3)	1.52 (0.19–12.4)
No	344 (93.9)	10 (2.9)	(ref)
Any regular alcohol use			
Yes	137 (36.2)	4 (2.9)	1.01 (0.29–3.5)
No	241 (63.8)	7 (2.9)	(ref)

BBV: blood-borne virus; STD: sexually transmitted disease; HCWs: health care workers; NA: nil or insufficient data; (ref): reference group for OR calculations. ORs for categories with more than two comparison groups refer to a comparison between the listed subset and all other HCWs (i.e., those falling outside this subset).
All p-values calculated for the listed ORs are >0.05 and, thus, non-significant.

Prior history of a sexually transmitted disease was reported among 32 (8.5%; 32/378) of study participants. Overall, 17 (4.5%; 17/378) study participants reported having been at least partly vaccinated against hepatitis B. Working as a clinical HCW was associated with a significantly higher rate of HBV vaccination compared with those who were not clinical HCWs (16/204, 7.8% vs 0/176, 0%; p<0.001).

HIV testing

Overall, 360 (95.2%; 360/378) reported being tested for HIV in the past and many reported repeated test experiences with 303 (80.1%; 303/378) receiving at least two tests. HIV screening to establish HIV infection status was not performed in this study.

Discussion

This study reports lower than expected HBV and HCV seropositivity rates of 2.9% and 1.3%, respectively among workers in a tertiary hospital in southern Rwandan despite high reported exposure to blood and body fluids.

There is a paucity of studies on epidemiology of HBV/HCV infections in both general and at-risk populations in Rwanda and the region, with the majority of prior work done among HIV-infected and blood donor groups. A study among HIV-positive people found a rate of 5.2% for hepatitis B and 5.7% for hepatitis C,[6] while another study of HIV-positive pregnant women found rates of 2.4% and 4.9%, respectively.[5] Pooled data from the 2011–12 blood donation unit screening, which might be expected to provide a moderate underestimate of community seroprevalence, detected 1.6% of units as HBV positive and 2.9% as HCV positive.[7] By contrast, the generally reported rate of HBsAg positivity in sub-Saharan Africa is typically above 8%,[1] and that of hepatitis C, while more variable, is between 2 and 14% in the region.[16] In a comparable study population in Uganda, HBsAg seropositivity was 8.1%.[5] A study done in Cameroon showed HBsAg positivity rate of 4.9% and anti-HCV seropositivity rate of 1.7% among HCWs, which were lower than the 5.1 and 13.8% HBsAg and HCV Ab positivity seen in the general population, despite rates of workplace blood exposure of over 50%.[9]

We postulate that differences in protective factors (such as educational levels, socio-economic status, access to preventative measures, as well as awareness of HBV/HCV infection and control practices), occupational risks patterns, difference in disease prevalence in general populations and differences in exposure risks over time may account for the observed heterogeneity of prevalence in comparable settings. It is also conceivable that significant heterogeneity may exist in prevalence rates in different parts of the Rwanda, due to the country's recent history of large-scale refugee movements. In Rwanda, major education campaigns targeting the HIV epidemic in the last decade may have enhanced uptake of preventative precautions, including high rates of HIV screening amongst HCWs and use of protective methods (gloves, condoms and better sharps disposal).

Using a similar model for HBV/HCV infections may promote infection control for blood- borne diseases and limit HBV/HCV transmission.[1] In some departments, the major drive by Rwanda to universal childhood vaccination against hepatitis B, which started in 2002, may also be paying dividends. Higher rates of vaccination, especially among paediatric patients, could plausibly translate to lower risks of HBV infections among HCWs caring for them, compared to HCW managing adults. However, no inter-departmental differences in HBV rate were observed in this study, although the study was not powered to detect such differences given the low sero-prevalence. Given the start date of the vaccination initiative, and our inclusion of only adults in the study, it is too early for any HCWs in this study to have been direct beneficiaries of neonatal HBV vaccination themselves.

A very low rate of vaccination, which was incomplete in most vaccinated participants in the study, was reported. Only 17 (4.5%) HCWs reported prior hepatitis B vaccination, and only 3 (0.8%) individuals had completed the recommended three-dose course. Comparable findings have been reported in settings where the vaccine is available, albeit as part of routine childhood vaccination programs.[8,9] Alarmingly, only 42 (11.1%) of the HCWs in this study knew of the HBV vaccine's availability, pointing to a major unmet health promotion opportunity. This highlights a major unmet public health risk and priority need to mitigate risk of transmission and the long-term complications of chronic HBV. Immunisation, being the most cost-effective HBV protective strategy, should be scaled-up in this high-risk demographic group.

As per hospital current practices, RDTs were used as screening point of care diagnostics and, for all positive samples by RDT, confirmatory ELISAs were done. However, no confirmatory tests were done for RDT negative samples. Although the RDTs used have reported high sensitivity profiles, this diagnostic approach may underestimate HBV/HCV prevalence. The lack of HBcAb testing in this study also limits a proper assessment of past exposure to hepatitis B in HCWs with no current active infection, with some SSA studies reporting high rates of lifetime HBV exposure.[9] In contrast, over 95% of study participants reported being screened for HIV, highlighting the much greater awareness of, and access to, HIV infection and associated screening.

In this study, HBV/HCV sero-prevalence rates were overestimated during power calculation and primary study outcomes were thus inadequate to allow for a robust statistical assessment of some secondary objectives, despite enrolling a significant number (378) of study participants.

Although all HCWs at the study site were invited to participate, data were only available for around 50% of the eligible population (376/747 HCWs). While it is inevitable that a study involving potentially sensitive issues like hepatitis among HCWs will not attract 100% participation, it is possible that those who chose not to participate differed from those who did, and this could have impacted on our study results. In an effort to estimate the size and direction of this effect, we compared serological results of those HCWs who consented only for hepatitis B and C blood testing (n=155) with the study participants in a post-hoc analysis. Those who underwent only hepatitis testing did not have significantly higher rates of hepatitis B (6/155, 3.8%; p=0.59) or hepatitis C (1/155, 0.6%; p=0.68), showing no statistical evidence of significant bias, between those who did and did not complete the study questionnaire.

A limitation of the study was that study participants were drawn from a single tertiary hospital and study findings may not be generalisable to all HCWs in Rwanda, especially if HBV and HCV rates are heterogeneous across the country. Advantages of studying this large teaching hospital was the lack of any recent vaccination efforts, its large staff and its urban location, but this may not be representative of other, more rural, hospitals. In this teaching hospital, a large number of non-medical and early career cadres may also have limited a true HBV/HCV risk assessment given that these cadres may have lower absolute and rate-based exposure risks than more experienced clinical sub-groups.

Conclusions

Among workers in a Rwandan tertiary hospital, lower than expected HBV and HCV sero-prevalence rates were found in a group that reported high risks of exposure and low rates of hepatitis B vaccination, despite being considered a high-risk group for HBV/HCV transmission. Promotion of HBV/HCV awareness, screening for HBV/HCV infections following the example of HIV screening, vaccination of eligible workers and measures to promote infection control practices are urgently recommended to provide protection to this potentially high-risk group.

Authors' contributions: LM, EM, PK, BK, FK, CM, TDW and JTO conceived the study; FK, TDW and JTO designed the study; PB, VM, TDW and JTO were part of the interview team and supervised the interviews; FK and JTO carried out the laboratory assessment; FK analysed the data; FK, JTO and TDW critically reviewed study results and the manuscript for intellectual content; PB, TDW and FK drafted the manuscript. All authors read and approved the final manuscript. FK, TDW and JTO are guarantors of the paper.

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Competing interests: None declared.

Ethical approval: The National Health Research Committee and Rwanda National Ethics Committee approved the study proposal [No 412/RNEC/2013].

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